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Corrections, additions, or notice of important omissions, reports and maps of mines and mining districts, pamphlets on metallurgical processes, brief notes on new mineral localities, etc., will be highly appreciated, and should be addressed to David T. Day, U. S. Geological Survey, Washington, D. C. Duplicate copies of such reports, etc., are especially desired for extending the fine set of mining pamphlets in the library of the Survey, and will be thankfully acknowledged if sent to the

DIRECTOR UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C.

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1893

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY

WASHINGTON

GOVERNMENT PRINTING OFFICE

1894

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W. cont.

U. S. Geological Survey.

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CONTENTS.

LETTER OF TRANSMITTAL.

WASHINGTON, D. C., *June 1, 1894.*

SIR: I have the honor of submitting herewith the tenth number of the annual series Mineral Resources of the United States. This volume bears the title "Mineral Resources of the United States, 1893." It carries forward the statistical record to December 31, 1893, together with much descriptive matter to a later date in 1894.

As your retirement from the office of Director has been announced, it is fitting to acknowledge my hearty gratitude and that of my associates for your steadfast support in carrying out this work and for your many acts of kindness and consideration, which no one can ever forget who has profited by your leadership.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

HON. J. W. POWELL,
Director, U. S. Geological Survey,
Washington, D. C.

INTRODUCTION.

Scope.—This is the tenth report of the series "Mineral Resources of the United States." It presents a statement of the mineral products during the calendar year 1893, the industrial conditions affecting these products and the recent additions to the knowledge of mineral deposits in this country. Its scope is thus similar to the preceding volumes, with the addition of more than the usual references to the condition of the mineral industries in foreign countries.

Arrangement.—For convenient reference the metallic industries are grouped. These are followed by the mineral fuels, the materials used for structural purposes and pottery, abrasive materials, precious stones, phosphates and other minerals contributary to the chemical industry, mineral paints, and finally the commercial products of mineral springs.

Acknowledgments.—The statistics of production have been obtained from the producers, except in isolated cases, where some other well established agency already exists by which the statistics are collected accurately. Thus, the statistics of the precious metals are collected and reviewed by the Director of the Mint and the coal product of the State of Illinois is collected by the Bureau of Labor. Similarly the statistics of the iron and steel industries, collected by Mr. James M. Swank, for the purposes of the American Iron and Steel Association, are here accepted as authoritative. The report on anthracite coal is still prepared under the supervision of Mr. John H. Jones, for many years chief of the Bureau of Anthracite Coal Statistics, from the figures collected by his successor, Mr. William W. Ruley. In addition to this, many contributions of groups of statistics have been due to the courtesies of State officials and individuals.

The names of the statistical experts who, acting under the authority of the United States, have collected statistics from the producers are given at the heads of the special chapters.

The technical press, besides affording much information concerning new mining enterprises, has been largely drawn upon for prices, market reports, and new technical processes.

The statistics of imports and exports are all obtained from the Bureau of Statistics of the Treasury Department, frequently by special compilation.

Units.—The customary units in each trade are used. The following table illustrates the great diversity thus occasioned, but the system is the best for those most interested. The table may also be used for conversion purposes.

Comparative table of units of measure used in this report.

		Number of pounds contained.	One short ton (2,000 pounds) contains—	One long ton (2,240 pounds) contains—	One metric ton (2,205 pounds) contains—
Barrels	Salt	280	7 1/7	8	7.875
	Petroleum, crude (*a*) 42 gallons	280	7 1/2	8	7.875
	Petroleum, refined (*b*) 50 gallons	327 1/2	6 1/10	6 11/13	6.733
	Lime	200	10	11 1/5	11.025
	Natural cement	300	6 2/3	7 7/15	7.35
	Artificial Portland cement	400	5	5 3/5	5.513
	Coal (Louisiana)	208	9 8/13	10 10/13	10.601
Flasks		76 1/2	26 1/7	29 3/11	28.824
Bushels	Anthracite coal	70	28 4/7	32	31.5
	Bituminous coal	80	25	28	27.563
	Pennsylvania bituminous coal	76	26 6/19	29 9/19	29.013
	Coke	40	50	56	55.125
	Salt	56	35 5/7	40	39.375
Ounces	Troy	1/12	....	....	....
	Avoirdupois	1/16	....	....	....
Gallons (mineral water)		8.339	239 7/8	268 5/8	264.42
Carat (4 grains)		....	....	....	....

(*a*) 45° B.
(*b*) Illuminating oil 150° fire test, 48° B.

MINERAL RESOURCES OF THE UNITED STATES.

SUMMARY.

The total value of the mineral products of the United States in 1893 was the smallest since 1889. It represented $609,821,670, compared with $688,616,954 in 1892; a decline of 11.44 per cent. In 1892 there was an increase of 30½ millions or 4.67 per cent. over 1891. The decline in value was most conspicuous in pig iron and structural materials, but most other minerals also declined in the amount and the value of the product, the exceptions being gold, anthracite coal, aluminum, phosphate rock, and gypsum. Bituminous coal showed a slight increase in quantity but the normal increase was checked and the total value was less than in 1892. Petroleum increased in value but decreased in quantity. Salt, quicksilver, and several smaller products increased in quantity but shared the usual decline in value. This general decline was attributed to the financial depression and the consequent decreased consumptive demands. It was only conspicuous during the last half of the year, as considerable time is necessary for affecting the mining industry, and as it is correspondingly slow in recovering, its effect will be equally pronounced in 1894.

METALS.

Iron and steel.—Pig iron declined from 9,157,000 long tons in 1892 to 7,124,502 tons in 1893. The total value declined over $46,000,000, or from $131,161,039 in 1892 to $84,810,426 in 1893. The limestone used for iron flux amounted to 3,958,055 long tons, worth $2,374,833.

The total product of iron ores fell to 11,587,629 long tons, worth $19,265,973, an average value of $1.66 at the mines.

In 1892 the product was 16,296,666 long tons, worth $33,204,896, or $2.04 per ton at the mines.

Gold and silver.—The gold product increased from 1,596,375 Troy ounces with a coining value of $33,000,000 in 1892 to 1,739,081 ounces worth $35,950,000 in 1893. This product is the largest since 1886. The increase was due chiefly to the new mines in Colorado. Silver production was very active in the first part of 1893, due to the effort of smelters to work up accumulated stocks. The heavy decline in the last part of the year made the total less than in 1892 by 3,500,000 ounces, as follows: 1892, 63,500,000 ounces, coining value $82,099,150; 1893, 60,000,000 ounces, coining value $77,575,757.

Copper.—The industry took little notice of the depressed money market and the decreased consumption. The product from American ores aggregated 337,416,848 pounds, against 353,275,742 pounds in 1892. In addition, 7,723,387 pounds were produced in 1893 from imported pyrites. The necessary expenditures were also made for keeping up future production.

Lead.—Product: 163,982 short tons, worth $11,839,590, compared with 173,654 short tons in 1892, worth $13,892,320.

Zinc.—The rapidly increasing product of late years was checked and a slight decline noted; product: 78,832 short tons, worth $6,306,560, compared with 87,260 short tons, worth $8,027,920 ,in 1892.

Quicksilver.—The product showed a noteworthy increase from 27,993 flasks in 1892 to 30,164 flasks in 1893. The price fell, making the total value $1,108,527 in 1893, compared with $1,245,689 for the smaller product of 1892. The increased product came chiefly from the New Almaden, Mirabel, and Ætna mines.

Manganese.—The decline in quantity from 13,613 long tons in 1892 to 7,718 long tons in 1893 was offset by the following imports: 67,717 long tons in 1893 and 58,364 long tons in 1892. The product of manganiferous iron, silver, and zinc ores shows change.

Aluminum.—The usual increase in product continued. In 1893, 339,629 pounds were made chiefly, by the Pittsburg Reduction Company; it was valued at $266,903 in the producer's hands. The largest single use is for adding to steel before casting. It is also used for improving iron castings, for ornamental fancy articles, and aluminum cooking utensils, began to be generally introduced during the year. The quality of aluminum bronze castings is improving.

The southern deposits of bauxite furnish more and more of the raw material. The Arkansas bauxite deposit will probably be developed in 1894 for making alum.

Tin.—More careful examinations of the Kings Mountain, North Carolina, locality furnish indications of considerable ore which may yield 3 per cent. No work was done at the other deposits except running the concentrator at Hill City, South Dakota, for about a month. Eight thousand nine hundred and thirty-eight pounds of tin were smelted and sold from part of the concentrates.

Nickel.—The United States product was from Lancaster Gap, Pennsylvania, and Missouri. It is estimated at 49,399 pounds, worth $22,197, a marked decline from 1892, due to Canadian competition. The Nevada and Oregon mines have not become producers, but prospecting and development continues. The New Caledonia mines increased their product and accumulated stock.

Antimony.—The value decreased from $56,466 to $45,000 in 1893. The product came from Nevada, and was smelted in San Francisco.

Platinum.—The product from the gold placers is still insignificant. The production in 1893 was 75 ounces.

FUELS.

Coal.—The product of all kinds of coal in 1893 was 162,814,977 long tons, or 182,352,774 short tons, valued at $208,438,696, against 160,115,242 long tons, or 179,329,071 short tons, valued at $207,566,381, in 1892. The increase in 1893 was 2,699,735 long tons, or 3,023,703 short tons, in quantity, but owing to a decline in the price of bituminous coal, the result of overproduction during the latter part of the year, the value increased but $872,315. The product in 1893 consisted of 48,185,306 long tons, or 53,967,543 short tons of anthracite coal from Pennsylvania, an increase from 1892 of 1,334,856 long tons, or 1,495,039 short tons, and of 114,629,671 long tons, or 128,385,231 short tons of bituminous (including scattering lots of anthracite from Colorado, New Mexico, and Virginia), an increase over 1892 of 1,364,879 long tons, or 1,528,664 short tons. The value of Pennsylvania anthracite increased $3,245,078, the average price, in spite of the industrial depression, advancing from $1.92 to $1.94 per ton. The value of bituminous coal decreased $2,372,763, the average price declining from 99 cents per ton in 1892 to 96 cents in 1893. In stating the value of anthracite the marketable product only is included; that is, the amount of coal used at the collieries, which is merely culm or slack which would otherwise be wasted, while included in the product, is not included in the value. This item of colliery consumption in 1893 was 4,016,709 long tons, or 4,498,714 short tons. The value of bituminous includes all grades of coal produced except what is thrown on the dump and neither sold nor used.

Coke.—The total product of coke in the United States in 1893 was 9,460,310 tons as compared with 12,010,829 tons in 1892. This great reduction is due to the depression in the blast-furnace industry. Coke-made pig iron in 1893 was 5,390,184 tons as compared with 6,822,266 tons in 1892, and pig iron made with anthracite and with mixed anthracite and coke aggregated 1,347,529 tons in 1893 as compared with 1,797,113 tons in 1892. This would account for a reduction of about 2,000,000 tons of coke. The remainder of the decrease is due to the falling off in demand at foundries and other works where coke is used. Pennsylvania is still the chief coke-producing State, contributing 65.8 per cent. of the total, and Alabama is second, contributing 12.2 per cent.

Petroleum.—The chief features of interest in 1893 were: (1) The great decline in production of the older fields and the increase of the newer. (2) The decline in stocks held at the wells. (3) The increase in price. (4) The increase in exports. (5) The success in refining limestone oils.

Pennsylvania declined from 27,149,034 barrels of 42 gallons in 1892 to 19,283,122 barrels in 1893. Lima, Ohio, fell off from 15,169,507 barrels in 1892 to 13,646,804 barrels in 1893. On the other hand the production of West Virginia increased from 3,810,086 barrels in 1892 to 8,445,412 barrels in 1893.

Indiana increased from 698,068 barrels in 1892 to 2,335,293 barrels in 1893. The total product for all States declined from 50,509,136 barrels in 1892 to 48,412,666 barrels in 1893. The year 1891 marked the highest output, it being 54,291,980 barrels. This was the year of the remarkable product of the McDonald field in Pennsylvania.

The average value of certificate oil in the Pennsylvania fields was 64 cents a barrel compared with 55⅝ cents in 1892; an increase of 8⅜ cents. The price for Lima oil advanced from 36⅝ cents in 1892 to 47¼ cents in 1893, an increase of 10⅝ cents.

The total exports of petroleum in the calendar year 1893, including crude, refined, and residuum was 804,221,230 gallons, the largest export recorded, and an increase of nearly 60,000,000 gallons compared with 1892. All forms of oil except lubricating oil shared in the increase.

Natural gas.—The consumption of natural gas is limited more and more to domestic use. Only in Indiana has comsumption increased for manufacturing purposes. Another feature of the situation is the increase in price to consumers. The total value of the product in 1893 was $14,346,250; in 1892, $14,800,714.

STRUCTURAL MATERIALS.

Stone.—The value of the total product of stone of all kinds decreased to $33,865,573 in 1893 from $48,706,625 in 1892. The depression was very great in the last half of the year and continues in 1894. The product of lime is an estimate, and is probably too high; the figures are merely kept as the best available.

Soapstone.—Soapstone in slabs, etc., aggregated 21,071 short tons in 1893, worth $255,067. Fibrous talc amounted to 35,861 short tons, worth $403,436. Both industries show the usual decline.

Clays.—The returns from the division of manufactures in the Census Office indicate that the value of brick clay in 1890 was $8,500,000, and about $9,000,000 in 1893. The total value of the finished brick, tile, and terra cotta aggregated $67,000,000. The production of potter's clay of all qualities aggregated 400,000 tons, worth $900,000.

Cement.—Natural rock cement decreased slightly, i. e., to 7,411,815 barrels, worth $5,104,708; artificial Portland cement to 590,652 barrels, worth $1,158,138.

Feldspar.—The product increased slightly, aggregating 18,391 long tons, worth $68,037; the value shows the usual decrease.

Flint.—Product in 1893, 29,671 long tons, worth $63,792.

Asphaltum.—The product came chiefly from California, with small amounts from Utah and Kentucky. The total in 1893 includes the ozocerite product of Utah, and amounted to 47,779 short tons, worth $372,232. The product of asphaltum alone in 1892 was 87,930 short tons, worth $445,375.

ABRASIVE MATERIALS.

Millstones.—The value decreased from $23,417 in 1892 to $16,645 in 1893; the product came from New York, Pennsylvania, and Virginia.

Grindstones.—Value in 1892, $272,244; in 1893, $338,787, including in the latter figure $19,159 worth of whetstones made from sandstone chiefly in Ohio.

Corundum and emery.—The product remained nearly stationary, i. e., 1,771 short tons, worth $181,300 in 1892, and 1,713 short tons, worth $142,325 in 1893.

Novaculite.—The Arkansas, New Hampshire and other whetstones and oilstones produced in 1893 from novaculite had a value of $135,173, against $146,730 in 1892. This does not include the sandstone products of Ohio.

MINERALS USED FOR CHEMICAL PURPOSES.

Phosphate rock.—Florida produced 438,804 long tons and South Carolina 502,564 tons; total value, $4,136,070. The chief event of importance was the cyclone of August 27, which wrecked the river phosphate industry in South Carolina and raised the price for Florida rock.

Marls.—The local use of marls in New Jersey, Virginia, and Alabama continues to decrease, being displaced by commercial fertilizers.

Gypsum.—Stocks decreased in 1892, due to the manufacture of staff for the World's Fair buildings. This caused the increased production of 1892 to continue. The product in 1892 was 246,374 short tons, worth $671,548; 1893 it was 253,615 short tons, worth $696,615.

Salt.—The product in 1892 was 11,698,890 barrels (of 280 pounds each); this increased slightly in 1893 to 11,816,772 barrels. The total value shows a decrease from $5,654,915 in 1892 to $4,054,668. This decrease is largely apparent only, since the cost of package is omitted in the latter year.

Bromine.—The market price in London advanced quite significantly, due to better understanding between the producers, so that 348,399 pounds, the product of 1893, showed a total value of $104,520, against only $64,502 for 379,480 pounds in 1892.

Iodine.—Search is being made for large quantities of salt brines containing even traces of iodine, with a view to a new process for extracting it.

Sulphur.—The product is still light and limited to the western mines. Quantity in 1893: 1,200 short tons, worth $42,000 at Salt Lake City. The product in 1892 was 2,688 tons.

Pyrites.—The product declined from 114,717 long tons in 1892, worth $305,191, to 83,277 long tons, worth $275,302, in 1893. The imports increased. New sources of supply are being developed in North Carolina.

Borax.—The product declined to 8,699,000 pounds, worth $652,425.

Fluorspar.—Price showed a slight decline with a small increase in quantity to 12,400 short tons, worth $84,000.

Chromic iron ore.—The product was 1,450 long tons, all from Glenn County, California. It was worth $21,750 in San Francisco. The consumption is chiefly supplied by imports from Asia Minor.

MINERAL PIGMENTS.

Barytes.—Product 28,970 short tons, worth $88,506, a decrease from 32,108 tons in 1892. There is some promise of an increase again in 1894.

Metallic paint.—The product of metallic paint decreased from 30,211 short tons, valued at $452,966, in 1892, to 19,950 short tons, worth $297,189, in 1893.

Ocher, umber, etc.—The product of ocher decreased to 10,517 short tons, worth $129,393. Of umber the product was about the same as in 1892, though the value increased slightly. Sienna decreased from 500 tons to 150 tons. The amount of soapstone ground for paint was 100 tons. Of mineral black the product was 70 tons.

Venetian reds.—The product declined from 4,900 short tons, worth $106,800, to 3,214 tons, worth $64,400.

Cobalt oxide.—Including the exports contained in speiss, the total product was 8,422 pounds, worth in the condition in which it was first sold $10,346. The price for pure cobalt oxide ready for pottery or paint use was worth $200 per pound.

Zinc white.—The product declined slightly, as follows: 24,059 short tons in 1893 against 27,500 tons in 1892. Prices remained steady.

Graphite.—The product, 843,103 pounds, includes the crude material mined for crucibles and all other purposes as well as that for pencils. It is valued at $63,232 in the state in which it was first mined.

MISCELLANEOUS.

Precious stones.—The value of rough gems found in the United States decreased from $312,050 in 1892 to $264,041 in 1893. The principal items of interest was the discovery of a diamond weighing $3\frac{1}{16}$ carats in Wisconsin, and the large sale of American turquoise.

Mica.—The industry is still crippled by irregular mining methods The product was 66,971 pounds in 1893, worth $88,929.

Asbestos.—Deposits of chrysotile somewhat similar to the Canadian have been found near Casper, Wyoming, but need development. The domestic product from California was insignificant, i. e., 50 tons, worth $2,500.

Infusorial earth.—The product decreased. Forty-three thousand six hundred and fifty-five dollars was the value of the product in 1892, which fell to $22,582 in 1893.

Magnesite.—The deposits in California yielded 704 short tons in 1893, part of which was calcined and part sold crude. The price in San Francisco was $10 per ton.

Mineral waters.—The statistics are limited to the actual amount sold; these show a gain from 21,876,604 gallons in 1892 to 23,544,495 gallons in 1893, but, as usual, values declined, thus: 1892, $4,905,970; 1893, $4,246,734.

Metallic products of the United States in 1893.

Products.	Quantity.	Value.
Pig iron .... long tons..	7,124,502	$84,810,426
Silver .... troy ounces..	60,000,000	77,575,757
Gold .... do....	1,739,081	35,950,000
Copper .... pounds..	337,416,848	32,054,601
Lead .... short tons..	163,982	11,839,590
Zinc .... do....	78,832	6,306,560
Quicksilver .... flasks..	30,164	1,108,527
Aluminum .... pounds..	339,629	266,903
Antimony .... short tons..	250	45,000
Nickel .... pounds..	49,399	22,197
Tin .... do....	8,938	1,788
Platinum .... troy ounces..	75	517
Total value of metallic products	....	249,981,866

Non-metallic mineral products of the United States in 1893.

Products.	Quantity.	Value.
Bituminous coal .... long tons..	114,629,671	$122,751,618
Pennsylvania anthracite .... do....	48,185,306	85,687,078
Lime .... barrels..	58,000,000	35,960,000
Building stone	....	33,865,573
Petroleum .... barrels..	48,412,666	28,932,326
Natural gas	....	14,346,250
Clay (all except potter's clay)	....	9,000,000
Cement .... barrels..	8,002,467	6,262,841
Mineral waters .... gallons sold..	23,544,495	4,246,734
Phosphate rock .... long tons..	941,368	4,136,070
Salt .... barrels..	11,816,772	4,054,668
Limestone for iron flux .... long tons..	3,958,055	2,374,833
Zinc white .... short tons..	24,059	1,804,420
Potter's clay .... long tons..	400,000	900,000
Gypsum .... short tons..	253,615	696,615
Borax .... pounds..	8,699,000	652,425
Mineral paints .... short tons..	37,714	530,284
Fibrous talc .... do....	35,861	403,436
Asphaltum .... do....	47,779	372,232
Soapstone .... do....	21,071	255,067
Precious stones	....	264,041
Pyrites .... long tons..	83,277	275,302
Corundum .... short tons..	1,713	142,325
Novaculite .... pounds..	....	135,173
Mica .... do....	66,971	88,929
Barytes .... short tons..	28,970	88,506
Bromine .... pounds..	348,399	104,520
Fluorspar .... short tons..	12,400	84,000
Feldspar .... long tons..	18,391	68,037
Manganese ore .... do....	7,718	66,614
Flint .... do....	29,671	63,792
Graphite .... pounds..	843,103	63,232
Sulphur .... short tons..	1,200	42,000
Marls .... do....	75,000	40,000
Infusorial earth .... do....	....	22,582
Millstones	....	16,645
Chromic iron ore .... long tons..	1,450	21,750
Cobalt oxide .... pounds..	8,422	10,346
Magnesite .... short tons..	704	7,040
Asbestos .... do....	50	2,500
Total value of non-metallic mineral products.	....	358,839,804
Total value of metallic products	....	249,981,866
Estimated value of mineral products unspecified *a*	....	1,000,000
Grand total	....	609,82[illegible],670

a Including building sand, glass sand, limestone used as flux in lead smelting, limestone in glass-making, iron ore used as flux in lead smelting, tin ore, iridosmine, nitrate of soda, carbonate of soda, sulphate of soda, bauxite and alum clays used by paper manufacturers.

Mineral products of the United States

	Products.	1880.		1881.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, value at Philadelphia.....long tons..	3,375,912	$89,315,569	4,144,254	$87,029,334
2	Silver, coining value..............troy ounces..	30,320,000	39,200,000	33,077,000	43,000,000
3	Gold, coining value.......................do....	1,741,500	36,000,000	1,676,300	34,700,000
4	Copper, value at New York City.....pounds..	60,480,000	11,491,200	71,680,000	12,175,000
5	Lead, value at New York City....short tons..	97,825	9,782,500	117,085	11,240,160
6	Zinc, value at New York City ....do....	23,239	2,277,432	26,800	2,680,000
7	Quicksilver, value at San Francisco...flasks..	59,926	1,797,780	60,851	1,764,679
8	Nickel, value at Philadelphia ....pounds..	329,968	164,984	265,668	292,235
9	Aluminum, value at Pittsburg............do....	....	....	....	....
10	Tin...do....	....	....	....	....
11	Antimony, value at San Francisco.short tons..	50	10,000	50	10,000
12	Platinum, value (crude) at San Francisco, ...troy ounces..	100	400	100	400
13	Total value of metallic products.........	....	190,039,865	....	192,892,408
	NON-METALLIC (spot values).				
14	Bituminous coal......................long tons..	38,242,641	53,443,718	48,179,475	60,224,344
15	Pennsylvania anthracite ....do....	25,580,189	42,196,678	28,500,016	64,125,036
16	Building stone..	....	18,356,055	....	20,000,000
17	Petroleum ....barrels..	26,286,123	24,183,233	27,661,238	25,448,339
18	Lime ....do....	28,000,000	19,000,000	30,000,000	20,000,000
19	Natural gas..	....	....	....	....
20	Clay (all except potter's clays)..................	....	....	....	....
21	Cement.......................................barrels..	2,072,943	1,852,707	2,500,000	2,000,000
22	Salt ....do....	5,961,060	4,829,566	6,200,000	4,200,000
23	Phosphate rock ....long tons..	211,377	1,123,823	266,734	1,980,259
24	Limestone for iron flux.......................do....	4,500,000	3,800,000	6,000,000	4,100,000
25	Mineral waters ....gallons sold..	2,000,000	500,000	3,700,000	700,000
26	Zinc white ....short tons..	10,107	763,738	10,000	700,000
27	Potters' clay ....long tons..	25,783	200,457	25,000	200,000
28	Mineral paints ....short tons..	4,036	135,840	6,720	100,000
29	Borax ....pounds..	3,692,443	277,233	4,046,000	304,461
30	Gypsum...................................short tons..	90,000	400,000	85,000	350,000
31	Grindstones	....	500,000	....	500,000
32	Fibrous talc...........................short tons..	4,210	54,730	5,000	60,000
33	Pyrites ....long tons..	2,000	5,000	10,000	60,000
34	Soapstone ....short tons..	8,441	66,665	7,000	75,000
35	Manganese ore ....long tons..	5,761	86,415	4,895	73,425
36	Asphaltum.............................short tons..	444	4,440	2,000	8,000
37	Precious stones.......................................	....	100,000	....	110,000
38	Bromine....................................pounds..	404,690	114,752	300,000	75,000
39	Corundum...............................short tons..	1,044	29,280	500	80,000
40	Barytes (crude) ....do....	20,000	80,000	20,000	80,000
41	Graphite ....pounds..	....	49,800	400,000	30,000
42	Millstones	....	200,000	....	150,000
43	Novaculite ....pounds..	420,000	8,000	500,000	8,580
44	Marls ....short tons..	1,000,000	500,000	1,000,000	500,000
45	Flint ....long tons..	20,000	80,000	25,000	100,000
46	Fluorspar ....short tons..	4,000	16,000	4,000	16,000
47	Chromic iron ore ....long tons..	2,288	27,808	2,000	30,000
48	Infusorial earth.....................short tons..	1,833	45,660	1,000	10,000
49	Feldspar ....long tons..	12,500	60,000	14,000	70,000
50	Mica..pounds..	81,669	127,825	100,000	250,000
51	Ozocerite, refined..........................do....	....	....	....	....
52	Cobalt oxide..................................do....	7,251	24,000	8,280	25,000
53	Slate ground as a pigment ....short tons..	1,000	10,000	1,000	10,000
54	Sulphur ....do....	600	21,000	600	21,000
55	Asbestos ....do....	150	4,312	200	7,000
56	Rutile ....pounds..	100	400	200	700
57	Lithographic stone....................short tons..	....	....	50	1,000
58	Total value of non-metallic mineral products.	....	173,279,135	....	206,783,144
59	Total value of metallic products.........	....	190,039,865	....	192,892,408
60	Estimated value of mineral products unspecified. (*a*)	....	6,000,000	....	6,500,000
61	Grand total..................................	....	369,319,000	....	406,175,552

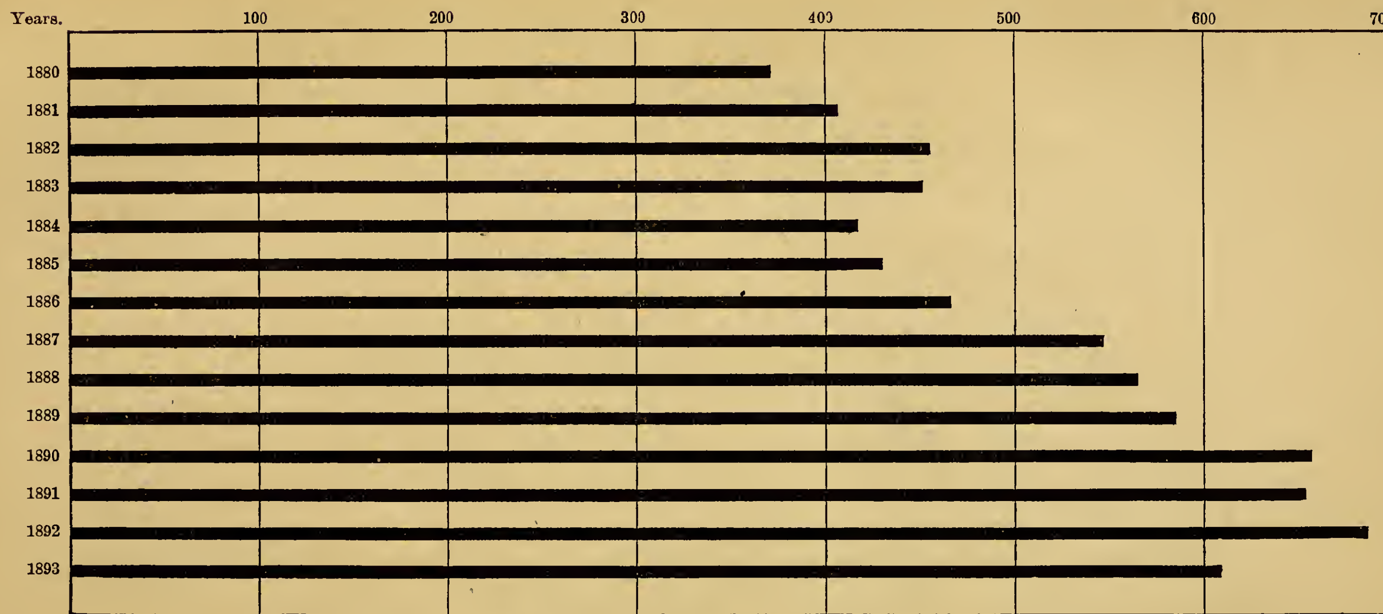
a Including clays, except potter's clay, prior to 1884.

for the calendar years 1880 to 1893.

1882.		1883.		1884.		1885.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,623,323	$106,336,429	4,595,510	$91,910,200	4,097,868	$73,761,624	4,044,425	$64,712,400	1
36,197,695	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000	39,910,279	51,600,000	2
1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000	1,538,376	31,800,000	3
91,646,232	16,038,091	117,151,795	18,064,807	145,221,934	17,789,687	170,962,607	18,292,999	4
132,890	12,624,550	143,957	12,322,719	139,897	10,537,042	129,412	10,469,431	5
33,765	3,646,620	36,872	3,311,106	38,544	3,422,707	40,688	3,539,856	6
52,732	1,487,042	46,725	1,253,632	31,913	936,327	32,073	979,189	7
281,616	309,777	58,800	52,920	64,550	48,412	277,904	179,975	8
....	....	83	875	150	1,350	283	2,550	9
....	....	....	....	....	....	....	....	10
60	12,000	60	12,000	60	12,000	50	10,000	11
200	600	200	600	150	450	250	187	12
....	219,755,109	....	203,128,859	....	186,109,599	....	181,586,587	13
60,861,190	76,076,487	68,531,500	82,237,800	73,730,539	77,417,066	64,840,668	82,347,648	14
31,358,264	70,556,094	34,336,469	77,257,055	33,175,756	66,351,512	34,228,548	76,671,948	15
....	21,000,000	....	20,000,000	....	19,000,000	....	19,000,000	16
30,510,830	24,065,988	23,449,633	25,790,252	24,218,438	20,595,966	21,847,205	19,198,243	17
31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000	40,000,000	20,000,000	18
....	215,000	....	475,000	....	1,460,000	....	4,857,200	19
....	....	....	....	....	5,500,000	....	6,000,000	20
3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000	4,150,000	3,492,500	21
6,412,373	4,320,140	6,192,231	4,211,042	6,514,937	4,197,734	7,038,653	4,825,345	22
332,077	1,992,462	378,380	2,270,280	431,779	2,374,784	437,856	2,846,064	23
3,850,000	2,310,000	3,814,273	1,907,136	3,401,930	1,700,965	3,356,956	1,678,478	24
5,000,000	800,000	7,529,423	1,119,603	10,215,328	1,459,143	9,148,401	1,312,845	25
10,000	700,000	12,000	840,000	13,000	910,000	15,000	1,050,000	26
30,000	240,000	32,000	250,000	35,000	270,000	36,000	275,000	27
7,840	105,000	7,840	84,000	7,840	84,000	4,424	43,575	28
4,236,291	338,903	6,500,000	585,000	7,000,000	490,000	8,000,000	480,000	29
100,000	450,000	90,000	420,000	90,000	390,000	90,405	405,000	30
....	700,000	....	600,000	....	570,000	....	500,000	31
6,000	75,000	6,000	75,000	10,000	110,000	10,000	110,000	32
12,000	72,000	25,000	137,500	35,000	175,000	49,000	220,500	33
6,000	90,000	8,000	150,000	10,000	200,000	10,000	200,000	34
4,532	67,980	6,155	92,325	10,180	122,160	23,258	190,281	35
3,000	10,500	3,000	10,500	3,000	10,500	3,000	10,500	36
....	150,000	....	207,050	....	222,975	....	209,900	37
250,000	75,000	301,100	72,264	281,100	67,464	310,000	89,900	38
500	80,000	550	100,000	600	108,000	600	108,000	39
20,000	80,000	27,000	108,000	25,000	100,000	15,000	75,000	40
425,000	34,000	575,000	46,000	....	....	327,883	26,231	41
....	200,000	....	150,000	....	150,000	....	100,000	42
600,000	10,000	600,000	10,000	800,000	12,000	1,000,000	15,000	43
1,080,000	540,000	972,000	486,000	875,000	437,500	875,000	437,500	44
25,000	100,000	25,000	100,000	30,000	120,000	30,000	120,000	45
4,000	20,000	4,000	20,000	4,000	20,000	5,000	22,500	46
2,500	50,000	3,000	60,000	2,000	35,000	2,700	40,000	47
1,000	8,000	1,000	5,000	1,000	5,000	1,000	5,000	48
14,000	70,000	14,100	71,112	10,900	55,112	13,600	68,000	49
100,000	250,000	114,000	285,000	147,410	368,525	92,000	161,000	50
....	....	....	....	....	....	....	....	51
11,653	32,046	1,096	2,795	2,000	5,100	68,723	65,373	52
2,000	24,000	2,000	24,000	2,000	20,000	1,975	24,687	53
600	21,000	1,000	27,000	500	12,000	715	17,875	54
1,200	36,000	1,000	30,000	1,000	30,000	300	9,000	55
500	1,800	550	2,000	600	2,000	600	2,000	56
....	....	....	....	....	....	....	....	57
....	231,340,150	....	243,812,214	....	227,379,506	....	247,312,093	58
....	219,755,109	....	203,128,859	....	186,109,599	....	181,586,587	59
....	6,500,000	....	6,500,000	....	500,000	....	500,000	60
....	457,595,259	....	453,441,073	....	413,989,105	....	429,398,680	61

Mineral products of the United States for the

	Products.	1886.		1887.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, value at Philadelphia.....long tons..	5, 683, 329	$95, 195, 760	6, 417, 148	$121, 925, 800
2	Silver, coining value..............troy ounces..	39, 445. 312	51, 000, 000	41, 269, 240	53, 350, 000
3	Gold, coining value.........................do....	1, 881, 250	35, 000, 000	1, 596, 500	33, 000, 000
4	Copper, value at New York City.....pounds..	161, 235, 381	16, 527, 651	185, 227, 331	21, 115, 916
5	Lead, value at New York City ....short tons..	130, 629	12, 200, 749	145, 700	13, 113, 000
6	Zinc, value at New York City...........do....	42, 641	3, 752, 408	50, 340	4, 782, 300
7	Quicksilver, value at San Francisco ...flasks..	29, 981	1, 060, 000	33, 825	1, 429, 000
8	Nickel, value at Philadelphia ....pounds..	214, 992	127, 157	205, 566	133, 200
9	Aluminum, value at Pittsburg ....do....	3, 000	27, 000	18, 000	59, 000
10	Tin..do....	....	....	....	....
11	Antimony, value at San Francisco..short tons..	35	7, 000	75	15, 000
12	Platinum, value (crude) at San Francisco, ...troy ounces..	50	100	448	1, 838
13	Total value of metallic products	....	214, 897, 825	....	248, 925, 054
	NON-METALLIC (spot values).				
14	Bituminous coal.....................long tons..	65, 810, 676	78, 481, 056	78, 470, 857	98, 004, 656
15	Pennsylvania anthracite................do....	34, 853, 077	76, 119, 120	37, 578, 747	84, 552, 181
16	Building stone....................................	....	19, 000, 000	....	25, 000, 000
17	Petroleum..............................barrels..	28, 064, 841	19, 996, 313	28, 278, 866	18, 877, 094
18	Lime.......................................do....	42, 500, 000	21, 250, 000	46, 750, 000	23, 375, 000
19	Natural gas..	....	10, 012, 000	....	15, 817, 500
20	Clay (all except potter's clay)................	....	6, 200, 000	....	7, 000, 000
21	Cement................................barrels..	4, 500, 000	3, 990, 000	6, 692, 744	5, 674, 377
22	Salt.......................................do....	7, 707, 081	4, 736, 585	7, 831, 962	4, 093, 846
23	Phosphate rock ....long tons..	430, 549	1, 872, 936	480, 558	1, 836, 818
24	Limestone for iron flux..................do....	4, 717, 163	2, 830, 297	5, 377, 000	3, 226, 200
25	Mineral waters...................gallons sold..	8, 950, 317	1, 284, 070	8, 259, 609	1, 261, 463
26	Zinc white ....short tons..	18, 000	1, 440, 000	18, 000	1, 440, 000
27	Potters' clay.......................long tons..	40, 000	325, 000	43, 000	1, 340, 000
28	Mineral paints ....short tons..	21, 056	315, 000	24, 640	330, 000
29	Borax....................................pounds..	9, 778, 290	488, 915	11, 000, 000	550, 000
30	Gypsum ....short tons..	95, 250	428, 625	95, 000	425, 000
31	Grindstones	....	250, 000	....	224, 400
32	Fibrous talc.........................short tons..	12, 000	125, 000	15, 000	160, 000
33	Pyrites ....long tons..	55, 000	220, 000	52, 000	210, 000
34	Soapstone..........................short tons..	12, 000	225, 000	12, 000	225, 000
35	Manganese ore.....................long tons..	30, 193	277, 636	34, 524	333, 844
36	Asphaltum..........................short tons..	3, 500	14, 000	4, 000	16, 000
37	Precious stones...................................	....	119, 056	....	163, 600
38	Bromine ....pounds..	428, 334	141, 350	199, 087	61, 717
39	Corundum........................ short tons..	645	116, 190	600	108, 000
40	Barytes, crude ....do....	10, 000	50, 000	15, 000	75, 000
41	Graphite...............................pounds..	415, 525	33, 242	416, 000	34, 000
42	Millstones	....	140, 000	....	100, 000
43	Novaculite ....pounds..	1, 160, 000	15, 000	1, 200, 000	16, 000
44	Marls ....short tons..	800, 000	400, 000	600, 000	300, 000
45	Flint...................................long tons..	30, 000	120, 000	32, 000	185, 000
46	Fluorspar ....short tons..	5, 000	22, 000	5, 000	20, 000
47	Chromic iron ore ....long tons..	2, 000	30, 000	3, 000	40, 000
48	Infusorial earth..................short tons..	1, 200	6, 000	3, 000	15, 000
49	Feldspar ....long tons..	14, 900	74, 500	10, 200	56, 100
50	Mica ....pounds..	40, 000	70, 000	70, 000	142, 250
51	Ozocerite, refined..........................do....	....	....	....	....
52	Cobalt oxide ....do....	35, 000	36, 878	18, 340	18, 774
53	Sulphur.............................short tons..	2, 500	75, 000	3, 000	100, 000
54	Asbestos...................................do....	200	6, 000	150	4, 500
55	Rutile...................................pounds..	600	2, 000	1, 000	3, 000
56	Magnesite ....short tons..	....	....	....	....
57	Total value of non-metallic mineral products.	....	251, 338, 769	....	294, 416, 320
58	Total value of metallic products..........	....	214, 897, 825	....	248, 925, 054
59	Estimated value of mineral products unspecified.	....	800, 000	....	800, 000
60	Grand total......................................	....	467, 036, 594	....	544, 141, 374



VALUE OF ALL MINERAL PRODUCTS OF THE UNITED STATES 1880 TO 1893.

[Millions of dollars.]

calendar years 1880 to 1893—Continued.

1888.		1889.		1890.		1891.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
6,489,738	$107,000,000	7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,337,985	1
45,783,632	59,195,000	51,354,851	66,396,988	54,500,000	70,464,645	58,330,000	75,416,565	2
1,604,927	33,175,000	1,590,869	32,886,744	1,588,880	32,845,000	1,604,840	33,175,000	3
231,270,622	33,833,954	231,246,214	26,907,809	265,115,133	30,848,797	295,810,076	38,455,300	4
151,919	13,399,256	156,397	13,794,235	143,630	12,668,166	178,554	15,534,198	5
55,903	5,500,855	58,860	5,791,824	63,683	6,266,407	80,337	8,033,700	6
33,250	1,413,125	26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	7
204,328	127,632	252,663	151,598	223,488	134,093	118,498	71,099	8
19,000	65,000	47,468	97,335	61,281	61,281	150,000	100,000	9
....	....	....	....	....	....	125,289	25,058	10
100	20,000	115	28,000	129	40,756	278	47,007	11
500	2,000	500	2,000	600	2,500	100	500	12
....	253,731,822	....	267,247,033	....	305,735,670	....	300,232,798	13
91,106,998	101,860,529	85,383,059	94,346,809	99,392,871	110,420,801	105,268,962	117,188,400	14
41,624,611	89,020,483	40,714,721	65,879,514	41,489,858	66,383,772	45,236,992	73,944,735	15
....	25,500,000	....	42,809,706	....	47,000,000	....	47,294,746	16
27,612,025	17,947,620	35,163,513	26,963,340	45,822,072	35,365,105	54,291,980	30,526,553	17
49,087,000	24,543,500	68,474,668	33,217,015	60,000,000	35,000,000	60,000,000	35,000,000	18
....	22,629,875	....	21,097,099	....	18,742,725	....	15,500,084	19
....	7,500,000	....	8,000,000	....	8,500,000	....	9,000,000	20
6,503,295	5,021,139	7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	21
8,055,881	4,374,203	8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	22
448,567	2,018,552	550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	23
5,438,000	2,719,000	6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	24
9,578,648	1,679,302	12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	25
20,000	1,600,000	16,970	1,357,600	....	1,600,000	23,700	1,600,000	26
36,750	300,000	294,344	635,578	350,000	756,000	400,000	900,000	27
29,680	405,000	34,307	483,766	47,732	681,992	49,652	678,478	28
7,589,000	455,340	8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	29
110,000	550,000	267,769	784,118	182,995	574,523	208,126	628,051	30
....	281,800	....	439,587	....	450,000	....	476,113	31
20,000	210,000	23,746	244,170	41,354	389,196	53,054	493,068	32
54,331	167,058	93,705	202,119	111,836	273,745	119,320	338,880	33
15,000	250,000	12,715	231,708	13,670	252,309	16,514	243,981	34
29,198	279,571	24,197	240,559	25,084	219,050	23,416	239,129	35
53,800	331,500	51,735	171,537	40,841	190,416	45,054	242,264	36
....	139,850	....	188,807	....	118,833	....	235,300	37
307,386	95,290	418,891	125,667	387,847	104,719	343,000	54,880	38
589	91,620	2,245	105,565	1,970	89,395	2,265	90,230	39
20,000	110,000	19,161	106,313	21,911	86,505	31,069	118,363	40
400,000	33,000	....	72,662	....	77,500	....	110,000	41
....	81,000	....	35,155	....	23,720	....	16,587	42
1,500,000	18,000	5,982,000	32,980	....	69,909	1,375,000	150,000	43
300,000	150,000	139,522	63,956	153,620	69,880	135,000	67,500	44
30,000	175,000	11,113	49,137	13,000	57,400	15,000	60,000	45
6,000	30,000	9,500	45,835	8,250	55,328	10,044	78,330	46
1,500	20,000	2,000	30,000	3,599	53,985	1,372	20,580	47
1,500	7,500	3,466	23,372	2,532	50,240	....	21,988	48
8,700	50,000	6,970	39,370	8,000	45,200	10,000	50,000	49
48,000	70,000	49,500	50,000	60,000	75,000	75,000	100,000	50
43,500	3,000	50,000	2,500	350,000	26,250	50,000	7,000	51
8,491	15,782	13,955	31,092	6,788	16,291	7,200	18,000	52
....	....	1,150	7,850	....	....	1,200	39,600	53
100	3,000	30	1,800	71	4,560	66	3,960	54
1,000	3,000	1,000	3,000	400	1,000	300	800	55
....	....	....	....	....	....	439	4,390	56
....	310,741,114	....	315,639,932	....	347,770,491	....	356,756,171	57
....	253,731,822	....	267,247,033	....	305,735,670	....	300,232,798	58
....	900,000	....	1,000,000	....	1,000,000	....	1,000,000	59
....	565,372,936	....	583,886,965	....	654,506,161	....	657,988,969	60

Mineral products of the United States for the calendar years 1880 to 1893—Continued

Products.	1892.		1893.	
	Quantity.	Value.	Quantity.	Value.
METALLIC.				
Pig iron.............long tons..	9,157,000	$131,161,039	7,124,502	$84,810,426
Silver.............troy ounces..	63,500,000	82,099,150	60,000,000	77,575,757
Gold.............do....	1,596,375	33,000,000	1,739,081	35,950,000
Copper.............pounds..	353,275,742	37,977,142	337,416,848	32,054,601
Lead.............short tons..	173,654	13,892,320	163,982	11,839,590
Zinc.............do....	87,260	8,027,920	78,832	6,306,560
Quicksilver.............flasks..	27,993	1,245,689	30,164	1,108,527
Aluminum.............pounds..	259,885	172,824	339,629	266,903
Antimony.............short tons..	....	56,466	250	45,000
Nickel.............pounds..	92,252	50,739	49,399	22,197
Tin.............do....	162,000	32,400	8,938	1,788
Platinum.............troy ounces..	80	550	75	517
Total value of metallic products......	....	307,716,239	....	249,981,866
NON-METALLIC.				
Bituminous coal.............long tons..	113,264,792	125,124,381	114,629,671	122,751,618
Pennsylvania anthracite.............do....	46,850,450	82,442,000	48,185,306	85,687,078
Lime.............barrels..	65,000,000	40,000,000	58,000,000	35,900,000
Building stone.............	....	48,706,625	....	33,865,573
Petroleum.............barrels..	50,509,136	26,034,196	48,412,666	28,932,326
Natural gas.............	....	14,800,714	....	14,346,250
Clay (all, except potters' clay).............	....	9,000,000	....	9,000,000
Cement.............barrels..	8,758,621	7,152,750	8,002,467	6,262,841
Mineral waters.............gallons sold..	21,876,604	4,905,970	23,544,495	4,246,734
Phosphate rock.............long tons..	681,571	3,296,227	941,368	4,136,070
Salt.............barrels..	11,698,890	5,654,915	11,816,772	4,054,668
Limestone for iron flux.............long tons..	5,172,114	3,620,480	3,958,055	2,374,833
Zinc, white.............short tons..	27,500	2,200,000	24,059	1,804,420
Potters' clay.............long tons..	420,000	1,000,000	400,000	900,000
Gypsum.............short tons..	246,374	671,548	253,615	696,615
Borax.............pounds..	13,500,000	900,000	8,699,000	652,425
Mineral paints.............short tons..	51,704	767,766	37,714	530,284
Grindstones.............	....	272,244	....	(a)
Fibrous talc.............short tons..	41,925	472,485	35,861	403,436
Asphaltum.............do....	87,930	445,375	47,779	372,232
Soapstone.............do....	23,908	437,449	21,071	255,067
Precious stones.............	....	312,050	....	264,041
Pyrites.............long tons..	114,717	305,191	83,277	275,302
Corundum.............short tons..	1,771	181,300	1,713	142,325
Novaculite.............pounds..	....	146,730	....	135,173
Mica.............do....	75,000	100,000	66,971	88,929
Barytes.............long tons..	32,108	130,025	28,970	88,506
Bromine.............pounds..	379,480	64,502	348,399	104,520
Fluorspar.............short tons..	12,250	89,000	12,400	84,000
Feldspar.............long tons..	15,000	75,000	18,391	68,037
Manganese ore.............do....	13,613	129,586	7,718	66,614
Flint.............do....	20,000	80,000	29,671	63,792
Graphite.............pounds..	....	104,000	843,103	63,232
Sulphur.............short tons..	2,688	80,640	1,200	42,000
Marls.............do....	125,000	65,000	75,000	40,000
Infusorial earth.............do....	....	43,655	....	22,582
Millstones.............	....	23,417	....	16,645
Chromic iron ore.............long tons..	1,500	25,000	1,450	21,750
Cobalt oxide.............pounds..	7,869	15,738	8,422	10,346
Magnesite.............short tons..	1,004	10,040	704	7,040
Asbestos.............do....	104	6,416	50	2,500
Rutile.............pounds..	100	300	....	....
Ozocerite, refined.............do....	60,000	8,000	(b)	(b)
Total value of non-metallic mineral products.............	....	379,900,715	....	358,839,804
Total value of metallic products.............	....	307,716,239	....	249,981,866
Estimated value of mineral products unspecified.............	....	1,000,000	....	1,000,000
Grand total.............	....	688,616,954	....	609,821,670

a Included in sandstone product. *b* Included in asphaltum.

IRON AND STEEL.

PROGRESS OF THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES IN 1892 AND 1893.

By James M. Swank,

General Manager of the American Iron and Steel Association.

In preceding papers contributed to "Mineral Resources" we have dealt with varying phases of the development of our iron and steel industries, prominence being always given to the statistics of production from year to year. In 1887 the maximum of our production of steel rails was attained, and in 1890 our production of pig iron reached the highest mark.

In 1891 and 1892 our iron and steel industries were very actively employed, although prices slowly but steadily declined. In the latter year we made almost as much pig iron as in 1890. But in 1893 all the industries of the country were subjected to a great strain, owing to the financial panic of that year, and our iron and steel industries were conspicuously and most injuriously affected by the prevailing depression. In the production of iron ore, pig iron, steel in various forms, rolled iron and steel, and the more finished forms of iron and steel there were over one hundred financial failures during the year. Scarcely a week passed when the announcement was not made of the passage into the hands of receivers or assignees of one or more enterprises of the character above indicated. While the record of failures in the iron trade thus far in 1894 is much smaller than in any period of equal length in 1893, the interruption to the prosperity of our iron and steel industries, which began early in 1893, still continues. Production in 1893, and up to the present time in 1894, has been greatly below the average of immediately preceding years, while prices have been much lower in the early months of the present year than at any time in 1893, low as they then were. Prices of all kinds of iron and steel have never been so low in this country as during the last twelve months. There are some indications, however, that the general list of prices will rise in 1894 as the result of the scarcity of some products, caused by the inability of many manufacturers to continue production at the prices which have been prevailing, and also by the refusal of coal miners and coke workers to work at current wages, thus largely cutting off the supply of both coal and coke, and compelling many furnaces, steel works, and rolling mills to suspend operations. The prices of Bessemer pig iron and billets have materially advanced during the present month of May.

Iron and steel works in the United States in 1894.—The depression in the iron trade of this country in 1893 and thus far in 1894 was preceded by great activity in 1892 in the enlargement of old plants and in the erection of new plants, the most noticeable activity being in the erection of tin-plate works and in the extension of our facilities for the rolling of fine sheets for tinning and terne plating. This particular activity had commenced in 1891, after the passage of the tariff of 1890, and it was continued in 1893 notwithstanding the depression, but in the year last mentioned very little progress was made in the building of any other iron or steel works.

The American Iron and Steel Association has just published a new edition of its "Directory to the Iron and Steel Works of the United States," the information contained in its pages being brought down to the early months of 1894. A summary of the facts presented in this volume in comparison with a similar summary made in January, 1892, shows the following results:

The condition of the iron and steel works in 1894 compared with 1892.

	January, 1894.	January, 1892.
Number of completed blast furnaces	519	569
Number of blast furnaces building	....	11
Annual capacity of completed blast furnaces....long tons..	16,271,027	14,550,708
Annual capacity of the bituminous furnaces....do....	11,679,700	10,097,946
Annual capacity of the anthracite furnaces....do....	3,305,887	3,198,387
Annual capacity of the charcoal furnaces....do....	1,285,440	1,254,375
Number of completed rolling mills and steel works	487	460
Number of rolling mills and steel works building and rebuilding....	9	18
Number of puddling furnaces	4,715	5,120
Number of heating furnaces	3,054	2,913
Number of trains of rolls	1,690	1,592
Annual capacity of completed rolling mills....long tons..	12,477,890	10,563,655
Number of rolling mills having cut-nail factories	55	65
Number of cut-nail machines	5,094	5,546
Number of wire-nail works	54	49
Number of completed standard Bessemer-steel works	43	46
Number of Bessemer-steel works building	1	2
Number of standard Bessemer converters	95	95
Annual capacity (built and building) in ingots and direct castings....long tons..	7,740,900	5,857,143
Number of completed Clapp-Griffiths steel works	4	5
Number of Clapp-Griffiths converters	7	9
Annual capacity in ingots....long tons..	146,500	151,786
Number of completed Robert-Bessemer steel works	4	4
Number of Robert-Bessemer converters	6	6
Number of completed open-hearth steel works	81	71
Number of open-hearth steel works building	1	4
Number of open-hearth furnaces	189	164
Annual capacity (built and building) in ingots and direct castings....long tons..	1,740,000	1,383,929
Number of completed crucible steel works	48	45
Number of crucible steel works building	1	1
Number of steel-melting pots which can be used at each heat......	3,103	2,934
Annual capacity in ingots and direct castings....long tons..	99,000	93,750
Number of completed tin-plate works	56	20
Number of tin-plate works building	2	10
Number of forges making wrought iron from ore	11	10
Annual capacity in blooms and billets....long tons..	17,870	18,929
Number of pig and scrap iron bloomaries	14	20
Annual capacity in blooms....long tons..	30,925	32,143

In the following table is presented a detailed statement by States of the number of blast furnaces, rolling mills, steel works, cut-nail machines, wire-nail works, tin-plate works, and forges and bloomaries in the United States in January, 1894.

List of iron and steel works in the United States, January, 1894.

States.	Furnaces.				Rolling mills and steel works.	Steel works in detail.					Tin-plate works.	Forges and bloomaries.	Cut-nail machines.	Wire-nail works.
	Anthracite.	Bituminous.	Charcoal.	Total.		Bessemer.	Clapp-Griffiths.	Robert-Bessemer.	Open hearth.	Crucible.				
Maine					1									
New Hampshire					1				1					
Massachusetts			4	4	13		1		4	1	1		291	8
Rhode Island					1									1
Connecticut			7	7	7					3				3
New York	19	2	6	27	23	1			3	4	8	8		5
New Jersey	14			14	19				3	6	3	3	193	1
Pennsylvania	109	76	14	199	221	20	2	1	42	25	25	10	1,392	9
Delaware					9									
Maryland		5	6	11	6	1				1	3	1		
Virginia		24	8	32	10	1							146	1
West Virginia		4		4	6	2							856	1
Kentucky		6	3	9	9	1			2				126	
Tennessee		13	9	22	5	1			1	1		1	41	
North Carolina		2		2								1		
Georgia		2	3	5	2									
Alabama		38	14	52	10				2			1	77	
Texas			4	4	2									
Ohio		55	10	65	61	6			12	1	6		1,164	7
Indiana		2		2	26	2		1	3	1	3		316	3
Illinois		19		19	28	6	1	1	5	3	5		346	6
Michigan			20	20	4			1	1	1	1			
Wisconsin		4	6	10	3	1								2
Minnesota		1		1	2									
Missouri		3	2	5	7				1		1		50	1
Iowa					3					1				1
Kansas														1
Colorado		3		3	2	1								
Oregon			1	1	1									
Wyoming					1									
Washington			1	1										2
California					4				1				96	2
Total	142	259	118	519	487	43	4	4	81	48	56	25	5,094	54

The following extracts from the preface to the directory above referred to exhibit in still greater detail than has yet been presented the progress that has been made from January, 1892, to January, 1894, in the perfection of our facilities for the manufacture of all the iron and steel products embraced in the above table.

Blast furnaces.—In the edition of the directory for 1892 there were enumerated and described 569 completed blast furnaces and 11 which were in course of erection. The total annual capacity of the completed furnaces was 14,550,708 long tons. In the present edition we enumerate and describe 519 completed furnaces, with an aggregate annual capacity of 16,271,027 long tons, or just 50 furnaces less than in 1892, and 7 furnaces which have been partly erected but upon which work has been suspended. Not one new furnace in the United States is now being built—a remarkable circumstance. Since the appearance of the directory in February, 1892, there have been built 16 new furnaces, and in the present edition we have transferred to the abandoned list 66 furnaces which were classed in 1892 among the furnaces that were then active or likely to be active at some future time.

Of the 66 furnaces now transferred to the abandoned list 20 are in Pennsylvania, 11 in New York, 7 in Ohio, 6 in Virginia, 4 in Tennessee, 3 each in Michigan and Missouri, 2 each in Connecticut, Maryland, and Alabama, and 1 each in Maine, New Jersey, Kentucky, Georgia, Illinois, and Wisconsin. Of the 16 new furnaces built since January, 1892, 7 are in Tennessee, 5 in Virginia, and 1 each in New York, North Carolina, Alabama, and Wisconsin. It is a curious fact that since January, 1892, 20 furnaces have been abandoned in Pennsylvania and not one furnace has been built in that State. Of the 7 furnaces upon which work has been suspended 2 are in Alabama, 2 in Wisconsin, and 1 each in Pennsylvania, Virginia, and Tennessee.

Of the 519 furnaces described in the present directory 118 use charcoal as fuel and the remainder use anthracite and bituminous coal and coke. In the directory for 1892 the number of charcoal furnaces described was 138, or just 20 more than in 1894. The number of anthracite and bituminous furnaces described in 1892 was 431, and in 1894 the number is 401, or 30 less than in 1892. It will be seen that the number of charcoal furnaces has decreased in two years proportionately much more than the number of furnaces using mineral fuel.

The average annual capacity of the 569 completed furnaces which were described in the directory for 1892 was 25,572 long tons, and the average annual capacity of the 519 furnaces which are described in the present edition is 31,351 long tons.

The aggregate annual capacity of the 519 completed furnaces which are now described is 1,720,319 tons more than the capacity of the 569 completed furnaces which were described in January, 1892. The total annual capacity of the 118 charcoal furnaces which are described in the present directory is 1,285,440 long tons, and the total annual capacity of the 138 charcoal furnaces which were described in 1892 was 1,254,375 long tons. It will be noted that, while the aggregate furnace capacity of the country increased 1,720,319 tons from 1892 to 1894, that of the charcoal furnaces alone increased only 31,065 tons.

The average annual capacity of the charcoal furnaces described in 1892 was 9,090 long tons, and the average annual capacity of the charcoal furnaces described in 1894 is 10,894 long tons. The average annual capacity of all the furnaces using mineral fuel in 1892 was 30,850 long tons, and the average annual capacity of all the mineral fuel furnaces in 1894 is 37,371 long tons.

Rolling mills and steel works.—In the present edition of the directory we enumerate and describe 487 completed rolling mills and steel works in the United States, of which 446 contain trains of rolls and 41 have no rolls. In the edition of two years ago we described 460 completed rolling mills and steel works. In the intervening time 57 new rolling mills and steel works have been built, 1 has been revived, and 31 have been abandoned, the net increase in the period mentioned being 27. In January, 1894, there were 8 rolling mills and steel plants in course of erection and 1 rebuilding, against a total of 18 works which were in course of erection at the beginning of 1892.

Puddling furnaces.—The number of puddling furnaces attached to rolling mills in January, 1894, each double furnace being regarded as the equivalent of two single furnaces, was 4,715, against 5,120 in January, 1892, a decrease of 405 furnaces, or about 8 per cent. This is the first edition of the directory in late years that has noted a decrease in the number of puddling furnaces, each previous edition having noted an increase.

Bessemer steel works.—Since the appearance of our last directory we have built 4 new standard Bessemer steel plants—one at Garwood, New Jersey, to make steel car wheels, but which has recently been abandoned; one at Shenango, Pennsylvania, to make steel billets; one at McKeesport, Pennsylvania, to make steel slabs and billets; and one at Indianapolis, Indiana, to make steel bars and miscellaneous shapes. In the same time 7 standard Bessemer steel plants have been burned or abandoned—2 in Massachusetts, 1 in New Jersey, 1 in Tennessee, 2 in Illinois, and 1 in Missouri, and in the same period 1 Clapp-Griffiths steel plant has been abandoned. We now have 43 standard Bessemer plants, with 95 converters, against 46 in 1892, with 95 converters. One new standard Bessemer plant is being erected at Youngstown, Ohio, to contain two 10-long-ton converters, for the production of rails, structural shapes, etc. The construction of one 4-long-ton converter for the production of castings was commenced at Sharon, Pennsylvania, in 1891, but work upon it has been suspended. In addition to the Bessemer plants above mentioned we now have 4 Clapp-Griffiths and 4 Robert-Bessemer steel plants, the former with 7 converters and the latter with 6 converters. No new Clapp-Griffiths or Robert-Bessemer plants have been built since 1889.

The annual converting capacity of all the standard Bessemer steel plants in 1894, built and building, is 7,740,900 long tons of ingots and direct castings, against 5,857,143 tons in January, 1892. These figures exhibit a remarkable increase in converting capacity in two years. While the demand for steel rails of standard sections for steam railroads has greatly fallen off in recent years, the demand for Bessemer steel for girder rails for street railways, structural shapes, axles, springs, wire rods, and many other miscellaneous uses has greatly increased. The production of Bessemer billets, slabs, and blooms to supply these uses has greatly interfered with the demand for puddled iron.

Open-hearth steel.—Since the appearance of the directory for 1892 we have built 15 new open-hearth steel plants, while 5 have been burned or abandoned, showing a net increase of 10 plants. We now have 81 completed open-hearth steel plants, and in addition 1 new plant is in course of erection at Chicago by the Illinois Steel Company.

The annual capacity in ingots and direct castings of the open-hearth steel plants in 1894, built and building, is 1,740,000 long tons, against 1,383,929 tons in January, 1892. These figures show a very healthy growth in two years. There has been in the last few years an increased demand in this country for open-hearth steel for boiler plates and ship plates, armor plates, gun forgings for the Army and Navy, heavy and light castings, locomotive tires, tools, structural shapes, machinery generally, and many other purposes. Like Bessemer steel, open-hearth steel has become a formidable competitor of puddled iron. But the open hearth is also a formidable competitor of iron foundries. In 1892 there were 18 open-hearth plants which made direct castings, and in 1894 there are 28 plants which are prepared to make these castings.

Basic steel.—The manufacture of basic steel in this country is virtually confined to 4 works in Pennsylvania, 3 using the open hearth and 1 using the Bessemer process. Outside of Pennsylvania basic steel has been made only experimentally or on a very small scale. The industry has made no progress in the South.

Crucible steel works.—Three more crucible plants are enumerated in the present edition than in the edition of two years ago, 4 plants having been abandoned in the meantime and 7 having been built. We now have 48 completed crucible steel plants and 1 in course of erection, against 45 completed and 1 building two years ago.

Cut-nail machines.—In January, 1892, there were 65 rolling mills which were devoted in whole or in part to the manufacture of cut nails and spikes, and which contained 5,546 nail machines. In January, 1894, the number of rolling mills which manufactured cut nails and spikes was 55, with 5,094 nail machines. These figures show a decrease of 452 cut-nail machines in two years. The directory for 1892 showed a decrease of 520 cut-nail machines from 1889 to 1892.

Wire rods and wire.—There are now in this country 23 works which roll iron or steel wire rods, and we have 64 completed iron or steel wire drawing plants and 1 additional plant in course of erection.

Wire-nail works.—In the directory for 1892 we enumerated 49 completed wire-nail works and 2 additional works in course of erection. In the present edition we enumerate 54 completed wire-nail works and 1 partly erected works, located in 17 States. Their average capacity is much greater than that of the works described two years ago.

Tin-plate works.—In the directory for 1892 we enumerated and described 20 works which were either making or were prepared to make tin plates or terne plates, and 10 additional tin-plate works which were in course of erection. In the present edition we describe 56 completed, 2 building, and 1 partly erected tin-plate works. Nearly all of these works have been built since the passage of the McKinley tariff act in 1890.

Forges and bloomaries.—Under this classification we enumerate only the works which make wrought iron direct from the ore and works which make blooms from pig iron or scrap iron for sale. Works which make blooms in connection with rolling mills and for use exclusively in these rolling mills are not separately classified, as they are auxiliary and not independent enterprises. In the directory for 1892 we enumerated 30 forges and bloomaries, and we now enumerate 25.

Natural gas.—Natural gas is still used in a large number of our rolling mills and steel works. In the present directory we enumerate 79 works which use this fuel in whole or in part—42 in Allegheny county, Pennsylvania, 15 in other counties of western Pennsylvania, 5 in Ohio, and 17 in Indiana. One works now being rebuilt in West Virginia and 2 works in course of erection in Indiana will also use natural gas. In the directory for 1892 there were enumerated 74 works which used natural gas, but their consumption of this fuel was much larger than that of the 79 works which now use it. It is only in Indiana that the consumption of natural gas has increased during the last two years. In January, 1892, only 6 works in that State used natural gas.

Production of pig iron in 1893.—The total production of pig iron in the United States in 1893 was 7,124,502 long tons, against 9,157,000 tons in 1892, 8,279,870 tons in 1891, and 9,202,703 tons in 1890. The production in 1893 was 2,032,498 tons, or over 22 per cent., less than in 1892. This great decline in production may be fairly said to have occurred wholly in the second half of 1893, as the production of the first half was larger than that of the second half of 1892, and almost as large as that of the first half of 1892. In the following table we give the production of pig iron by half years during the last four years:

Production of pig iron by half years from 1890 to 1893.

Periods.	1890.	1891.	1892.	1893.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
First half	4,560,513	3,368,107	4,769,683	4,562,918
Second half	4,642,190	4,911,763	4,387,317	2,561,584
Total	9,202,703	8,279,870	9,157,000	7,124,502

As compared with the first half of 1893 the production in the second half of that year shows a decrease of nearly 44 per cent., the largest semi-annual decrease in production of which there is any statistical record.

The following table shows the production of pig iron in 1893 by States, compared with the production in 1891 and 1892.

Production of pig iron by States for the last three years.

States.	Long tons of 2,240 pounds.		
	1891.	1892.	1893.
Massachusetts	8,990	7,946	7,853
Connecticut	21,811	17,107	12,478
New York	315,112	310,395	191,115
New Jersey	92,490	87,975	74,305
Pennsylvania	3,952,387	4,193,805	3,643,022
Maryland	123,398	99,131	151,773
Virginia	295,292	342,847	302,856
North Carolina	3,217	2,908	2,843
Georgia	49,858	9,950	39,675
Alabama	795,673	915,296	726,888
Texas	18,662	8,613	6,257
West Virginia	86,283	154,793	81,591
Kentucky	44,844	56,548	47,501
Tennessee	291,738	300,081	207,915
Ohio	1,035,013	1,221,913	875,265
Indiana	7,729	7,700	5,567
Illinois	669,202	949,450	405,261
Michigan	213,145	184,421	117,538
Wisconsin	197,160	174,961	131,772
Missouri	29,229	57,020	32,360
Minnesota	1,226	14,071	10,373
Colorado	18,116	32,441	45,555
Oregon	9,295	7,628	4,739
Total	8,279,870	9,157,000	7,124,502

Prices of pig iron in 1892 and 1893.—The following table gives the average monthly prices of pig iron in the United States in 1892 and 1893 at leading markets in Pennsylvania, in tons of 2,240 pounds. The monthly averages are obtained from weekly quotations. We also add the prices of old iron rails, per long ton, at Philadelphia.

Average price of old iron rails and pig iron, by months, in 1892 and 1893.

Months.	Old iron "T" rails, at Philadelphia.	No. 1 anthracite foundry pig iron, at Philadelphia.	Gray forge pig iron, at Philadelphia.	Gray forge pig iron, lake ore mixed, at Pittsburg.	Bessemer pig iron, at Pittsburg.
1892.					
January	$21.00	$17.50	$14.25	$13.50	$15.65
February	20.50	17.00	14.25	13.25	15.25
March	20.25	16.50	14.00	13.00	14.75
April	20.00	16.00	14.00	13.00	14.50
May	19.90	15.95	13.75	12.94	14.36
June	19.50	15.69	13.50	12.75	14.10
July	19.17	15.06	13.00	12.75	14.00
August	19.00	15.00	13.00	12.50	14.00
September	19.00	15.00	13.00	12.50	13.96
October	19.00	15.00	13.25	12.50	13.90
November	18.40	15.17	13.25	12.50	14.03
December	18.00	15.12	13.25	12.50	13.90
1893.					
January	18.00	14.80	13.10	12.30	13.59
February	18.50	14.75	13.00	12.25	13.51
March	18.00	14.69	13.00	12.25	13.75
April	18.00	14.58	13.00	12.25	13.86
May	17.50	14.85	13.00	12.25	13.51
June	16.62	15.00	13.00	12.25	13.50
July	16.00	15.00	13.00	12.00	13.21
August	16.12	14.50	12.94	12.00	13.08
September	15.62	14.33	12.58	11.69	12.19
October	14.80	14.20	12.25	10.87	11.60
November	14.00	13.75	12.00	10.66	11.46
December	14.00	13.75	11.94	10.44	11.17

Production of Bessemer steel ingots and rails in 1893.—The total production of Bessemer steel ingots in the United States in 1893 was 3,215,686 long tons, against 4,168,435 long tons in 1892, showing a decrease in 1893 of 952,749 tons, or over 22 per cent. The production in the last half of 1893 was a little over half the production in the first half.

The following table gives the production of Bessemer steel ingots in each half of 1893 and the total production in that year as compared with the total production in 1892:

Total product of Bessemer steel ingots in 1893.

States.	First half 1893.	Second half 1893.	Total 1893.	Total 1892.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	1,337,079	789,141	2,126,220	2,397,984
Illinois	220,059	94,770	314,829	879,952
Ohio	232,980	115,161	348,141	409,855
Other States	301,939	124,557	426,496	480,644
Total	2,092,057	1,123,629	3,215,686	4,168,435

The total production of Bessemer steel rails in 1893, except the comparatively small quantity of standard rails and a larger quantity of street rails which were made by manufacturers from purchased blooms, was 1,036,353 long tons, against 1,458,732 long tons in 1892, a decrease of 422,379 tons, or almost 29 per cent.

The following table shows the production of Bessemer steel rails in each half of 1893 and the total production of the year compared with that of 1892, with the exceptions above noted for both years:

Total production of Bessemer steel rails in 1893.

States.	First half 1893.	Second half 1893.	Total 1893.	Total 1892.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Pennsylvania	429,059	210,372	639,431	885,652
Illinois	170,263	61,997	232,260	450,542
Other States	104,918	59,744	164,662	122,538
Total	704,240	332,113	1,036,353	1,458,732

The production of Bessemer steel rails in 1893 was the smallest annual production since 1885.

Prices of Bessemer steel rails in 1892 and 1893.—The price of Bessemer steel rails at mills in Pennsylvania was $30 per long ton during the whole of 1892 and $29 during the first nine months of 1893. In October, 1893, the price fell to an average of $27.50, in November to an average of $25, and in December to $24, which is the present price.

The following table gives the average annual prices of Bessemer steel rails at mills in Pennsylvania from 1867 to 1894 per long ton:

Prices of Bessemer steel rails from 1867 to 1894.

Years.	Price.	Years.	Price.	Years.	Price.	Years.	Price.
1867	$166.00	1874	$94.25	1881	$61.13	1888	$29.83
1868	158.50	1875	68.75	1882	48.50	1889	29.25
1869	132.25	1876	59.25	1883	37.75	1890	31.75
1870	106.75	1877	45.50	1884	30.75	1891	29.92
1871	102.50	1878	42.25	1885	28.50	1892	30.00
1872	112.00	1879	48.25	1886	34.50	1893	28.12
1873	120.50	1880	67.50	1887	37.08	1894	24.00

Production of tin plates in 1891, 1892, and 1893.—The provision of the McKinley tariff act, which imposes a duty of 2.2 cents per pound on tin plates and terne plates, did not take effect until July 1, 1891. We give below a table compiled from the reports of Col. Ira Ayer, special agent of the Treasury Department, which shows the production of tin plates and terne plates during the two and one-half years which elapsed from July 1, 1891, to December 31, 1893, the quantity made from American black plates and from imported black plates being given in parallel columns.

Production of tin plates and terne plates, by quarters, from 1891 to 1893.

Quarter ended—	American black plate.	Foreign black plate.	Total.	American.	Foreign.
	Pounds.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*
September 30, 1891	785,547	41,375	826,922	95	5
December 31, 1891	1,200,661	209,160	1,409,821	85.16	14.84
March 31, 1892	2,132,082	1,077,143	3,209,225	66.44	33.56
June 30, 1892	5,178,263	3,022,488	8,200,751	63.14	36.86
September 30, 1892	5,920,082	5,032,643	10,952,725	54.05	45.95
December 31, 1892	8,043,449	11,713,042	19,756,491	40.71	59.29
March 31, 1893	11,371,968	18,194,431	29,566,399	38.46	61.54
June 30, 1893	18,264,225	21,279,362	39,543,587	46.19	53.81
September 30, 1893	8,794,027	18,351,453	27,145,480	32.40	67.60
December 31, 1893	15,907,669	11,443,572	27,351,241	58.16	41.84
Total for 30 months	77,597,973	90,364,669	167,962,642	46.20	53.80

Reference has been made, on page 18, to the fact that there are now in the United States 56 completed tin-plate works and 3 partly completed works. Of the whole number, 1 is in Massachusetts, 8 are in New York, 3 are in New Jersey, 25 are in Pennsylvania, 3 are in Maryland, 8 are in Ohio, 4 are in Indiana, 5 are in Illinois, 1 is in Michigan, and 1 is in Missouri.

MAY 31, 1894.

IRON ORES.

By John Birkinbine.

Comparisons.—The calendar year 1893 shows a marked decline in the quantity of iron ore mined, and in the prices received for that product. In no year since 1887 has the amount of iron ore produced been so small as in 1893, and the published quotations of the ores, which find an extended market, have been lower than ever before. The total output of all the mines, as reported, amounts to 11,587,629 long tons, as against 16,296,666 long tons in 1892, a decrease of 4,709,037 long tons, or 28.90 per cent. The following table will illustrate the remarkable decrease in production and in the value of ore at the mines, which the year 1893 shows as compared with 1889 and 1892, the only late years in which the statistics of valuation have been collected:

Comparison of the iron ore product of the United States in 1889, 1892, and 1893.

Years.	Amount produced.	Total valuation of product, on cars or wagons at mines.	Value per long ton.
	Long tons.		
1889	14,518,041	$33,351,978	$2.30
1892	16,296,666	33,204,896	2.04
1893	11,587,629	19,265,973	1.66

The average value therefore declined 38 cents per ton in one year, while in four years preceding the total reduction was 26 cents per ton. Expressed in percentages, the decline in average value was 11.3 per cent from 1889 to 1892, or, approximately, 2.8 per cent. per year, but the values reported for 1893 average 18.63 per cent. less than in 1892.

The deficiency in product was not confined to a few localities, but extended practically over the entire country; mines which had been producing uninterruptedly for many years were idle, or worked only sufficiently to maintain them in condition for possible renewed activity. At others, work was entirely suspended and the mines practically abandoned, at least until such time as trade will offer a return sufficient to encourage the large outlay necessary to reopen them, an outlay which in some cases may be so great as to permanently remove what have been considered important mines from the list of producers. In the review of States which follows, the proportionate decline will be found to be greatest in some which contribute the largest quantities of ore, but the reduction is noticeable in all but two States, viz, Minnesota and Colorado, some new developments in the former, and improved operations at the only blast-furnace plant in the latter, being responsible for the increased output over 1892.

The production of pig iron in the United States in the first half of the year 1893 did not show as great a decline as the latter half, for various blast furnace companies consumed stocks of iron ore which were on hand either at the furnaces or on docks. Later the hand-to-mouth policy of the purchasers of pig iron and finished iron and steel products, made necessary by a general financial stringency and uncertainty as to possible changes in existing tariff schedules, decreased the number of furnace orders and caused sharp competition among iron-ore producers for those orders which were placed. Many blast furnaces, therefore, went out of blast or purchased less ore, and whatever ore was bought was obtained principally from mines whose accumulated stock had to be moved, or from the larger mines where the cost of production, due to labor-saving appliances, etc., was lower than at smaller operations. Some new exploitations also were able to offer the furnace companies low rates, which forced the closing of some of the older, less favorably situated, and the smaller or the poorer equipped mines. Owing to a small demand and unremunerative prices during 1893, nearly all the iron-ore mines in the United States either operated for but a portion of the year with a greatly reduced force, or closed down. This was the case even at some of the new mines on the Mesabi range of Minnesota, where, because of the methods employed of winning ore cheaply from shallow open workings by means of steam shovels, it was expected that the mines could run continuously at a profit when ore mining was impracticable elsewhere. The low price of the rich Lake Superior ores was a prominent factor in the decrease of foreign importations, and also of the large decrease in the domestic production of iron ore in the eastern States, particularly Pennsylvania, New York, and New Jersey.

The iron-ore production of the United States for 1893 was slightly above that of Germany for the same period, the former holding by a narrow margin its position as the largest iron-ore mining country in the world, which position it has maintained since 1890. Great Britain produced nearly as much iron-ore as Germany.

To indicate the rapid decline in values, attention may be called to a standard Gogebic iron ore of well known Bessemer grade which in the early part of 1893 sold at what was considered at that time a very low rate, viz, $3.75 per long ton delivered on docks at Cleveland, Ohio. Other producers were slow to adopt this rate, claiming that it was insufficient to maintain a mine, but it was reported in trade journals, and has not been contradicted, that 60,000 tons of this same ore were sold in February, 1894, at $2.75 per long ton delivered at the same port, a drop of $1 from the previous low price. In March, 1894, it was reported that 100,000 tons of second grade Mesabi ores were sold at $2.25 per long ton, while 500,000 long tons of a standard Minnesota

Bessemer ore were disposed of at $2.95 per long ton delivered at lower lake points. (*a*)

As in previous years, considerable amounts of mill cinder, scrap, zinc residuum, blue billy, etc., were charged into blast furnaces, with the iron ores, and while it has not been found practicable to collect all of this data, the amount of zinc residuum which was used has been collated; this amounted to 37,667 long tons, valued at $39,007, or $1.04 per ton. On the other hand, iron ore is largely used as a fix or fettling in puddling furnaces, as a flux in silver smelting, employed in the manufacture of paint, etc., and the quantities so used are practically offset by the amount of materials other than iron ore charged into the blast furnaces.

As above reported the total output of iron ore in 1893 amounted to but 11,587,629 long tons, but there were many changes in mine ownership and management, many assignments made and receivers appointed, so that notwithstanding the improved facilities for collecting data, and the growing interest exhibited by operators and consumers in the publication of statistics by the Survey, it is probably just to allow in addition to the actual figures collected, a percentage for mines not reporting, and the gross output of all the domestic iron mines may be stated at 11,625,000 long tons. However, in treating of the output of ore by kinds and by States the amounts actually reported to the Division of Mining Statistics will be used. It is gratifying to note the increased appreciation of the value of the mineral statistics among the producers of iron ore, and their general willingness to cooperate in securing correct data, but the changes in management or supervision of operations introduce a sufficient number of uncertain factors to cause the above allowance.

Classification of ores.—The following classification of iron ores is the same as used in previous reports and is practically the commercial division generally adopted by sellers and purchasers:

1. *Red hematite* comprises those ores in which the iron occurs as an anhydrous oxide, giving a red streak on a porcelain plate, the color of the ore being generally a brownish red, or red, although sometimes a dark gray, almost black. This class includes "red hematite," "fossil," or "Clinton" ores, "specular," "micaceous" ore, "slate" ore, etc., as well as some "martite," which is a pseudomorph after magnetite.

2. *Brown hematite*, which contains more water than the red hematite, is generally of a brown or yellow color, and when powdered shows a brown or brownish yellow streak on the porcelain plate. The varieties are known as "limonite," "turgite," "pipe" ore, "bog" ore, "goethite," "oolitic" ore, etc.

3. *Magnetite* comprises those ores in which iron occurs as a magnetic oxide, generally black or blue-black, or occasionally steel gray or green-

a These quotations of sales made in the early part of 1894 are for ores mined in 1893, and offer no encouragement to expect a recovery in the near future. Statements of the decline in value of iron ores appear in "Replies to Inquiries," Bulletin No. 9, Committee on Finance, U. S. Senate, Fifty-third Congress, second session.

ish in color, and which when powdered give a black streak on a test plate, and are attracted by a magnet. In this class is included some "martite," which is mined with magnetite.

4. *Carbonate* includes those iron ores which contain an excess of carbonic acid. They are generally gray, yellow, or rather buff and brown in color, and are tested by the use of hydrochloric acid. They comprise the "black band" ores, "clay ironstones," "spathic" ores, "siderite," etc.

From some mines brown and red hematite, or red hematite and magnetite, or carbonate and brown hematite ores are obtained out of the same workings, the extent to which ores are hydrated or weathered transferring them from one class to another; or different classes of ore are found intermixed or alternating in the same deposit. Wherever possible an attempt has been made in the statistical review to separate into classes the different ores coming from the same operations, but in some workings this was impracticable, and the product is credited to the predominating character of ore won.

Product by States.—The following table will show the character, according to the above classification, and the amounts of the iron ore produced in the various States and Territories during the year 1893, from which it will be seen that there were mined 8,272,637 tons of red hematite, equivalent to 71.39 per cent.; 1,849,272 long tons of brown hematite, equivalent to 15.96 per cent.; 1,330,886 tons of magnetite, equivalent to 11.49 per cent., and 134,834 tons of carbonate ore, equivalent to 1.16 per cent. of the total iron-ore output of the country. Two or more States are grouped when separate amounts would disclose in any way the operations of an individual or corporate mining enterprise without express permission. The States are arranged in their order as producers of ore.

Production of different varieties of iron ore in the year 1893 by States.

States and Territories.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Michigan	4, 636, 128	23, 420	8, 776		4, 668, 324
Alabama	1, 281, 292	461, 118			1, 742, 410
Minnesota	1, 499, 927				1, 499, 927
Pennsylvania	57, 633	158, 376	480, 164	1, 812	697, 985
Virginia and West Virginia	41, 665	568, 800	6, 500		616, 965
New York	15, 890	35, 592	440, 693	41, 947	534, 122
Wisconsin	434, 629	4, 800			439, 429
Tennessee	185, 365	181, 411		6, 220	372, 996
New Jersey	2, 348	2, 349	351, 453		356, 150
Georgia and North Carolina	38, 012	138, 221	9, 782		186, 015
Colorado	4, 654	139, 117	27, 179	720	171, 670
Missouri	68, 263	9, 600			77, 863
Ohio				68, 141	68, 141
Connecticut and Massachusetts		40, 752			40, 752
Kentucky	2, 231	30, 244		4, 239	36, 714
Texas		22, 620	3, 000		25, 620
Maryland		2, 075		11, 755	13, 830
Idaho, Montana, New Mexico, Oregon, and Utah	4, 600	30, 777	3, 339		38, 716
Total	8, 272, 637	1, 849, 272	1, 330, 886	134, 834	11, 587, 629

The following table, showing the quantities and character of the iron ore produced during the years 1889, 1890, 1891, 1892, and 1893, while illustrating the continued preference for hematite ores, demonstrates that each variety shared in the decline above mentioned.

Comparative production of iron ore, by kinds, in 1889, 1890, 1891, 1892, and 1893.

Kinds of ore.	1893.	1892.	1891.	1890.	1889.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Red hematite	8, 272, 637	11, 646, 619	9, 327, 398	10, 527, 650	9, 056, 288
Brown hematite	1, 849, 272	2, 485, 101	2, 757, 564	2, 559, 938	2, 523, 087
Magnetite	1, 330, 886	1, 971, 965	2, 317, 108	2, 570, 838	2, 506, 415
Carbonate	134, 834	192, 981	189, 108	377, 617	432, 251
Total	11, 587, 629	16, 296, 666	14, 591, 178	16, 036, 043	14, 518, 041

An analysis of the table demonstrates that relatively red hematite has about held its positition, the quantity mined being 71.47 per cent. of the total ore product in 1892 and 71.39 per cent. in 1893; brown hematite shows a proportionate increase from 15.25 per cent. in 1892 to 15.96 per cent. in 1893; the slight apparent gain in this class is offset by a fall in the percentage of magnetite ore won from 12.10 per cent. in 1892 to 11.49 per cent. in 1893, and a similar decline in the carbonate ores from 1.18 per cent. in 1892 to 1.16 per cent. in 1893. The relative increase in the proportion of brown hematite ore mined does not, however, indicate a gain, for the actual output of ore of this character is below the total for 1892. The bulk of the brown hematite was used in Virginia, Alabama, Tennessee, Pennsylvania, and Colorado.

All the States which contributed over 100,000 tons of iron ore in 1893 show a decided decrease in output, with the exception of Minnesota, and in Colorado, for local reasons already mentioned. This reduction is especially pronounced in Michigan, New York, Wisconsin, Pennsylvania, and Alabama.

In the Lake Superior region the output of iron ore was nearly one-third less than it was in 1892; there was a slightly greater decline than this in Pennsylvania's product, and in New York scarcely three fifths of the product in 1892 was obtained.

Product of iron ore by States in 1889, 1890, 1891, 1892, and 1893.

States.	1889.	1890.	1891.	1892.	1893.
	Long tons.	Long tons.	Long tons.	Long tons.	Long tons.
Michigan	5,856,169	7,141,656	6,127,001	7,543,544	4,668,324
Alabama	1,570,319	1,897,815	1,986,830	2,312,071	1,742,410
Pennsylvania	1,560,234	1,361,622	1,272,928	1,084,047	697,985
New York	1,247,537	1,253,393	1,017,216	891,099	534,122
Wisconsin	837,399	948,965	589,481	790,179	439,429
Minnesota	864,508	891,910	945,105	1,255,465	1,499,927
Virginia	498,154	543,583	658,916	741,027	(a) 616,965
New Jersey	415,510	495,808	525,612	465,455	356,150
Tennessee	473,294	465,695	543,923	406,578	372,996
Georgia	248,020	244,088	250,755	185,054	(b) 186,015
Missouri	265,718	181,690	106,949	118,494	77,863
Ohio	254,294	169,088	104,487	95,768	68,141
Colorado	109,136	114,275	110,942	141,769	171,670
Montana, Oregon, New Mexico, and Utah	(c) 86,405	81,632	(d) 93,730	44,875	(d) 38,716
Kentucky	77,487	77,685	65,089	50,523	36,714
Maryland	(e) 29,380	35,657	37,379	40,171	13,830
Massachusetts	46,242	32,934	47,502	44,911	40,752
Connecticut	29,690	26,058	30,923	31,324	
West Virginia	13,101	25,116	6,200	6,000	(f)
North Carolina	10,125	22,873	19,210	25,379	(g)
Texas	13,000	22,000	51,000	22,903	25,620
Maine	12,319	2,500	....	....	....
Total	14,518,041	16,036,043	14,591,178	16,296,666	11,587,629

a Including West Virginia.
b Including North Carolina.
c Including Idaho and Washington.
d Including Idaho.
e Including Delaware.
f See Virginia.
g See Georgia.

The rank of the principal States as producers exhibits no material change from that given in 1892 with these exceptions: Virginia has risen from seventh to fifth place, New York and Wisconsin being correspondingly lower, while New Jersey and Tennessee changed positions, the former being now ninth, while the latter is eighth in order of precedence.

In contributing to the low price of iron ore the miners', laborers', mechanics', and stevedores' wages, railroad and lake freights, etc., have all shared in the reduction more liberally than the royalties, which in many cases have remained at the same figures as in former years. The royalties will share in any further decline in the price, and even at the rates which ore now commands many mines will be unable to resume operations and pay the royalties which have been collected for years. As an instance of this a prominent mine on the Menominee range in Michigan is making preparations to resume active operations in order to give work to the men, the owner of the property generously agreeing to waive all claim to royalty for one year, otherwise the mine would have remained idle until better prices could be obtained for ore.

MICHIGAN.

Michigan still holds first rank as an iron-ore producer with an output, in 1893, of 4,668,324 long tons, or 40.29 per cent. of the total for the United States. This is, however, a falling off of 2,875,220 long tons, or 38.11 per cent. from the 1892 product of 7,543,544 long tons. Michigan's percentage of the total output of the country in 1892 was 46.29 per cent., whereas in 1893, as above stated, it was but 40.29 per cent. Of the 1893 total for the State 4,636,128 long tons, or 99.31 per cent., was classed as red hematite, 23,420 long tons, or 0.50 per cent., as brown hematite, and 8,776 long tons, or 0.19 per cent., as magnetite, giving to Michigan first, tenth, and sixth places, respectively, in the proportionate production of these three classes of ore, due to supplying 56.04, 1.27, and 0.66 per cent. of the total output of each variety.

The falling off in the outputs of the various kinds of ore in Michigan and the percentages of such decline are shown in the following table:

Comparison of the iron-ore product of Michigan in 1892 and 1893.

Character of ore.	Production.		Decrease.	Percentage decrease.
	1892.	1893.		
	Long tons.	*Long tons.*	*Long tons.*	
Red hematite	7,228,406	4,636,128	2,592,278	35.86
Brown hematite	187,306	23,420	163,886	87.50
Magnetite	127,832	8,776	119,056	93.14
Total	7,543,544	4,668,324	2,875,220	38.11

Considering the mines locally it was found that the greatest deficiency in production was in the Gogebic range (which is partly in Michigan and partly in Wisconsin), for while the older Marquette and Menominee ranges also declined in output, the proportions were not as great as in the Gogebic range. This may be due in part to the fact that the newly developed Mesabi ores of Minnesota replaced some of the ore formerly obtained from this range. These Mesabi ores are soft, easily mined at present, and the freight on them to lower lake ports closely approaches those paid on Gogebic ores.

A remarkable instance of the low price of iron ore which prevailed during the latter half of 1893 is obtained from the record of a sheriff's sale of the stock piles of the Colby, Tilden, and Comet mines, for which $1.10 per long ton was obtained for the ore sold. The deficiency in demand, and the inadequate compensation obtainable for such ore as was sold, brought absolute distress upon the inhabitants of the Gogebic range, and in many cases skilled miners, willing and anxious for work, were absolutely penniless, and became unwilling objects of charity.

The number of unemployed workmen can not be determined with exactness, some reports claiming that in the iron-ore regions of Michigan 60,000 men, who were in one way or another dependent on the iron-ore industry, were out of employment. In one instance a manager of an iron-ore company in the Lake Superior region was requested by its unemployed workmen to be allowed to take the place of a steam shovel which was used for loading ore on cars from stock piles; permission being granted, the men struggled to obtain places which would yield for a hard day's labor a pittance of about 50 cents. It is doubtful if the distress in the silver-mining industry, which has been widely discussed through the press, was as pronounced as in some portions of the Lake Superior iron-ore region. As indicative of the prevalent distress it was authoritatively reported that on the Gogebic iron-ore range in Michigan the three towns of Ironwood, Bessemer, and Wakefield had 5,447 persons who were receiving aid, because the iron-ore mines of that range had closed down. As showing the nationalities represented by the population, it is of interest to note that of these 5,447 persons, 1,011 were Scandinavians, 838 English, 792 Irish, 742 Fins, 626 Poles, and the balance Bohemians, Italians, Hungarians, Austrians, French, etc., but 63 being native Americans.

The Marquette range has held its position remarkably, due, no doubt, to the facts that the hard iron ores are now better prepared for furnace use, that the majority of the ores won are of high Bessemer grade, that in transportation less moisture is absorbed than by the softer ores of the Gogebic and Mesabi ranges, and that the distances covered in carrying the Marquette ores to lower lake ports are less than from the other ranges, except the Menominee. In addition, the companies operating on the Marquette range were, as a rule, generally longer established and stronger financially than the most of those operating the Gogebic mines. Some of the former own vessels, and most of them have superior machinery equipment at the mines.

In consequence of the depressed condition of the trade, but little development work was done, and although some few new mines were opened, but little, if any, ore was shipped from them.

ALABAMA.

This State continues to occupy second place as an iron-ore producer, but it seems probable that in the course of a year or two this position will be taken by Minnesota, where, owing to the opening of the new mines, and the development of the northwestern portion of the country, the State will assume a more prominent position in the iron-ore industry.

The output of Alabama in 1893 was 1,742,410 long tons, or 15.04 per cent of the total for the country. Of this amount 1,281,292 long tons or 73.54 per cent of the State's total was red hematite, in which class of ore Alabama occupied third place, supplying 15.49 per cent of the total for the country. This is a decline from the previous year of 375,736 tons, or 22.68 per cent in this class of ore; 461,118 long tons, or 26.46 per cent of the ore mined was classed as brown hematite, a decline from the amount won in 1892 of 193,925 long tons, equivalent to a deficiency of 29.60 per cent. In this class of ore Alabama occupied second position, producing 24.94 per cent of the country's total. This State produced 569,661 long tons, or 24.64 per cent less ore in 1893 than in 1892.

The principal features of the year 1893 were (1) a reduction in the prices for winning ore to a point formerly thought to be unattainable, and (2) a more careful selection of the material fed to blast furnaces. During the year a large amount of experimental work has been done in an attempt to beneficiate some of the more siliceous ores. The greatest activity in mining operations continues in the vicinity of Birmingham, where the hard and soft red hematite iron ore is won, and in the northeastern section of the State where brown hematite ore is obtained for local charcoal and coke furnaces.

The Russellville district, in northwestern Alabama, although producing considerable ore, fell behind its last year's output, owing to the suspension of near-by furnace plants.

MINNESOTA.

This State produced 1,499,927 long tons of iron ore in 1893, or 12.94 per cent. of the total for the United States, giving it third place. The increase over its 1892 output of 1,255,465 long tons was 244,462 long tons, or 19.47 per cent. All of this ore was of the red hematite character, in which class the State stood second, supplying 18.13 per cent. of the total of this variety of ore.

The new Mesabi range opened at an inauspicious time for obtaining a large output, yet last year it mined 684,194 tons of ore, a large amount for what was really the first active mining year on this range. The production would probably have been larger, but for the fact already mentioned, viz, an exceedingly active competition with the older Lake Superior ranges, and the low prices obtained for the ore, taken in connection with the royalties demanded at most of the mines, acting as an offset for the cheapness with which the ores could be won. The royalties on some of the mines were such that a number of leases were reported as canceled last year on that account. It has been stated that the average royalty on all the ore mines on the Mesabi range, including the fee-simple mines, amounted to about 37½ cents per ton in 1892–93. Another point which prevented a large demand for the ore was its fine comminution, which led some managers to use but small proportions of the ore in the blast furnace charge. It is probable that this objection will be overcome, however, and it is stated that the furnace at Duluth was for a time run on all Mesabi ores, with good results.

PENNSYLVANIA.

This State, together with New York and Colorado, produced all four classes of iron ore in 1893. The output of Pennsylvania in 1893 was 697,985 long tons, giving it fourth place, although producing but 6.02 per cent. of the country's total. This amount represents a decline of 386,062 long tons., equivalent to 35.61 per cent. from the 1892 product of 1,084,047 long tons.

Of this 697,985 long tons produced, 480,164 tons or 68.79 per cent. was magnetite; 158,376 tons or 22.69 per cent., brown hematite; 57,633 tons or 8.26 per cent., red hematite; and 0.26 per cent. or 1,812 tons, carbonate ore. Pennsylvania occupying in the country's total of these classes of ore first, fourth, seventh, and sixth places, and producing 36.08 per cent., 8.56 per cent., 0.70 per cent., and 1.34 per cent., respectively of the nation's output of varieties named.

The State has declined in the production of all the different classes of ore, as will be seen in the following table:

Product of iron ore in Pennsylvania in 1892 and 1893 by classes.

Classes of ore.	Production.		Decrease.	Percentage decrease.
	1892.	1893.		
	Long tons.	*Long tons.*	*Long tons.*	
Magnetite	685,986	480,164	205,822	30
Brown hematite	229,700	158,376	71,324	31.05
Red hematite	163,307	57,633	105,674	64.71
Carbonate	5,054	1,812	3,242	64.15

In Pennsylvania the major portion of the iron ore mined is obtained from the eastern and southern portions of the State, and as the blast furnaces in this district were among the first to feel the change in demand a number blew out, their inactivity affecting the amount of ore mined locally. Some local ore, however, was displaced by Lake Superior ores, which also competed with the highest grades of foreign ores practically at tide water. The bulk of the magnetite mined in Pennsylvania continues to come from the Cornwall ore hills, and probably there is no better indication of the severity of the business depression than in the greatly reduced output from this deposit, where ore can be mined so cheaply and supplied to so many blast furnaces close by. For a part of the year all blast furnaces at Cornwall, and most of those within a few miles of the ore hills, were idle, a condition unprecedented, and the deposit produced but 439,705 long tons, or 69.28 per cent. of what it contributed in 1892. By reference to the record of large producers farther on it will be seen that notwithstanding this marked deficiency the Cornwall ore hills produced more iron ore in 1893 than any other single mining operation in the country, whereas, with a product of 195,009 tons greater in 1892, there were in that year 3 plants which exceeded the output of Cornwall.

VIRGINIA.

This State now holds fifth position as an iron-ore producer, with an output for 1893 of 612,465 long tons, or 5.29 per cent. of the country's total. This advance in relative position was not due to increased production in Virginia, but to the fact that the proportionate decline of 17.35 per cent. from the 741,027 long tons mined in 1892 was less than in the two other States which formerly outranked her.

Three classes of ore were obtained in the State, 92.14 per cent. being brown hematite, 6.80 per cent. red hematite, and the balance, 1.06 per cent., magnetite. Virginia occupies first position among the States producing brown hematite, contributing 30.51 per cent.; eighth among those producing red hematites, contributing 0.50 per cent.; and seventh position among magnetite producers, contributing 0.49 per cent. of the country's total. While there was an increase of 15,545 tons, or 59.51 per cent., over the red hematite production of 26,120 tons in 1892, and an addition of 3,346 long tons, or 106.09 per cent., of magnetite won over the output of 3,154 tons in 1892, these gains were more than counterbalanced by a decline of 147,453 long tons., or 20.72 per cent., from the brown hematite production of 711,753 long tons in 1892. Virginia has had to bear its share of the business depression, and the decreased iron-ore output tells of blast furnaces idle and capital unremunerative.

NEW YORK.

This State's record of 534,122 long tons, or 4.61 per cent. of the country's total, gives it sixth place and shows a loss of 356,977 long tons, or 40.06 per cent, when compared with the 1892 total of 891,099 long tons.

Of the State's product for 1893, the magnetite mines contributed 440,693 long tons, or 82.51 per cent; the brown hematite operations, 35,592 long tons, or 6.66 per cent; the carbonate workings, 41,947 tons, or 7.85 per cent; and the red hematite mines, 15,890 long tons, or 2.98 per cent. As a producer of magnetite, New York occupied second place, with 33.11 per cent of the country's output of this class of ore; it also holds the same position as a carbonate producer with 31.11 per cent. of the total; among the brown hematites it ranks seventh, supplying 1.92 per cent, while its production of red hematite ore gave it tenth place with 0.19 per cent of the total.

The decline in the various classes of ore produced in 1893 as compared with 1892 will be found below.

Production of various classes of iron ore in New York in 1892 and 1893.

Character of ore.	Production.		Decrease.	Percentage decrease.
	1892.	1893.		
	Long tons.	*Long tons.*	*Long tons.*	
Magnetite	648, 564	440, 693	207, 871	32. 05
Carbonate	64, 041	41, 947	22, 094	34. 50
Red hematite	124, 800	15, 890	108, 910	87. 27
Brown hematite	53, 694	35, 592	18, 102	33. 71
Total	891, 099	534, 122	356, 977	40. 06

The blowing out of furnaces, etc., was most severely felt at the Clinton or fossil ore mines of the State, which are situated in the central and northern central portions, and at the magnetite mines of the Lake Champlain region in the northeastern portion. The operations of the largest producer of carbonate in New York, situated on the Hudson river, indicate approaching exhaustion in that portion of the developments where the best ore has been obtained.

WISCONSIN.

Wisconsin stands seventh on the list with a product of 439,429 long tons, or 3.79 per cent of the total. Of this amount 434,629 tons, or 98.91 per cent, was of the red hematite variety, and the balance, 4,800 tons, or 1.09 per cent, was brown hematite. This State exhibits a decline of 350,750 tons, or 44.39 per cent, from the 1892 total of 790,179 tons. A new blast furnace enterprise which depends upon local brown hematite mines for its supply of ore is mainly responsible for maintaining Wisconsin among the list of States which produced this class of ore in 1893.

TENNESSEE.

Tennessee occupies eighth position, supplying 3.22 per cent. of the total iron ore output. Of the 372,996 tons which Tennessee produced in 1893, 185,365 tons, or 49.69 per cent., was classed as red hematite, and 181,411 tons, or 48.64 per cent., brown hematite; the balance, 6,220 tons, or 1.67 per cent., was reported as carbonate ore. These figures show a decline from the amount produced by Tennessee's mines in 1892 (viz., 406,578 long tons) of 33,582 tons, or 8.26 per cent.

The carbonate or spathic iron ore which was mined in 1893 was the initial output of this class of ore in Tennessee, and was obtained from the southwestern portion of Lawrence county, near the Alabama border. It was smelted in the proportion of one part spathic ore and two parts brown hematite in the Spathite Iron Company's furnace at Florence, Alabama. The following are some analyses of the ore:

Partial analyses of spathic iron ore, Iron City, Lawrence county, Tennessee.

	1.	2.	3.
	Per cent.	*Per cent.*	*Per cent.*
Moisture			0.495
Ferric oxide	27.64	43.76	54.271
Manganous oxide	.32		.023
Lime	32.72	20	21.96
Magnesia	.82		
Carbon dioxide		15.71	
Phosphorus pentoxide	.88	1.79	1.068
Sulphur		.07	
Alumina	2.19		.853
Silica	6.82	6	6.695
Carbonic acid, loss	28.38		
Metallic iron	19.35	30.63	37.99
Manganese	.23		
Phosphorus	.385	.78	.466

Analyst, No. 1, Leutscher; No. 2, Wharton; No. 3, Dudley.

The iron contents of the ores obtainable will probably range between the figures given in analyses Nos. 1 and 2, and the adaptability of the material will depend practically upon its fluxing character as affecting itself and other ores with which it is mixed. Based upon its iron contents alone, the ore would not be economical to use, but when considered as a flux carrying iron, it may prove of sufficient value to mine and transport to blast furnaces within convenient distance. The claim is also made that this spathic ore possesses the meritorious features generally credited to most carbonate ores, of producing iron especially useful for the production of pig iron for foundry purposes.

NEW JERSEY.

This State showed a falling off of 109,305 tons, or 23.48 per cent, from the 1892 total of 465,455 long tons, the amount produced in 1893 being but 356,150 long tons, or 3.07 per cent of the country's total. Of this amount 351,453 long tons, or 98.68 per cent, was magnetite, the balance being about equally divided between the red and brown hematites.

OTHER STATES.

Of the remaining States only Georgia and Colorado contributed over 100,000 long tons each to the total, the former producing 176,233 long tons, of which 138,221 tons were brown hematite, and the balance, 38,012 tons red hematite; while the latter's total of 171,670 long tons was composed of all four kinds of ore, 139,117 tons being brown hematite, 27,179 tons, magnetite, 4,654 tons red hematite, and 720 tons carbonate.

Ohio's product, 68,141 long tons, was all carbonate ore, in which class it occupied first place, supplying 50.54 per cent of this variety of ore.

Massachusetts and Connecticut obtained their brown hematite ores from the Salisbury region. Kentucky contributed both brown and red hematite in addition to some carbonate ores. Texas supplied brown hematite, with the exception of some magnetite which was mined in development work in the Llano district. Maryland produced some carbonate ore which was used in the local furnaces, and also a small quantity of brown hematite, mined in the western portion of the State. Oregon is credited with brown hematite ores used in the one blast furnace in that State. In most of the other Western States and Territories the ore produced was used as a flux in smelting precious metals, and was principally brown hematite and magnetite, although some red hematite was also employed.

VALUE OF IRON ORES PRODUCED.

In the following table the valuation of the iron ore produced in the United States during the year ending December 31, 1893, is reported by States except where such publication would disclose the operations of individuals or companies. It shows that the average value per ton of iron ore at the mines in all important producing States (i. e., those mining over 100,000 tons) has declined, but in the less important States there have apparently been some slight advances.

The average value of iron ore for the United States as a whole was $1.66 per ton at the mine, as against a similar average of $2.04 in 1892, a decline of 38 cents per ton or 18.63 per cent. The highest average value reported was $3.01 in Connecticut and Massachusetts, and the lowest 86 cents in Alabama.

The higher value of iron ore in Colorado and the West is owing to a relatively high wage rate and limited production, and the greater reported value of ores mined in Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania is due to the fact that the ore mined near points of consumption is subject to heavy royalties or is of special quality, and also because more expensive exploitation is in many instances necessary by reason of the depth or size of workings, exhaustion of portions of long exploited deposits, etc.

In Michigan the value per ton fell from $2.20 in 1892 to $1.84 in 1893, a decline of 36 cents per ton, or 16.36 per cent., while in Minnesota the value was but $1.55 per ton in 1893 as against $2.46 in 1892, a decrease of 91 cents per ton, or 36.99 per cent. This, however, is not entirely due to the decline in the market value of the iron ore from the Vermilion range, although this is quite marked, nor to the fact that the distances to be covered by ores from Minnesota average greater than those from Michigan, and therefore freights on the former average higher than on the latter, but in 1893 the Mesabi range had its first year of large output, and the ores being new and of a soft character did not command as high prices as the harder and well-known ores of the Vermilion range; thus the average for the State was reduced. It is more than probable that the prices which were obtained for iron ore in these two States in the latter part of 1893 were insufficient to pay interest on the investment of capital, royalty, cost of mining, depreciation, etc. In fact, some mines are known to have been operated either to keep a force of men together or merely because it was found better to run at a slight loss than to close down entirely with fixed charges continuing.

In three prominent southern iron-producing States, Alabama, Virginia, and Tennessee, the value of ore has fallen to $0.86, $1.70, and $1.05 per ton, respectively, representing declines of 20 cents per ton, or 18.87 per cent., for Alabama; 21 cents per ton, or 11 per cent., for

Virginia; and 19 cents per ton, or 15.32 per cent., for Tennessee, as compared with the values reported in 1892.

It will be interesting to group the various States whose iron ores present similarities either in the methods of occurrence, means of exploitation, or general characteristics, and which supply certain markets, noting the quantities produced by each group, and the value of the ores won. The States of Michigan, Wisconsin, and Minnesota; offer such a group, and their product is (with the exception of some fossil and brown hematite ores of Wisconsin) all marketed as Lake Superior ores. These States in 1893 produced a total of 6,607,680 long tons, principally red hematite, which had an average value of $1.74 per ton. This amount of ore represents 57.02 per cent. of the entire output of the iron ore mines of the United States, and it yielded a higher average percentage of iron than the balance of the country's product.

The Virginias, North Carolina, Georgia, Alabama, and Tennessee may be assigned to a second group, the ores of which will yield less than the average of the country, but which produces a large quantity of cheap iron ores. The output of this group, representing 25.25 per cent. of the total for the country, is second to that of the Lake Superior district, amounting to 2,918,386 long tons, the value of which averages $1.08 per ton. The ores are mainly red and brown hematites.

Another group, which may be formed with propriety, comprises the States of New York, Pennsylvania, New Jersey, and Maryland, these four contributing an aggregate of 1,602,087 long tons, or 13.82 per cent. of the total for the country, of an average value of $2.20 per ton. This group embraces nearly all of the magnetite mined, and includes all varieties of ore, the yield of those won being close to the general average, but considerably below the average for Lake Superior ores.

Kentucky and Ohio could be grouped as producers of carbonates or their derivatives, but their output is small compared with the above, and the other producing States may be more properly considered individually.

The above grouping in a general way suggests the relative advantages as ore-producers of the districts mentioned, but their commercial importance is influenced by convenience to fuel supply and to markets for the iron which may be produced from the ores.

Value of iron ore produced during the year 1893, by States.

States.	Production.	Value.	Value per ton.
	Long tons.		
Michigan	4,668,324	$8,611,192	$1.84
Alabama	1,742,410	1,490,259	.86
Minnesota	1,499,927	2,321,204	1.55
Pennsylvania	697,985	1,374,313	1.97
Virginia and West Virginia	616,965	1,050,977	1.70
New York	534,122	1,222,934	2.29
Wisconsin	439,429	584,094	1.33
Tennessee	372,996	392,771	1.05
New Jersey	356,150	909,458	2.55
Georgia and North Carolina	186,015	203,682	1.09
Colorado	171,670	514,312	3.00
Missouri	77,863	160,532	2.07
Ohio	68,141	104,897	1.54
Connecticut and Massachusetts	40,752	122,475	3.01
Kentucky	36,714	47,746	1.30
Texas	25,620	25,997	1.01
Maryland	13,830	25,585	1.85
Other States and Territories	38,716	103,545	2.67
Total	11,587,629	19,265,973	1.66

It should be remembered that this amount, although large, represents practically the cost of mining, and royalty; to reach points of consumption, charges for transportation, handling, etc., will probably make the iron ore product of the country represent a value exceeding $36,000,000.

STOCKS OF IRON ORE AT MINES.

The stocks of ore on hand December 31, 1892, aggregating 2,911,740 long tons, increased 614,421 long tons, or 21.10 per cent. during the year 1893, reaching a total of 3,526,161 long tons reported on December 31, 1893. This represents 30.43 per cent. of the total production of the United States for the year 1893. As would naturally be expected, the largest stocks on hand were of ores from the Lake Superior region, the bulk of the production being sent as mined to lower lake ports by water. During the suspension of navigation in the winter months the ore on hand at mines accumulates, and on the stock piles of the States of Michigan, Minnesota, and Wisconsin there was on December 31, 1893, 2,594,438 long tons, or 73.58 per cent. of the total stocks reported for the United States. But this proportion may be more apparent than actual, because accounting of stocks is not practiced elsewhere as a rule. Some mines, operated by blast-furnace companies for the supply of their plants, keep no record of stocks; in other cases the quantity of ore accumulating is determined by skip loads which are hoisted from the mine. However, allowing for discrepancies elsewhere, it is evident that the Lake Superior mining companies carried the bulk of the stocks of ore at mines, in addition to the liberal amounts held at receiving docks on Lake Erie, and that there was at mines throughout the United States at the close, approximately, one-third of all the ore mined during the year. The quantities of ore reported on hand at the close of the years 1892 and 1893 are exhibited in the following table:

Stocks of iron ore on hand.

States.	December 31, 1892.	December 31, 1893.
	Long tons.	*Long tons.*
Michigan	1,520,477	1,844,370
Alabama	47,918	60,171
Minnesota	247,053	294,393
Pennsylvania	62,124	95,312
Virginia and West Virginia	92,984	28,880
New York	244,583	246,851
Wisconsin	251,649	455,675
Tennessee	101,027	146,027
New Jersey	72,390	62,038
Georgia and North Carolina	24,830	13,500
Colorado	4,200	80
Missouri	*a*127,546	146,472
Ohio	60,013	73,507
Connecticut and Massachusetts	2,810	1,892
Kentucky	6,504	9,725
Texas	18,103	25,806
Maryland	8,000	7,900
Other States and Territories	19,529	13,562
Total	2,911,740	3,526,161

a In a previous report for 1892 this was given as 248,337 long tons, but as the return from one mine gave as stock on hand ore which it was necessary to treat before it became marketable the figures have been corrected in the present return.

LAKE SUPERIOR ORE SHIPMENTS.

It has been shown in previous reports that the Lake Superior region is the most important iron producing district in the country, and that most of its ore is sent by water to lower lake ports where large receiving docks act as distributing mediums to blast furnaces. As shipments can only be made by water during seven to eight months of the year, it necessarily follows that enormous stocks of ore accumulate on the docks of these distributing points toward the close of the shipping season, and often considerable amounts remain on hand at the opening of navigation, the stocks exerting an important influence on the iron-ore market.

The ports from which iron ore is shipped have received an addition in Duluth, Minnesota, which made its initial shipment this season, and it is probable that in the future this harbor, which receives ore from the Mesabi range, will increase its shipments. As will be seen from the table below which has been taken from the *Cleveland Iron Trade Review*, Escanaba, Michigan, still holds first rank, but the amount of ore sent forward from that port represents but little more than half of the trade credited to it in 1892. Ashland, Wisconsin, fell off in nearly the same proportion, while Marquette, Michigan, was the only one of the older shipping ports which showed increased shipments. For the purpose of comparison the total shipments for 1892 and for 1893 are also given.

Lake shipments of iron ore, 1892 and 1893.

Ports.	1893.	1892.
	Long tons.	*Long tons.*
Escanaba, Mich	2,048,981	4,010,085
Ashland, Wis	1,117,520	2,223,683
Marquette, Mich	1,043,988	1,026,338
Two Harbors, Minn	992,352	1,165,076
Duluth, Minn	440,292	
Gladstone, Mich	203,343	115,886
Superior, Wis	80,273	4,245
Total shipments	5,836,749	8,545,313

As an example of quick work, and to supplement the statistics furnished in previous reports, the following data are presented concerning the new iron-ore shipping dock of the Duluth, Mesabi & Northern Railroad Company at Duluth, Minnesota. This dock is 2,340 feet long, 52 feet wide, 53 feet high above the water line, and has 384 pockets, having a storage capacity of 150 tons each, a total of 57,600 tons. Eight thousand piles and 10,000,000 feet of lumber were required for its construction. The first pile was driven January 20, 1893; the first ore was received July 22. Using but 200 pockets, the shipments up to November 20, 1893, were 430,000 tons. It is not an uncommon occurrence to load a boat with 2,000 tons of ore in 1 hour and 30 minutes. The cost of the dock complete was $425,000.

LAKE ERIE ORE RECEIPTS.

The difference between the lake shipments and the amount received at the lower lake ports represents the iron ore sent to Chicago, Milwaukee, and other points having blast furnaces, accessible by water transportation.

The greater portion of the iron ore brought through the Great Lakes goes to Ashtabula and Cleveland, Ohio, the other ports following in the order named in the accompanying table, in which the receipts to December 1, 1893, and the stocks on docks at that date, are given together with similar data for 1892.

Receipts of iron ore at lower lake ports in season of 1892 and 1893, and stocks on hand December 1.

Ports.	Receipts.		Stocks.	
	1893.	1892.	1893.	1892.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula	1,845,738	2,555,416	1,296,431	1,312,658
Cleveland	1,260,716	1,950,224	1,163,930	1,347,992
Fairport	792,517	866,611	578,033	610,609
Erie	469,299	645,230	359,827	401,683
Buffalo	*a*308,238	197,000	119,170	125,000
Conneaut	203,207	1,130	91,337	None.
Lorain	165,667	190,400	201,632	147,600
Toledo	145,515	139,987	92,911	71,409
Huron	137,700	65,000	89,000	45,000
Sandusky	4,464	49,736	78,439	87,500
Total	5,333,061	6,660,734	4,070,710	4,149,451

a Includes Tonawanda.

The figures given of stocks held at mines added to those carried at lower lake ports make a total of 6,665,148 long tons, which exceeds the entire amount mined in the States of Michigan, Minnesota, and Wisconsin in 1893. But as the stock at the lower lake ports was taken on December 1, the amount on hand December 31, 1893, was slightly less, making the stocks of Lake Superior ores held by mine-owners or their agents at that date very close to the 1893 output of these States.

The receipts of ore at lower lake ports were less than in 1889, 1890, and 1892, but greater than they were in 1891, while the stocks of ore on hand December 1, 1893, viz., 4,070,710, are the largest on record, with the exception of last year when there were 4,149,451 long tons on hand. How much of this stock of ore on hand is practically sold can not be definitely estimated, but the bulk of that unsold is stated to be of non-Bessemer grades. During 1893 a larger proportion than usual of the ore brought down was shipped direct to the furnaces, advantage being taken of the rebate given where ore does not go upon the dock.

The following table showing the percentage of the lake shipments received at various lower lake ports from 1883 to 1893, inclusive, will illustrate the relative positions which they each occupied in the years mentioned.

Percentages of lake shipments of iron ore received at lower lake ports in the years 1883 to 1893, inclusive.

Ports.	1883.	1884.	1885.	1886.	1887	1888.	1889.	1890.	1891.	1892.	1893.
Ashtabula, Ohio	39.6	35.3	38.7	29.6	32.1	34.1	36.8	31.7	32.4	38.4	34.6
Cleveland, Ohio	42.7	49.1	39.2	45.6	35.4	25.7	26.2	28.3	25.5	29.3	23.6
Fairport, Ohio	2.4	1.3	2.1	4.9	14.6	16.2	15.6	15.9	14.2	13.0	14.9
Buffalo, N. Y	2.4	.5	.5	1.4	.8	6.3	5.6	8	8.3	2.9	5.8
Erie, Pa	6.3	6.3	8.1	4	6.1	6.3	5.5	7.1	7.9	9.7	8.8
Lorain, Ohio	1.5	1.6	.9	4.4	3.9	5.2	5.3	4.1	5.4	2.9	3.1
Sandusky, Ohio	3.5	5.8	9.5	7	4.7	4.1	3.5	2.5	2.1	.7	.1
Toledo, Ohio	1.6	0.1	1.0	1.2	1.8	2	1.5	2.4	3.9	2.1	2.7
Huron, Ohio	......	......	......	1.9	.6	.1	......	......	.3	1	2.6
Conneaut, Ohio	......	......	......	......	......	......	......	......	......	......	3.8

STOCKS AT ORE DOCKS.

The stock of ore on hand at the opening of navigation May 1, 1894, was larger than any previous year except 1891, being 2,588,370 long tons as against 2,095,797 long tons in 1893, and 1,537,188 tons in 1892.

Deducting the stock of ore on hand May 1, 1894, from the stock on hand December 1, 1893, the winter shipments to furnaces appear to have been 1,482,340 long tons. These winter shipments for the past ten years have been as follows:

Winter shipments of iron ore from Lake Superior docks.

Winter of—	Amount.	Winter of—	Amount.
	Long tons.		*Long tons.*
1884–'85	1,285,220	1889–'90	1,670,878
1885–'86	1,090,648	1890–'91	1,231,264
1886–'87	817,168	1891–'92	1,971,301
1887–'88	855,141	1892–'93	2,053,654
1888–'89	1,289,802	1893–'94	1,482,340

The shipments to furnaces during the season of navigation amounted to 3,358,148 long tons, which added to the shipments as above when lake traffic is suspended, makes the total shipments of Lake Superior ore to furnaces during the year ending May 1, 1894, 4,840,488 long tons; the lowest amount sent forward since the year ending May 1, 1889.

IMPORTANT IRON-ORE PRODUCERS.

While, as a rule, the larger iron-ore producers, owing to improved methods of mining, lower proportionate fixed charges, etc., are better able to meet competition than the smaller mines, the effect of a decreased demand was severely felt by all, in some instances necessitating the closing of mines, and in others operating with a diminished force. During the year 1893 there were but 54 mining establishments which produced over 50,000 long tons, while in 1892 there were 71 such. The combined product for 1893 from the 54 operations was 8,302,099 long tons, equivalent to 71.65 per cent. of the entire output of the country. Of these important mines 24 were situated in Michigan, 11 in Alabama, 7 in Minnesota, 4 in Wisconsin, 3 in New York, 2 in Virginia, and one each in New Jersey, Pennsylvania, and Tennessee. Of these mines, 4 produced over 400,000 long tons, 5 between 300,000 and 400,000 tons, 3 between 200,000 and 300,000 tons, 18 between 100,000 and 200,000 tons, and 24 between 50,000 and 100,000 tons. The average output of the 54 large producers in 1893 was 153,743 long tons per mine, but a similar average for the 71 large producers in 1892 was 176,928 long tons.

The names of mines and the amounts of iron ore mined by such of the larger companies or firms as expressed no objection to such publication, will be found in the following table, arranged according to reported production:

Important iron-ore producing operations in 1893.

Names of mines.		Production.
		Long tons.
Cornwall, Penna		439,705
Metropolitan Land and Iron Company, Gogebic range, Mich.:		
Norrie	219,606	
North Norrie	118,865	
East Norrie	100,026	
		438,497
Chandler, Vermilion range, Minn		436,595
Chapin, Menominee range, Mich		414,907
Minnesota Iron Company, Vermilion range, Minn		362,570
Ishkooda mines (a group), Ala		353,587
Pittsburg and Lake Angeline, Marquette range, Mich		345,323
Penn Iron Company, Menominee range, Mich		340,382
Lake Superior, Marquette range, Mich		325,879
J. R. & C. J. Smith, Fossil, Ware, and Muscado mines (group), Ala		271,017
Cleveland Iron Company, Marquette range, Mich		242,706
Commonwealth, Menominee range, Mich		208,925
Buffalo Mining Company, Marquette range, Mich		187,774
Aurora, North Aurora, and Vaughn (group), Gogebic range, Mich		185,688
Pewabic, Marquette range, Mich		184,755
Winthrop & Mitchell, Marquette range, Mich		169,243
Colby & Tilden, Nos. 1 and 2 (group), Gogebic range, Mich		155,862
Biwabik, Mesabi range, Minn		151,200
Irondale, Ala		135,010
Salisbury, Marquette range, Mich		132,000
Aragon, Menominee range, Mich		130,439
Newport and Bonnie, Gogebic range, Mich		121,450
Mountain Iron, Mesabi range, Minn		119,441
Etowah Mining Company, Etowah, Line, and Winchester mines (group), Ala		118,347
Cliffs shaft, Marquette range, Mich		112,700
Sloss, Ala		111,949
Pabst, Gogebic range, Mich		109,262
Negaunee, Marquette range, Mich		108,627
Ashland, Gogebic range, Mich		93,800
Volunteer, Marquette range, Mich		90,000
Port Henry Iron Ore Company, No. 21, Lake Champlain district, N. Y		85,295
Commodore, Mesabi range, Minn		85,000
Inman, Tenn		75,378
Richards, N. J		65,674
Canton, Mesabi range, Minn		64,000
Champion, Ala		61,796
Shelby, Ala		60,164
Graces Gap, Ala		60,000
Stephens, Ala		55,000
Jackson, Marquette range, Mich		54,188
Tannehill, Ala		52,000
Iron Belt, Gogebic range, Wis		51,903
Total for 42 mines		7,368,038
Add for 12 mines not mentioned by name		934,061
Total for 54 mines		8,302,099

Of the total, 7,218,698 long tons was red hematite obtained from forty-three mines; 781,149 long tons was magnetic ore from five mines, and 302,342 long tons was brown hematite taken from five operations. There was one mine which produced both red hematite and magnetite, which completes the total number of mines (54), but while the amount of each kind of ore produced is included in the above totals, the mine itself has not been classified in either group.

MATERIAL HANDLED TO OBTAIN IRON ORES.

In collecting the statistics for the year 1893 an endeavor was made to obtain approximate figures as to the total amount of material moved in winning iron ore. Generally speaking the brown hematites require the removal of the largest amount of material, followed by the carbonate, red hematite, and magnetite ores in the order named. It was found impossible to obtain complete figures, as at a number of the mines no records are kept, at others (brown hematite) only the record of the number of tons passing through the washers was preserved, the overtop or stripping where the ore was won by open cut not being included, except where some of this overtop went into the washers; but the range of quantities furnished by various reporters are tabulated below. The quantity of material handled in some of the States is due to opening new mines, dead work, mining lean magnetite or red hematite, which was concentrated, etc. Most of the brown hematite workings, are open cut, and a considerable overtop must be removed until the ore body proper is reached, which will yield 1 ton of ore from 2 to 8 tons of material put through the washer, although there are exceptional cases where still greater averages are handled.

The carbonate ores require roasting to raise the iron contents by removing the carbonic acid, but as this class of ore is generally mined underground there is a smaller quantity of refuse material, and in most localities about 2 tons of material handled per long ton of ore produced may be taken as an average, although, as will be seen in the table, sometimes 6 or more tons of material must be removed and treated to produce a ton of merchantable ore of this class.

The red hematite and magnetite ores are mined chiefly underground, and with the exception of some lean magnetite, which requires concentration, are ready for shipment as they come from the mine, after the rock has been sorted out and the larger pieces of ore crushed to a size appropriate for furnace use.

The following tables will show the variations of the amount of material treated from such records as were obtainable for each variety of ore:

Material moved in mining brown hematite.

States.	Amount of material treated per ton of merchantable ore.	States.	Amount of material treated per ton of merchantable ore.
	Tons.		*Tons.*
Alabama	1½ to 9	Missouri	(*a*)
Colorado	1⅛ to 3¾	New York	1.06 to 5.6
Connecticut	2¼	Pennsylvania	1¼ to 10
Georgia	2 to 5	Tennessee	1⅓ to 3.8
Idaho	(*a*)	Texas	(*a*)
Kentucky	3 to 4	Utah	3
Maryland	(*a*)	Virginia	1.1 to 10
Massachusetts	(*a*)	Wisconsin	2.2
Michigan	(*a*)		

a Not given.

Material moved in mining red hematite.

States.	Amount of material treated per ton of merchantable ore.	States.	Amount of material treated per ton of merchantable ore.
	Tons.		*Tons.*
Alabama	$1\frac{1}{7}$ to $1\frac{1}{5}$	New York	(*a*)
Colorado	(*a*)	Pennsylvania	1 to 6
Georgia	2 to 2.8	Tennessee	1.05
Michigan	1 to $4\frac{3}{4}$	Utah	$1\frac{1}{2}$
Minnesota	1.03 to 2	Virginia	(*a*)
Missouri	1 to 3	Wisconsin	1.06 to 1.2
Montana	1.03		

a Not given.

Material moved in mining carbonate iron ores.

States.	Amount of material treated per ton of merchantable ore.	States.	Amount of material treated per ton of merchantable ore.
	Tons.		*Tons.*
Colorado	$1\frac{4}{7}$	Ohio	$1\frac{1}{2}$ to 6
Kentucky	4	Pennsylvania	4
Maryland	*a* 10 to 18	Tennessee	1.8
New York	2		

a This is for the winning of kidney or pot ore and practically includes stripping.

Material moved in mining magnetite.

States.	Amount of material treated per ton of merchantable ore.	States.	Amount of material treated per ton of merchantable ore.
	Tons.		*Tons.*
Colorado	(*a*)	New York	1.01 to 2.34
Michigan	(*a*)	North Carolina	1.58
Montana	1	Pennsylvania	1 to $1\frac{1}{3}$
New Jersey	1.12 to 3	Texas	$8\frac{1}{3}$
New Mexico	(*a*)	Virginia	2.8

a Not given.

IMPORTATION OF FOREIGN IRON ORES.

As would naturally be expected, the low price of Lake Superior and other domestic iron ores, and the generally decreased demand, resulted in a restricted importation of foreign ores. With the exception of the Cuban ores (the only two operations on this island which have been as yet worked, being owned by American companies and used to supply Pennsylvania and Maryland furnaces), Portugal, and Turkey in Asia, all the other foreign contributors to our iron-ore supply sent smaller amounts of iron ore in 1893 than in the previous year, the total for the year ending December 31, 1893, being 526,951 long tons, valued at $906,687, against 806,585 longs tons, valued at $1,795,644, imported in 1892.

The value of the iron ore imported, as set forth in the tables below does not represent the true value of the material at the mines, but merely the selling prices at the port of shipment, to which must be added the ocean carriage, import duty of 75 cents per ton, dock charges, commissions, etc. Some of these ores, while classed as iron ore, are used for other purposes. Thus, the high valuation placed on those imported from Turkey in Europe and Asia, and other countries (mainly British Australasia), is due to the chromic oxide contents. Some of the Grecian and other ores contain considerable manganese, thus enhancing their value.

The Bureau of Statistics of the U. S. Treasury Department has kindly supplied the following table showing the quantities and values of iron ores imported into the United States during the year ending December 31, 1893, to which, for purposes of comparison, similar data for the years 1889, 1890, 1891, and 1892 have been added. From this it will be seen that, as in the previous year, Cuba contributed the largest proportion in 1893, her quota of 349,977 long tons being two-thirds (66.4 per cent) of the total importations. The next important contributor was Spain, followed in order by England, French Africa, and Oceanica, and Italy, the last three sending almost equal amounts. The Cuban ore came from the southeastern portion of that island; the Spanish importations from the southern and northern provinces; those of Italy from the island of Elba; England supplied ores from the Hodbarrow and other mines; French Africa and Oceanica sent ores principally from Algeria and New Caledonia; Greece from the islands of Seriphos (and Cypriano); British Columbia from Texada Island; Portugal from the northern portion of the country, while Turkey's contribution was from the western sections of their possessions in Europe and Asia. All or nearly all of the Canadian iron ore was obtained near the city of Ottawa.

Quantity and value of iron ores imported into the United States in the calendar years 1889, 1890, 1891, 1892, and 1893.

	1889.		1890.		1891.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Spain	298, 568	$621, 481	512, 933	$1, 099, 031	323, 771	$716, 920
Cuba	243, 255	535, 524	351, 814	778, 895	257, 189	720, 508
French Africa and Oceanica	97, 583	180, 697	96, 428	188, 360	96, 961	193, 606
Italy	87, 410	228, 164	134, 399	393, 280	154, 073	544, 914
England	54, 496	111, 638	51, 857	155, 275	39, 451	119, 052
Greece	23, 955	32, 880	48, 807	87, 397	24, 412	34, 589
Newfoundland and Labrador	14, 450	43, 100	6, 320	18, 960	....	....
British Columbia	13, 670	27, 860	....	....	588	2, 189
Portugal	6, 659	15, 151	16, 526	36, 941	9, 940	22, 130
France	6, 565	17, 911	2, 404	5, 647	9	3, 084
Quebec, Ontario, Manitoba, and Northwest Territory	4, 091	10, 697	22, 211	57, 667	2, 126	4, 008
Turkey in Europe	....	....	....	....	3, 850	92, 571
Turkey in Asia	2, 870	27, 265	3, 078	32, 345	158	2, 075
Nova Scotia, New Brunswick, etc	....	....	....	....	35	270
Other countries	1	24	53	320	301	605
Total	853, 573	1, 852, 392	1, 246, 830	2, 854, 118	912, 864	*a* 2, 456, 521

	1892.		1893.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Spain	236, 957	$483, 847	99, 640	$187, 263
Cuba	307, 115	618, 222	349, 977	488, 156
French Africa and Oceanica	62, 502	126, 238	16, 541	33, 357
Italy	95, 313	321, 988	16, 371	46, 457
England	35, 638	76, 910	16, 798	54, 610
Greece	44, 602	69, 044	10, 244	17, 324
British Columbia	2, 749	10, 141	469	1, 441
Portugal	6, 490	14, 386	10, 552	23, 589
Quebec, Ontario, Manitoba, and Northwest Territory	8, 606	17, 199	372	990
Turkey in Europe	3, 346	32, 818	1, 029	10, 803
Turkey in Asia	....	....	4, 700	40, 576
Other countries	3, 267	24, 851	258	2, 121
Total	806, 585	1, 795, 644	526, 951	906, 687

a The difference between the total value in this table and that of the United States custom-house department is due to the fact that in several of the ports of entry a value was given, but the amount of iron ore was not furnished by the department, and these were therefore omitted in the total valuations.

If the importations are divided according to customs districts it will be seen that, as in former years, the ports of Baltimore and Philadelphia were the prominent points of entry, increasing their joint percentage from 95 per cent of the total imports in 1891 and 1892 to 97.5 per cent in 1893. The ore imported at Puget Sound, Washington, viz, 469 tons from British Columbia, was used as a flux in silver smelting. The major portion of the iron ores imported are red and brown hematites, although some magnetite and chromic and manganiferous iron ores are also brought to this country. As would naturally be supposed from an examination of the points of entry, most of the iron ore is used at or near the Atlantic seaboard, in fact, two iron and steel companies, viz, the Bethlehem Iron Company and Pennsylvania Steel Company, consumed the major portion of the ores at their furnaces at Bethlehem and Steelton, Pennsylvania, and Sparrow Point, Maryland.

Distribution by customs districts of foreign iron ores imported in 1889, 1890, 1891, 1892, and 1893.

Ports.	1889.		1890.		1891.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Philadelphia, Pa	525, 124	$1, 192, 141	683, 665	$1, 641, 654	416, 846	$1, 098, 992
Baltimore, Md	273, 050	519, 736	481, 250	1, 015, 093	453, 373	1, 219, 015
New York, N. Y	25, 824	72, 297	38, 717	101, 908	25, 817	89, 975
Perth Amboy, N. J	11, 558	26, 075	25, 524	50, 984	14, 089	42, 087
Boston, Mass	50	283	....	....	....	....
Total Atlantic ports	835, 606	1, 810, 532	1, 229, 156	2, 809, 639	910, 125	2, 450, 069
Oswegatchie, N. Y	....	....	....	....	1, 958	3, 591
Buffalo Creek, N. Y	78	198	82	185	114	342
Chicago, Ill	5	58	....	....	35	276
Detroit, Mich	18	36	....	....	44	75
Oswego, N. Y	2, 309	6, 353	12, 617	23, 446	....	....
Cuyahoga, Ohio	1, 224	3, 403	4, 675	15, 460	....	....
Total Lake ports	3, 634	10, 048	17, 374	39, 091	2, 151	4, 284
Puget Sound, Wash	13, 670	27, 860	....	....	588	2, 189
Willamette, Oreg	....	....	....	....	....	....
San Francisco, Cal	61	2, 525	60	5, 110	....	....
San Diego, Cal	....	....	1	20	....	....
Total Pacific ports	13, 731	30, 385	61	5, 130	588	2, 189
Saluria, Texas	....	....	....	....	....	....
Pensacola, Fla	135	608	....	....	....	....
Total Gulf ports	135	608	....	....	....	....
Miscellaneous	467	819	239	258	....	....
Total imports	853, 573	1, 852, 392	1, 246, 830	2, 854, 118	912, 864	*a* 2, 456, 542

Ports.	1892.		1893.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Philadelphia, Pa	438, 920	$940, 783	201, 777	$402, 548
Baltimore, Md	328, 326	758, 033	311, 892	477, 204
New York, N. Y	23, 533	61, 260	1, 526	5, 393
Perth Amboy, N. J	4, 428	8, 153	9, 782	14, 550
Boston, Mass	....	....	....	....
Total Atlantic ports	795, 207	1, 768, 229	524, 977	899, 695
Oswegatchie, N. Y	8, 605	17, 196	266	566
Buffalo Creek, N. Y	1	3	....	....
Chicago, Ill	....	....	1	16
Detroit, Mich	....	....	....	....
Oswego, N. Y	....	....	75	150
Cuyahoga, Ohio	....	....	....	....
Total Lake ports	8, 606	17, 199	342	732
Puget Sound, Wash	2, 568	9, 597	469	1, 441
Willamette, Oreg	191	544	....	....
San Francisco, Cal	....	....	1, 132	4, 545
San Diego, Cal	....	....	....	....
Total Pacific ports	2, 759	10, 141	1, 601	5, 986
Saluria, Tex	13	67	....	....
Pensacola, Fla	....	....	....	....
Total Gulf ports	13	67	....	....
Miscellaneous	....	....	31	274
Total imports	806, 585	*a* 1, 795, 636	526, 951	906, 687

a The difference in the total value between this table and that published by the United States custom-house department is due to the fact that in several of the ports of entry a value was given, but the amount of iron ore imported was not furnished by the department, and these were therefore omitted in the total valuations.

The assistance of owners, managers, and other officers of firms or corporations engaged in the mining of iron ores, has permitted the presentation of the foregoing statistical statement, and the interest taken in compiling the report by Mr. F. L. Bitler, of Philadelphia, Pa., and Mr. Dwight E. Woodbridge, of Duluth, Minn., has been of material help in the work undertaken. Acknowledgment of the aid rendered by various persons is therefore cheerfully made.

MIN 93——4

GOLD AND SILVER.

By R. E. Preston,
(*Director of the Mint.*)

Product.—During 1893 the gold product increased and the silver product declined. The production of gold increased most markedly in the Cripple Creek district of Colorado. The product and its distribution by States is shown in the following tables.

It should be stated that the fall in the price of silver had the temporary effect of increasing the output during the earlier months of 1893, for the smelters used every effort to work up their stocks of ores and sell before any further depreciation in price should take place. The product of the first four months of 1894 shows the real effect of the fall in silver, the product declined over 37½ per cent, compared with the corresponding first four months of 1893.

Approximate distribution by producing States and Territories of the product of gold and silver in the United States, as estimated by the Director of the Mint.

CALENDAR YEAR 1892.

States and Territories.	Gold.		Silver.		Total value.
	Fine ounces.	Value.	Fine ounces.	Coining value.	
Alaska	48,375	$1,000,000	8,400	$10,860	$1,010,860
Arizona	51,761	1,070,000	1,161,900	1,502,255	2,572,255
California	580,500	12,000,000	392,200	507,087	12,507,087
Colorado	256,387	5,300,000	26,632,300	34,433,681	39,733,681
Georgia	4,583	94,734	400	517	95,251
Idaho	83,271	1,721,364	3,461,200	4,475,087	6,196,451
Michigan	3,386	70,000	65,600	84,816	154,816
Montana	139,871	2,891,386	19,038,800	24,615,822	27,507,208
Nevada	76,021	1,571,500	2,454,500	3,173,495	4,744,995
New Mexico	45,956	950,000	1,176,700	1,521,390	2,471,390
North Carolina	3,800	78,560	9,800	12,671	91,231
Oregon	67,725	1,400,000	54,200	70,077	1,470,077
South Carolina	5,968	123,365	400	517	123,882
South Dakota	178,987	3,700,000	58,100	75,119	3,775,119
Texas	....	....	328,100	424,210	424,210
Utah	31,936	660,175	8,490,800	10,978,004	11,638,179
Washington	18,071	373,561	165,700	214,238	587,799
Alabama, Maryland, Tennessee, Virginia, Vermont, Wyoming	500	10,336	900	1,164	11,500
Total	1,597,098	33,014,981	63,500,000	82,101,010	115,115,991

CALENDAR YEAR 1893.

States and Territories.	Gold.		Silver.		Total value.
	Fine ounces.	Value.	Fine ounces.	Coining value.	
Alaska	48,863	$1,010,100	9,600	$12,412	$1,022,512
Arizona	57,286	1,184,200	2,935,700	3,795,652	4,979,852
California	584,370	12,080,000	470,100	607,806	12,687,806
Colorado	364,119	7,527,000	25,838,600	33,407,483	40,932,483
Georgia	4,702	97,200	500	646	97,846
Idaho	79,669	1,646,900	3,910,700	5,056,259	6,703,159
Michigan	2,032	42,000	43,500	56,242	98,242
Montana	172,989	3,576,000	16,906,400	21,858,780	25,433,780
Nevada	46,367	958,500	1,561,300	2,018,651	2,977,151
New Mexico	44,171	913,100	458,400	592,679	1,505,779
North Carolina	2,593	53,600	13,400	17,325	70,925
Oregon	79.592	1,645,300	11,800	15,257	1,659,557
South Carolina	5,998	124,000	500	646	124,646
South Dakota	193,809	4,006,400	140,400	181.527	4,186,927
Texas	....	....	349,400	451,750	451,750
Utah	41,293	853,600	7,196,300	9,304,307	10,157,907
Washington	10,744	222,100	152,700	197,430	419,530
Alabama, Maryland, Tennessee, Virginia, Vermont, Wyoming	726	15,000	700	905	15,905
Total	1,739,323	35,955,000	60,000,000	77,575,757	113,525,757

PRODUCTION OF SILVER IN THE UNITED STATES IN 1892.

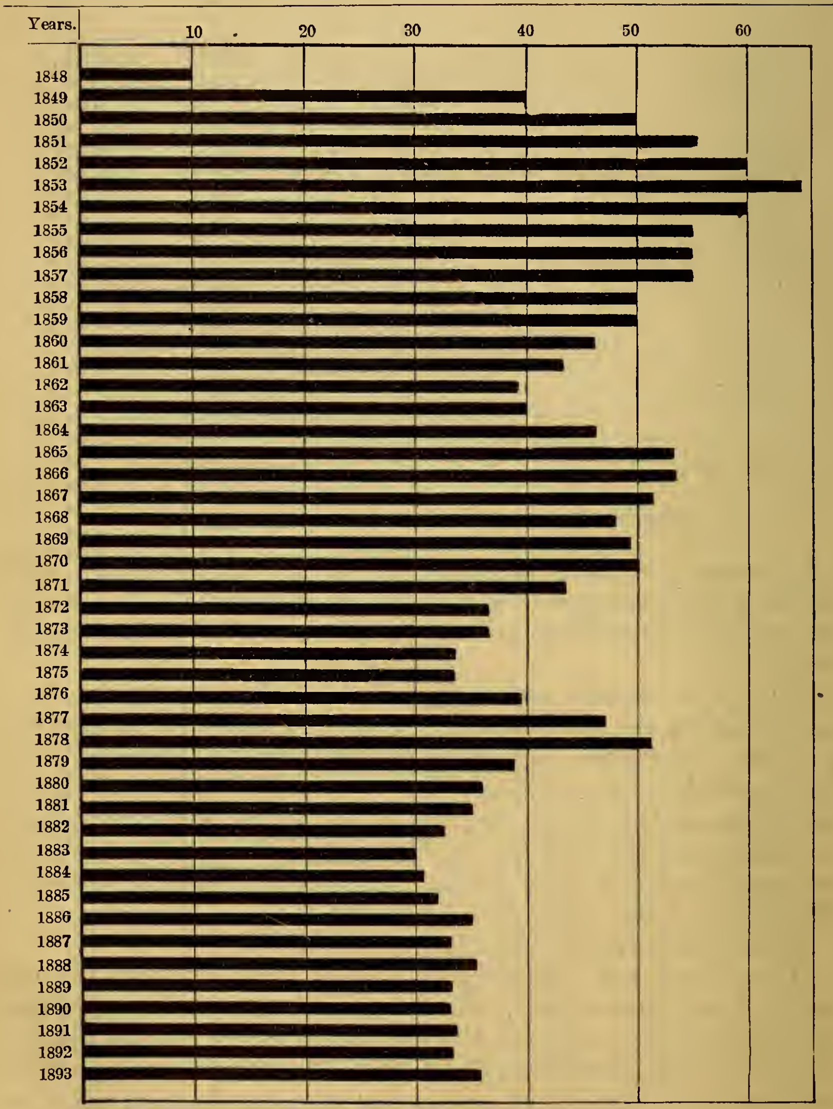
The former Director of the Mint (Mr. Edward O. Leech) says with respect to the production of silver in the United States in the calendar year 1892 (*see* Production of Gold and Silver in the United States, 1892, p. 15):

"From all the reports and data in the possession of this Bureau, I have estimated the silver product of our own mines for the calendar year 1892 at 58,000,000 ounces (troy) of fine silver, worth at the average commercial price of silver during the year ($0·875 per fine ounce), $50,750,000, and of the coining value of $74,989,900, against a product for the calendar year 1891 of 58,330,000 ounces of fine silver, worth at the average price of silver during the year ($0·988 per fine ounce), $57,630,040, of the coining value of $75,416,565."

And on page 16 of the same report he continues:

"In all prior years the aggregate silver product reported by the agents of this Bureau has exceeded the finished product reported by private refineries. This year it is less, but I believe that the product reported by the agent of the Bureau from the different mining States and Territories more correctly represents the product of our mines for the calendar year 1892 than the finished product reported by private establishments, much of which was obtained from ores mined prior to the calendar year 1892, as well as from foreign ores and bullion."

If the Director of the Mint, in 1892, had followed the method in accordance with which the Bureau's estimate of the silver output of the country had been made for several years prior thereto, his calculations



PRODUCT OF GOLD IN THE UNITED STATES FROM 1848 TO 1893.
[In millions of dollars.]

would have shown the silver product of that year, as will be seen further on, to have been, in round numbers, 63,500,000 fine ounces, of the commercial value, at the average price of fine silver during the year, of $0·8750 per ounce, of $55,562,500, and the coining value of $82,101,010, instead of, at 58,000,000 fine ounces, of the commercial value of $50,750,000, and the coining value of $74,989,900.

For a number of years prior to 1892, it had been the custom of the Bureau, in these reports, to make two separate estimates of the production of silver during the year under consideration, and to give their mean as the approximate silver product of such year. One of these estimates was obtained by adding together the private refiner's output of fine metal of domestic origin, the amount of unrefined silver of domestic origin deposited at the mints and assay offices of the United States, and the exports of silver in copper matte and ores. The other was reached by the addition of the total deposits of silver at United States mints and assay offices classified as of domestic production, the exports of domestic bullion (except mint or assay office bars), the silver exported in copper matte and ore, the bars of domestic production furnished by private refineries to manufacturers and jewelers for industrial employment, and the stock of bars of current years' product (exclusive of bars bearing the stamp of a United States mint or assay office) held by banks and private refineries at the close of the year; and deducting from the sum thus obtained the silver in foreign ores and bullion smelted and refined in the United States and classified at the mints and custom-houses as of domestic production.

This is the same method that has been adopted by the Bureau for a series of years in making the estimate of the annual production of gold in the United States. Previous to 1892 it had never been the practice of the Bureau to base its estimates of the gold or silver output of the country on the data furnished by the agents employed by the Mint Bureau to report on the production of the several States and Territories, because, as remarked in the Report on the Production of Gold and Silver in the United States, 1891, p. 22—

"However conscientiously the agents selected may have performed the duties assigned them, experience has proven that the tendency to exaggeration on the part of direct producers is so great, and the sources of information in many cases so imperfect, as to preclude the possibility of accepting such reports, in all cases, as correctly exhibiting the product of the different States and Territories, or in the aggregate the product of the mines of the United States."

The Bureau's method, described above, of estimating the annual product of the precious metals in the United States has been universally commended by the best statisticians of the precious metals.

In the absence of any explanation or reason for such a radical change in the method of estimating the production of silver in the United States—a method which has commended itself so strongly to the minds of the most expert statisticians of the precious metals—it is not only proper, but necessary, to return to the usual practice, and make a new estimate of the silver product of the United States in 1892 on the same basis as for previous years.

The silver output of the United States, in 1892, is based on the approximations contained in the two following tables:

Approximate silver product of the mines of the United States during the calendar year 1892.

Sources.	Fine ounces.
Domestic product in fine silver bars reported by private refineries	58,786,831
Unrefined silver of domestic production deposited at mints and assay offices.	3,317,933
Silver contained in domestic copper and argentiferous matte exported for reduction (approximate)	1,439,802
Approximate silver product for 1892	63,544,566

Approximate disposition of the silver product of the mines of the United States during the calendar year 1892.

Disposition.		Fine ounces.
Bullion deposited at mints and assay offices classified as of domestic production		57,272,382
Domestic bullion (other than U. S. mint or assay office bars) exported from the United States (custom-house rating at commercial value $19,237,677 corresponding, at the average price of silver during the year, $0.875 per fine ounce)		21,985,916
Silver contained in copper matte exported from the United States, silver contents not registered (approximate)		1,439,802
Silver bars of domestic production furnished by private refineries to jewelers and manufacturers for industrial uses		1,482,915
Total		82,181,015
Deduct:		
Fine silver from private refineries in the United States deposited at the mints or entered at the custom-houses for exportation as of domestic production, but reported to this bureau by the private refineries as derived from foreign ores	14,923,318	
Decrease in the approximate stock of silver bars (exclusive of any bars bearing the stamp of a U. S. mint or assay office) in the United States, held by the Mercantile Safe Deposit Company and other institutions at the close of the calendar year 1892, according to information furnished the Bureau of the Mint	3,831,472	
Total		18,754,790
Approximate domestic silver product for the calendar year 1892		63,426,225

Taking the mean of the approximate silver product of the mints of the United States during the calendar year 1892, and of the approximate disposition of that product, gives the approximate silver output of the country in that year at 63,485,395 ounces, or in round numbers 63,500,000 ounces, of the commercial value of $55,562,500, and the coining value of $82,101,010. It thus appears that the product of silver in the United States in 1892 exceeded that of 1891 (58,330,000 ounces) by 5,170,000 fine ounces, of the coining value of $6,684,444. In what proportion this increase was distributed among the several States and

Territories is shown in the following table, which gives the production of silver in each for 1891 and 1892, and exhibits the increase or decrease of the yield in each in the latter year:

Production of silver in the United States in 1891 and 1892, and the increase or decrease in each year, by States and Territories.

States and Territories.	1891.	1892.	Increase.	Decrease.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alaska	8,000	8,400	400	
Arizona	1,480,000	1,161,900		318,100
California	750,000	392,200		357,800
Colorado	21,160,000	26,632,300	5,472,300	
Georgia	400	400		
Idaho	4,035,000	3,461,200		573,800
Michigan	73,000	65,600		7,400
Montana	16,350,000	19,038,800	2,688,800	
Nevada	3,520,000	2,454,500		1,065,500
New Mexico	1,325,000	1,176,700		148,300
North Carolina	5,000	9,800	4,800	
Oregon	320,000	54,200		175,800
South Carolina	500	400		100
South Dakota	100,000	58,100		41,900
Texas	375,000	328,100		46,900
Utah	8,750,000	8,490,800		259,200
Washington	165,000	165,700	700	
Alabama, Maryland, Tennessee, Vermont, Virginia, Wyoming	3,100	900		2,200
Total	58,330,000	63,500,000	8,167,000	2,997,000
Net increase			5,170,000	

COINING VALUE OF SILVER PRODUCED IN THE UNITED STATES FROM 1864 TO 1893.

[Millions of dollars.]

Approximate distribution in round numbers, by States and Territories, of the estimated total product of precious metals in the United States calendar years 1881 to 1891.

States and Territories.	1881. Gold.	1881. Silver.	1881. Total.	1882. Gold.	1882. Silver.	1882. Total.
Alaska	$15,000		$15,000	$150,000		$150,000
Arizona	1,060,000	$7,300,000	8,360,000	1,065,000	$7,500,000	8,565,000
California	18,200,000	750,000	18,950,000	16,800,000	845,000	17,645,000
Colorado	3,300,000	17,160,000	20,460,000	3,360,000	16,500,000	19,860,000
Dakota	4,000,000	70,000	4,070,000	3,300,000	175,000	3,475,000
Georgia	125,000		125,000	250,000		250,000
Idaho	1,700,000	1,300,000	3,000,000	1,500,000	2,000,000	3,500,000
Maine		5,000	5,000			
Montana	2,330,000	2,630,000	4,960,000	2,550,000	4,370,000	6,920,000
Nevada	2,250,000	7,060,000	9,310,000	2,000,000	6,750,000	8,750,000
New Mexico	185,000	275,000	460,000	150,000	1,800,000	1,950,000
North Carolina	115,000		115,000	190,000	25,000	215,000
Oregon	1,100,000	50,000	1,150,000	830,000	35,000	865,000
South Carolina	35,000		35,000	25,000		25,000
Tennessee	5,000		5,000			
Utah	145,000	6,400,000	6,545,000	190,000	6,800,000	6,990,000
Virginia	10,000		10,000	15,000		15,000
Washington	120,000		120,000	120,000		120,000
Wyoming	5,000		5,000	5,000		5,000
Total	34,700,000	43,000,000	77,700,000	32,500,000	46,800,000	79,300,000

States and Territories.	1883. Gold.	1883. Silver.	1883. Total.	1884. Gold.	1884. Silver.	1884. Total.
Alaska	$300,000		$300,000	$200,000		$200,000
Arizona	950,000	$5,200,000	6,150,000	930,000	$4,500,000	5,430,000
California	14,120,000	1,460,000	15,580,000	13,600,000	3,000,000	16,600,000
Colorado	4,100,000	17,370,000	21,470,000	4,250,000	16,000,000	20,250,000
Dakota	3,200,000	150,000	3,350,000	3,300,000	150,000	3,450,000
Georgia	199,000	1,000	200,000	137,000		137,000
Idaho	1,400,000	2,100,000	3,500,000	1,250,000	2,720,000	3,970,000
Montana	1,800,000	6,000,000	7,800,000	2,170,000	7,000,000	9,170,000
Nevada	2,520,000	5,430,000	7,950,000	3,500,000	5,600,000	9,100,000
New Mexico	280,000	2,845,000	3,125,000	300,000	3,000,000	3,300,000
North Carolina	167,000	3,000	170,000	157,000	3,500	160,500
Oregon	660,000	20,000	680,000	660,000	20,000	680,000
South Carolina	56,500	500	57,000	57,000	500	57,500
Utah	140,000	5,620,000	5,760,000	120,000	6,800,000	6,920,000
Virginia	6,000		6,000	2,000		2,000
Washington	80,000	500	80,500	85,000	1,000	86,000
Wyoming	4,000		4,000	6,000		6,000
Other	17,500		17,500	76,000	5,000	81,000
Total	30,000,000	46,200,000	76,200,000	30,800,000	48,800,000	79,600,000

States and Territories.	1885. Gold.	1885. Silver.	1885. Total.	1886. Gold.	1886. Silver.	1886. Total.
Alaska	$300,000	$2,000	$302,000	$446,000	$2,000	$448,000
Arizona	880,000	3,800,000	4,680,000	1,110,000	3,400,000	4,510,000
California	12,700,000	3,500,000	15,200,000	14,725,000	1,400,000	16,125,000
Colorado	4,200,000	15,800,000	20,000,000	4,450,000	16,000,000	20,450,000
Dakota	3,200,000	100,000	3,300,000	2,700,000	425,000	3,125,000
Georgia	136,000		136,000	152,500	1,000	153,500
Idaho	1,800,000	3,500,000	5,300,000	1,800,000	3,600,000	5,400,000
Montana	3,300,000	10,060,000	13,360,000	4,425,000	12,400,000	16,825,000
Nevada	3,100,000	6,000,000	9,100,000	3,090,000	5,000,000	8,090,000
New Mexico	800,000	3,000,000	3,800,000	400,000	2,300,000	2,700,000
North Carolina	152,000	3,000	155,000	175,000	3,000	178,000
Oregon	800,000	10,000	810,000	990,000	5,000	995,000
South Carolina	43,000		43,000	37,500	500	38,000
Utah	180,000	6,750,000	6,930,000	216,000	6,500,000	6,716,000
Washington	120,000	70,000	190,000	147,000	80,000	227,000
Texas, Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	90,000	5,000	95,000	5,000	205,000	210,000
Total	31,801,000	51,600,000	83,401,000	34,869,000	51,321,500	86,190,500

Approximate distribution in round numbers, by States and Territories, of the estimated total product of precious metals in the United States, etc.—Continued.

States and Territories.	1887.			1888.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$675,000	$300	$675,300	$850,000	$3,000	$853,000
Arizona	830,000	3,800,000	4,630,000	871,500	3,000,000	3,871,500
California	13,400,000	1,500,000	14,900,000	12,750,000	1,400,000	14,150,000
Colorado	4,000,000	15,000,000	19,000,000	3,758,000	19,000,000	22,758,000
Dakota	2,400,000	40,000	2,440,000	2,600,000	100,000	2,700,000
Georgia	110,000	500	110,500	104,000	500	104,500
Idaho	1,900,000	3,000,000	4,900,000	2,400,000	3,000,000	5,400,000
Michigan	35,000	26,000	61,000	42,000	84,000	126,000
Montana	5,230,000	15,500,000	20,730,000	4,200,000	17,000,000	21,200,000
Nevada	2,500,000	4,900,000	7,400,000	3,525,000	7,000,000	10,525,000
New Mexico	500,000	2,300,000	2,800,000	602,000	1,200,000	1,802,000
North Carolina	225,000	5,000	230,000	136,000	3,500	139,500
Oregon	900,000	10,000	910,000	825,000	15,000	840,000
South Carolina	50,000	500	50,500	39,000	200	39,200
Utah	220,000	7,000,000	7,220,000	290,000	7,000,000	7,290,000
Washington	150,000	100,000	250,000	145,000	100,000	245,000
Texas	....	250,000	250,000	....	300,000	300,000
Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	22,000	1,000	23,000	30,000	500	30,500
Total	33,147,000	53,433,300	86,580,300	33,167,500	59,206,700	92,374,200

	1889.			1890.		
Alaska	$900,000	$10,343	$910,343	$762,500	$9,097	$772,197
Arizona	900,000	1,939,393	2,839,393	1,000,000	1,292,929	2,292,929
California	13,000,000	1,034,343	14,034,343	12,500,000	1,163,636	13,663,636
Colorado	4,000,000	20,686,868	24,186,868	4,150,000	24,307,070	28,457,070
Dakota	2,900,000	64,646	2,964,646	3,200,000	129,292	3,329,292
Georgia	107,000	465	107,465	100,000	517	100,517
Idaho	2,000,000	4,395,959	6,395,959	1,850,000	4,783,838	6,633,838
Michigan	70,000	77,575	147,575	90,000	71,111	161,111
Montana	3,500,000	19,393,939	22,893,939	3,300,000	20,363,636	23,663,636
Nevada	3,000,000	6,206,060	9,206,060	2,800,000	5,753,535	8,553,535
New Mexico	1,000,000	1,461,010	2,461,010	850,000	1,680,808	2,530,808
North Carolina	145,000	3,878	148,878	118,500	7,757	126,257
Oregon	1,200,000	38,787	1,238,787	1,100,000	96,969	1,196,969
South Carolina	45,000	232	45,232	100,000	517	100,517
Utah	500,000	9,050,505	9,550,505	680,000	10,343,434	11,023,434
Washington	175,000	103,434	278,434	204,000	90,505	294,505
Texas	....	300,000	300,000	....	387,878	387,878
Alabama, Tennessee, Virginia, Vermont, and Wyoming	25,000	1,293	26,293	40,000	2,585	42,585
Total	32,967,000	64,768,730	97,735,730	32,845,000	70,485,714	103,330,714

States and Territories.	1891.		
	Gold.	Silver.	Total.
Alaska	$900,000	$10,343	$910,343
Arizona	975,000	1,913,535	2,888,535
California	12,600,000	969,697	13,569,697
Colorado	4,600,000	27,358,384	31,958,384
South Dakota	3,550,000	129,293	3,679,293
Georgia	80,000	517	80,517
Idaho	1,680,000	5,216,970	6,896,970
Michigan	75,000	94,384	169,384
Montana	2,890,000	21,139,394	24,029,394
Nevada	2,050,000	4,551,111	6,601,111
New Mexico	905,000	1,713,131	2,618,131
North Carolina	95,000	6,465	101,465
Oregon	1,640,000	297,374	1,937,374
South Carolina	125,000	646	125,646
Utah	650,000	11,313,131	11,963,131
Washington	335,000	313,334	548,334
Texas	....	484,848	484,848
Alabama, Tennessee, Virginia, Vermont, and Wyoming	25,000	4,008	29,008
Total	33,175,000	75,416,565	108,591,565

Rank of the States and Territories in the production of gold and silver.

1886.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	Montana.	3	Utah.	3	California.
4	Nevada.	4	Nevada.	4	Nevada.
5	Dakota.	5	Idaho.	5	Utah.
6	Idaho.	6	Arizona.	6	Idaho.
7	Arizona.	7	New Mexico.	7	Arizona.
8	Oregon.	8	California.	8	Dakota.
9	Alaska.	9	Dakota.	9	New Mexico.
10	New Mexico.	10	"Other."	10	Oregon.
11	Utah.	11	Washington.	11	Alaska.
12	North Carolina.	12	Oregon.	12	Washington.
13	Georgia.	13	North Carolina.	13	"Other."
14	Washington.	14	Alaska.	14	North Carolina.
15	South Carolina.	15	Georgia.	15	Georgia.
16	"Other."	16	South Carolina.	16	South Carolina.

1887.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Montana.	1	Montana.
2	Montana.	2	Colorado.	2	Colorado.
3	Colorado.	3	Utah.	3	California.
4	Nevada.	4	Nevada.	4	Nevada.
5	Dakota.	5	Arizona.	5	Utah.
6	Idaho.	6	Idaho.	6	Idaho.
7	Oregon.	7	New Mexico.	7	Arizona.
8	Arizona.	8	California.	8	New Mexico.
9	Alaska.	9	Texas.	9	Dakota.
10	New Mexico.	10	Washington.	10	Oregon.
11	North Carolina.	11	"Other."	11	Alaska.
12	Utah.	12	Dakota.	12	Washington.
13	Washington.	13	Michigan.	13	Texas.
14	Georgia.	14	Oregon.	14	North Carolina.
15	South Carolina.	15	North Carolina.	15	Georgia.
16	Michigan.	16	Georgia.	16	"Other."
17	"Other."	17	South Carolina.	17	South Carolina.
		18	Alaska.	18	Michigan.

1888.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Montana.	2	Montana.	2	Montana.
3	Colorado.	3	Nevada. Utah.	3	California.
4	Nevada.			4	Nevada.
5	Dakota.	4	Arizona. Idaho.	5	Utah.
6	Idaho.			6	Idaho.
7	Arizona.	5	California.	7	Arizona.
8	Alaska.	6	New Mexico.	8	Dakota.
9	Oregon.	7	Texas.	9	New Mexico.
10	New Mexico.	8	Dakota. Washington.	10	Alaska.
11	Utah.			11	Oregon.
12	Washington.	9	Michigan.	12	Texas.
13	North Carolina.	10	Oregon.	13	Washington.
14	Georgia.	11	North Carolina.	14	North Carolina.
15	Michigan.	12	Alaska.	15	Michigan.
16	South Carolina.	13	Georgia. "Other."	16	Georgia.
17	"Other."			17	South Carolina.
		14	South Carolina.	18	"Other."

Rank of the States and Territories in the production of gold and silver—Continued.

1889.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
	Montana.	3	Utah.	3	California.
3	Nevada.	4	Nevada.	4	Utah.
4	Dakota.	5	Idaho.	5	Nevada.
5	Idaho.	6	Arizona.	6	Idaho.
6	Oregon.	7	New Mexico.	7	Dakota.
7	New Mexico.	8	California.	8	Arizona.
8	Alaska.	9	Texas.	9	New Mexico.
	Arizona.	10	Washington.	10	Oregon.
9	Utah.	11	Michigan.	11	Alaska.
10	Washington.	12	Dakota.	12	Texas.
11	North Carolina.	13	Oregon.	13	Washington.
12	Georgia.	14	Alaska.	14	North Carolina.
13	Michigan.	15	North Carolina.	15	Michigan.
14	South Carolina.	16	"Other."	16	Georgia.
15	"Other."	17	Georgia.	17	South Carolina.
		18	South Carolina.	18	"Other."

1890.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	Montana.	3	Utah.	3	California.
4	Dakota.	4	Nevada.	4	Utah.
5	Nevada.	5	Idaho.	5	Nevada.
6	Idaho.	6	New Mexico.	6	Idaho.
7	Oregon.	7	Arizona.	7	Dakota.
8	Arizona.	8	California.	8	New Mexico.
9	New Mexico.	9	Texas.	9	Arizona.
10	Alaska.	10	Dakota.	10	Oregon.
11	Utah.	11	Oregon.	11	Alaska.
12	Washington.	12	Washington.	12	Texas.
13	North Carolina.	13	Michigan.	13	Washington.
14	South Carolina.	14	Alaska.	14	Michigan.
	Georgia.	15	North Carolina.	15	North Carolina.
15	Michigan.	16	"Other."	16	Georgia.
16	"Other."	17	Georgia.		South Carolina.
			South Carolina.	17	"Other."

1891.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	South Dakota.	3	Utah.	3	California.
4	Montana.	4	Idaho.	4	Utah.
5	Nevada.	5	Nevada.	5	Idaho.
6	Idaho.	6	Arizona.	6	Nevada.
7	Oregon.	7	New Mexico.	7	South Dakota.
8	Arizona.	8	California.	8	Arizona.
9	New Mexico.	9	Texas.	9	New Mexico.
10	Alaska.	10	Oregon.	10	Oregon.
11	Utah.	11	Washington.	11	Alaska.
12	Washington.	12	South Dakota.	12	Washington.
13	South Carolina.	13	Michigan.	13	Texas.
14	North Carolina.	14	Alaska.	14	Michigan.
15	Georgia.	15	North Carolina.	15	South Carolina.
16	Michigan.	16	"Other."	16	North Carolina.
17	"Other."	17	South Carolina.	17	Georgia.
		18	Georgia.	18	"Other."

Rank of the States and Territories in the production of gold and silver—Continued.

1892.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	South Dakota.	3	Utah.	3	California.
4	Montana.	4	Idaho.	4	Utah.
5	Idaho.	5	Nevada.	5	Idaho.
6	Nevada.	6	New Mexico.	6	Nevada.
7	Oregon.	7	Arizona.	7	South Dakota.
8	Arizona.	8	California.	8	Arizona.
9	Alaska.	9	Texas.	9	New Mexico.
10	New Mexico.	10	Washington.	10	Oregon.
11	Utah.	11	Michigan.	11	Alaska.
12	Washington.	12	South Dakota.	12	Washington.
13	South Carolina.	13	Oregon.	13	Texas.
14	Georgia.	14	North Carolina.	14	Michigan.
15	North Carolina.	15	Alaska.	15	South Carolina.
16	Michigan.	16	Georgia.	16	Georgia.
		17	South Carolina.	17	North Carolina.

Product of gold and silver in the United States from 1792.

[The estimate for 1792–1873 is by Dr. R. W. Raymond, United States Mining Commissioner, and since by the Director of the Mint.]

Years.	Total.	Gold.	Silver.
April 2, 1792–July 31, 1834	$14,000,000	$14,000,000	(*a*)
July 31, 1834–Dec. 31, 1844	7,750,000	7,500,000	$250,000
1845	1,058,327	1,008,327	50,000
1846	1,189,357	1,139,357	50,000
1847	939,085	889,085	50,000
1848	10,050,000	10,000,000	50,000
1849	40,050,000	40,000,000	50,000
1850	50,050,000	50,000,000	50,000
1851	55,050,000	55,000,000	50,000
1852	60,050,000	60,000,000	50,000
1853	65,050,000	65,000,000	50,000
1854	60,050,000	60,000,000	50,000
1855	55,050,000	55,000,000	50,000
1856	55,050,000	55,000,000	50,000
1857	55,050,000	55,000,000	50,000
1858	50,500,000	50,000,000	500,000
1859	50,100,000	50,000,000	100,000
1860	46,150,000	46,000,000	150,000
1861	45,000,000	43,000,000	2,000,000
1862	43,700,000	39,200,000	4,500,000
1863	48,500,000	40,000,000	8,500,000
1864	57,100,000	46,100,000	11,000,000
1865	64,475,000	53,225,000	11,250,000
1866	63,500,000	53,500,000	10,000,000
1867	65,225,000	51,725,000	13,500,000
1868	60,000,000	48,000,000	12,000,000
1869	61,500,000	49,500,000	12,000,000
1870	66,000,000	50,000,000	16,000,000
1871	66,500,000	43,500,000	23,000,000
1872	64,750,000	36,000,000	28,750,000
1873	71,750,000	36,000,000	35,750,000
1874	70,800,000	33,500,000	37,300,000
1875	65,100,000	33,400,000	31,700,000
1876	78,700,000	39,900,000	38,800,000
1877	86,700,000	46,900,000	39,800,000
1878	96,400,000	51,200,000	45,200,000
1879	79,700,000	38,900,000	40,800,000
1880	75,200,000	36,000,000	39,200,000
1881	77,700,000	34,700,000	43,000,000
1882	79,300,000	32,500,000	46,800,000
1883	76,200,000	30,000,000	46,200,000
1884	79,600,000	30,800,000	48,800,000
1885	83,400,000	31,800,000	51,600,000
1886	86,000,000	35,000,000	51,000,000
1887	86,350,000	33,000,000	53,350,000
1888	92,370,000	35,175,000	59,195,000
1889 { mint	97,446,000	32,800,000	64,646,000
1889 { census	99,282,866	32,886,180	66,396,686
1890	103,330,714	32,845,000	70,485,714
1891	108,591,565	33,175,000	75,416,565
1892	115,101,000	33,000,000	82,101,000
1893	113,531,000	35,955,000	77,576,000

a Insignificant.

COPPER.

By C. Kirchhoff.

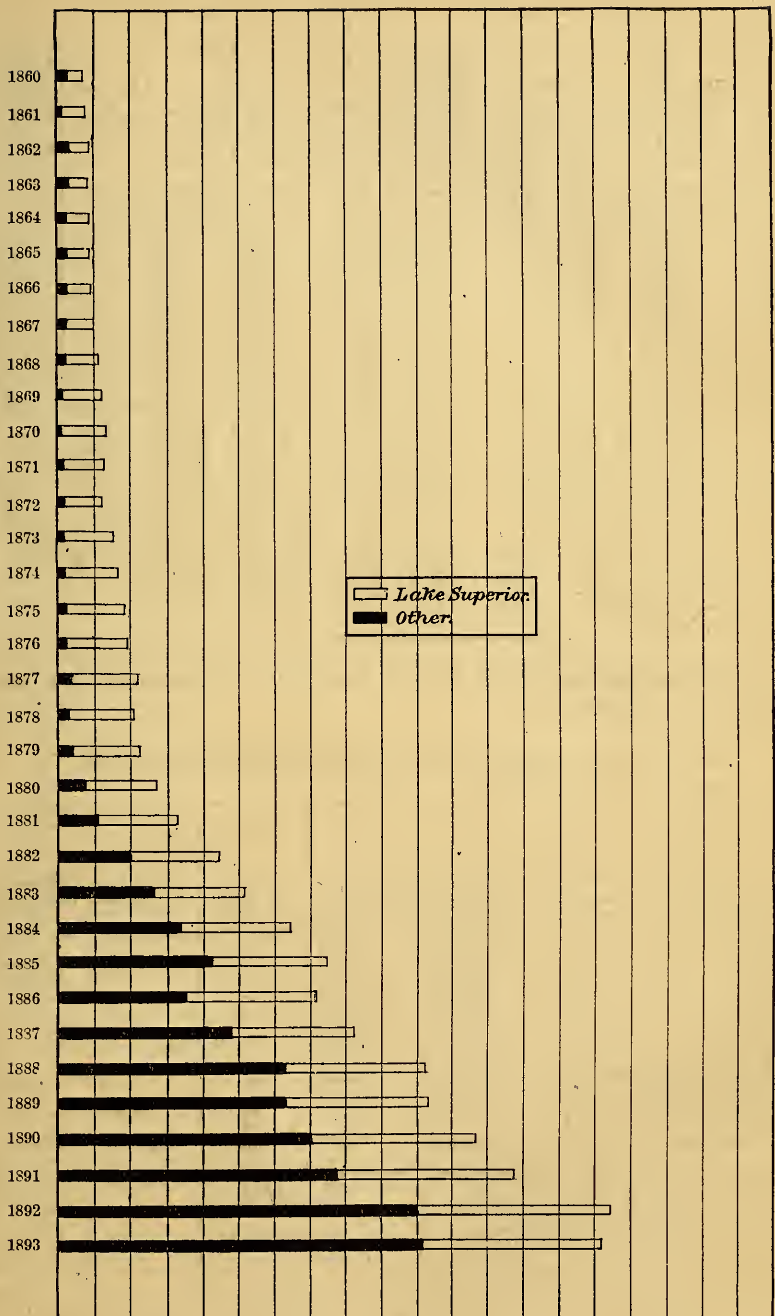
The copper mining and smelting industries of the United States have been conspicuous during 1893 through their ability, in a time of wide-spread disaster and suspension of operations, to continue at work at full capacity with relatively few and unimportant reductions in wages.

The international arrangement as to exports expired on July 1, when the pressure of accumulating supplies, through shrinking home consumption, began to be felt. In the second half of the year, during which the consumptive requirements in this country sank enormously, producers found relief—it is true at a sacrifice in prices—through very heavy shipments of the metal to Europe.

No sensational developments in the direction of the discovery of new districts, or the collapse of older regions, have taken place. Individual mines have prepared for, or are preparing for, an increased production. The Bessemerizing of copper matte is gaining ground, and the competition among the electrolytic refining plants is crowding down charges, until as low as 1½ cents per pound of copper, 95 per cent. of value of precious metal paid, has been offered. Supplies have cheapened, and generally costs have been somewhat lowered, establishing more firmly the position of American copper producers as the strongest among those of the world.

DOMESTIC PRODUCTION.

The following table, showing the growth in the production of copper in the United States, is compiled, as far as the years previous to 1882 are concerned, from the best data available. Since that year the statistics are those collected by this office, with the exception of the year 1889, when the figures were gathered by the Census Office. It should be stated that the yield of copper from imported ores and of pyrites is not here included.



Comparison of the Production of Lake Superior Copper with other Regions.

Production of copper in the United States from 1845 to 1893.

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.	Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Long tons.	*Long tons.*	*Long tons.*			*Long tons.*	*Long tons.*	*Long tons.*	
1845	100	12	....	12.0	1870	12,600	10,992	6,277	87.2
1846	150	26	....	17.3	1871	13,000	11,942	7,242	91.9
1847	300	213	....	71.0	1872	12,500	10,961	7,215	87.7
1848	500	461	....	92.2	1873	15,500	13,433	8,414	86.7
1849	700	672	....	96.0	1874	17,500	15,327	8,984	87.6
1850	650	572	....	88.0	1875	18,000	16,089	9,586	89.4
1851	900	779	....	86.6	1876	19,000	17,085	9,683	89.9
1852	1,100	792	....	72.0	1877	21,000	17,422	10,075	83.0
1853	2,000	1,297	....	64.9	1878	21,500	17,719	11,272	82.4
1854	2,250	1,819	....	80.8	1879	23,000	19,129	11,728	83.2
1855	3,000	2,593	....	86.4	1880	27,000	22,204	14,140	82.2
1856	4,000	3,666	....	91.7	1881	32,000	24,363	14,000	76.1
1857	4,800	4,255	....	88.6	1882	40,467	25,439	14,309	62.9
1858	5,500	4,088	....	74.3	1883	51,574	26,653	14,788	51.6
1859	6,300	3,985	....	63.3	1884	64,708	30,961	18,069	47.8
1860	7,200	5,388	....	74.8	1885	74,052	32,209	21,093	43.5
1861	7,500	6,713	....	89.5	1886	70,430	36,124	22,553	51.3
1862	9,000	6,065	....	67.4	1887	81,017	33,941	20,543	41.9
1863	8,500	5,797	....	68.2	1888	101,054	38,604	22,453	38.2
1864	8,000	5,576	....	69.7	1889	101,239	39,364	21.727	38.7
1865	8,500	6,410	....	75.4	1890	115,966	45,273	26,727	38.9
1866	8,900	6,138	....	69.0	1891	126,839	50,992	....	40.2
1867	10,000	7,824	603	78.2	1892	154,018	54,999	....	35.7
1868	11,600	9,346	2,276	80.6	1893	147,033	50,270	....	34.2
1869	12,500	11,886	5,497	95.1					

In detail the production of copper territorially distributed has been as follows since 1883:

Total copper production in the United States, 1883 to 1893, inclusive.

Sources.	1883.	1884.	1885.	1886.	1887.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	59,702,404	69,353,202	72,147,889	80,918,460	76,028,697
Arizona	23,874,963	26,734,345	22,706,366	15,657,035	17,720,462
Montana	24,664,346	43,093,054	67,797,864	57,611,621	78,699,677
New Mexico	823,511	59,450	79,839	558,385	283,664
California	1,600,862	876,166	469,028	430,210	1,600,000
Utah	341,885	265,526	126,199	500,000	2,500,000
Colorado	1,152,652	2,013,125	1,146,460	409,306	2,012,027
Wyoming	962,468	....	....	....	....
Nevada	288,077	100,000	8,871	50,000	....
Idaho	....	46,667	40,381	....	....
Missouri	260,306	230,000	....	....	....
Maine and New Hampshire	212,124	249,018	211,602	315,719	200,000
Vermont	400,000	655,405			
Southern States	395,175	317,711	40,199	29,811	....
Middle States	64,400	2,114	190,641	....	....
Lead desilverizers, etc	782,880	950,870	910,144	1,282,496	2,432,804
Total domestic copper	115,526,053	144,946,653	165,875,483	157,763,043	181,477,331
From imported pyrites and ores	1,625,742	2,858,754	5,086,841	4,500,000	3,750,000
Total (including copper from imported pyrites)	117,151,795	147,805,407	170,962,324	162,263,043	185,227,331

Total copper production in the United States, etc.—Continued.

Sources.	1888.	1889.	1890.	1891.	1892.	1893.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	86,472,034	88,175,675	101,410,277	114,222,709	123,198,460	112,605,078
Arizona	31,797,300	31,586,185	34,796,689	39,873,279	38,436,099	43,902,824
Montana	97,897,968	98,222,444	112,980,896	112,063,320	163,206,128	155,209,133
New Mexico	1,631,271	3,686,137	850,034	1,233,197	1,188,796	280,742
California	1,570,021	151,505	23,347	3,397,405	2,980,944	239,682
Utah	2,131,047	65,467	1,006,636	1,562,098	2,209,428	1,135,330
Colorado, including copper smelters (*a*)	1,621,100	1,170,053	3,585,691	6,336,878	7,593,674	7,695,826
Wyoming	232,819	100,000	....	....	....	....
Nevada	50,000	26,420	....	....	....	20,000
Idaho	50,000	156,490	87,243	146,825	226,000	36,367
Washington	....	....	....	....	....	39,785
Maine and New Hampshire } Vermont }	271,631	72,000				
Southern States	18,201	18,144	378,840	296,463	467,448	732,793
Middle States	....	....				
Lead desilverizers, etc	2,618,074	3,345,442	4,643,439	4,989,590	5,491,702	7,456,838
Total domestic copper	226,361,466	226,775,962	259,763,092	284,119,764	344,998,679	329,354,398
From imported pyrites and ores	4,909,156	5,190,252	6,017,041	11,690,312	8,277,063	7,723,387
Total (including copper from imported pyrites)	231,270,622	231,966,214	265,780,133	295,810,076	353,275,742	337,077,785

a Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.

The available supply of copper for the domestic markets may be computed as follows:

Supply of copper 1891, 1892, and 1893.

	1891.	1892.	1893.
	Pounds.	*Pounds.*	*Pounds.*
Production of domestic copper	284,119,764	344,998,679	329,354,398
Imported ores and pyrites	11,690,312	8,277,063	7,723,387
Imports of pigs, bars, ingots, and old copper	3,154,557	1,552,515	5,536,690
Total	298,964,633	354,828,257	342,614,475
Exports:			
Ingots and bars	69,279,024	30,515,736	138,984,128
Estimated fine copper contents of matte	50,000,000	66,000,000	50,000,000
Re-exports copper in foreign ore	2,082,708	707,739	2,019,821
Re-exports foreign pig bars, and old copper	534,949	1,274,410	
Total	121,896,681	98,497,885	191,003,949
Available supply	177,067,952	256,330,372	151,610,526

Since the establishment of the arrangement between the European and American companies careful monthly statistics have been compiled, the American statistician being Mr. John Stanton, of New York. The European companies include the principal producers of the Peninsula, Germany, the Cape, Australia, Venezuela, and Mexico. According to the returns thus collected, the monthly production of copper in the United States since July, 1892, has been as follows, the first column giving the aggregate returns from the reporting mines, which include the principal Lake, Montana, and Arizona producers; the second, being the metals from pyrites and from a number of smaller outside sources, is estimated:

American product.

Years and months.	Reporting mines.	Outside sources.	Total.
1892.	*Long tons.*	*Long tons.*	*Long tons.*
July	9,294	924	10,218
August	10,807	870	11,677
September	9,710	994	10,704
October	9,668	1,289	10,957
November	9,888	1,036	10,924
December	9,872	1,174	11,046
Total	59,239	6,287	65,526
1893.			
January	9,187	989	10,176
February	8,213	1,042	9,245
March	9,065	1,321	10,386
April	11,775	1,042	12,817
May	12,706	1,042	13,748
June	11,524	1,042	12,566
July	11,049	1,042	12,091
August	11,745	1,042	12,787
September	11,750	1,042	12,792
October	11,503	1,042	12,545
November	10,705	1,042	11,747
December	10,538	1,042	11,580
Total last six months	67,290	6,252	73,542
Total year 1893	129,760	12,730	142,490
1894.			
January	10,832	1,340	12,172
February	10,245	1,340	11,585
March	13,759	1,340	15,099
April	12,475	1,340	13,815
May	12,668	1,340	14,008

The product of the foreign reporting mines was as follows:

Foreign reporting mines.

Years and months.	Long tons.	Years and months.	Long tons.
1892.		1893.	
July	6,358	July	6,095
August	6,888	August	7,057
September	5,478	September	6,303
October	6,476	October	7,081
November	6,789	November	6,953
December	7,666	December	7,248
Total	39,655	Total last six months	40,737
		Total 1893	81,785
1893.		1894.	
January	5,736	January	8,145
February	6,762	February	7,217
March	6,896	March	6,922
April	6,913	April	7,385
May	6,806	May	8,013
June	7,935		

The exports of fine copper from the United States were as follows:

United States exports.

Years and months.	Long tons.	Years and months.	Long tons.
1892.		1893.	
July	3,450	August	9,127
August	1,545	September	16,131
September	1,458	October	11,478
October	3,144	November	7,821
November	3,897	December	8,293
December	4,486		
Total	17,980	Total first six months	20,361
		Total last six months	60,031
1893.		Total year 1893	80,392
January	3,171	1894.	
February	1,815	January	7,717
March	2,334	February	5,590
April	3,450	March	7,137
May	4,482	April	6,209
June	5,109	May	6,140
July	7,181		

The following is, in detail, the output of the Lake Superior mines, as reported by the companies, from 1884 to 1890:

Production of Lake Superior copper mines, 1884 to 1890.

Mines.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Calumet and Hecla	40,473,585	47,247,990	50,518,222	46,016,123	50,295,720	48,668,296	59,868,106
Quincy	5,650,436	5,848,530	5,888,511	5,603,691	6,367,809	6,405,686	8,064,253
Osceola	4,247,630	1,945,208	3,560,786	3,574,972	4,134,320	4,534,127	5,294,792
Franklin	3,748,652	4,007,105	4,264,297	3,915,838	3,655,751	4,346,062	5,638,112
Allouez	1,928,174	2,170,476	1,725,463	885,010	314,198	1,762,816	1,407,828
Atlantic	3,163,585	3,582,633	3,503,670	3,641,865	6,974,877	3,698,837	3,619,972
Pewabic	227,834	....	....	....	....	....	....
Central	1,446,747	2,157,408	2,512,886	2,199,133	1,817,023	1,270,592	1,413,391
Grand Portage	255,860	....	....	....	....	....	....
Conglomerate	1,198,691	....	....	....	....	....	....
Mass	481,396	363,500	247,179	....	....	58,349	62,187
Copper Falls	891,168	1,150,538	1,378,679	719,150	1,199,950	1,440,000	1,330,000
Phœnix	631,004	344,355	1,101,804	11,000	....	....	....
Hancock	562,636	203,037	150,000	....	....	....	....
Huron	1,927,660	2,271,163	1,992,695	1,881,760	2,370,857	2,219,473	1,736,777
Ridge	74,030	63,390	158,272	84,902	50,924	28,000	21,569
St. Clair	139,407	....	....	....	....	....	....
Cliff	28,225	....	22,342	....	....	....	....
Wolverine	751,763	328,610	3,125	2,300	....	....	....
Nonesuch	23,867	28,484	....	....	....	....	....
Isle Royale	16,074	....	....	....	....	....	....
National	87,368	162,252	184,706	25,187	....	454,134	123,879
Minnesota	1,144	12,608	....	....	....	....	....
Belt	130,851	27,433	7,300	....	....	....	....
Sheldon and Columbia	9,828	....	....	....	....	....	....
Adventure	4,333	4,000	1,000	....	....	692	15,485
Peninsula	1,225,981	....	....	....	....	736,507	1,108,660
Tamarack	....	181,669	3,646,517	7,396,529	11,411,325	10,605,451	10,106,741
Ogima	1,106	12,000	....	....	....	....	....
Kearsarge	....	....	....	21,237	829,185	1,918,849	1,598,525
Evergreen Bluff	954	1,500	1,000	....	....	21,580	....
Ash Bed	1,517	....	....	....	....	....	....
Sundry companies—tributers	21,696	34,000	50,000	50,000	50,000	6,224	....
Total	69,353,202	72,147,889	80,918,460	76,028,697	86,472,034	88,175,675	101,410,277

The permission to publish the report of the Calumet and Hecla Company for the years 1891, 1892, and 1893 has not been given. The following table, therefore, records only the output of the other leading producers in that district:

Production of Lake Superior copper mines in 1891, 1892, and 1893.

Mines.	1891.	1892.	1893.
	Pounds.	*Pounds.*	*Pounds.*
Tamarack	16, 161, 312	16, 426, 633	15, 085, 113
Quincy	10, 542, 519	11, 103, 926	14, 398, 477
Osceola	6, 543, 358	7, 098, 656	6, 715, 870
Franklin	4, 319, 840	3, 769, 605	3, 504, 244
Atlantic	3, 653, 671	3, 703, 875	4, 221, 933
Kearsarge	1, 727, 390	1, 467, 758	1, 627, 030
Peninsula	1, 599, 670	973, 217	
Copper Falls	1, 427, 000	1, 350, 000	750, 000
Huron	1, 257, 059	461, 499	562, 776
Allouez	1, 241, 423	546, 530	
Central	1, 237, 500	1, 625, 982	1, 180, 040
Centennial	531, 983	106, 801	

THE LAKE SUPERIOR MINES.

To the Quincy mine the year was chiefly eventful through the purchase of 640 acres of land adjoining the mine and containing at greater depth the mineral deposit which it is now working, known as the Pewabic vein. An issue of new stock, payable in installments, was made, and $150,000 was paid out of the earnings of the year on account of the purchase. When the hoisting and stamping equipment has been proportionately increased it is expected that the earning capacity of the mine will be doubled. During the year 1893 the mine produced 17,708,035 pounds of mineral, yielding 14,398,477 pounds of refined copper, which yielded $1,508,631.51, while the silver sold for $2,407.55. The running expenses at the mine were $740,362.01; the building and construction account was $74,930.78, and the smelting, freight, and other expenses were $202,347.15, leaving as a mining profit $493,399.12. Adding interest and other receipts the earnings were carried to $511,213.70, out of which dividends aggregating $300,000 and $150,000 purchase-money were paid. This carried the balance of assets up to $714,424.49.

Operations of the Quincy copper mine, Lake Superior.

	1889.	1890.	1891.	1892.	1893.
Rock mined ... tons..	167, 077	187, 244	276, 336	349, 400	451, 354
Rock hoisted ... do....	123, 998	168, 017	269, 817	327, 849	429, 587
Rock stamped ... do....	117, 875	165, 140	263, 678	323, 051	422, 239
Product of stamp material...pounds..	6, 641, 785	7, 262, 485	8, 649, 585	8, 639, 670	11, 765, 040
Product of masses ... do....	1, 178, 225	2, 740, 365	4, 177, 490	4, 982, 145	5, 942, 995
Total refined copper ... do....	6, 405, 686	8, 064, 253	10, 542, 519	11, 103, 926	14, 398, 477
Earnings	$182, 601. 14	$596, 677. 60	$414, 970. 39	$296, 195. 25	$511, 213. 70

The Tamarack, although it produced less in the calendar year 1893 than in 1892, continued its prosperous career. During the fiscal year ending July 1, 1893, the company took from conglomerate workings 369,367 tons of rock, and there was stamped 345,925 tons, which yielded 21,976,368 pounds of mineral, which at 73.08 per cent. afforded 16,061,106 pounds of ingot. This makes the percentage of refined copper in the stamp rock 2.32 per cent. The receipts were $1,857,274.20, while the costs were $852,090.31 for the running expenses at the mine and $284,062.07 for smelting, freight, etc., leaving a mining profit of $721,121.82. The construction costs included $14,756.45 for the old mine and stamp mill, $68,351.12 for No. 3 shaft, section 11; $67,120.14 for No. 4 shaft and $2,701.06 for engine and shaft equipments, a total of $152,928.77. To this is added a balance of $39,195.53 available for these purposes, leaving $607,388.58 as profit, out of which dividends aggregating $600,000 were paid, making the total $3,470,000. The balance of assets on June 30, 1893, was $828,452.96. The total share capital paid in was $1,520,000. The construction expense on the old mine was $944,938.20. On No. 2 shaft $200,873.15 was spent. Nos. 3 and 4 shafts, in section 11, which are to open the deposit in greater depth were down, at the end of the fiscal year, 3,312 feet for the former and 3,117 feet for the latter. Their cost thus far has been $539,457.33. Captain Daniell reported in August last that he expected to strike the conglomerate in less than a year. The rate of sinking in the fiscal year 1892–'93 was 1,100 feet for No. 3 and 1,050 feet for No. 4. Exploration work in depth has gone in on the Osceola amygdaloid with favorable results. The Tamarack stamp mill, besides crushing 345,925 tons of its own rock, also treated 55,511 tons for the Kearsarge. The cost of stamping and washing the 401,436 tons was 32.836 cents per ton. The cost of the refined copper at the mine was 5.31 cents, the cost of smelting, freight, etc., was 1.77 cents, and the cost of construction was 0.95 cent, making a total cost per pound of 8.03 cents.

The Osceola produced somewhat less copper in 1893 than in 1892. There was hoisted 266,740 tons of rock, of which 236,875 tons was sent to the mill, producing 7,243,675 pounds of copper, in addition to which 625,756 pounds of mass and barrel work was obtained making a total of 7,869,431 pounds. At 85.34 per cent. this afforded 6,715,870 pounds of copper. The cost per ton of rock hoisted was $1.83, and per ton of rock stamped, which yielded 1.42 per cent. of fine copper was $2.06. The cost of stamping was 34.92 cents per ton. A sixth stamp was added to the mill during the year. The income was $739,135.40, the copper having sold at an average of 10.95 cents. The running expenses at the mine were $487,250.23; the smelting, freight, and selling expenses were $104,449.08, and the outlays on mine plant were $44,989.54, leaving a net income of $102,446.55. Out of this dividends aggregating $100,000 were paid, making the total to date

$1,847,500. The balance of assets in January, 1893, including $230,764.50 cash, and bills receivable were $267,183.07. The cost in 1893 compared as follows with previous years:

Cost of refined copper at the Osceola mine.

	1890.	1891.	1892.	1893.
Mining cost per ton of stamp rock	$2.39	$2.13	$2.07	$2.06
Cost of refined copper at mine	8.31	7.63	7.20	7.26
Cost of smelting, transportation, and handling	1.51	1.64	1.54	1.55
Cost for construction	1.42	.84	.38	.67
Total cost per pound	11.24	10.11	9.12	9.48

The Kearsarge mine hoisted 91,873 tons of rock, and discarding 16,423 tons, stamped 75,450 tons producing 1,992,445 pounds of mineral which at 81.66 per cent. gave 1,627,030 pounds of refined copper, or 1.08 per cent. in the stamp rock. The receipts for copper, at 10.87 cents, yielded $176,778.93 to which were added interest receipts of $5,515.68. The running expenses at the mine were $151,692.24, and the smelting, freight, etc., $29,472.55, which left a net income during the year of $1,129.82. This added to the previous balance of assets, carried the latter up to $155,021.32. Thus far the mine has paid one dividend of $80,000 since 1887. The cost of producing copper at the Kearsarge from 1889 to 1893, inclusive, has been as follows:

Cost of fine copper at the Kearsarge mine.

	1889.	1890.	1891.	1892.	1893.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Cost per pound at mine	7.27	8.64	8.84	9.50	9.32
Cost per pound, smelting, freight, etc.	1.94	1.83	1.65	1.95	1.81
Total excluding construction	9.21	10.47	10.49	11.45	11.13
Cost of construction	.31	.21	1.03	.77	....
Total cost, sold	9.52	10.68	11.52	12.22	11.13

The working expenses of the Atlantic Mining Company were lower in 1893 than before, as shown in the following table:

Cost of copper at the Atlantic mine per ton of rock treated.

Items of cost.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Mining, selecting, breaking, and all surface expenses, including taxes	80.88	87.23	83.73	87.87	104.14	95.29	83.98	79.49
Transportation to mill	3.48	3.80	3.47	3.88	3.46	3.86	3.33	3.28
Stamping and separating	26.53	27.31	26.89	27.78	27.78	25.82	25.09	24.95
Freight, smelting, marketing, and New York expenses	24,25	23.07	21.42	20.22	20.37	18.47	17.67	18.22
Total working expenses	135.14	141.41	135.51	129.75	155.75	143.44	130.07	125.94
Total expenditures	138.01	145.22	142.82	153.27	166.70	154.51	133.51	160.24
Net profit	15.29	30.53	54.36	6.23	27.71	0.16	....	....
Yield of copper, per cent	0.709	0.712	0.667	0.663	0.650	0.615	0.615	0.669

During the year 1893 the mill stamped an average of 1,021 tons of rock per day, crushing in all 315,670 tons, which yielded 5,558,370 pounds of mineral, or 4,221,933 pounds of refined copper, thus showing a yield of 13.375 pounds per ton, or 0.669 per cent. The income was $455,500.30, while the mine expenses were $340,040.21; smelting, freight, insurance, $57,514.56; thus showing a gross profit of $57,945.53, to which was added $5,463.63 for the sale of timber and timber lands. The building of a railroad to the new mill site, the purchase of lands and the preparation of the mill site, with some construction at the mine, however, absorbed $108,288.84, so that the surplus account was drawn down to $250,636.02. It is estimated that about $100,000 will be required to finish the new mill.

Developments in the Central mine during 1893 have not been favorable, explorations beyond the slide having shown nothing but poor ground. The mine yielded 1,116,700 pounds of stamp copper, 212,640 pounds of barrel copper, and 187 masses weighing 275,250 pounds, a total of 1,604,590 pounds of mineral which yielded 1,180,040 pounds of refined copper. This sold at an average of 10.42 cents per pound. The working of the mine showed a deficiency of $49,392.66, reducing the surplus to $127,838.33.

The Franklin expended considerable money in 1893 in repairs and improvements and carried on exploration work quite vigorously. Through the falling off in the grade of the rock from 1.529 per cent. of refined copper in 1892 to 1.402 per cent. in 1893, the product was decreased. There were stamped 124,890 tons of rock, yielding 4,225,188 pounds of mineral, equal to 3,504,244 pounds of refined copper. The mine expenses were $250,509.49, the outlays for smelting, freight, insurance, etc., were $48,229.35, and the costs of construction and exploration $44,029.11. The total receipts were $352,667.78, leaving a profit of $9,899.83. A dividend of $80,000 was paid by drawing on the surplus fund of $344,020.05.

MONTANA.

The Anaconda did not in 1893 repeat its record of 1892, when 100,000,000 pounds of copper were produced; in fact, its yield in 1893 was only a trifle over 75,000,000 pounds, or about one-half of its capacity, running full all the year around. The only important additions to plant made was the enlargement of the old Bessemerizing works to 24 converters and the building of a new plant for 24 converters. In the spring of 1894, however, the Anaconda resumed production at its maximum rate.

The last annual report of the Boston and Montana Company covers a period of eighteen months, a change from the former fiscal year to the calendar year having been made. It was a period of the completion of the transfer of smelting operations to the new concentrating and smelting works at Great Falls. Under the circumstances it is somewhat difficult to figure the cost of production during the period under review, and, even if deduced from the published data relating to expenditures, the result does not correctly reflect the capacity of the concern for making cheap copper. The running expenses at Butte and Great Falls were $3,155,956.06, and the total outlay for freight, commissions, taxes, and refining footed up to $1,078,493.56, a total of $4,234,449.62. The shipments in matte and copper from Butte and Great Falls aggregated 50,296,540 pounds, thus indicating a cost of 8.4 cents per pound, exclusive of any credit for the precious metals. The receipts for product were $5,078,725.47, leaving a mining profit of $844,275.85. New stock to the amount of $625,000 was sold. During the year $211,000 of bonds were redeemed and canceled, leaving outstanding $521,000 of the first issue, $335,000 of the second issue, and $600,000 of the third, a total of $1,456,000, on which 7 per cent. interest is paid. From 1888 to 1891, inclusive, the company paid $2,075,000 in dividends. Prior to July 1 the construction expense at Great Falls was $1,485,275.35. During the eighteen months there was added thereto $553,694.99, so that the plant, now practically complete, stands at $2,038,970.34, which is not included in the assets.

The mines produced 331,630 tons, the Mountain View contributing 108,816½ tons, the Pennsylvania 98,726 tons, and the Colusa 118,968½ tons. Of this quantity 99,305 tons were treated at the Butte works, now abandoned, which yielded 19,304,057 pounds of copper, an average of 9.72 per cent. in 1893 against 9.176 per cent. in the previous year. The silver contained in the matte and ore shipped was 236,840 ounces and the gold 513.35 ounces. Captain Couch estimates the reserves at 150,000 tons in the Mountain View, 30,000 tons in the Pennsylvania, 175,000 tons in the Colusa, and 250,000 tons in the block of 400 feet of ground between the Mountain View and the Colusa. He speaks in strong terms of the performance of the Riedler pump at the Leonard shaft. He advocates the sinking of a new shaft between the Mountain View and the Colusa.

Mr. Frank Klepetko, the superintendent of the Great Falls plant, reports that there were smelted, from July 1, 1892, to January 1, 1893, the equivalent of 46,230 tons of ore, which yielded 4,389,143 pounds of copper, or 4.75 per cent. During the first six months of 1893, 73,691 tons were treated, yielding 7.05 per cent., and during the second half of the year 99,037 tons, yielding 9.4 per cent. The total smelting for the eighteen months has been equivalent to 218,958 tons of ore, from which there were produced 33,398,915 pounds of copper. The inventory of copper on hand in ore and in material in process showed 6,584,830 pounds, of which over 2,500,000 were in the form of rich ore in reserve.

The additions to this plant include two Victor turbines of 2,300 horse power, a Tod blowing engine for the converter plant, three blast furnaces, an eighth tilting reverberatory furnace, and additional converters, which bring the total up to fourteen, with a monthly capacity of 5,500,000 pounds, which might possibly be pushed to 7,000,000. Three refining furnaces have been built, with a capacity of 14 tons daily, each. The electrolytic refinery, which was planned for a capacity of 1,000,000 pounds monthly, is producing at the rate of 1,600,000 pounds monthly. An air-compressing plant is being added to the electrolytic works for the purpose of forcing solutions to a higher level for circulation.

The Montana Ore Purchasing Company is the most important addition to the list of producers in 1893, and is making further preparations to enlarge. The small blast furnace is to be replaced by a larger one capable of smelting 150 tons per day. The present calcining plant of two O'Hara furnaces is to be expanded by two turret roasters of special design. The two 21½-foot reverberatory furnaces have worked exceptionally large charges, the record being 95,000 pounds. The works have two converter stands, so that with five converters two are kept constantly blowing. New boilers and a new engine are being put in, and the bin capacity is being enlarged, so that the present capacity for producing about 1,300,000 pounds of copper monthly will be considerably increased by the fall. At the Glengarry mine a hoisting plant is to be put in to reach a depth of 1,000 feet. A trestle will connect it with the Liquidator concentrating mill, whose capacity is to be increased from 180 tons to 250 tons per 24 hours.

Early in 1894 the Williams smelter was partly burned down, but is again being rebuilt.

A very promising copper camp has been developed in 1893 in Soap Gulch, near Melrose, about 28 miles from Butte. As yet no ore shipments of moment have been made.

Montana's proportion of the copper product.

Years.	United States.	Montana.	Montana.	Lake Superior.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*
1882	90, 646, 232	9, 058, 284	....	....
1883	115, 526, 053	24, 664, 346	21.4	50.1
1884	144, 946, 635	43, 098, 054	29.7	48.4
1885	165, 875, 483	67, 797, 864	40.9	43.5
1886	156, 763, 043	57, 611, 621	36	50.1
1887	181, 477, 331	78, 699, 677	43.4	41.7
1888	226, 361, 466	97, 897, 968	43.3	38.2
1889	226, 055, 962	98, 222, 444	43.5	38.7
1890	259, 098, 092	112, 980, 896	43.6	38.9
1891	284, 119, 764	112, 063, 320	39.4	40.2
1892	345, 121, 280	163, 206, 128	47.3	35.7
1893	329, 354, 398	155, 209, 133	47.1	34.2

ARIZONA.

The production of the active mines of Arizona has changed but little. The Copper Queen is building two trough converters and will change its furnace practice so as to make chiefly matte, to be Bessemerized on the spot. The company has, in addition to its reserves of oxidized ores, large quantities of sulphuret ores which can be made available, while at the same time cost is lowered.

The United Verde has also put in a Bessemerizing plant, not yet completed, and the building of a railroad to the mines is in contemplation.

The construction of the railroad to Globe is progressing, so that soon the Old Dominion, whose mines are showing up very well, will be in position to produce copper at considerably lower cost, the long haul on fuel and the transportation of product having been very costly.

The Arizona Copper Company has put up a leaching plant. The Detroit, at Clifton, is leaching the middlings from the concentrator. The Commercial Mining Company is doing little work.

TENNESSEE.

Mr. Titus Ulke reports as follows: The Ducktown Sulphur, Copper and Iron Company commenced work in 1891, and in 1892 opened the Mary mine and built the Herreshoff smelter at Isabella, 3 miles south of Ducktown, Tennessee. In January and February, 1893, the company sold 200 tons of matte, representing 100 tons of metal copper. During the remainder of the year 538 tons of matte were sold, containing 216 tons of copper. This matte was produced in June, July, September, and December. There were also shipped from the works bars of 97½ per cent. blister copper, representing 3½ tons of the metal. Since the end of the year 1893 the smelting plant and mine have been in continuous operation, and the company is now engaged in enlarging the plant. At the Mary mine the average daily output was over 150 tons of ore, consisting, after sorting, chiefly of pyrrhotite mixed with some copper pyrite in a hornblendic gangue. It contains about 3½ per cent. of copper, traces of silver and gold, 28 per cent. sulphur, 11 per cent. silica, 45 per cent. iron, and the balance is lime, alumina, etc. This ore is roasted in the open air in heaps of 150 to 200 tons, the roasting lasting two months generally, and the roasted ore averaging 10 to 12 per cent. sulphur. There are at present some 60 heaps in operation. Besides heap roasting, the company possesses 60 shelf or smalls burners, in which the mine smalls are treated. Each burner of 6 shelves roasts 1½ tons per twenty-four hours down to the desired degree of desulphurization, usually to below 8 per cent. sulphur. The sulphur in the ore is not utilized for acid manufacture. In twenty-four hours the furnace roasts 3 charges of 1,000 pounds each. The roasted ore, with the necessary amount of quartz, is charged to the Herreshoff furnace which is capable of smelting 300 charges and more of 950 pounds each, with 16 per cent. of coke per twenty-four hours. The above charge of about 120 to 140 tons of ore per day produces about 6 to 7 tons of 50 per cent. matte, and a slag averaging 0.7 per cent. of copper.

The Pittsburgh and Tennessee Copper Company, according to the report of the superintendent, Mr. Carl Henrich, has been prospecting the lower levels of some of the pyrrhotite deposits of Ducktown for the last two years. The company is at present opening the old "Polk County mine," below the "black copper zone," worked thirty years since, and is building large roasting and smelting works. It is expected that the smelter will be running in July, 1894. It will then treat about 150 tons of ore per day running from 3 to $3\frac{3}{4}$ per cent. of copper.

The London Coal and Iron Company in 1893 shipped iron ore from their mine at Isabella, but not any copper ore, although much oxidized copper ore was formerly obtained from the same mine in pockets in the gossan.

Among the refining plants of the country the latest addition is the works building at Salt Late City, Utah, by Posey, Green & Co., which is to depend chiefly upon the Copperopolis and Copper Mountain groups of mines in Utah and the Nancy Hanks group in Nevada. A Bessemer and an electrolytic plant are embraced in the undertaking.

IMPORTS.

The imports of fine copper contained in ores, and of regulus and black copper, and of ingot copper, old copper, plates not rolled, rolled plates, sheathing metal, and manufactures not otherwise specified, and of brass are given in the following tables:

Fine copper contained in ores, and regulus and black copper imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Fine copper contained in ores.		Regulus and black copper. (a)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		Pounds.		
June 30, 1867	....	$936, 271	....	....	$936, 271
1868	3, 496, 994	197, 203	....	....	197, 203
1879	24, 960, 604	448, 487	....	....	448, 487
1870	1, 936, 875	134, 736	....	....	134, 736
1871	411, 315	42, 453	499	$60	42, 513
1872	584, 878	69, 017	4, 247	1, 083	70, 100
1873	702, 086	80, 132	1, 444, 239	279, 631	359, 763
1874	606, 266	70, 633	28, 880	5, 397	76, 030
1875	1, 337, 104	161, 903	12, 518	2, 076	163, 979
1876	538, 972	68, 922	8, 584	1, 613	70, 535
1877	76, 637	9, 756	1, 874	260	10, 016
1878	87, 039	11, 785	....	....	11, 785
1879	51, 959	6, 199	....	....	6, 199
1880	1, 165, 283	173, 712	2, 201, 394	337, 163	510, 875
1881	1, 077, 217	124, 477	402, 640	51, 633	176, 110
1882	1, 473, 109	147, 416	224, 052	30, 013	177, 429
1883	1, 115, 386	113, 349	....	....	113, 349
1884	2, 204, 070	219, 957	2, 036	204	220, 161
1885	3, 665, 739	343, 793	285, 322	20, 807	364, 600
Dec. 31, 1886	4, 503, 400	341, 558	1, 960	98	341, 656
1887	3, 886, 192	194, 785	27, 650	1, 366	196, 151
1888	4, 859, 812	381, 477	4, 971	324	381, 801
1889	3, 772, 838	274, 649	60, 525	4, 244	278, 893
1890	3, 448, 237	241, 732	221, 838	15, 688	257, 420
1891	8, 931, 554	774, 057	2, 403, 919	214, 877	988, 934
1892	7, 669, 978	453, 474	303, 087	17, 390	470, 864
1893	7, 256, 015	435, 448	3, 175, 559	202, 197	637, 645

a Not enumerated until 1871.

Copper imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Bars, ingots, and pigs.		Old, fit only for remanufacture.		Old, taken from bottoms of American ships abroad. (*a*)		Plates not rolled.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
June 30, 1867	1,635,953	$287,831	569,732	$81,930	....	....	....	....
1868	61,394	6,935	318,705	42,652	....	....	....	....
1869	13,212	2,143	290,780	34,820	....	....	....	....
1870	5,157	418	255,386	31,931	....	....	....	....
1871	3,316	491	369,634	45,672	....	....	430	$129
1872	2,638,589	578,965	1,144,142	178,536	....	....	148,192	33,770
1873	9,697,608	1,984,122	1,413,040	255,711	32,307	$4,913	550,431	97,888
1874	713,935	134,326	733,326	137,087	9,500	930	....	....
1875	58,475	10,741	396,320	55,564	11,636	1,124	8	4
1876	5,281	788	239,987	35,545	10,304	1,981	5,467	600
1877	230	30	219,443	28,608	41,482	5,136	....	....
1878	1	1	198,749	25,585	....	6,004	....	....
1879	2,515	352	112,642	11,997	11,000	1,107	27,074	4,496
1880	1,242,103	206,121	695,255	91,234	....	....	120	11
1881	219,802	36,168	541,074	63,383	14,680	1,504	20	3
1882	6,200	836	508,901	59,629	16,075	1,629	....	....
1883	....	....	330,495	36,166	9,415	666	....	....
1884	(*b*) 542	107	149,701	12,099	....	554	....	....
1885	914	172	81,312	6,658	....	1,160	....	....
Dec. 31, 1886	276	37	37,149	2,407	....	584	....	....
1887	212	22	39,957	2,374	....	129	....	....
1888	1,787	299	37,620	2,535	....	....	....	....
1889	3,160	522	19,912	1,176	....	....	....	....
1890	5,189	859	284,789	26,473	....	....	....	....
1891	2,556	389	134,407	9,685	....	....	....	....
1892	22,097	2,588	71,485	6,114	....	....	....	....
1893	554,348	58,480	59,375	6,945	....	6,326	....	....

a Not enumerated until 1873. *b* Includes "plates not rolled" since 1884.

Years ending—	Plates rolled, sheets, pipes, etc.		Sheathing metal, in part copper. (*a*)		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
June 30, 1867	....	$1,101	220,889	$37,717	$15,986	$424,565
1868	....	1	101,488	18,852	21,492	89,932
1869	....	39	43,660	6,592	43,212	86,806
1870	....	2,039	....	....	485,220	519,608
1871	....	7,487	....	....	668,894	722,673
1872	....	18,895	....	....	1,007,744	1,817,910
1873	....	4,514	....	....	869,281	3,216,429
1874	....	27	282,406	50,174	125,708	448,252
1875	....	617	136,055	23,650	35,572	127,272
1876	....	326	18,014	2,903	29,806	71,949
1877	....	203	110	22	41,762	75,761
1878	....	1,201	647	55	35,473	68,319
1879	....	786	300	20	39,277	58,035
1880	....	4,134	6,044	693	130,329	432,522
1881	....	82	39,520	4,669	284,509	390,318
1882	5,855	1,551	....	....	77,727	141,372
1883	2,842	379	6,791	1,047	40,343	78,601
1884	6,529	2,330	19,637	926	55,274	71,290
1885	470	120	86,619	9,894	61,025	79,027
Dec. 31, 1886	3,770	339	21,573	1,917	31,871	37,155
1887	37,925	5,493	18,189	1,867	37,289	47,174
1888	5,208	737	23,622	2,696	14,567	20,834
1889	13,848	2,082	23,520	2,572	13,430	19,782
1890	4,209	917	37,458	4,467	24,752	57,468
1891	122,219	23,291	228,486	29,112	12,926	75,403
1892	1,788	600	417,134	51,380	49,764	110,446
1893	7,056	1,065	1,670	167	16,166	89,149

a Does not include copper sheathing in 1867, 1868, and 1869.

The source of the imports of fine copper in ore into the United States during 1893 is shown in the following table:

Imports of fine copper in ore in 1893.

Countries from which imported.	Quantity.	Value.
	Pounds.	
Spain	166,870	$11,680
Dominion of Canada:		
Nova Scotia, New Brunswick, etc	1,344	48
Quebec, Ontario	4,795,704	307,000
British Columbia	7,790	778
Newfoundland and Labrador	1,788,261	91,099
Mexico	639,606	41,201
Venezuela	257,112	12,570
All other countries	66,700	3,612
Total	7,723,387	467,988

The above table includes 467,372 pounds which were either re-exported or entered in bonded warehouses and not withdrawn during 1893, so that the actual amount of imported fine copper contained in ores consumed in the United States in 1893 was 7,256,015 pounds, as given in the table on page 75.

EXPORTS.

The exports of copper in the form of ore (including matte), ingot copper, and manufactured copper for a series of years have been as follows:

Copper and copper ore of domestic production exported from the United States, 1864 to 1893.

[Cwts. are long hundredweights of 112 pounds.]

Years ending—	Ore and matte.		Pigs, bars, sheets, and old.		Manufactured.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Cwts.		*Pounds.*			
June 30, 1864	109,581	$181,298	102,831	$43,229	$208,043	$432,570
1865	225,197	553,124	1,572,382	709,106	282,640	1,544,870
1866	215,080	792,450	123,444	33,553	110,208	936,211
1867	87,731	317,791	(a) 4,637,867	303,048	171,062	791,901
1868	92,612	442,921	1,350,896	327,287	152,201	922,409
1869	121,418	237,424	1,134,360	233,932	121,342	592,698
1870	(a) 19,198	537,505	2,214,658	385,815	118,926	1,042,246
1871	(a) 54,445	727,213	581,650	133,020	55,198	915,431
1872	35,564	101,752	267,868	64,844	121,139	287,735
1873	45,252	170,365	38,958	10,423	78,288	259,076
1874	13,326	110,450	503,160	123,457	233,301	467,208
1875	(a) 51,305	729,578	5,123,470	1,042,536	43,152	1,815,266
1876	15,304	84,471	14,304,160	3,098,395	343,544	3,526,410
1877	21,432	109,451	13,461,553	2,718,213	195,730	3,023,394
1878	32,947	169,020	11,297,876	2,102,455	217,446	2,488,921
1879	23,070	102,152	17,200,739	2,751,153	79,900	2,933,205
1880	21,623	55,763	4,206,258	667,242	126,213	849,218
1881	9,958	51,499	4,865,407	786,860	38,036	876,395
1882	25,936	89,515	3,340,531	565,295	93,646	748,456
1883	112,923	943,771	8,221,363	1,293,947	110,286	2,348,004
1884	386,140	2,930,895	17,044,760	2,527,829	137,135	5,595,859
1885	432,300	4,739,601	44,731,858	5,339,887	107,536	10,187,024
Dec. 31, 1886	417,520	2,341,164	19,553,421	1,968,772	76,386	4,386,322
1887	501,280	2,774,464	12,471,393	1,247,928	92,064	4,114,456
1888	794,960	6,779,294	31,706,527	4,906,805	211,141	11,897,240
1889	818,500	8,226,206	16,813,410	1,896,752	86,764	10,209,722
1890	431,411	4,413,067	10,971,899	1,365,379	139,949	5,918,395
1891	672,120	6,565,620	69,279,024	8,844,304	293,619	15,703,543
1892	(b) 943,040	6,479,758	30,515,736	3,438,048	245,064	10,162,870
1893	835,040	4,257,128	138,984,128	14,213,378	462,136	18,932,642

a Evidently errors in quantities. *b* Corrected figures.

In detail the exports of copper in bars and ingots, which increased so enormously in 1893, are shown in the following table:

Exports of copper bars and ingots.

Countries to which exported.	1893.	1892.
	Pounds.	*Pounds.*
United Kingdom	42, 649, 832	3; 086, 927
Germany	17, 677, 887	6, 055, 682
France	27, 960, 646	9, 721, 467
Other countries in Europe	49, 914, 487	11, 502, 454
Other countries	781, 276	149, 206
Total	138, 984, 128	30, 515, 736

It is assumed, although nothing definite is known in the copper trade, that a large part of the metal exported to "other countries in Europe" went to Russia.

The exports of ore and matte during 1893 are reported as follows by the Bureau of Statistics of the Treasury Department:

Exports of copper matte and ore in 1893.

Months.	Baltimore.	Boston.	New York.
	Long tons.	*Long tons.*	*Long tons.*
January	2, 205		1, 891
February	10	15	1, 275
March			2, 549
April			3, 673
May			2, 310
June			5, 951
July			2, 952
August	1, 907	403	2, 821
September	3, 631	203	3, 401
October	1, 179		2, 020
November	304		1, 707
December			1, 345
Total	9, 236	621	31, 895

It is estimated that the 41,752 long tons thus reported contained 50,000,000 pounds fine.

THE COPPER MARKETS.

The following table summarizes the highest and lowest prices obtained for Lake copper monthly in the New York markets from 1860 to 1893, both inclusive:

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 to 1893.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	24	23½	24	23¾	23¾	23	23½	23	23¼	22½	22¾	21¾
1861	20	19	19½	19	19¾	19¼	19¾	19	19¾	19¼	19	18
1862	28	27	28	25	25	23	23	21½	21½	20¾	23	20¾
1863	35	31	37	35	37	31	31	30	30½	30	30½	30
1864	41¼	39	42	41¼	42½	41½	44	42½	44	43	49	44
1865	50½	46	46	44	44½	34	35	34	34	30	30½	28½
1866	42	38	38	35½	35½	29½	30	28½	31	29	33	31
1867	29¼	27	27¾	27½	27½	24	24½	23½	24¼	24	24½	24
1868	23½	21½	24	22½	24	23¼	24¼	23¼	24¼	24	24	23⅛
1869	26¼	23¾	27	26	26¾	24	24	23¼	24¼	23¾	23¾	22
1870	22	21⅛	21¼	20⅞	20¾	19	19¾	19¼	19½	19	20⅝	19
1871	22⅞	22	22⅜	21⅞	22	21½	21¾	21¼	21¾	21⅜	21½	21¼
1872	28½	27⅛	28⅜	28¼	30½	28⅜	44	30½	42	36	34¾	33
1873	35	32½	35	34	35	34½	34½	33½	33½	32	31½	29⅛
1874	25	24½	25	24⅓	24¾	24	25	24¾	25	24½	24¾	24¼
1875	23½	21½	22¾	21¾	21¾	21½	21¾	21½	23¼	22⅝	23	23
1876	23¼	23	22⅞	22½	22¼	22	22⅝	22	22⅛	21	21	19¼
1877	19½	19	20½	19½	19¼	19	19½	19¼	19¼	19	19⅜	19
1878	17⅝	17¼	17½	17⅛	17⅛	16⅞	17	16⅞	16¾	16¼	16⅜	16¼
1879	16	15½	15½	15½	15¾	15¾	16	15¾	16¼	16	16¼	16⅛
1880	25	21⅜	24½	24	24	22¾	22½	24	21	18	18½	17⅞
1881	19⅜	19⅛	19⅜	19⅛	19⅜	19	19	18¾	18⅞	18¼	18¼	16⅜
1882	20⅜	20¼	20	19	19¼	18⅞	18⅞	17⅞	18¼	18	18¼	18
1883	18⅛	18	17⅞	17¾	17⅝	17⅛	16	15¾	16	15⅞	15⅞	15
1884	15	14⅞	15	14⅞	15	14⅞	15	14½	14¼	14⅛	14¼	14
1885	11½	10⅜	11⅛	10⅕	11⅛	10⅖	11¼	10 1/10	11½	9⅘	11½	11
1886	11⅝	11⅜	11⅝	11⅜	11½	11⅜	11½	11⅜	11⅛	10	10⅛	10
1887	12	11⅛	11⅛	10⅕	10½	10⅜	10⅕	10	10	9 19/20	10¼	10
1888	17 4/10	15 17/20	16 6/10	16	16 7/20	15 19/20	16 9/10	16	16¾	16 3/10	16 13/20	16 9/20
1889	17½	16½	16¾	16½	15¾	15	16	15½	12⅛	12	12¼	12
1890	14½	14¼	14¼	14¼	14¼	14	14½	14¼	15¼	14⅝	16¾	15¼
1891	15	14⅝	14⅞	14¼	14¼	13⅝	13¾	13½	13¾	12¾	13	12⅞
1892	11	10¾	10¾	10½	12	10¾	12	11¾	12¼	12	11⅞	11½
1893	12½	12¼	12¼	12	12	11¾	11½	11¼	11⅛	11	11	10¾

Highest and lowest prices of Lake Superior ingot copper, etc.—Continued.

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	$21\frac{3}{4}$	$21\frac{1}{2}$	$21\frac{1}{2}$	$21\frac{1}{2}$	22	$21\frac{1}{4}$	22	$21\frac{1}{2}$	$21\frac{1}{2}$	$20\frac{1}{4}$	$20\frac{1}{4}$	$19\frac{3}{4}$
1861	18	$17\frac{1}{2}$	19	$17\frac{3}{4}$	$20\frac{1}{4}$	19	$20\frac{1}{4}$	20	$22\frac{1}{2}$	$20\frac{1}{4}$	27	$22\frac{1}{2}$
1862	$24\frac{1}{2}$	$22\frac{1}{2}$	$24\frac{1}{2}$	24	27	$24\frac{1}{4}$	$32\frac{7}{8}$	27	$32\frac{7}{8}$	$30\frac{1}{2}$	$31\frac{1}{2}$	$30\frac{1}{2}$
1863	32	29	31	29	$32\frac{1}{4}$	31	$34\frac{1}{4}$	$32\frac{1}{4}$	$38\frac{1}{2}$	$34\frac{1}{2}$	$38\frac{3}{4}$	$38\frac{1}{2}$
1864	55	49	$52\frac{1}{2}$	50	$52\frac{1}{2}$	$47\frac{1}{2}$	48	47	49	47	50	$48\frac{1}{2}$
1865	$30\frac{1}{4}$	28	32	$30\frac{1}{2}$	$32\frac{3}{4}$	$31\frac{1}{2}$	33	$32\frac{1}{2}$	$45\frac{1}{2}$	33	$45\frac{1}{2}$	$39\frac{1}{2}$
1866	$33\frac{1}{2}$	31	31	30	$31\frac{1}{2}$	$30\frac{3}{4}$	31	$30\frac{3}{4}$	$30\frac{3}{4}$	$26\frac{1}{2}$	29	$26\frac{1}{2}$
1867	26	24	$26\frac{1}{4}$	$25\frac{3}{4}$	$27\frac{1}{4}$	$26\frac{1}{4}$	$26\frac{3}{4}$	$22\frac{3}{4}$	23	$22\frac{3}{4}$	23	$21\frac{1}{2}$
1868	$24\frac{1}{2}$	$23\frac{1}{8}$	$24\frac{1}{4}$	24	24	$23\frac{3}{4}$	24	23	24	$22\frac{1}{2}$	$24\frac{1}{2}$	$23\frac{3}{4}$
1869	$22\frac{1}{4}$	$21\frac{7}{8}$	$23\frac{1}{8}$	$21\frac{7}{8}$	23	22	$22\frac{3}{4}$	22	$22\frac{1}{2}$	22	22	$21\frac{1}{2}$
1870	$20\frac{1}{2}$	$20\frac{3}{8}$	$21\frac{3}{8}$	$20\frac{1}{8}$	$21\frac{1}{2}$	$20\frac{3}{4}$	$21\frac{3}{4}$	$21\frac{1}{2}$	$23\frac{3}{8}$	$21\frac{3}{4}$	$22\frac{5}{8}$	$22\frac{1}{4}$
1871	$22\frac{1}{4}$	$21\frac{5}{8}$	23	$22\frac{3}{8}$	$23\frac{7}{8}$	$22\frac{7}{8}$	$23\frac{7}{8}$	$23\frac{1}{4}$	$24\frac{1}{4}$	$23\frac{1}{4}$	27	$24\frac{1}{2}$
1872	34	33	35	$32\frac{1}{2}$	$35\frac{1}{4}$	33	$34\frac{3}{4}$	$31\frac{1}{4}$	$32\frac{1}{4}$	$30\frac{3}{4}$	$32\frac{1}{2}$	$30\frac{1}{2}$
1873	29	$26\frac{5}{8}$	$27\frac{1}{2}$	27	27	$25\frac{1}{2}$	$25\frac{1}{2}$	24	24	21	25	23
1874	$24\frac{1}{4}$	20	21	19	$21\frac{1}{4}$	21	$22\frac{1}{4}$	$21\frac{1}{4}$	$23\frac{3}{4}$	$22\frac{1}{4}$	$23\frac{1}{4}$	$23\frac{1}{4}$
1875	23	$22\frac{5}{8}$	$23\frac{3}{8}$	23	$23\frac{7}{8}$	$23\frac{1}{8}$	$23\frac{1}{4}$	23	$23\frac{1}{4}$	23	$23\frac{3}{8}$	$23\frac{3}{8}$
1876	20	$19\frac{1}{2}$	$19\frac{1}{2}$	$18\frac{3}{4}$	21	$18\frac{3}{4}$	$21\frac{1}{4}$	$20\frac{1}{2}$	$20\frac{1}{2}$	20	20	$19\frac{5}{8}$
1877	$19\frac{1}{4}$	19	19	$17\frac{7}{8}$	$18\frac{1}{2}$	$17\frac{7}{8}$	18	$17\frac{3}{4}$	$17\frac{3}{4}$	$17\frac{5}{8}$	$17\frac{3}{4}$	$17\frac{1}{2}$
1878	$16\frac{1}{4}$	16	16	16	$16\frac{1}{4}$	16	16	$15\frac{1}{2}$	$15\frac{7}{8}$	$15\frac{1}{2}$	16	$15\frac{7}{8}$
1879	$16\frac{1}{8}$	16	$16\frac{3}{8}$	16	17	$16\frac{1}{4}$	$21\frac{1}{2}$	18	$21\frac{3}{4}$	21	$21\frac{1}{2}$	21
1880	$18\frac{7}{8}$	$18\frac{1}{2}$	$19\frac{1}{8}$	19	$18\frac{7}{8}$	$18\frac{3}{4}$	$18\frac{7}{8}$	$18\frac{3}{4}$	$18\frac{7}{8}$	$18\frac{3}{4}$	$19\frac{1}{8}$	$18\frac{7}{8}$
1881	$16\frac{1}{2}$	16	$16\frac{5}{8}$	$16\frac{3}{8}$	$18\frac{1}{8}$	$16\frac{3}{4}$	$18\frac{3}{8}$	18	19	$18\frac{1}{8}$	$20\frac{3}{8}$	$19\frac{1}{4}$
1882	$18\frac{1}{4}$	$18\frac{1}{8}$	$18\frac{1}{4}$	$18\frac{1}{8}$	$18\frac{1}{4}$	18	$18\frac{1}{4}$	18	$18\frac{1}{8}$	18	18	$17\frac{7}{8}$
1883	$15\frac{1}{8}$	15	15	15	$15\frac{1}{4}$	$15\frac{1}{8}$	$15\frac{1}{4}$	$15\frac{1}{8}$	15	$14\frac{7}{8}$	15	$14\frac{7}{8}$
1884	$14\frac{1}{8}$	$13\frac{7}{8}$	14	$13\frac{7}{8}$	$13\frac{1}{8}$	13	$13\frac{1}{8}$	$12\frac{7}{8}$	13	$12\frac{1}{2}$	$12\frac{1}{8}$	11
1885	$11\frac{1}{4}$	$10\frac{7}{8}$	$11\frac{1}{4}$	11	$11\frac{1}{2}$	$10\frac{19}{20}$	$11\frac{1}{3}$	$10\frac{4}{5}$	$11\frac{1}{8}$	$10\frac{4}{5}$	$11\frac{1}{2}$	$11\frac{1}{10}$
1886	$10\frac{1}{8}$	10	$10\frac{1}{4}$	10	$11\frac{1}{8}$	$10\frac{1}{4}$	$11\frac{3}{4}$	$11\frac{1}{8}$	12	$11\frac{3}{4}$	$12\frac{1}{8}$	$11\frac{7}{8}$
1887	$10\frac{3}{4}$	$10\frac{1}{8}$	$10\frac{3}{4}$	$10\frac{3}{5}$	11	$10\frac{5}{8}$	$12\frac{3}{20}$	$10\frac{3}{10}$	$14\frac{19}{20}$	$11\frac{11}{20}$	$17\frac{3}{4}$	$14\frac{19}{20}$
1888	$16\frac{9}{10}$	$16\frac{13}{20}$	17	$16\frac{3}{5}$	$17\frac{7}{10}$	$16\frac{9}{10}$	$17\frac{3}{5}$	$17\frac{7}{20}$	$17\frac{3}{5}$	$17\frac{1}{4}$	$17\frac{9}{20}$	$17\frac{1}{10}$
1889	12	12	12	12	12	11	11	11	$13\frac{1}{4}$	$11\frac{1}{4}$	$14\frac{1}{2}$	14
1890	$17\frac{1}{4}$	$16\frac{1}{2}$	$17\frac{1}{4}$	17	17	17	$16\frac{7}{8}$	$16\frac{3}{4}$	$16\frac{3}{4}$	$16\frac{3}{4}$	16	15
1891	$12\frac{7}{8}$	$12\frac{1}{2}$	$12\frac{3}{8}$	12	$12\frac{1}{2}$	$12\frac{1}{8}$	$12\frac{3}{8}$	$11\frac{3}{8}$	$11\frac{1}{2}$	11	$11\frac{1}{8}$	$10\frac{1}{4}$
1892	$11\frac{3}{4}$	$11\frac{1}{4}$	$11\frac{3}{4}$	$11\frac{8}{10}$	$11\frac{6}{10}$	$11\frac{1}{10}$	$11\frac{3}{4}$	$11\frac{1}{10}$	12	$11\frac{3}{4}$	$12\frac{3}{8}$	$12\frac{1}{4}$
1893	$10\frac{1}{2}$	$10\frac{1}{4}$	$10\frac{1}{8}$	$9\frac{3}{5}$	$9\frac{7}{8}$	$9\frac{3}{4}$	$9\frac{3}{4}$	$9\frac{3}{4}$	$10\frac{1}{4}$	$9\frac{3}{4}$	$10\frac{1}{2}$	$10\frac{3}{8}$

The prices actually realized differ, of course, from the averages of these quotations. For a number of years they are recorded in the following table, the quantities sold being added.

Prices realized for lake copper from 1888 to 1893.

Mines.	1888.		1889.		1890.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Allouez	314, 198	13. 71	1, 762, 816	12. 08	1, 407, 828	14. 73
Franklin	3, 655, 751	15. 07	1, 300, 667	12. 05	2, 529, 542	14. 80
Atlantic	3, 974, 972	14. 78	3, 698, 837	12. 09	2, 821, 616	15. 21
Central	1, 817, 023	14. 80	1, 270, 592	12. 57	1, 413, 391	14. 94
Huron	2, 414, 169	14. 92	1, 900, 081	12. 83	1, 375, 000	14. 86
Osceola	4, 134, 320	15. 03	4, 534, 127	11. 94	5, 294, 792	15. 51
Quincy	6, 367, 809	15. 93	6, 405, 686	11. 96	8, 064, 253	15. 36
Kearsarge	829, 185	16. 60	1, 918, 849	12. 58	1, 598, 525	15. 08
Tamarack (*a*)	11, 036, 469	12. 90	8, 928, 249	11. 99	14, 076, 957	14. 01

Mines.	1891.		1892.		1893.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Allouez	1, 241, 423	12. 06	546, 530	11. 45	....	....
Franklin	1, 862, 081	12. 61	3, 769, 605	11. 75	3, 504, 244	9. 91
Atlantic	3, 180, 135	12. 86	3, 703, 875	11. 69	4, 221, 933	10. 63
Central	1, 313, 197	12. 02	1, 625, 982	11. 95	1, 180, 040	10. 42
Huron	....	....	....	....	....	....
Osceola	6, 543, 358	12. 51	7, 098, 656	11. 69	6, 715, 870	10. 95
Quincy	10, 542, 519	12. 84	11, 103, 926	11. 27	14, 398, 477	10. 48
Kearsarge	1, 727, 390	12. 38	1, 467, 758	11. 39	1, 627, 030	10. 87
Tamarack (*a*)	16, 805, 360	11. 35	16, 061, 106	11. 53	....	....

a Fiscal years ending June 30, 1889, 1890, 1891, 1892, and 1893.

In the case of the Quincy and the Franklin, the price is figured from the product and the gross amount received without any data concerning the stock at the beginning of the year.

As covering the longest period, the report of the yearly sales of the Osceola are the most interesting in showing the fluctuations in the price of Lake copper. Since 1874 the sales of this company have been as follows:

Sales of copper and average prices by the Osceola Mining Company, 1874 to 1893.

Years.	Sales.	Average price per pound.	Years.	Sales.	Average price per pound.
	Pounds.	*Cents.*		*Pounds.*	*Cents.*
1874	936,002	23.37	1884	4,247,630	12.82
1875	1,330,313	22.77	1885	1,639,169	10.75
1876	1,693,737	20.57	1886	3,560,786	10.51
1877	2,774,777	18.19	1887	3,583,723	11.86
1878	2,705,998	15.53	1888	4,134,320	15.03
1879	3,197,387	17.79	1889	4,534,127	11.94
1880	3,381,061	19.15	1890	5,294,792	15.51
1881	4,176,976	17.77	1891	6,543,358	12.51
1882	4,179,782	17.70	1892	7,098,656	11.69
1883	4,256,409	14.96	1893	6,715,870	10.95

The following table shows the fluctuations in prices in the English market:

Average values of copper in England.

Years.	Chile bars, or G. O. B.			Ore, 25 per cent.		Precipitate.	
	Long ton.			*Per unit.*		*Per unit.*	
	£	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1880	62	10	0	12	9	12	11
1881	61	10	0	12	6	13	$8\frac{3}{16}$
1882	66	17	0	13	$6\frac{3}{4}$	13	$10\frac{1}{16}$
1883	63	5	10	12	$4\frac{1}{2}$	12	$10\frac{1}{16}$
1884	54	9	1	10	$5\frac{1}{2}$	11	1
1885	44	0	10	8	4	9	$0\frac{1}{8}$
1886	40	9	3	7	9	8	$3\frac{5}{8}$
1887	43	16	11	8	6	8	$11\frac{3}{4}$
1888	79	19	$4\frac{1}{2}$	14	$3\frac{1}{4}$	16	3
1889	49	10	5	9	$6\frac{1}{8}$		
1890	54	5	5	10	7		
1891	51	9	$8\frac{1}{2}$	9	7		
1892	45	12	$8\frac{3}{4}$	8	7		
1893	43	15	$6\frac{3}{4}$	8	5		

In detail, the fluctuations, monthly, of good merchant copper in the English market were as follows in 1892 and 1893:

Fluctuations in good merchant copper in England in 1892 and 1893.

Months.	1892.			1893.			Months.	1892.			1893.		
	£	*s.*	*d.*	£.	*s.*	*d.*		£	*s.*	*d.*	£	*s.*	*d.*
January	45	13	$7\frac{1}{2}$	46	1	8	July	44	19	$5\frac{1}{2}$	42	17	$6\frac{3}{4}$
February	44	1	$5\frac{3}{4}$	45	13	$2\frac{1}{4}$	August	44	12	$2\frac{1}{2}$	41	10	2
March	46	1	1	45	11	$7\frac{3}{4}$	September	44	5	2	42	13	$2\frac{4}{7}$
April	45	16	10	44	18	$7\frac{1}{2}$	October	45	14	4	42	1	$2\frac{1}{4}$
May	46	10	4	43	15	$1\frac{3}{7}$	November	46	13	$10\frac{1}{4}$	42	11	$10\frac{1}{2}$
June	45	19	9	44	4	$3\frac{1}{8}$	December	47	4	$10\frac{1}{2}$	43	8	$2\frac{3}{4}$

The year opened quite auspiciously with Lake copper ranging between 12.25 cents and 12.50 cents, but the English market experienced a drop of nearly £2 on the discovery that about 3,300 tons of old syndicate copper had been found hidden away in France. During February the market softened, and American producers made persistent efforts to market metal in Europe. Home consumption was beginning to show signs of languor. In March the growing stringency in the money market affected holders adversely and was little influenced by the announcement that a syndicate had taken over 12,000 tons for a large holder who had carried the metal since the days of the collapse of the Secretan speculation. During the month 6,000 tons of Montana matte were sold in England at 9*s.* 1½*d.* to 9*s.* 3*d.* per unit for ordinary and 9*s.* 4½*d.* at 9*s.* 7½*d.* for argentiferous. The negotiations for a continuance of the international agreement had little effect upon buyers. The market yielded, gradually falling to 11.75 cents towards the close of the month. In April American producers made vigorous efforts to place copper abroad, it being reported that about 5,000 tons of Lake copper were sold at 11¼ cents. Contracts with American consumers involving about 15,000,000 pounds were made for delivery over three to six months at 11 cents. About 2,600 tons of Montana matte were sold in April, at 9*s.* 1*d.* to 9*s.* 3*d.* for ordinary, and at 9*s.* 6*d.* to 9*s.* 7½*d.* per unit for argentiferous. May dragged slowly, the only feature being the final announcement that the negotiations for a continuance of the international agreement had failed completely owing to the demand on the part of two prominent Montana interests for an increased allotment.

The arrangement, therefore, expired on July 1. With the shrinking demand and the deepening depression of business in this country, the market yielded steadily in June and July, until 10.25 cents was reached toward the close of the latter month.

Although the announcement was made that the Anaconda mine would be run only at the rate of about 3,500,000 pounds per month, the home consumption had fallen off so heavily that prices yielded further. Toward the end of the month the lake companies sought relief by the sale of about 8,000,000 pounds of copper to Germany at 9½ cents, and large sales were also made by other producers. In August alone 4,350 tons of Montana matte were sold in England at 8*s.* 3*d.* to 8*s.* 6*d.* for ordinary, and 8*s.* 6*d.* per unit for argentiferous. The Anaconda also made sales which in this and the two following months footed up to 6,000 tons at 8*s.* 6*d.* to 9*s.* per unit. During the second half of the year the American producers shipped an average of 10,000 long tons of copper per month to Europe at prices which swept all competition aside. The tremendous pressure told on the home market, and although the fact was never published, there is no doubt that consumers were supplied during this period as low as 9 cents for Lake copper. In November a better feeling developed, and quite a considerable quantity was taken by the domestic trade for future delivery. December brought further sales, reported to have been effected at 10.50 cents.

Since England is still the leading copper market of the world, the following tables, showing the import and export movement, are of great interest:

British imports and exports of copper.

Years.	Imports of— Bars, cakes, and ingots.	Imports of— Copper in ores and furnace products.	Total imports.	Exports.	Apparent English consumption.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1860	13,142	13,715	26,857	26,117	....
1865	23,137	23,922	47,059	41,398	....
1870	30,724	27,025	57,749	53,006	....
1871	33,228	23,671	56,899	56,633	....
1872	49,000	21,702	70,702	53,195	....
1873	35,840	26,756	62,596	55,716	....
1874	39,906	27,894	67,800	59,742	....
1875	41,931	29,483	71,414	51,870	....
1876	39,145	36,191	75,336	52,468	....
1877	39,743	53,582	93,325	54,088	....
1878	39,360	48,212	87,572	55,001	....
1879	46,670	50,421	97,091	62,412	30,774
1880	36,509	56,225	92,734	59,482	32,879
1881	32,170	54,057	86,227	61,689	31,607
1882	35,509	58,366	93,875	55,683	42,877
1883	35,653	63,493	99,146	59,350	40,469
1884	39,767	69,623	109,390	64,691	51,263
1885	41,933	81,616	123,549	62,080	54,323
1886	42,969	65,046	108,015	60,511	41,158
1887	29,198	73,891	103,089	69,453	53,096
1888	44,603	90,867	135,470	(*a*)72,066	42,562
1889	(*b*)38,576	101,407	139,983	75,627	65,759
1890	(*c*)49,461	91,788	141,249	89,747	66,170
1891	44,213	94,403	138,616	76,056	59,223
1892	(*d*)35,015	99,356	134,371	82,542	(*e*)48,367
1893	41,829	88,003	129,832	70,986	66,817

a Including 22,557 tons of Chile bars transferred to France.
b Including 1,166 tons of Chile bars transferred from France to England.
c Including 3,501 tons of Chile bars transferred from France to England.
d Including 3,585 tons of Chile bars transferred from France to England.
e Add 4,001 tons for comparison with former years, the difference arising from the new method of making up stock.

The following figures from the board of trade returns for the past nine years show in detail the form in which the copper is brought into Great Britain and in what form it is exported:

Imports of copper into Great Britain from 1885 to 1893, inclusive.

[Long tons.]

Character.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Pure in pyrites	16,333	13,905	14,940	15,448	16,097	16,422	15,406	15,110	15,320
Pure in precipitate	21,398	19,323	21,819	26,366	25,110	25,563	29,326	28,444	24,988
Pure in ore	15,683	13,749	15,148	19,452	22,219	18,000	14,172	13,585	11,701
Pure in regulus	28,202	18,069	21,984	29,601	37,981	31,803	35,499	42,217	35,994
Bars, cakes, etc	41,933	42,969	29,198	44,603	38,576	49,461	44,213	35,015	41,829
Total	123,549	108,015	103,089	135,470	139,983	141,249	138,616	134,371	129,832

The following table gives the details relating to the British imports of precipitate and regulus:

Imports of precipitate and regulus into Great Britain from 1885 to 1893, inclusive.

[Long tons.]

Countries.	1885.	1886.	Fine copper.	1887.	Fine cop. per.	1888. Fine copper.	1889. Fine copper.	1890. Fine copper.	1891. Fine copper.	1892. Fine copper.	1893. Fine copper.
Portugal	8,283	6,657	24,032	10,758	24,754	30,119	28,157	28,018	32,425	32,509	29,359
Spain	38,267	38,666		37,892							
Chile	5,255	1,637	737	1,595	718	734	1,919	2,122	595	2,040	2,714
United States	29,861	16,105	10,853	24,229	15,039	20,752	26,581	18,897	19,109	24,668	20,700
Other countries	6,000	5,240	1,770	5,366	2,292	4,362	6,434	8,329	12,696	11,444	8,209
Total	87,666	68,305	....	79,840	....	....	....	....	....	....	....
Fine copper	49,600	....	37,392	....	42,803	55,967	63,091	57,366	64,825	70,661	60,982

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of copper produce into Liverpool, London, and Swansea during the years from 1885 to 1893, which represent the total imports, with the exception of precipitate, into Newcastle and Cardiff, reliable returns of which can not be obtained, but which is estimated to vary from 8,000 to 10,000 tons fine per annum in former years, and as high as 25,000 tons lately:

Imports of copper product into Liverpool, Swansea, and London.

[Long tons.]

Countries.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Chile	28,985	27,191	20,008	24,479	22,070	22,909	14,378	17,619	15,875
United States	24,037	13,483	16,534	25,730	30,729	20,171	26,120	26,475	35,647
Spain and Portugal	4,655	5,721	5,178	5,915	5,189	5,202	4,734	5,372	5,674
Spain and Portugal (precipitate)	9,186	10,038	13,042	15,568	17,192	18,430	17,439	14,831	10,296
Spain and Portugal (pyrites)	16,333	13,905	14,940	15,448	16,097	16,422	15,406	15,110	15,320
Australia	8,951	10,096	6,047	6,746	6,285	6,561	6,265	5,547	6,393
Cape of Good Hope	5,405	7,073	8,271	8,829	11,507	9,927	7,452	8,092	5,472
Venezuela	4,074	3,055	2,261	3,574	4,299	5,245	5,017	5,028	1,434
Japan	3,010	3,572	200	4,469	2,523	10,674	7,852	4,989	2,370
Italy	835	889	1,055	1,058	1,043	953	649	725	1,091
Norway	27	....	....	545	234	80	30	38	....
Canada	....	8	94	156	181	264	189	120	50
Newfoundland	723	891	359	465	631	1,552	1,617	3,229	2,265
Mexico	374	243	61	158	3,938	3,325	3,616	869	1,185
Peru	229	68	13	202	271	254	279	287	462
River Plate	233	179	167	135	184	143	211	196	160
Other countries	325	1,049	1,074	4,054	1,389	225	236	1,245	1,944
Total tons fine	107,282	97,461	89,304	117,531	123,762	122,337	111,490	109,772	105,638

The quantities of copper in different forms which were imported from the United States to Great Britain and France are given in the following table. The figures for the receipts in Germany, at times important, are, unfortunately, not available:

Imports of copper from the United States in England and France.

[Long tons.]

	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
England:									
Ore	1,875	420	26	298	349	5	4	18	23
Matte	18,895	10,853	15,039	20,752	26,581	18,897	19,109	24,668	20,700
Bars and ingots	3,375	2,210	1,469	4,680	3,799	1,269	7,007	1,427	14,924
Total	24,145	13,483	16,534	25,730	30,729	20,171	26,120	26,113	35,647
France	9,235	4,167	3,910	6,496	1,058	1,733	8,329	2,430	11,209
United States into England and France	33,380	17,650	20,444	32,226	31,787	21,904	34,449	28,543	46,856
Chile into England and France	35,342	35,448	29,019	32,947	22,020	24,641	18,820	19,840	19,717

The exports of copper from Great Britain, estimating the fine contents of alloys, were as follows:

Exports of copper from Great Britain from 1885 to 1893, inclusive.

[Long tons.]

Character.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Raw English	18,766	19,036	40,700	32,058	48,189	58,571	51,765	58,518	45,349
Sheets	21,108	17,927							
Yellow metal, at 60 per cent	12,551	11,958	10,153	4,513	9,195	10,514	8,547	8,853	8,745
Brass, at 70 per cent	3,233	3,001	3,146	2,650	3,773	3,721	3,992	3,783	4,049
Total	55,658	51,922	53,999	39,221	61,157	72,806	64,304	71,154	58,143
Fine foreign	6,422	8,589	15,454	32,845*a*	14,470	16,941	11,752	11,388	12,843
Total	62,080	60,511	69,453	72,066	75,627	89,747	76,056	82,542	70,986

a Including 22,557 tons Chile bars transferred to France.

FRANCE.

The direct imports of copper from different countries into France were as follows, for a series of years:

Direct imports into France from 1885 to 1893, inclusive.

[Long tons.]

Countries.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Chile	6,357	8,257	9,011	8,468	2,470	2,803	4,442	2,221	3,842
United States	9,235	4,167	3,910	6,496	1,058	1,733	8,329	2,430	11,209
Mexico	....	....	....	2,700	738	....	....	2,515	7,620
Other countries	995	1,600	1,048	6,905	1,715	975	2,118	2,208	2,908
Total	16,587	14,024	13,969	24,569	5,981	5,511	14,889	9,374	25,579

THE PRINCIPAL FOREIGN PRODUCERS.

The copper production of the world, 1886 to 1893, inclusive

[Long tons.]

Countries.	1893.	1892.	1891.	1890.	1889.	1888.	1887.	1886.
EUROPE.								
Great Britain	(a) 400	495	720	935	905	(a) 1,500	389	1,471
Spain and Portugal:								
Rio Tinto	31,954	31,539	31,827	30,000	29,500	(a) 32,000	26,663	(a) 24,700
Tharsis	(a) 10,900	11,258	(a) 11,100	(a) 10,300	(a) 11,000	(a) 11,500	(a) 11,000	(a) 11,000
Mason and Barry	(a) 4,400	(a) 4,400	(a) 4,150	(a) 5,600	(a) 5,250	(a) 7,000	(a) 7,000	(a) 7,000
Sevilla	1,270	1,070	875	810	1,350	1,700	2,300	2,135
Portugueza	(a) 900	(a) 900	890	565	670	1,250	(a) 856	1,258
Poderosa and others	(a) 5,600	(a) 6,800	(a) 5,500	(a) 4,225	(a) 6,500	(a) 7,000	4,050	3,560
Germany:								
Mansfeld	14,150	15,360	14,250	15,800	15,506	13,380	13,025	12,595
Other German	(a) 3,100	(a) 2,600	(a) 2,000	(a) 2,000	(a) 1,850	(a) 1,850	(a) 1,850	1,870
Austria	1,215	1,100	965	1,210	1,225	1,010	883	733
Hungary	210	285	285	(a) 300	(a) 300	858	531	366
Sweden	(a) 750	735	655	830	830	1,036	905	520
Norway	(a) 1,740	1,410	1,247	1,390	1,357	1,570	1,450	2,220
Italy	2,500	2,500	2,200	2,200	3,500	3,500	2,500	2,100
Russia	(a) 15,000	4,900	4,800	4,800	4,070	4,700	5,000	4,875
Total Europe	84,089	85,352	81,464	80,965	83,813	89,854	78,402	76,403
NORTH AMERICA.								
United States	147,033	154,072	126,839	115,966	101,239	101,054	81,017	70,430
Canada	3,620	3,600	3,500	3,050	2,500	(a) 2,250	1,400	1,440
Newfoundland	....	2,390	2,040	1,735	2,615	2,050	1,180	1,125
Mexico:								
Boleo	7,980	6,415	4,175	3,450	3,280	2,566	1,950	250
Other Mexican	900	900	1,025	875	500	200	100	
Total North America	159,533	167,377	137,579	125,076	110,134	108,120	85,647	73,245
SOUTH AMERICA.								
Chile	21,350	22,565	19,875	26,120	24,250	31,240	29,150	35,025
Bolivia:								
Corocoro	2,500	2,860	2,150	1,900	(a) 1,200	1,450	(a) 1,300	1,100
Peru	460	290	280	150	275	250	50	75
Venezuela:								
New Quebrada	2,850	3,100	6,500	5,640	6,068	4,000	2,900	3,708
Argentine Republic	160	200	210	150	190	150	170	180
Total South America	27,320	29,015	29,015	33,960	31,983	37,090	33,570	40,088
AFRICA.								
Algiers	400	450	120	120	160	50	150	110
Cape of Good Hope:								
Cape Company	5,200	5,670	5,100	5,000	(a) 7,700	7,500	7,250	6,015
Namaqua	890	450	900	1,450				
Total Africa	6,490	6,570	6,120	6,570	7,860	7,540	7,400	6,125
ASIA.								
Japan	(a) 18,000	(a) 19,000	(a) 18,500	17,972	16,125	13,054	10,976	9,696
Total Asia	(a) 18,000	(a) 19,000	(a) 18,500	17,972	16,125	13,054	10,976	9,696
AUSTRALIA.								
Australia	7,500	6,500	7,500	7,500	8,300	7,550	7,700	9,700

a Estimated.

The copper production of the world, 1886 to 1893, inclusive—Continued.

RECAPITULATION.

[Long tons.]

Countries.	1893.	1892.	1891.	1890.	1889.	1888.	1887.	1886.
Europe	84,089	85,352	81,464	80,965	83,813	89,854	78,402	76,403
North America	159,533	167,377	137,579	125,076	110,134	108,120	85,647	73,245
South America	27,320	29,015	29,015	33,960	31,983	37,090	33,570	40,088
Africa	6,490	6,570	6,120	6,570	7,860	7,550	7,400	6,125
Asia	18,000	19,000	18,500	17,972	16,125	13,054	10,976	9,696
Australia	7,500	6,500	7,500	7,500	8,300	7,550	7,700	9,700
Total	302,932	313,814	280,178	272,043	258,215	263,218	223,695	215,257

THE FOREIGN PRODUCERS.

Among the leading Spanish mines Rio Tinto slightly increased its production. The total quantity of pyrites extracted was 1,332,002 tons, with an average copper contents of 2.996 per cent, against 1,402,063 tons in 1892, with copper contents of 2.819 per cent. Of this quantity 477,656 tons was shipped, against 406,912 tons in 1892, and 854,346 tons was for local treatment, as compared with 995,151 tons in 1892. The copper production at the mines amounted to 19,990 long tons and the copper in pyrites was 11,964 tons, a total of 31,954 tons. There was brought to market 18,858 tons of refined copper, and 11,265 tons of fine metal in pyrites. The reserve heaps of ore undergoing leaching are estimated to contain 101,867 tons of fine copper, which stand in the accounts of the company at £5 0*s*. 6*d*. A large proportion of the copper production continues to be obtained from this source. The gross profit on the sale of the products was £528,295; there was obtained from rents, etc., £13,184, and through adjustment of exchange account and transfer fees, £91,906. There was paid for interest on bonds, £179,491; for taxes, £31,490; for administration, £71,476; for plant written off, £8,939; on coal exploration account, £23,587, and for redemption of bonds, £92,640. Out of the balance available for dividends there was paid £227,500 in dividends, leaving a balance of £71,174 to be carried forward. The share capital is £3,250,000, and there are outstanding £3,534,360 in bonds. The company stripped during 1893, 605,355 cubic meters of overburden, and has arranged for 600,000 cubic meters in 1894, which is charged to the cost of the ore extracted.

The second largest producer is the Tharsis Company, which paid a dividend of 12½ per cent in 1893 out of a profit of £170,852, carrying over £14,602; mined 610,822 tons against 504,706 tons in 1892. Of this amount 250,250 tons were exported in 1893 against 235,162 in 1892. The balance was reserved for local treatment, which yielded 358 tons less of precipitate than in 1892, when the shipments were 7,686 tons. The company also delivered 159,000 tons of iron-ore pyrites; contracts, aggregating 200,000 tons, have been entered for 1894, at a slight advance in price over 1893. The company has bought the Lagunazo mine, an acquisition which, it is expected, will considerably increase production.

The production of Mason & Barry fell from 329,201 tons of ore in 1892 to 209,814 tons in 1893. The pyrites shipments amounted to 172,376 tons as against 130,756 tons in the previous year. The quantity of ore sold and invoiced for its sulphur value during 1893 amounted to 182,909 tons as against 116,619 tons in 1892. The profits were only £22,249, of which there remained for appropriation £21,624. A payment of 2*s.* per share was made, leaving a balance of £2,746 to the next account. A reduction of the capital of the company from 210,000 shares at £5 to 210,000 at £4 is proposed.

In Germany the famous Mansfeld Company, which produces annually about 15,000 tons of copper, lost 1,972,731 marks in its operations for 1893.

The Cape Copper Company earned £81,288 in 1893 against £60,343 in 1892.

LEAD.

BY C. KIRCHHOFF.

Considering the general business depression, with its low prices for all mineral products, and considering the rapid decline in the value of silver, the production of lead in the United States has held its own fairly well during 1893. It has been widely assumed that the output of lead would be adversely affected by the expected falling off in the mining of silver ores, since the profits formerly available to smelters in handling "dry" ores would fall off and render them more indifferent purchasers of lead ores. The leading Rocky mountain smelters have indeed been driven into a pooling arrangement in the purchase and distribution of ores. But developments during 1893 have again illustrated the truth of the observation repeatedly made in the history of metalliferous mining in the United States, that influences adverse to continued production tell very slowly. The element of hope is a sentimental factor whose power is usually underestimated in dealing with the effect of low values on mining operations. Fixed charges, for pumping, maintenance of openings, etc., are so important a factor that operations are usually continued until every resource in funds and in credit is exhausted.

The following table presents the figures of the total gross production of lead in the United States from 1825. Up to the year 1882 the figures have been compiled from the best data available. Since 1882 the statistics are those collected by this office, with the exception of the year 1889, when they were gathered by the Census Office.

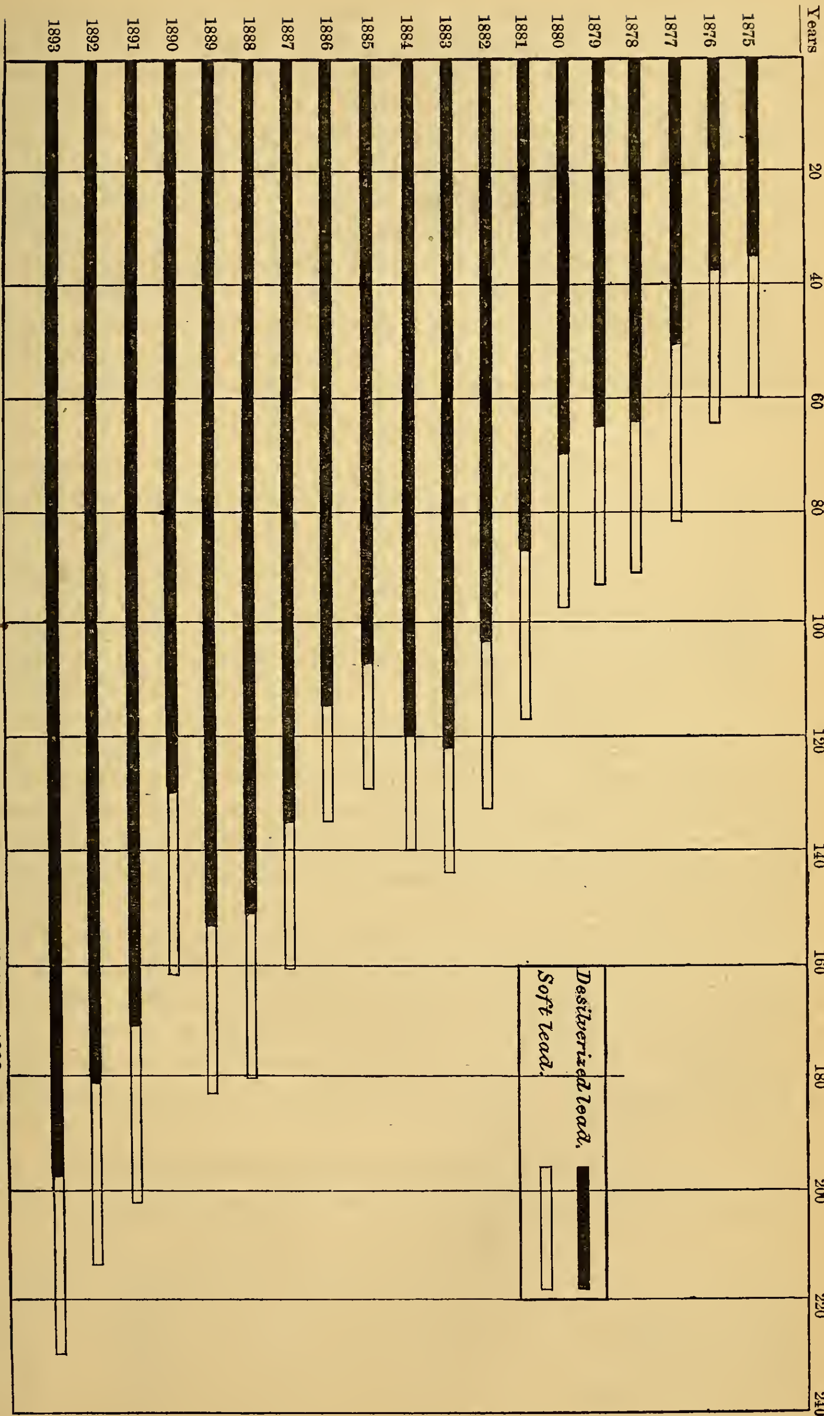
Production of refined lead in the United States from 1825 to 1893, both inclusive.

Years.	Total production.	Desilverized lead.	Soft lead. (e).	From foreign ores and base bullion.	Net American product.
	Short tons.	*Short tons.*	*Short tons.*		
1825	1,500				
1830	8,000				
1831	7,500				
1832	10,000				
1833	11,000				
1834	12,000				
1835	13,000				
1836	15,000				
1837	13,500				
1838	15,000				

Production of refined lead in the United States from 1825 to 1893 both inclusive—Cont'd.

Years.	Total production.	Desilverized lead.	Soft lead. (*e*)	From foreign ores and base bullion.	Net American product.
	Short tons.	*Short tons.*	*Short tons.*		
1839	17,500				
1840	17,000				
1841	20,500				
1842	24,000				
1843	25,000				
1844	26,000				
1845	30,000				
1846	28,000				
1847	28,000				
1848	25,000				
1849	23,500				
1850	22,000				
1851	18,500				
1852	15,700				
1853	16,800				
1854	16,500				
1855	15,800				
1856	16,000				
1857	15,800				
1858	15,300				
1859	16,400				
1860	15,600				
1861	14,100				
1862	14,200				
1863	14,800				
1864	15,300				
1865	14,700				
1866	16,100				
1867	15,200				
1868	16,400				
1869	17,500				
1870	17,830				
1871	20,000				
1872	25,880				
1873	42,540	20,159	22,381		
1874	52,080				
1875	59,640	34,909	24,731		
1876	64,070	37,649	26,421		
1877	81,900	50,748	31,152		
1878	91,060	64,290	26,770		
1879	92,780	64,650	28,130		
1880	97,825	70,135	27,690		
1881	117,085	86,315	30,770		
1882	132,890	103,875	29,015		
1883	143,957	122,157	21,800		
1884	139,897	119,965	19,932		
1885	129,412	107,437	21,975		
1886	135,629	114,829	20,800	(*a*)5,000	(*a*)130,629
1887	160,700	135,552	25,148	(*a*)15,000	(*a*)145,700
1888	180,555	151,465	29,090	28,636	151,919
1889	182,967	153,709	29,258	26,570	156,397
1890	161,754	130,403	31,351	18,124	143,630
1891	(*b*)202,406	171,009	31,397	23,852	178,554
1892	(*c*)213,262	181,584	31,678	39,957	173,305
1893	(*d*)229,333	196,820	32,513	65,351	163,982

a Estimated.
b Including 4,043 tons antimonial lead.
c Including 5,039 tons of antimonial lead.
d Including 5,013 tons of antimonial lead.
e Including a small quantity of lead produced in the Southern States.



PRODUCTION OF LEAD IN THE UNITED STATES DURING THE YEARS 1875 TO 1893, INCLUSIVE.

[In thousands of tons.]

The quantity given under desilverized lead includes the lead produced from refining foreign base bullion in bond. It also includes a moderate amount of lead obtained from nonargentiferous ores produced in Missouri and Kansas, purchased by lead desilverizers and refiners. It is not, therefore, strictly correct that all the lead from domestic sources, less the quantity returned as soft lead, was obtained by smelting ores from the Rocky mountain region. The quantity involved in the purchases alluded to is so small that the difference between 163,982 tons and 32,513 tons, or 131,469, really does closely approach it. Probably 130,000 tons would be a safe estimate.

The following table shows the gross production, the metal contents of foreign ores imported, and the quantities of foreign argentiferous base bullion refined in bond by American desilverizing works:

Production of lead from 1887 to 1893.

Years.	Gross production.	Lead contents of Mexican and Canadian ores.	Foreign lead refined in bond.	Net American product.	Available for home market.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1887	160,700	(*a*) 15,000		145,700	160,700
1888	180,555	28,636		151,919	150,555
1889	182,967	26,570		156,397	182,967
1890	161,754	18,124		143,630	161,754
1891	202,406	21,152	2,700	178,554	199,706
1892	213,262	27,083	12,874	173,305	200,388
1893	229,333	30,351	35,000	163,982	194,333

a Estimated.

Since the foreign base bullion refined in bond is not retained in this country, as is the lead extracted from Mexican and Canadian ores, a column has been added to the above table to indicate the quantities of the metal available for the home market, leaving out of account fluctuations in stocks.

Returns from producers show that there were in the hands of smelters of soft lead and of desilverizers, 6,311 short tons of refined lead on January 1, 1894, as compared with 6,411 tons on January 1, 1893. The stock of soft lead has declined from 2,169 to 1,799 short tons.

The Bureau of Statistics of the Treasury Department has compiled the following table showing the contents of the silver ore imported during the calendar year 1893:

Lead, silver, gold, and copper contents of ores imported in 1893.

Customs districts.	Total ore.	
	Pounds.	*Dollars.*
Arizona	19,411,138	1,656,529
Corpus Christi, Texas	22,236,280	1,037,942
Montana and Idaho	2,299,168	166,393
New York, New York	2,124,000	147,396
Paso del Norte, Texas	275,572,218	5,355,159
Saluria, Texas	41,601,008	1,231,809
San Francisco, California	(*a*)	1,498,344
Puget Sound, Washington	795,826	16,610
Totals		11,110,182

Lead, silver, gold, and copper contents of ores imported in 1893—Continued.

Customs districts.	Contained in ore.							
	Gold.		Silver.		Lead.		Copper.	
	Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Arizona	14,022	280,460	1,785,366	1,311,776	2,156,427	50,168	282,528	14,125
Corpus Christi, Texas	2,515	50,255	1,275,725	980,994	276,088	6,683	450	10
Montana and Idaho	....	....	(*a*)	135,396	1,205,423	30,997	....	....
New York, New York	....	....	(*a*)	146,669	9,807	196	5,604	531
Paso del Norte, Texas	7,958	146,676	5,845,791	4,351,549	52,592,813	856,215	8,620	719
Saluria, Texas	234	4,508	1,542,901	1,168,335	3,138,888	58,966	....	....
San Francisco, California	5,838	79,342	1,054,990	1,374,346	1,050,126	28,815	176,226	15,841
Puget Sound, Washington	19	364	6,901	4,991	272,875	10,477	7,790	778
Totals	30,586	561,605	....	9,474,056	60,702,447	1,042,517	481,218	32,004

a Complete data not obtainable.

Reports from the Rocky mountain smelters, including all the Colorado, California, Idaho, Utah, and Montana works, and the Tacoma and Rio Grande smelters, show that of the entire importations in silver ores, only 11,613 tons of lead were extracted by this group of smelters, of which 8,171 tons of lead were obtained by Colorado works. By far the greatest bulk of the ore, of course, goes to Missouri river smelters and refiners. The figures given for the Mexican ores coming in through Paso del Norte indicate an average lead contents of about 19 per cent., and silver contents of 42 ounces. The lead is valued at 1.6 cents per pound. The import statistics prove that thus far the importations of Canadian ore through Montana and Idaho, San Francisco and Puget sound are still small, so that the Kootenai has not yet made an impression.

The Utah smelters further increased their product to 22,916 short tons in 1893, as compared with 20,813 tons in 1892 and 16,800 tons in 1891.

The Montana works made 15,165 tons of lead in 1893, against 15,474 tons in 1892. The Puget Sound smelters did not get into full operation in 1893, but are expected to add to their product quite heavily in 1894.

Idaho produced quite heavily for 1893. Mr. F. F. Church, of the Assay office at Boise City, estimated the lead contents of the ores mined at 72,135,581 pounds, against 51,322,263 pounds in 1892. Shoshone county ranks first with 66,698,665 pounds. Alturas county following with 3,966,606 pounds. Custer county is credited with 922,510 pounds, and Lemhi county with 518,000 pounds. The Clayton and Ramshorn smelters made 1,126,821 pounds of lead. The balance of the ores are worked in smelters located in other States and Territories.

The following statement has been compiled, and has been published in the Congressional Record, showing the daily capacity of 14 leading mines in the Cœur d'Alene region:

Statement of daily capacity of 14 silver-lead mines of Shoshone county, Idaho, when running with full force and full time.

Names of mines.	Locations.	Managers.	Raw ore mined and milled.	Finished ore (concentrated).	Contents per ton of concentrates. Lead.	Contents per ton of concentrates. Silver.	Number of men employed.	Invested. *a*
			Tons.	*Tons.*	*Per ct.*	*Per ct.*		
Bunker Hill and Sullivan.	Wardner	F. W. Bradley	800	135	56	22	600	$615,000
Last Chance	...do	Charles Sweeny	200	40	66	24	125	73,000
Stemwinder	...do	G. B. McAuley	120	20	70	35	75	60,000
Sierra Nevada	...do	Wm. Y. Williams.	60	(*b*)	35	50	120	15,000
Gem	Gem	Finch & Campbell.	250	35	60	30	200	95,000
Helena and Frisco	...do	Jos. McDonald	250	35	40	50	200	100,000
Standard	...do	Finch & Campbell.	40	*b* 40	50	50	75	25,000
Granite	...do	G. B. McAuley	200	40	60	50	120	85,000
Poorman	Burke	P. Clark	400	70	60	35	250	355,000
Tiger	...do	F. R. Culbertson	200	30	60	35	160	180,000
Mammoth	...do	Richard Wilson	50	*b* 50	40	40	80	10,000
Hunter	Mullan	Martin Curran	400	60	55	40	200	101,000
Morning	...do	D. B. Huntley	500	70	50	25	180	295,000
Custer	Wallace	R. S. Neil	150	30	60	30	120	105,000
Total							2,505	2,114,000

a In concentrators, power plants, air compressors, electrical machinery, tramways, machine shops, etc.
b Shipping ore.

These figures would indicate a capacity to produce more than 100,000 tons of lead annually, working full time, three hundred days in the year, and not counting the product of smaller mines.

Mr. J. R. Holibaugh, of Joplin, Missouri, has compiled for this office the following statement showing the production of lead ore and zinc ore from southwest Missouri and southeast Kansas, grouped by districts, for the calendar year 1893.

Production of lead and zinc ore from southwest Missouri and southeast Kansas from January 1 to December 31, 1893.

JASPER COUNTY, MO.

Districts.	Pounds of lead.	Pounds of zinc.	Amount sold for.
Joplin	12,442,185	71,336,083	$960,573.00
Webb City	2,365,093	26,302,730	273,672.00
Carterville	6,435,039	75,429,146	868,634.00
Oronogo	3,555,720	777,950	71,885.00
Carthage	361,210	1,044,170	19,448.00
Alba	230	1,096,560	9,546.00
Lehigh		560,000	5,040.00
Zincite	295,710	5,367,390	59,819.00
Total for county	25,455,187	181,914,029	2,268,617.00

NEWTON COUNTY, MO.

Districts.	Pounds of lead.	Pounds of zinc.	Amount sold for.
Granby	3,640,000	11,440,000	$134,160.00
Mosley Mine (amounts estimated)	250,000	2,400,000	17,425.00
Wentworth	8,000	1,035,775	9,262.00
Spring City	362,510	2,882,340	29,860.64
Total for county	4,260,510	17,757,115	190,707.64

LAWRENCE COUNTY, MO.

Aurora	7,687,066	47,522,344	$471,597.00
Stotts City	....	229,130	2,135.00
Total for county	7,687,066	47,752,474	473,732.00

GEEEN COUNTY, MO.

Springfield	....	507,000	$6,080.00
Total for county	....	507,000	6,080,00

CHEROKEE COUNTY, KANS.

Galena	11,322,878	53,898,790	$708,119.00
Total for county	11,322,878	53,898,790	708,119.00
Grand totals	48,725,641	301,829,408	3,447,255.64

THE LEAD MARKET.

The year 1893 opened quietly, and it was only toward the end of January that larger consumers made some fairly large purchases for early delivery. The principal factor in keeping values firm and in leading to a moderate advance was the curtailment of production through natural causes. A weakening tendency developed during early March, but light stocks and moderate supplies led to a stiffening after some considerable purchases in the New York market. Buyers came forward again early in April and caused an advance in values, the highest price of the year, 4.12½ cents, being reached in the middle of the month. Rumors of sales of foreign lead checked the advance and started a downward tendency, which was accentuated by the pressure to sell under stress of financial stringency. A slight recovery toward the end of May and early in June was followed again by a drop to 3.40 cents at the end of the month. The middle of July brought a moderate recovery to 3.60 cents as a result of a shutting down of some of the mines. But the poor condition of business throughout the country dragged the metal down until the end of August. Then the curtailment of product in the Western mines and the natural diversion of Mexican ores to Europe, together with a faint revival of speculation, caused a rise to 3.62½ cents, and in the middle of September to 3.80 cents. The first week in October brought sales of fair quantities for forward delivery at 3.70 cents, but then forced sales of speculative holdings threw the market to 3.20 cents. Toward the end of the month 1,500 tons were sold at 3.30 cents for delivery during the balance of the year, but the demand generally was light and the metal sagged until it reached 3.10 cents in the middle of December. The year closed with the market dull and lifeless.

The following table, prepared from the annual reports of the daily price of lead, compiled by Mr. E. A. Caswell, of New York, shows the monthly average prices from 1884 to December, 1893, inclusive:

Average monthly prices of common pig lead in New York City.

[Cents per pound.]

Months.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
January	4.09	3.65	4.57	4.27	4.80	3.82½	3.82½	4.34½	4.17	3.80
February	3.98	3.65	4.75	4.43	4.92	3.68	3.79½	4.28½	4.11	3.89
March	4.12	3.67	4.87	4.35	5.14	3.69	3.91½	4.32½	4.16	3.91
April	3.84	3.63	4.77	4.29	4.72½	3.64½	3.87½	4.20½	4.22	4.02
May	3.64	3.67	4.72	4.49	4.24	3.79½	4.13	4.25½	4.21	3.82
June	3.62	3.73	4.77	4.62	3.88	3.97½	4.37	4.41	4.12	3.61
July	3.58	4.06	4.88	4.50	3.96	3.88	4.43	4.39	4.10	3.40
August	3.58	4.25	4.75	4.55	4.43	3.82½	4.51	4.44	4.02	3.27
September	3.61	4.26	4.63	4.44	4.99	3.92½	4.86	4.50	4.07	3.72
October	3.69	4.10	4.23	4.30	4.45	3.82½	5.21½	4.34	3.90	3.40
November	3.46	4.12	4.32	4.35	3.67½	3.79	4.90	4.17	3.78	3.29
December	3.60	4.57	4.32	5.00	3.73	3.82	4.19	4.00	3.74	3.21
Yearly average	3.73½	3.94½	4.63	4.46½	4.41	3.80½	4.33½	4.32½	4.05	3.61

The following table, compiled by Mr. E. A. Caswell, shows the daily fluctuations in prices in 1893:

Daily prices of common pig lead in New York City in 1893.

[Cents per pound.]

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	S.	3.80	3.85	3.95	3.95	3.85	3.40	3.30	3.62½	S.	3.30	3.30
2	H.	3.80	3.85	S.	3.95	3.90	S.	3.30	3.62½	3.65	3.30	3.30
3	3.75	3.80	3.85	3.95	3.95	3.80	3.40	3.25	S.	3.65	3.30	S.
4	3.75	3.80	3.80	3.95	3.95	S.	H.	3.20	H.	3.65	3.30	3.30
5	3.75	S.	S.	3.95	3.90	3.75	3.40	3.20	3.62½	3.65	S.	3.30
6	3.75	3.80	3.90	3.95	3.90	3.70	3.40	S.	3.62½	3.60	3.20	3.30
7	3.85	3.92½	3.90	3.95	S.	3.70	3.40	3.20	3.62½	3.55	H.	3.20
8	S.	3.85	3.90	3.95	3.85	3.70	3.40	3.20	3.62½	S.	3.20	3.20
9	3.85	3.95	3.85	S.	3.85	3.70	S.	3.20	3.80	3.50	3.20	3.20
10	3.80	3.95	3.85	4.12½	3.80	3.70	3.40	3.20	S.	3.50	3.20	S.
11	3.80	3.95	3.85	4.12½	3.80	S.	3.60	3.20	3.80	3.50	3.20	3.20
12	3.80	S.	S.	4.12½	3.80	3.65	3.60	3.20	3.80	3.40	S.	3.10
13	3.80	3.95	3.85	4.12¼	3.75	3.65	3.50	S.	3.80	3.40	3.20	3.10
14	3.80	3.95	3.85	4.12½	S.	3.65	3.50	3.20	3.80	3.30	3.20	3.10
15	S.	3.95	3.85	4.12½	3.75	3.65	3.55	3.20	3.80	S.	3.45	3.20
16	3.80	3.95	3.85	S.	3.75	3.65	S	3.20	3.80	3.30	3.45	3.20
17	3.80	3.90	3.97½	4.12½	3.75	3.55	3.40	3.20	S.	3.30	3.35	S.
18	3.80	3.90	3.97½	4.05	3.75	S.	3.40	3.20	3.80	3.30	3.35	3.10
19	3.80	S.	S.	4.05	3.75	3.55	3.40	3.20	3.80	3.20	S.	3.20
20	3.80	3.90	3.97½	4.05	3.75	3.55	3.40	S.	3.80	3.20	3.35	3.22½
21	3.80	3.90	3.97½	4.00	S.	3.50	3.40	3.20	3.80	3.20	3.35	3.20
22	S.	H.	3.97½	4.05	3.75	3.50	3.25	3.20	3.80	S.	3.30	3.25
23	3.80	3.90	3.97½	S.	3.75	3.50	S.	3.20	3.65	3.20	3.30	3.20
24	3.80	3.90	3.97½	4.00	3.75	3.50	3.40	3.20	S.	3.20	3.30	S.
25	3.80	3.90	3.97½	4.00	3.75	S.	3.40	3.20	3.65	3.35	3.30	H.
26	3.80	S.	S.	3.95	3.75	3.40	3.30	3.20	3.65	3.50	S.	3.20
27	3.80	3.90	3.97½	H.	3.90	3.40	3.30	S.	3.65	3.40	3.30	3.20
28	3.80	3.90	3.97½	3.95	S.	3.40	3.30	3.62½	3.65	3.30	3.30	3.20
29	S.	......	3.97½	3.95	3.90	3.40	3.30	3.62½	3.65	S.	3.30	3.20
30	3.80	......	3.95	S.	H.	3.40	S.	3.62½	3.65	3.30	H.	3.20
31	3.80	......	3.95	......	3.90	......	3.30	3.62½	......	3.30	......	S.

IMPORTS AND EXPORTS.

The following tables show the imports and exports of lead and its manufactures for a series of years:

Lead imported and entered for consumption in the United States, 1867 to 1893.

Years ending—	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
June 30—	*Lbs.*		*Lbs.*		*Lbs.*		*Lbs.*			
1867	611	$25	65,322,923	$2,812,668	185,825	$9,560			$6,222	$2,828,475
1868	6,945	239	63,254,677	2,668,915	142,137	7,229			6,604	2,682,987
1869			87,865,471	3,653,481	307,424	15,531			18,885	3,687,897
1870	5,973	176	85,895,724	3,530,837	141,681	6,879			10,444	3,548,336
1871	316	10	91,496,715	3,721,096	86,712	4,209			8,730	3,734,045
1872	32,231	1,425	73,086,657	2,929,623	15,518	859			20,191	2,952,098
1873			72,423,641	3,233,011	105	12	420	$50	21,503	3,254,576
1874			46,205,154	2,231,817			30,219	1,349	36,484	2,269,650
1875	13,206	320	32,770,712	1,559,017			58	4	25,774	1,585,115
1876			14,329,366	682,132			20.007	1,204	27,106	710,442
1877	1,000	20	14,583,845	671,482			16,502	1,242	1,041	673,785
1878			6,717,052	294,233			15,829	963	113	295,309
1879			1,216,500	42,983			3,748	209	930	44,122
1880			6,723,706	246,015			1,120	54	371	246,440
1881	5,981	97	4,322,068	159,129			900	65	1,443	160,734
1882	21,698	500	6,079,304	202,603			1,469	99	2,449	205,651
1883	600	17	4,037,867	130,108			1,510	79	8,030	138,234
1884	419	13	3,072,738	85,395	15,040	630			1,992	88,030
1885	4,218	57	5,862,474	143,103	971,951	22,217			1,372	166,749
1886	715,588	9,699	17,582,298	491,310	27,357	1,218			964	503,191
Dec. 31—										
1887	153,731	21,487	7,716,783	219,770	27,941	1,286			302	242,845
1888	88,870	2,468	2,582,236	69,891	23,103	1,202			977	74,538
1889	328,315	7,468	2,773,622	76,243	35,859	1,417			1,297	86,425
1890	493,463	12,947	19,336,233	593,671	68,314	3,338			1,133	611,089
1891	105,898	6,721	3,392,562	104,184	334,179	12,406			604	123,915
1892	127,873	9,932	1,549,771	110,953	90,135	6,207			2,063	129,155
1893	12,686	354	3,959,781	163,484	59,798	2,955			1,691	168,484

Old and scrap lead imported and entered for consumption in the United States, 1867 to 1889, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	1,255,233	$53,202	June 30, 1879	42,283	$1,153
1868	2,465,575	101,586	1880	213,063	5,262
1869	2,983,272	123,068	1881	123,018	2,729
1870	3,756,785	150,379	1882	220,702	5,949
1871	2,289,688	94,467	1883	1,094,133	31,724
1872	4,257,778	171,324	1884	160,356	4,830
1873	3,545,098	151,756	1885	4,866	106
1874	395,516	13,897	Dec. 31, 1886	24,726	882
1875	382,150	13,964	1887	136,625	4,323
1876	265,860	9,534	1888	33,100	904
1877	249,645	8,383	1889	50,816	1,494
1878	106,342	3,756	1890	(a)	(a)

a Included in pigs and bars after 1889.

Lead and manufactures of lead, of domestic production, exported from the United States.

Years ending—	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
Sept. 30, 1790	13,440	$810				$810
1803 (barrels)	900					
1804	19,804					
1805	8,000					
1808	40,583					
1809	126,537					
1810	172,323					
1811	65,497					
1812	74,875					
1813	276,940					
1814	43,600					
1815	40,245					
1816	35,844					
1817	111,034	9,993				9,993
1818	281,168	22,493				22,493
1819	94,362	7,549				7,549
1820	25,699	1,799				1,799
1821	56,192	3,512				3,512
1822	66,316	4,244				4,244
1823	51,549	3,098				3,098
1824	18,604	1,356				1,356
1825	189,930	12,697				12,697
1826	47,337	3,347	$1,820			5,167
1827	50,160	3,761	6,183			9,944
1828	76,882	4,184	5,545			9,729
1829	179,952	8,417	5,185			13,602
1830	128,417	4,831	4,172			9,003
1831	152,578	7,068	6,422			13,490
1832	72,439	4,483	983			5,466
1833	119,407	5,685	2,010			7,695
1834	13,480	805	2,224			3,029
1835	50,418	2,741	433			3,174
1836	34,600	2,218	4,777			6,995
1837	297,488	17,015	3,132			20,147
1838	375,231	21,747	6,461			28,208
1839	81,377	6,003	12,637			18,640
1840	882,620	39,687	15,296			54,983
1841	2,177,164	96,748	20,546			117,294
1842	14,552,357	523,428	16,789			540,217
June 30, 1843 (9 months)	15,366,918	492,765	7,121			499,886
1844	18,420,407	595,238	10,018			605,256
1845	10,188,024	342,646	14,404			357,050
1846	16,823,766	614,518	10,278			624,796
1847	3,326,028	124,981	13,694			138,675
1848	1,994,704	84,278	7,739			92,017
1849	680,249	30,198	13,196			43,394
1850	261,123	12,797	22,682			35,479
1851			16,426	229,448	$11,774	28,200
1852			18,469	747,930	32,725	51,194
1853			14,064	100,778	5,540	19,604
1854			16,478	404,247	26,874	43,352
1855			5,233	165,533	14,298	19,531
1856			5,628	310,029	27,512	33,140
1857			4,818	870,544	58,624	63,442
1858			27,327	900,607	48,119	75,446
1859			28,782	313,988	28,575	57,357
1860			56,081	903,468	50,446	106,527
1861			30,534	109,023	6,241	36,775
1862			28,832	79,231	7,334	36,166
1863			30,609	237,239	22,634	53,243
1864			30,411	223,752	18,718	49,129
1865			29,271	852,895	132,666	161,937
1866			44,483	25,278	2,323	46,806
1867			27,559	99,158	5,300	32,859
1868			37,111	438,040	34,218	71,329
1869			17,249			17,249
1870		28,315				28,315
1871		79,880				79,880
1872		48,132				48,132
1873		13,392				13,392
1874		302,044				302,044
1875		429,309				429,309
1876		102,726				102,726
1877		49,835				49.835

Lead and manufactures of lead, of domestic production, exported from the United States—Continued.

Years ending—	Manufactures of— Lead. Quantity.	Manufactures of— Lead. Value.	Pewter and lead. Value.	Bars, shots, etc. Quantity.	Bars, shots, etc. Value.	Total value.
	Pounds.			*Pounds.*		
June 30, 1878	....	$314,904	....	....	....	$314,904
1879	....	280,771	....	....	....	280,771
1880	....	49,899	....	....	....	49,899
1881	....	39,710	....	....	....	39,710
1882	....	178,779	....	....	....	178,779
1883	....	43,108	....	....	....	43,108
1884	....	135,156	....	....	....	135,156
1885	....	123,466	....	....	....	123,466
Dec. 31, 1886	....	136,666	....	....	....	136,666
1887	....	140,065	....	....	....	110,065
1888	....	194,216	....	....	....	194,216
1889	....	161,614	....	....	....	161,614
1890	....	181,030	....	....	....	181,030
1891	....	173,887	....	....	....	173,887
1892	....	154,375	....	....	....	154,375
1893	....	508,090	....	....	....	508,090

THE FOREIGN PRODUCERS.

For many countries direct statistical returns of production are not available. For Spain, Australia, Mexico, and Greece the export statistics have been taken for a basis, or the data on a compilation of the import statistics of the metal from the countries in question into the leading markets. In these cases the small domestic consumption has been neglected, and in the case of Australia no account has been taken of the export to the East Indies and China.

The Metallgesellschaft, of Frankfurt on the Main, has estimated the production of lead for a series of years as follows, in metric tons:

The world's production of lead.

Countries.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Germany	96,000	99,000	102,000	104,000	105,000	98,000	101,000
Spain	*a* 102,000	*a* 119,000	129,200	136,900	140,300	145,700	152,200
Great Britain	*a* 51,000	*a* 50,000	*a* 50,000	47,800	49,800	49,000	44,900
Austria-Hungary	13,200	12,300	12,500	12,900	11,600	11,200	11,600
Italy	19,000	*a* 19,000	17,000	18,000	17,700	18,500	*a* 18,000
Belgium	9,000	*a* 9,000	11,000	9,000	8,400	11,000	9,000
France	4,000	*a* 5,000	6,500	5,400	4,600	6,700	*a* 6,700
Greece	*a* 10,000	12,500	14,100	*a* 13,500	13,600	13,300	*a* 11,500
Other European countries	*a* 2,000	*a* 2,000	*a* 2,000	*a* 2,000	*a* 2,000	*a* 2,000	*a* 2,000
United States	119,387	132,150	137,790	141,852	130,272	161,948	157,187
Mexico	16,000	18,100	30,100	28,400	22,300	30,200	47,500
Australia	*a* 5,000	*a* 10,000	*a* 19,000	*a* 35,000	40,500	56,000	54,000
Total	446,587	488,050	531,190	554,752	546,072	603,548	615,587

a Estimated.

For the United States the figures collected by this office have been accepted.

The production of lead in Great Britain has steadily declined for a long time. The maximum during the last eighteen years was reached in 1877, when the output of lead ore from the British mines was 80,850 tons. According to the official statistics the output during the last ten years has been as follows:

Production of lead ore in Great Britain.

Years.	Long tons.	Years.	Long tons.
1883	56,487	1889	48,465
1884	54,485	1890	45,657
1885	51,302	1891	43,859
1886	53,420	1892	40,024
1887	51,563	1893	40,808
1888	51,259		

It is estimated that the lead obtainable from the ores mined was 32,205 tons in 1891 and 29,654 tons in 1892. This would indicate 30,200 tons for 1893.

The British lead supplies may be summarized in the following table, taken from the official English report:

British lead supplies.

	1891.	1892.
	Long tons.	*Long tons.*
Lead obtainable from British ores	32,205	29,654
Imports of metal and obtainable from foreign ores	186,172	197,356
Exports of British and foreign lead and obtainable from ores exported	65,484	75,846
Available for home consumption	152,893	151,164

The production of the English mines, therefore, covers only about one-fifth of the consumption of the country.

A moderate quantity of foreign ore is imported and smelted in Great Britain. The total for 1891 was 20,560 tons, and for 1892 it was 18,217 tons. In the latter year France sent 1,054 tons; Algiers, 9,669 tons; Australia, 1,084 tons; and Chili, 1,787 tons.

A very large business is done in refining and desilverizing base bullion produced in other countries. The import statistics do not separate base bullion from refined lead, so that the magnitude of the work can not be exactly measured. The imports of foreign lead were 169,724 tons in 1891 and 182,782 tons in 1892. The principal contributing countries were the following. It must be remembered, however, that the figures given for Holland really covers lead originating in Germany and Belgium, and that the quantity credited to the United States is Mexican lead refined in bond in this country:

Principal sources of British lead imports.

Countries.	1892.	Countries.	1892.
	Long tons.		*Long tons.*
Germany	9,406	Western Australia	1,133
Holland	3,467	South Australia	21,588
Belgium	1,628	Victoria	2,658
France	3,414	Queensland	1,305
Spain	87,694	New South Wales	25,528
Greece	9,184	United States	8,951
Turkey	979	Mexico	3,293

The exports of British lead were 29,266 tons in 1891 and 39,178 tons in 1892. Besides this, there was exported in 1891 16,028 tons of foreign lead and in 1892 15,613 tons. In 1892 the principal customers of British merchants were as follows:

Destination of British lead exports in 1892.

Countries.	British lead.	Foreign lead.	Manufactures of lead.
	Long tons.	*Long tons.*	*Long tons.*
East Indies	653		6,548
China	6,433		86
Hongkong	2,049		72
Japan	863		1,891
British North America	1,995		632
Russia	9,395	2,538	2,955
Germany	2,981		165
Holland		1,678	
Belgium		8,023	
France		1,379	

In 1893 the imports of lead into Austria were 5,925 metric tons.

According to official statistics Russia produced 838 metric tons of lead in 1890, and in 1891, 556 tons. The imports in 1891 were 19,233 metric tons.

It is probable that the Chinese market will ultimately be completely taken by the Australian producers, who are already shipping direct. The magnitude of this movement is not however known.

The mineral statistics of Spain have confessedly been so imperfect that the metal trade has relied upon the figures relating to exports for a conception of the magnitude of production. A special inquiry made by the Revista Minera led to the result that the production of Spain for the year ending June 30, 1893, was 69,146 tons of refined lead and 82,567 metric tons of argentiferous lead.

The lead imports into Germany were 17,501 metric tons in 1892, and 23,856 tons in 1893. The exports declined from 25,647 metric tons in 1892 to 23,945 tons in 1893.

The lead production of Hungary is officially reported as 2,033 metric tons in 1891, and 2,170 metric tons in 1892.

The geological survey of New South Wales reports the following as the exports of ore and silver lead from the famous Broken Hill district, for a series of years:

Exports of ore and silver lead from New South Wales.

Years.	Ore.	Silver lead.
	Long tons.	*Long tons.*
1888	11,739	18,102
1889	46,965	34,580
1890	89,720	41,320
1891	92,384	55,396
1892	87,505	45,850

The great bulk of the ore exported from New South Wales is sent to coast ports in other Australian colonies, where it is smelted.

The following statement has been compiled, showing the production of silver and of lead in 1892 of the different companies of the Broken Hill district:

Production of Broken Hill companies in 1892.

	Silver.	Lead.
	Ounces.	*Long tons.*
Broken Hill Property	8,078,191	36,048
British Broken Hill Property	368,518	3,978
Broken Hill Property, Block 10	2,037,284	127
Broken Hill Property, Block 14	717,814	11,378
Broken Hill South	445,663	2,503
Broken Hill Junction	50,617	246
Broken Hill Junction North	3,184	....
Maybell Silver	1,582	2
Pinnacles A	103,359	338
Maybell North	12,987	37
Gypsy Girl	42,259	613
Total	11,861,458	55,270

During the fiscal year 1893 the Broken Hill Property, Block 10, made a net profit of £30,195, and paid a dividend of £40,000, leaving a balance of £80,639.

ZINC.

By C. Kirchhoff.

In common with all other metal industries spelter manufacture suffered severely during the latter half of 1893 from the general business depression. As the statistics for the second half of 1893, presented elsewhere, show, production fell off heavily. Reports from all the works show that the output of the metal has been as follows:

Production of spelter in the United States.

Years.	Short tons.	Years.	Short tons.
1873	7,343	1886	42,641
1875	15,833	1887	50,340
1880 (census year ending May 31)	23,239	1888	55,903
1882	33,765	1889	58,860
1883	36,872	1890	63,683
1884	38.544	1891	80,837
1885	40,688	1892	87,260
		1893	78,832

For a series of years the production has been as follows:

Production of spelter in the United States by States.

Years.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1882	5,698	18,201	7,366	2,500	33,765
1883	5,340	16,792	9,010	5,730	36,872
1884	7,861	17,594	7,859	5,230	38.544
1885	8,082	19,427	8,502	4,677	40,688
1886	6,762	21,077	8,932	5,870	42,641
1887	7,446	22,279	11,955	8,660	50,340
1888	9,561	22,445	10,432	13,465	55,903
1889	10,265	23,860	13,658	11,077	58,860
1890	9,114	26,243	15,199	13,127	63,683
1891	8,945 4,217	28,711	22,747	16,253	80,873
1892	9,582 4,913	(a)31,383	24,715	16,667	87,260
1893	8,802 3,882	(a)29,596	22,815	13,737	78,832

a Including Indiana.

The larger number of works in the Eastern and Southern States has made it possible to separate the figures formerly presented in one group without revealing individual returns. In the above table the upper larger figures in 1891, 1892, and 1893 relate to the Eastern States.

Since 1892 this office has collected semi-annually the statistics of the production of spelter, in order to present data showing more closely the fluctuations in the output. The following table presents the results:

Production of spelter semi-annually.

[Short tons].

States.	First half 1892.	Second half 1892.	First half 1893.	Second half 1893.
Eastern and Southern	6,901	7,594	7,380	5,304
Illinois and Indiana	15,483	15,900	16,427	13,169
Kansas	14,161	10,554	13,269	9,546
Missouri	8,954	7,713	8,718	5,019
Total	45,499	41,761	45,794	33,038

The figures for the second half of 1893 strikingly illustrate the stress put upon the zinc industry through the financial panic, the older Illinois and Eastern producers having borne the strain most successfully.

Very few of the spelter producers reached in 1893 the maximum product of former years, and only in isolated instances did the output exceed former records. The only new works in the country is that of the Kansas Zinc Mining and Smelting Company, which completed a four-block plant at Girard, Kansas, early in 1894. The works of the American Spelter Company, at Galena, Kansas, were burnt in 1893. Other works closed down, like the Scammon, which was idle during the whole second half of the year, and the Wenona, which stopped in September.

Stocks.—Reports from the producers show the following stocks. The figures, however, must be accepted with some reserve, since there is evidence that in some cases the true totals are withheld by producers for commercial reasons:

Stocks of spelter.

January 1.—[Short tons.]

	1889.	1890.	1891.	1892.	1893.	1894.
Eastern and Southern States	1,621	1,149	788	2,367	3,316	3,796
Illinois	580	304	68	32	12	974
Kansas	800	1,075	233	1,065	483	335
Missouri	....	43	45	61	349	379
Total	3,001	2,571	1,134	3,525	4,160	5,484

Zinc oxide.—The production of zinc oxide for 1893 is estimated at 21,684 short tons, of which 14,954 tons was produced by Eastern works and 6,730 tons by Western establishments. The latter does not include the mixed lead and zinc product of the Canyon City plant.

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common Western spelter in New York City, 1875 to 1893.

[Cents per pound. Figures in parentheses are combination prices.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	6.75	6.37	6.67	6.25	6.50	6.20	(7.00)	6.50	(7.25)	7.15	(7.25)	7.15
1876	(7.60)	7.40	(7.75)	7.50	(7.75)	7.62	(8.00)	7.60	(8.00)	7.75	(8.00)	7.25
1877	6.50	6.25	6.62	6.50	6.50	6.37	6.37	6.25	6.25	6.00	6.12	5.87
1878	5.75	5.50	5.62	5.25	5.62	5.25	5.25	5.00	5.00	4.62	4.62	4.25
1879	4.50	4.25	4.62	4.40	4.62	4.37	4.75	4.25	4.50	4.25	4.37	4.12
1880	6.50	5.87	6.75	6.37	6.75	6.50	6.50	6.12	6.00	5.62	5.50	5.12
1881	5.25	4.87	5.25	5.12	5.00	4.87	5.12	4.75	5.00	4.87	5.00	4.75
1882	6.00	5.75	5.75	5.62	5.62	5.37	5.50	5.25	5.62	5.25	5.37	5.25
1883	4.62	4.50	4.62	4.50	4.75	4.62	4.75	4.60	4.75	4.50	4.62	4.37
1884	4.37	4.20	4.40	4.25	4.60	4.40	4.65	4.50	4.60	4.45	4.60	4.45
1885	4.50	4.12	4.30	4.25	4.30	4.12	4.30	4.12	4.25	4.10	4.10	4.00
1886	4.50	4.30	4.55	4.30	4.60	4.50	4.60	4.50	4.60	4.40	4.40	4.35
1887	4.60	4.50	4.60	4.40	4.60	4.40	4.65	4.45	4.65	4.45	4.65	4.50
1888	5.37	5.20	5.35	5.25	5.25	4.87	4.87	4.60	4.65	4.60	4.60	4.50
1889	5.00	5.00	5.00	4.90	4.87	4.70	4.65	4.65	4.85	4.62	5.00	5.00
1890	5.45	5.35	5.35	5.20	5.20	5.00	5.00	4.90	5.45	5.00	5.60	5.35
1891	6.00	5.25	5.25	5.00	5.10	5.00	5.10	4.90	4.90	4.85	5.10	4.90
1892	4.70	4.60	4.60	4.55	4.60	4.50	4.80	4.60	4.90	4.80	4.90	4.80
1893	4.35	4.30	4.30	4.25	4.25	4.20	4.50	4.30	4.40	4.20	4.25	4.15

Prices of common Western spelter in New York City, 1875 to 1893—Continued.

[Cents per pound. Figures in parentheses are combination prices.]

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	(7.35)	7.25	(7.25)	7.10	(7.25)	7.10	(7.40)	7.15	(7.40)	7.15	(7.40)	7.15
1876	7.25	7.12	7.25	7.00	7.12	6.80	6.75	6.62	6.62	6.37	6.50	6.37
1877	5.87	5.62	5.90	5.80	5.87	5.75	5.90	5.70	5.87	5.62	5.75	5.50
1878	4.75	4.50	4.87	4.50	4.87	4.75	4.82	4.50	4.75	4.50	4.37	4.25
1879	4.75	4.37	5.62	4.80	6.00	5.62	6.37	6.00	6.25	5.87	6.25	6.00
1880	5.00	4.87	5.25	4.87	5.12	4.75	5.00	4.87	4.90	4.65	4.75	4.65
1881	5.00	4.75	5.12	5.00	5.25	5.00	5.37	5.25	5.87	5.50	6.00	5.87
1882	5.37	5.12	5.50	5.12	5.37	5.12	5.37	5.12	5.12	4.87	4.87	4.50
1883	4.50	4.30	4.40	4.30	4.50	4.40	4.45	4.35	4.40	4.37	4.37	4.35
1884	4.55	4.45	4.62	4.52	4.62	4.50	4.55	4.40	4.40	4.30	4.25	4.00
1885	4.40	4.10	4.60	4.40	4.62	4.50	4.62	4.50	4.60	4.45	4.60	4.45
1886	4.40	4.30	4.40	4.30	4.40	4.25	4.30	4.25	4.30	4.25	4.50	4.35
1887	4.50	4.50	4.60	4.55	4.65	4.60	4.65	4.50	4.80	4.52	5.87	5.00
1888	4.55	4.50	4.87	4.50	5.12	4.75	5.12	4.87	5.12	4.87	5.12	4.87
1889	5.10	5.00	5.20	5.15	5.15	5.10	5.15	5.10	5.25	5.05	5.35	5.30
1890	5.60	5.40	5.55	5.40	5.65	5.50	6.00	5.65	6.10	5.90	6.00	5.90
1891	5.10	5.05	5.10	5.00	5.00	4.85	5.15	4.95	4.90	4.75	4.75	4.65
1892	4.85	4.70	4.70	4.65	4.65	4.50	4.50	4.35	4.40	4.35	4.40	4.35
1893	4.15	3.90	3.90	3.55	3.75	3.65	3.70	3.55	3.85	3.60	3.80	3.70

During the early months of the year 1893 the spelter market was fairly steady, although the large production and a moderate demand made the tendency in the buyer's favor. Repeated efforts were made in March and April to arrange a combination of producers, and at one time a scheme of allotments had ripened until a majority of Western makers had agreed. The subsequent withdrawal of their assent by some interests led to a collapse of the movement. During its progress considerable speculative purchases of metal were made. June brought labor troubles in the Kansas coal mines and caused a moderate restriction of production. But the general business depression overshadowed this local trouble, and the rapid shrinkage in the demand caused a growing accumulation of metal. In November a short-lived revival of confidence brought more active buying and stiffening prices, but towards the end of the year indifference on the part of buyers and pressure to sell again put the market on the down grade.

IMPORTS AND EXPORTS.

Zinc imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Blocks or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*		*Pounds.*			
June 30, 1867..	5,752,611	$256,366	5,142,417	$311,767	....	....	$1,835	$569,968
1868..	9,327,968	417,273	3,557,448	203,883	....	....	1,623	622,779
1869..	13,211,575	590,332	8,306,723	478,646	....	....	2,083	1,071,061
1870..	9,221,121	415,497	9,542,687	509,860	....	....	21,696	947,053
1871..	11,159,040	508,355	7,646,821	409,243	....	....	26,366	943,964
1872..	11,802,247	522,524	10,704,944	593,885	....	....	58,668	1,175,077
1873..	6,839,897	331,399	11,122,143	715,706	....	....	56,813	1,103,918
1874..	3,593,570	203,479	6,016,835	424,504	....	....	48,304	676,287
1875..	2,034,252	101,766	7,320,713	444,539	....	....	26,330	572,635
1876..	947,322	56,082	4,611,360	298,308	....	....	18,427	372,817
1877..	1,266,894	63,250	1,341,333	81,815	....	....	2,496	147,561
1878..	1,270,184	57,753	1,255,620	69,381	....	....	4,892	132,026
1879..	1,419,791	53,294	1,111,225	53,050	....	....	3,374	109,718
1880..	8,092,620	371,920	4,069,310	210,230	....	....	3,571	585,721
1881..	2,859,216	125,457	2,727,324	129,158	....	....	7,603	262,218
1882..	18,408,391	736,964	4,413,042	207,032	....	....	4,940	948,936
1883..	17,067,211	655,503	3,309,239	141,823	....	....	5,606	802,932
1884..	5,869,738	208,852	952,253	36,120	....	....	4,795	249,767
1885..	3,515,840	113,268	1,839,860	64,781	....	....	2,054	180,103
Dec. 31, 1886..	4,300,830	136,138	1,092,400	40,320	....	....	9,162	185,620
1887..	8,387,647	276,122	926,150	32,526	....	....	11,329	319,977
1888..	3,825,947	146,156	295,287	12,558	....	....	12,080	170,794
1889..	2,052,559	77,845	1,014,873	43,356	....	....	19,580	140,781
1890..	1,997,524	101,335	781,366	43,495	....	....	9,740	154,570
1891..	808,094	41,199	21,948	1,460	....	....	....	42,659
1892..	297,969	16,520	27,272	2,216	115,293	$6,556	20,677	45,969
1893..	425,183	22,790	28,913	1,985	265	21	16,479	41,275

Imports of zinc oxide from 1885 to 1893, inclusive.

Years ending—	Dry.	In oil.
	Pounds.	*Pounds.*
June 30, 1885	2,233,128	98,566
Dec. 31, 1886	3,526,289	79,788
1887	4,961,080	123,216
1888	1,401,342	51,985
1889	2,686,861	66,240
1890	2,631,458	102,298
1891	2,839,351	128,140
1892	2,442,014	111,190
1893	3,900,749	254,807

Exports of zinc and zinc ore of domestic production, 1864 to 1893, inclusive.

Years ending—	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwt.		*Pounds.*			
June 30, 1864	14,810	$116,431	95,738	$12,269		$128,700
1865	99,371	114,149	184,183	22,740		136,889
1866	4,485	25,091	140,798	13,290		38,381
1867	3,676	32,041	312,227	30,587		62,628
1868	8,344	74,706	1,022,699	68,214		142,920
1869		65,411				65,411
1870	15,286	81,487	110,157	10,672		92,159
1871	9,621	48,292	76,380	7,823		56,115
1872	3,686	20,880	62,919	5,726		26,606
1873	234	2,304	73,953	4,656		6,960
1874	2,550	20,037	43,566	3,612		23,649
1875	3,083	20,659	38,090	4,245	$1,000	25,904
1876	10,178	66,259	134,542	11,651	4,333	82,243
1877	6,428	34,468	1,419,922	115,122	1,118	150,708
1878	16,050	83,831	2,545,320	216,580	567	300,978
1879	10,660	40,399	2,132,949	170,654		211,053
1880	13,024	42,036	1,368,302	119,264		161,300
1881	11,390	16,405	1,491,786	132,805	168	149,378
1882	10,904	13,736	1,489,552	124,638		138,374
1883	3,045	11,509	852,333	70,981	734	83,224
1884	4,780	16,685	126,043	9,576	4,666	30,927
1885	6,840	22,824	101,685	7,270	4,991	35,085
Dec. 31, 1886	26,620	49,455	917,229	75,192	13,526	138,173
1887	4,700	17,286	136,670	9,017	16,789	43,092
1888	4,560	13,034	62,234	4,270	19,098	41,402
1889	26,760	73,802	879,785	44,049	35,732	153,583
1890	77,360	195,113	3,295,584	126,291	23,587	344,991
1891	115,820	149,435	4,294,656	278,182	38,921	466,538
1892	18,380	41,186	12,494,335	669,549	166,794	877,529
1893	980	1,271	7,278,874	403,590	248,382	653,243

In connection with the exports of spelter, the fact must be borne in mind that for years a certain quantity of special high-grade metal produced by Eastern and Southern works has been purchased principally by foreign governments to be used in the manufacture of brass for cartridges. Common spelter has been exported only under extraordinary circumstances; for instance, when a combination of foreign producers carried values abroad to an unduly high level.

FOREIGN SPELTER PRODUCTION.

Messrs. Henry R. Merton & Co., of London, make the following report on the spelter production of Europe:

Estimate of the production of zinc in Europe.

[Long tons.]

Countries.	1893.	1892.	1891.	1890.	1889.	1888.	1887.
Rhine district and Belgium	149,750	143,305	139,695	137,630	134,648	133,245	130,995
Silesia	90,310	87,760	87,080	87,475	85,483	83,375	81,375
Great Britain	28,375	30,310	29,410	29,145	30,806	26,783	19,339
France and Spain	20,585	18,662	18,360	18,240	16,785	16,140	16,028
Poland	7,560	4,270	3,760	3,620	3,026	3,785	3,580
Austria	4,530	6,735	6,440	7,135	6,330	4,977	5,338
Total	301,110	291,042	284,745	283,245	277,078	268,305	256,655
Countries.	**1886.**	**1885.**	**1884.**	**1883.**	**1882.**	**1881.**	**1880.**
Rhine district and Belgium	129,020	129,754	129,240	123,891	119,193	110,989	98,830
Silesia	81,630	79,623	76,116	70,405	68,811	66,497	64,459
Great Britain	20,730	24,299	29,259	28,661	25,581	24,419	a 22,000
France and Spain	15,305	14,847	15,341	14,671	18,075	a 18,358	15,000
Poland	4,145	5,019	4,164	3,733	4,400	a 4,000	a 4,000
Austria	5,000	5,610	6,170	6,267	6,709	5,825	5,970
Total	255,830	259,152	260,290	247,628	242,769	230,088	210,259

a Estimated.

The output of the works in the different districts was as follows:

Productions of zinc by principal foreign producers.

[Long tons.]

Districts.	1893.	1892.	1891.	1890.	1889.	1888.	1887.	1886.
Rhine district and Belgium:								
Vieille Montagne	54,305	55,770	53,820	52,865	52,016	51,670	51,517	50,790
Stolberg Co	15,135	14,950	15,040	14,855	14,634	14,036	14,070	14,065
Austro-Belge	9,855	9,720	9,425	9,250	9,245	9,140	9,280	9,130
G. Dumont & Frères	8,680	8,675	8,370	8,350	8,863	8,759	8,368	8,000
Rhein-Nassau Co	8,205	8,040	8,075	7,960	7,470	7,586	7,588	7,730
L. de Laminne	6,920	6,845	6,810	6,760	6,693	6,597	6,745	6,550
Escombrera Bleyberg	5,775	6,070	5,770	5,630	5,560	4,930	4,925	5,315
Grillo	5,625	5,550	5,390	5,490	5,353	5,299	5,100	5,075
Märk, Westf., Bergw., Ver	5,620	5,540	5,600	5,485	5,805	5,537	5,553	4,950
Nouvelle Montagne	5,290	5,240	5,550	5,350	5,090	5,032	4,975	4,995
Berzelius	5,345	5,290	5,155	5,175	4,910	4,818	4,890	4,985
Eschger Ghesquiere & Co	4,370	4,100	3,840	4,065	4,303	4,137	4,079	3,710
Société Prayon	4,250	4,085	4,130	4,100	3,956	3,906	3,905	3,725
Société de Boom	7,110	5,430	2,720	2,295	*a* 750	1,798	...	...
Zinkmaatshappy in Limburg	*a* 2,000	...	...	...	...	...	...	...
Société Campine	*a* 700	...	...	...	...	...	...	...
Schulte & Co	565	...	...	...	...	...	...	...
Total	149,750	143,305	139,695	137,630	134,648	133,245	130,995	129,020
Silesia:								
Schlesische Actien-Gesellschaft	25,255	24,915	25,245	24,840	23,675	22,917	22,680	22,730
G. von Giesche's Erben	18,920	18,295	18,700	18,550	18,206	17,594	17,600	17,505
Herzog von Ujest	17,210	17,085	16,795	16,355	16,202	15,456	15,835	15,610
Graf H. Henckel von Donnersmarck	11,695	11,115	11,230	11,670	11,392	11,193	11,565	9,355
Graefin Schaffgotsch	6,885	6,070	5,310	6,265	6,405	6,402	6,430	6,505
Graf G. Henckel von Donnersmarck	4,215	4,070	3,905	4,090	3,943	4,114	1,565	1,670
Graf Lazy Henckel von Donnersmarck (included in Graf H. Henckel v. D.)	...	...	...	...	...	...	...	2,450
H. Roth	1,775	1,845	1,730	1,750	1,660	1,555	1,670	1,675
Wünsch	2,075	2,120	1,920	1,880	1,907	1,906	1,885	1,860
Vereinigte Königs & Laurahütte	1,170	1,230	1,180	1,020	1,130	1,166	1,065	1,185
Baron v. Horschitz'sche Erben	960	875	850	830	963	935	910	915
Fiscus	150	140	215	225	170	137	170	170
Total	90,310	87,760	87,080	87,475	85,653	83,375	81,375	81,630
Great Britain:								
Vivian & Sons	7,060	7,791	7,235	6,605	6,842	6,510	4,840	7,389
English Crown Spelter Co., Limited	5,380	5,527	5,180	4,945	4,981	4,980	4,007	3,248
Dillwyn & Co	3,450	3,759	3,580	3,930	4,540	3,904	2,843	3,015
Swansea Vale Spelter Co	2,105	2,063	1,840	1,615	2,161	2,150	1,798	2,060
Villiers Spelter Co	2,050	1,920	2,125	1,890	2,180	1,993	1,810	1,880
Pascoe, Grenfell & Sons	1,260	1,080	1,060	1,160	1,272	1,330	1,124	727
Nenthead & Tynedale Co	1,855	1,600	1,440	1,530	1,507	1,516	1,317	1,193
John Lysaght, Limited	2,760	3,000	4,185	4,450	5,113	3,750	1,600	1,218
Staffordshire Knot	...	...	...	350	1,100	150	...	...
Minera Mines	...	1,350	2,265	2,170	610	...	...	...
H. Kenyon & Co	500	500	500	500	500	500	500	500
Leeswood Co	1,495	1,720	...	...	...	...	...	...
Dynevor Co	460	...	...	...	...	...	...	...
Total	28,375	30,310	29,410	29,145	30,806	26,783	19,839	21,230
France and Spain:								
Asturienne	18,695	18,462	18,360	18,240	16,785	16,140	16,028	15,305
St. Amand	1,890	200	...	...	...	...	...	...
Total	20,585	18,662	18,360	18,240	16,785	16,140	16,028	15,305
Austria:								
Sagor	1,360	1,475	1,280	1,430	1,210	1,087	866	1,000
Cilli	2,510	1,710	1,810	1,880	1,670	1,240	1,275	1,360
Siersza-Niedzieliska	3,690	3,550	3,350	3,825	3,450	2,650	3,200	2,640
Total	7,560	6,735	6,440	7,135	6,330	4,977	5,338	5,000
Poland	4,530	4,270	3,760	3,620	3,026	*a* 3,785	3,580	4,145

a Estimated.

The production of zinc ore in Great Britain was as follows:

Production of zinc ore in Great Britain.

Years.	Long tons.
1893	23,754
1892	26,880
1891	22,216
1890	22,041
1889	23,202

The imports of zinc ore were 36,726 tons in 1891 and 32,695 tons in 1892. In the latter year the principal sources of supply were France, which shipped 2,444 tons; Germany, 7,302 tons; Italy, 16,750 tons, and the United States, 1,646 tons.

England is a heavy importer of zinc. In 1891 the imports amounted to 58,513 long tons, and in 1892, 52,793 tons. During the latter year the principal sources of supply were: Belgium, with 13,789 tons; France, with 2,021 tons; Germany, with 15,170 tons; Holland (in transit), with 15,076 tons; and the United States, with 5,609 tons. In 1893 the total imports amounted to 56,926 tons.

A considerable quantity of spelter is exported. In 1891 the exports amounted to 7,674 tons of British and 2,617 tons of foreign spelter. In 1892 the exports of British were 9,811 tons and of foreign 2,271 tons. Of this quantity 2,535 tons of British spelter went to Holland, 4,026 tons of British and 810 tons of foreign spelter to British East India, and 1,425 tons of British and 20 tons of foreign spelter were sent to China. In 1893 the exports of British spelter were 9,733 long tons.

The export trade in manufactured zinc is quite heavy from Great Britain. In 1891 the quantity amounted to 20,158 tons, and in 1892 to 18,958 tons. During the latter year the largest shipments were 4,134 tons to Belgium, 3,842 tons to Germany, and 10,812 tons to Holland. In 1893 the exports amounted to 18,442 long tons.

Some of the large foreign smelters report their business results annually. Among the most interesting are the following:

The Vieille Montagne Company, of Belgium, the largest concern in the world, produced in 1893 55,133 metric tons of spelter, rolled 55,570 tons of sheet zinc, and made 8,457 tons of zinc white. It will be observed that since all the European works, by agreement, limited the output to 275,540 tons in 1893 this company makes nearly one-fifth of the total. The annual report states that the average price in 1893 was only 422.30 francs per ton, as compared with 507.80 francs in 1892. Although this decline would represent, theoretically, a decrease of earnings for the Vieille Montagne Company of 4,700,000 francs, the falling off really amounted to only 936,000 francs. The gross profits of the year 1893 were 5,844,164.15 francs, and deducting general expenses of administration, interest, discounts, etc., amounting to 622,681.69 francs, left 5,221,482.46.

The directors wrote off for depreciation 1,270,000 francs, and placed to the reserve fund 700,296.49. Of the balance, 10 per cent, or 350,148.25 went to the administration, 2½ per cent, or 87,537.05 to the directors, 5 per cent to the stock of 9,000,000 francs, and 2,362,500 as dividends. The company has a marine and fire insurance fund of 978,827.18 francs, a special reserve of 1,000,000 francs, the legal reserve fund of 4,129,496.56 francs, and an emergency fund, created in 1887, of 1,585,000 francs. The balance sheet shows quick assets of 19,389,281 francs, including 1,383,514.03 francs in supplies, 13,301,933.79 francs in stock of ore and product, and 3,576,679.44 francs outstanding accounts. Against this stand: owing to bankers 298,765.04 francs, bills payable 493,326.46 francs, and open accounts 3,477,243.28. With a capital stock of 9,000,000 francs the mining property is valued at 4,129,085.97 francs, while the enormous plant and equipment are carried on the books at 6,107,692.26 francs. These figures convey an idea of the strength of the largest zinc-producing concern in the world.

The Austro-Belge Company, often known as the Corphalie Company, produced in 1893 9,724 tons. This company draws a large share of its supplies of ore from its own mines in Italy and Spain. The gross profit was 850,793.78 francs, or a falling off of 222,883.89 francs as compared with 1892, a decline due to the drop in prices. The company paid 100 francs per share, or 636,300 francs, in dividends, distributed 48,700 francs among the management, and wrote off 165,793.78 francs. The company has a depreciation fund of 1,367,010.60 francs, and a reserve fund of 400,000 francs.

The Schlesische Zink Hütten Gesellschaft zu Lipine made a profit in 1893 of 4,160,110 marks against 4,660,055 marks in 1892, the dividend declared being reduced from 15 per cent in 1892 to 14 per cent in 1893.

The Rheinisch-Nassau Berg-Werks und Hütten Gesellschaft returned a gross profit of 225,204 marks in 1893, while the Berzelius Company made 309,100 marks.

QUICKSILVER.

Production.—With no remarkable finds of quicksilver deposits, the production from the old mines increased from 27,993 flasks (76½ pounds each) in 1892 to 30,164 flasks in 1893, all from California. The New Almaden mine, which produced 6,614 flasks, is increasing again and was the largest producer in the State. The Napa Consolidated produced nearly as much, 6,120 flasks, and the new Mirabel (old Bradford) continued to increase, showing 5,211 flasks. Several new finds, which did not prove important, were noted in the neighborhood of the Klamath river, and a sensational report was current to the effect that a large find had been made in San Francisco itself on what became known as Cinnabar Hill. It failed to interest the quicksilver men, however.

Some interest is being shown again in the selenide ores of southern Utah. It seems that the rich material was quickly exhausted, but it is said that a large quantity of low grade ore has been located.

The production of the past few years is shown in the following tables:

Total product of quicksilver in the United States.

[Flasks of 76½ pounds, net.]

Years.	New Almaden.	New Idria.	Redington	Sulphur Bank.	Great Western.	Napa Consolidated.	Great Eastern.	Mirabel.	Ætna.	Lake	Abbott.	Various mines.	Total yearly production of California mines.
1850	7,723												7,723
1851	27,779												27,779
1852	15,901											4,099	20,000
1853	22,284												22,284
1854	30,004												30,004
1855	29,142											3,858	33,000
1856	27,138											2,862	30,000
1857	28,204												28,204
1858	25,761											5,239	31,000
1859	1,294											11,706	13,000
1860	7,061											2,939	10,000
1861	34,429											571	35,000
1862	39,671		444									1,885	42,000
1863	32,803		852									6,876	40,531
1864	42,489		1,914									3,086	47,489
1865	47,194	(*a*)	3,545									2,261	53,000
1866	35,150	6,525	2,254									2,621	46,550
1867	24,461	11,493	7,862									3,184	47,000
1868	25,628	12,180	8,686									1,234	47,728
1869	16,898	10,315	5,018									1,580	33,811
1870	14,423	9,888	4,546									1,220	30,077
1871	18,568	8,180	2,128									2,810	31,686
1872	18,574	8,171	3,046									1,830	31,621
1873	11,042	7,735	3,294		340							5,231	27,642

a Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.

Total product of quicksilver in the United States—Continued.

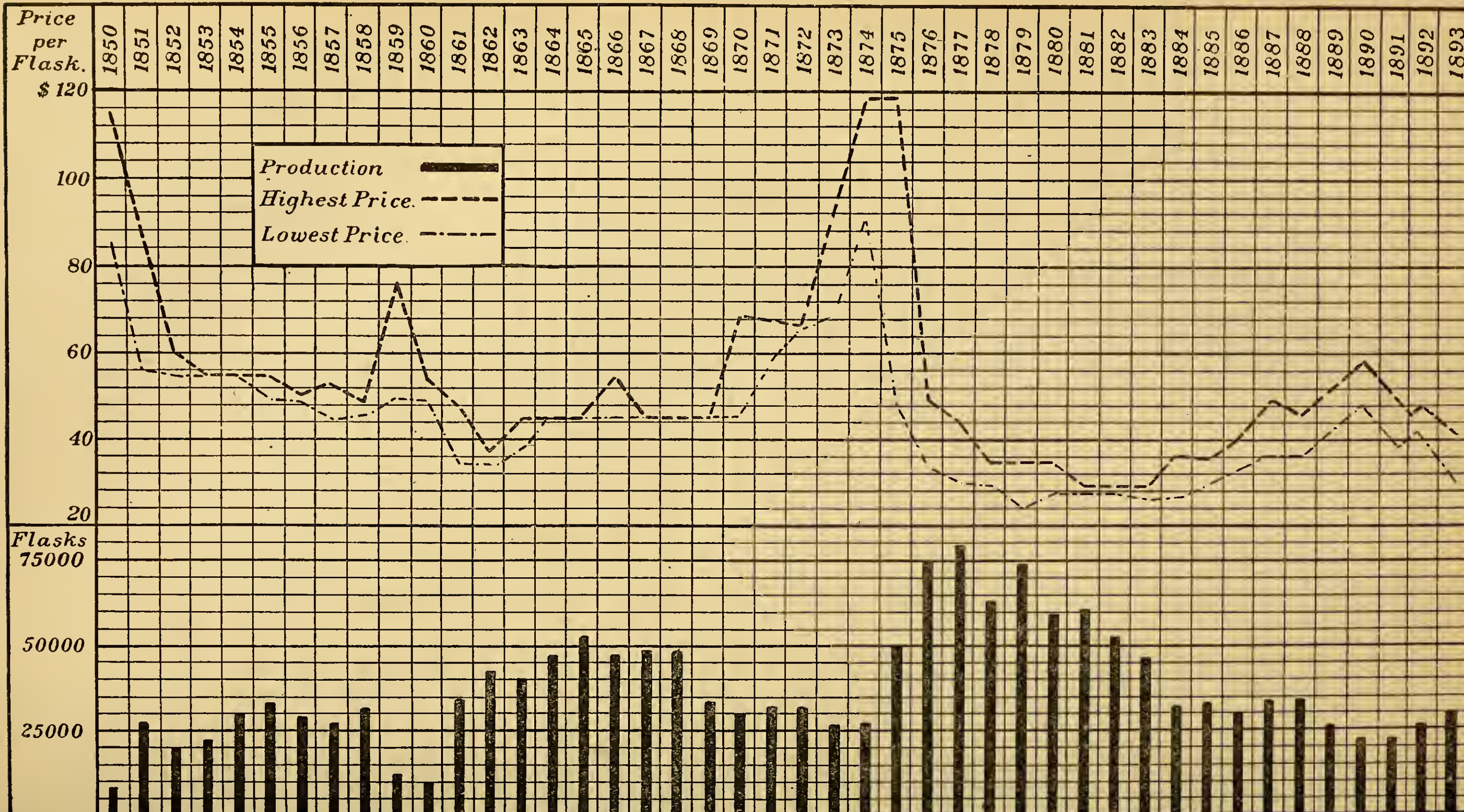
[Flasks of 76½ pounds, net.]

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Great Western.	Napa Consolidated.	Great Eastern.	Mirabel.	Ætna.	Lake	Abbott	Various mines.	Total yearly production of California mines.
1874 ..	9,084	6,911	6,678	573	1,122	......	......	......	......	.....	.....	3,388	27,756
1875 ..	13,648	8,432	7,513	5,372	3,384	......	412	......	......	.....	.....	11,489	50,250
1876 ..	20,549	7,272	9,183	8,367	4,322	573	387	......	......	.....	.....	22,063	72,716
1877 ..	23,996	6,316	9,399	10,993	5,856	2,229	505	......	......	.....	.....	20,101	79,395
1878 ..	15,852	5,138	6,686	9,465	4,963	3,049	1,366	......	......	.....	.....	17,361	63,880
1879 ..	20,514	4,425	4,516	9,249	6,333	3,605	1,455	......	......	.....	.....	23,587	73,684
1880 ..	23,465	3,209	2,139	10,706	6,442	4,416	1,279	......	......	.....	.....	8,270	59,926
1881 ..	26,060	2,775	2,194	11,152	6,241	5,552	1,065	......	......	.....	.....	5,812	60,851
1882 ..	28,070	1,953	2,171	5,014	5,179	6,842	2,124	......	......	.....	.....	1,379	52,732
1883 ..	29,000	1,606	1,894	2,612	3,869	5,890	1,669	......	......	.....	.....	185	46,725
1884 ..	20,000	1,025	881	890	3,292	4,307	332	......	......	.....	.....	1,186	31,913
1885 ..	21,400	1,144	385	1,296	3,469	3,506	446	......	......	.....	.....	427	32,073
1886 ..	18,000	1,406	409	1,449	1,949	5,247	735	......	......	.....	.....	786	29,981
1887 ..	20.000	1,890	673	1,490	1,446	5,574	689	1,513	......	.....	.....	520	*a*33,825
1888 ..	18.000	1,320	126	2,164	625	5,024	1,151	3,848	......	.....	.....	992	33,250
1889 ..	13,100	980	812	2,283	556	4,590	1,345	1,874	......	.....	.....	924	26,464
1890 ..	12,000	977	505	1,608	1,334	3,429	1,046	1,290	......	.....	.....	737	22,926
1891 ..	8,200	792	442	1,375	1,844	4,454	1,660	1,686	......	.....	.....	2,451	22,904
1892 ..	5,563	848	728	1,393	5,867	5,680	1,630	3,208	1,592	612	672	200	27,993
1893 ..	6,614	869	1,012	1,200	3,187	6,120	1,445	5,211	3,795	578	133	....	30,164
Total.	936,736	133,775	101,935	88,651	71,620	80,087	20,741	18,660	5,387	1,190	805	186,950	1,646,537

a Includes 65 flasks from Oregon.

Production of quicksilver in flasks, in California, from 1880 to 1893, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna (*a*).	Napa (*a*).	Great Eastern.	Bradford (*b*).	Various mines.	Total.
1880.												
January	1,539	203	142	760	1,000	550	......	205	39	......	232	4,670
February	1,809	96	310	965	535	565	......	375	110	......	130	4,895
March	2,155	443	239	1,286	730	565	......	251	210	......	98	5,977
April	1,667	165	103	611	645	574	......	161	96	......	239	4,261
May	1,938	226	356	1,130	560	572	......	315	164	......	90	5,351
June	1,985	269	127	819	550	585	......	420	142	......	386	5,283
July	1,688	250	135	933	......	540	......	455	118	......	70	4,189
August	2,360	312	189	878	340	525	......	455	133	......	68	5,260
September	2,166	245	175	687	300	452	......	480	122	......	81	4,708
October	1,858	216	166	865	1,100	557	......	358	57	......	98	5,275
November	2,238	539	96	1,209	500	467	......	591	42	......	66	5,748
December	2,062	245	101	563	410	490	......	350	46	......	42	4,309
Total....	23,465	3,209	2,139	10,706	6,670	6,442	......	4,416	1,279	......	1,600	59,926
1881.												
January	2,259	330	140	895	1,300	451	......	430	13	......	43	5,861
February	2,187	171	32	635	600	399	......	233	......	......	4	4,261
March	2,466	206	354	1,100	350	400	......	505	179	......	......	5,560
April	2,507	158	284	706	357	447	......	466	123	......	23	5,071
May	1,346	200	218	1,163	500	681	......	659	97	......	25	4,889
June	1,780	201	196	1,463	340	801	......	621	94	......	68	5,564
July	2,208	110	160	1,057	255	714	......	481	47	......	156	5,188
August	2,260	209	190	1,139	300	585	......	490	57	......	120	5,350
September	2,090	212	187	1,076	201	457	......	592	113	......	37	4,965
October	2,223	140	165	969	400	414	......	485	106	......	63	4,965
November	2,572	577	180	588	375	434	......	310	166	......	30	5,232
December	2,162	261	88	361	250	458	......	280	70	......	15	3,945
Total....	26,060	2,775	2,194	11,152	5,228	6,241	......	5,552	1,065	......	584	60,851



PRODUCTION AND PRICE OF QUICKSILVER IN THE UNITED STATES.

Production of quicksilver in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna (*a*).	Napa (*a*).	Great Eastern.	Bradford (*b*).	Various mines.	Total.
1882.												
January	1,632	179	178	623	50	395	......	430	144	......	33	3,664
February	1,924	121	145	460	210	348	......	440	98	......	21	3,767
March	2,078	160	70	359	200	505	......	459	91	......	24	3,946
April	2,110	127	174	319	229	486	......	525	57	......	......	4,027
May	2,446	269	211	354	13	521	......	737	55	......	5	4,611
June	2.318	121	131	522	30	456	......	485	76	......	28	4,167
July	2,522	169	195	579	......	410	......	380	111	......	15	4,381
August	2,432	130	184	418	50	490	......	582	388	......	11	4,685
September	2.766	129	225	430	140	513	......	641	348	......	17	5,209
October	2,844	266	251	370	60	516	......	580	229	......	13	5,129
November	2,619	156	96	280	81	200	......	718	306	......	55	4,511
December	2,379	126	311	300	75	339	......	865	221	......	19	4,635
Total	28,070	1,953	2,171	5,014	1,138	5,179	......	6,842	2,124	......	241	52,732
1883.												
January	2,497	112	367	280	77	390	......	590	262	......	7	4,582
February	2,150	133	181	310	7	361	......	295	156	......	4	3,600
March	2,230	142	202	335	......	305	......	485	162	......	14	3,875
April	1,756	76	243	310	......	294	......	530	142	......	3	3,354
May	2,344	144	135	350	......	293	......	325	164	......	13	3.768
June	2,214	137	165	91	......	400	......	360	184	......	10	3,561
July	2,618	85	141	130	......	446	......	452	150	......	2	4,024
August	3,000	139	94	112	......	315	......	695	76	......	......	4,431
September	3,010	164	45	265	......	297	......	750	81	......	30	4,642
October	2,672	272	109	206	......	215	......	521	134	......	......	4,129
November	2,212	115	78	160	......	208	......	613	102	......	......	3,488
December	2,297	87	134	63	......	342	......	274	56	......	18	3,271
Total	29,000	1,606	1,894	2,612	84	3,869	......	5,890	1,669	......	101	46,725
1884.												
January	1,440	103	127	263	......	373	329	135	28	......	7	2,805
February	1,458	59	104	......	......	241	276	174	9	......	......	2,321
March	1,606	36	123	68	......	223	249	152	2	......	......	2,459
April	1,785	75	50	76	......	232	422	69	......	......	......	2,709
May	1,672	125	53	200	......	169	245	6	......	......	......	2,470
June	1,859	44	118	......	200	258	215	......	......	......	......	2,694
July	1,543	29	71	52	200	258	374	101	......	......	......	2,628
August	1,804	63	47	20	306	334	228	110	......	......	......	2,912
September	1,448	67	52	35	58	354	136	169	58	......	......	2,377
October	1,625	115	68	25	160	328	153	90	104	......	......	2,668
November	1,906	157	32	53	150	230	132	240	91	......	......	2,985
December	1,860	152	36	98	105	292	172	130	40	......	......	2,885
Total	20,000	1,025	881	890	1,179	3,292	2,931	1,376	332	......	7	31,913
1885.												
January	1,700	190	40	24	......	172	189	131	37	......	......	2,483
February	1,506	70	24	85	35	245	96	180	75	......	......	2,316
March	1,500	80	......	83	......	314	88	145	33	......	19	2,262
April	2,003	80	......	69	......	340	142	145	37	......	......	2,816
May	2,000	75	......	194	......	269	62	190	......	......	3	2,793
June	1,750	62	50	91	......	330	112	250	63	......	5	2,713
July	1,750	75	43	209	......	321	45	191	50	......	10	2,694
August	2,104	80	49	150	......	324	118	175	......	......	47	3,047
September	1,936	95	57	85	......	347	201	180	......	......	77	2,978
October	1,598	85	42	123	......	236	52	185	65	......	82	2,468
November	1,576	122	43	61	......	292	54	190	43	......	87	2.468
December	1,977	130	37	122	......	279	150	235	43	......	62	3,035
Total	21,400	1,144	385	1,296	35	3,469	1,309	2,197	446	......	392	32,073

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna (*a*).	Napa (*a*).	Great Eastern.	Bradford (*b*).	Various mines.	Total.
1886.												
January	1,431	70	42	100	......	339	162	147	73	......	34	2,398
February	1,100	175	24	108	......	274	132	192	53	......	45	2,103
March	1,522	20	21	91	......	226	209	218	43	......	75	2,425
April	1,256	90	36	172	......	115	328	172	62	......	62	2,293
May	1,600	101	18	36	......	99	228	128	76	......	95	2,381
June	1,806	110	19	113	......	126	276	123	71	......	78	2,722
July	1,572	95	24	98	......	138	345	138	64	......	127	2,601
August	1,240	105	35	119	......	156	313	74	76	......	84	2,202
September	1,210	179	30	100	......	107	303	82	64	......	33	2,108
October	1,280	106	50	150	......	171	392	124	65	......	52	2,390
November	1,900	180	76	191	......	109	477	209	55	......	35	3,232
December	2,083	175	34	171	......	89	313	162	33	......	66	3,126
Total	18,000	1,406	409	1,449	......	1,949	3,478	1,769	735	......	786	29,981
1887.												
January	1,904	162	76	185	......	56	450	181	51	......	12	3,077
February	1,700	149	43	40	......	86	240	150	......	......	......	2,408
March	1,584	110	48	95	......	105	125	275	74	......	140	2,456
April	1,671	157	29	105	......	90	200	212	91	......	31	2,586
May	2,040	126	27	50	......	152	100	215	80	......	40	2,830
June	1,700	127	93	170	......	126	200	220	82	......	104	2,822
July	1,567	175	57	125	......	194	200	205	56	201	40	2,820
August	1,517	160	61	90	......	108	200	275	72	220	78	2,881
September	1,535	297	42	120	......	123	400	160	26	195	25	2,923
October	1,405	171	64	140	......	132	300	304	66	228	49	2,859
November	1,225	113	71	214	......	127	165	247	82	295	74	2,613
December	2,152	143	62	156	......	147	300	250	9	232	34	3,485
Total	20,000	1,890	673	1,490	......	1,446	2,880	2,694	689	1,371	627	33,760
1888.												
January	2,650	118	......	292	......	61	246	235	84	179	84	3,949
February	1,730	82	......	156	......	64	105	223	79	243	51	2,733
March	1,400	90	......	150	......	43	95	288	108	270	37	2,481
April	1,579	110	......	138	......	95	143	324	153	292	28	3,862
May	1,610	125	......	155	......	69	226	320	80	357	95	3,037
June	1,500	120	......	189	......	26	94	345	110	454	118	2,956
July	1,100	120	......	167	......	34	50	248	94	463	83	2,359
August	1,109	110	......	215	......	29	......	347	93	527	117	2.547
September	1,178	60	......	195	......	42	......	370	58	357	88	2,348
October	1,269	185	36	180	......	47	......	444	88	294	96	2,635
November	1,400	90	30	176	......	28	......	475	82	220	103	2,604
December	1,475	110	60	151	......	87	......	450	122	192	92	2,739
Total	18,000	1,320	126	2,164	......	625	959	4,065	1,151	3,848	992	33,250
1889.												
January	1,200	65	......	173	......	81	......	385	94	230	109	2,337
February	820	65	......	173	......	45	......	400	76	182	52	1,813
March	1,290	70	......	175	......	34	......	380	89	116	63	2,217
April	1,249	70	......	215	......	30	......	320	92	119	108	2,203
May	870	70	206	192	......	......	......	445	97	132	73	2,085
June	950	75	117	235	......	......	......	415	211	152	63	2,218
July	966	70	124	211	......	41	......	340	135	110	69	2,066
August	1,000	70	64	216	......	17	......	450	168	170	68	2,223
September	970	75	73	224	......	97	......	360	77	136	61	2,073
October	1,300	80	89	164	......	70	......	385	87	214	64	2,453
November	1,800	130	139	150	......	80	......	380	107	134	72	2,492
December	1,185	140	......	155	......	61	......	330	112	179	122	2,284
Total	13,100	980	812	2,283	......	556	......	4,590	1,345	1,874	924	26,464

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna (*a*).	Napa (*a*).	Great Eastern.	Bradford (*b*).	Various mines.	Total.
1890.												
January	952	100	60	109	......	55	......	270	46	75	41	1,708
February	728	60	......	186	......	11	......	245	126	46	60	1,462
March	1,000	57	11	80	......	110	......	265	77	121	111	1,832
April	779	70	1	89	......	48	......	210	109	82	......	1,388
May	1,100	60	......	82	......	70	......	175	84	93	5	1,669
June	1,066	65	......	178	......	111	......	155	74	85	68	1,802
July	1,100	70	......	131	......	106	......	210	70	127	95	1,909
August	1,000	100	80	147	......	129	......	190	153	119	69	1,987
September	1,000	55	120	174	......	202	69	195	66	136	38	2,055
October	1,064	95	111	127	......	203	303	135	58	173	42	2,311
November	1,084	165	97	143	......	115	326	238	78	125	68	2,439
December	1,127	80	25	162	......	174	233	210	105	108	140	2,364
Total	12,000	997	505	1,608	......	1,334	931	2,498	1,046	1,290	737	22,926
1891.												
January	850	60	22	170	......	131	347	260	119	142	216	2,317
February	814	75	70	93	......	274	135	296	121	132	85	2,095
March	827	22	50	130	......	94	......	365	166	75	......	1,729
April	968	65	60	109	......	164	......	315	153	96	48	1,978
May	800	70	123	120	......	76	......	240	67	151	100	1,747
June	700	55	61	126	......	210	......	101	187	104	177	1,721
July	545	55	27	92	......	131	......	235	113	111	164	1,473
August	620	....	27	57	......	243	......	336	98	141	126	1,648
September	500	65	......	122	......	46	......	359	72	49	256	1,469
October	500	95	......	100	......	145	......	413	201	139	97	1,690
November	455	100	2	105	......	130	125	380	136	296	202	1,931
December	621	130	......	151	......	200	242	305	227	250	980	3,106
Total	8,200	792	442	1,375	......	1,844	849	3,605	1,660	1,686	2,451	22,904

a Producton of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Months.	New Almaden.	Napa Consolidated.	Great Western.	Mirabel.	Great Eastern.	Sulphur Bank.	Ætna.	Redington.	Abbott.	New Idria.	Lake.	Various.	Total.
1892.													
January	610	570	298	262	175	105	......	38	75	73	226	42	2,474
February	633	390	583	226	127	129	......	51	46	60	97	41	2,383
March	600	625	625	137	125	96	......	41	58	60	......	5	2,372
April	516	409	620	207	150	127	......	101	40	90	......	10	2,270
May	485	415	563	296	73	130	......	37	67	75	......	......	2,141
June	500	386	500	279	137	120	......	55	20	70	12	......	2,079
July	350	440	588	199	113	110	200	36	71	45	9	8	2,169
August	328	570	547	108	134	106	200	73	50	65	70	......	2,251
September	300	480	379	167	155	120	70	44	89	50	43	94	1,991
October	400	635	437	384	161	125	285	95	62	75	48	......	2,707
November	488	420	382	525	165	112	395	57	58	95	21	......	2,718
December	353	340	345	418	115	113	442	100	36	90	86	......	2,438
Total	5,563	5,680	5,867	3,208	1,630	1,393	1,592	728	672	848	612	200	27,993

Production of quicksilver in flasks in California in 1893, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Great Western.	Ætna.	Napa Consolidated.	Great Eastern.	Mirabel.	Abbott.	Lake.	Total.
January	400	70	109	110	338	242	605	99	746	45	132	2,896
February	390	60	138	110	400	285	450	86	640	18	211	2,788
March	375	55	156	100	201	328	300	96	485	70	......	2,166
April	550	60	144	100	197	110	465	171	525	......	......	2,322
May	600	70	116	100	314	460	735	112	485	......	......	2,992
June	600	60	227	90	320	430	515	128	425	......	12	2,807
July	500	69	92	45	201	330	430	121	150	......	26	1,964
August	500	70	......	123	145	300	340	117	255	......	55	1,905
September	649	60	......	112	137	275	475	100	160	......	35	2,003
October	600	90	......	110	194	285	720	149	420	......	73	2,641
November	650	95	30	100	340	245	370	112	400	......	34	2,376
December	800	110	......	100	400	505	715	154	520	......	......	3,304
Total	6,614	869	1,012	1,200	3,187	3,795	6,120	1,445	5,211	133	578	30,164

The shipments of quicksilver by sea in 1893 were larger than for many years, and were notable for the quantity sent to China late in the year.

Quicksilver shipments in 1893.

By sea to—	Flasks.
New York	6,450
Mexico	3,990
China	3,800
Australia	1,150
Central America	804
Canada	289
New Zealand	87
British Columbia	11
Total by sea	16,581
Total by rail	11,654
Total shipments	28,235

The above are simply the recorded shipments, not including small consignments to local mines. These were sufficient in the aggregate to effect a slight reduction of stock.

Prices.—The San Francisco price opened at $41.50 to $42 per flask. There was an advance of 50 cents a flask twice in the first half of the year, on April 10 and June 12, leaving the market at the close of the first half $43 to $43.50. On August 1, there was a sudden reduction of $3 per flask; on August 24 prices advanced 50 cents. There was another advance on September 13, to $41 and $41.50. After this the tendency was downward. On December 21, a sudden drop was made to $34.50, and later in the month to $30, a price at which very little mining has ever been done at a profit in this country, and it is supposed that most of the mines will close if this low price persists.

Highest and lowest prices of quicksilver in 1893.

[Per flask.]

Months.	San Francisco.		London.	
	Highest.	Lowest.	Highest.	Lowest.
			£ s. d.	£ s. d.
January	$42.00	$39.00	6 5 0	6 2 0
February	42.00	39.00	6 7 6	6 5 0
March	42.00	39.00	6 10 0	6 7 6
April	43.00	40.50	6 15 0	6 10 0
May	43.00	40.00	6 15 0	6 10 0
June	43.50	40.50	6 17 6	6 15 0
July	43.50	40.50	6 17 6	6 15 0
August	41.00	39.00	6 10 0	6 5 0
September	41.50	39.50	6 10 0	6 5 0
October	41.50	40.00	6 10 0	6 5 0
November	41.00	39.50	6 10 0	6 7 6
December	39.50	30.00	6 7 6	6 6 0
Extreme range	43.50	30.00	6 17 6	6 2 0

The following table shows the range in price of quicksilver in the San Francisco and London markets for the past forty-two years:

Highest and lowest prices of quicksilver during the past forty-two years.

[Per flask.]

Years.	Price in San Francisco.		Price in London.	
	Highest.	Lowest.	Highest.	Lowest.
			£ s. d.	£ s d.
1850	$114.75	$84.15	15 0 0	13 2 6
1851	76.50	57.35	13 15 0	12 5 0
1852	61.20	55.45	11 10 0	9 7 6
1853	55.45	55.45	8 15 0	8 2 6
1854	55.45	55.45	7 15 0	7 5 0
1855	55.45	51.65	6 17 6	6 10 0
1856	51.65	51.65	6 10 0	6 10 0
1857	53.55	45.90	6 10 0	6 10 0
1858	49.75	45.90	7 10 0	7 5 0
1859	76.50	49.75	7 5 0	7 0 0
1860	57.35	49.75	7 0 0	7 0 0
1861	49.75	34.45	7 0 0	7 0 0
1862	38.25	34.45	7 0 0	7 0 0
1863	45.90	38.25	7 0 0	7 0 0
1864	45.90	45.90	9 0 0	7 10 0
1865	45.90	45.90	8 0 0	7 17 6
1866	57.35	45.90	8 0 0	6 17 0
1867	45.90	45.90	7 0 0	6 16 0
1868	45.90	45.90	6 17 0	6 16 0
1869	45.90	45.90	6 17 0	6 16 0
1870	68.85	45.90	10 0 0	6 16 0
1871	68.85	57.35	12 0 0	9 0 0
1872	66.95	65.00	13 0 0	10 0 0
1873	91.80	68.85	20 0 0	12 10 0
1874	118.55	91.80	26 0 0	19 0 0
1875	118.55	49.75	24 0 0	9 17 6
1876	53.55	34.45	12 0 0	7 17 6
1877	44.00	30.60	9 10 0	7 2 6
1878	35.95	29.85	7 5 0	6 7 6
1879	34.45	25.25	8 15 0	5 17 6
1880	34.45	27.55	7 15 0	6 7 6
1881	31.75	27.90	7 0 0	6 2 6
1882	29.10	27.35	6 5 0	5 15 0
1883	28.50	26.00	5 17 6	5 5 0
1884	35.00	26.00	6 15 0	5 2 6
1885	33.00	28.50	6 15 0	5 10 0
1886	39.00	32.00	7 10 0	5 16 3
1887	50.00	36.50	11 5 0	6 7 6
1888	47.00	36.00	10 0 0	6 12 6
1889	50.00	40.00	9 15 0	7 10 0
1890	58.00	47.00	10 10 0	9 1 0
1891	51.00	39.50	8 12 6	7 5 0
1892	47.50	41.50	7 10 0	6 2 6
1893	43.50	30.00	6 17 6	6 2 0
Extreme range	118.55	25.25	26 0 0	5 2 6

Production of the Almaden mine (Spain) and the Idria mine (Austria) from 1850 to the close of 1893.

Years.	Almaden.	Idria.	Years.	Almaden.	Idria.
	Flasks.	*Flasks.*		*Flasks.*	*Flasks.*
1850		4,100	1875		10,717
1851		4,092	1876		10,794
1852	101,517	4,085	1877	208,200	11,020
1853		4,409	1878		10,403
1854		4,060	1879		11,153
1855		4,446	1880	41,640	12,356
1856		5,935	1881	50,353	11,333
1857	110,058	9,189	1882	46,591	11,663
1858		4,977	1883	46,143	13,152
1859		8,239	1884	43,099	13,967
1860		4,821	1885	46,739	13,503
1861		6,493	1886	51,199	14,496
1862	122,117	4,712	1887	53,276	14,676
1863		5,878	1888	51,872	14,962
1864		7,263	1889	49,477	15,295
1865		4,908	1890	50,202	14,000
1866		5,327	1891	47,993	15,000
1867	153,224	7,532	1892	57,041	15,500
1868		8,253	1893	44,740	14,240
1869		9,179			
1870		10,745			
1871		10,904			
1872	165,608	11,116			
1873		10,939			
1874		10,789			

The world's production of quicksilver for fourteen years.

[Flasks of 34.5 kilograms, or 76.5 pounds avoirdupois.]

Years.	California.	Spain.		Austria-Hungary.		Italy. (*c*)	Russia.	Total.
		Almaden.	Various. (*a*)	Idria.	Various. (*b*)			
1880	59,926	45,322	(*d*)	12,356	712	4,220	....	122,536
1881	60,851	44,989	(*d*)	11,333	720	4,785	....	132,678
1882	52,732	46,716	2,795	11,663	588	4,900	....	119,394
1883	46,725	49,177	2,165	13,152	709	6,930	....	118,858
1884	31,913	48,098	2,219	13,967	733	8,500	....	105,430
1885	32,073	45,813	2,046	13,503	773	7,540	....	101,748
1886	29,981	51,199	2,277	14,496	1,400	8,235	....	107,588
1887	33,760	53,276	2,894	14,676	1,030	9,220	1,855	116,711
1888	33,250	51,872	1,877	14,962	1,018	10,200	4,777	117,956
1889	26,464	49,477	(*d*)	15,295	(*e*) 1,125	11,174	10,307	113,842
1890	22,926	50,202	(*d*)	14,000	....	12,470	8,918	108,516
1891	22,904	47,993	(*d*)	15,000	....	10,440	10,000	107,317
1892	27,993	57,041	(*d*)	15,500	....	9,000	9,500	119,034
1893	30,164	44,740	(*d*)	14,240	....	8,500	8,000	105,644

a Comprises mines in the provinces of Oviedo, Granada and Cuidad Real.
b Comprises mines in Carniola and in Hungary.
c Figures prior to 1890 taken from monograph on the quicksilver mines of Monte Amiata by P. de Ferrari M. E.
d Included in Almaden.
e Comprisos mines in Carniola only, the production of Hungary not being known.

Quicksilver imported and entered for consumption in the United States 1867 to 1893, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	....	$15,248	June 30, 1881	138,517	$57,733
1868	152	68	1882	597,898	233,057
1869	....	11	1883	1,552,738	593,367
1870	239,223	107,646	1884	136,615	44,035
1871	304,965	137,332	1885	257,659	90,416
1872	370,353	189,943	Dec. 31, 1886	629,888	249,411
1873	99,898	74,146	1887	419,934	171,431
1874	51,202	52,093	1888	132,850	56,997
1875	6,870	20,957	1889	341,514	162,064
1876	78,902	50,164	1890	802,871	445,807
1877	38,250	19,558	1891	123,966	61,355
1878	294,207	135,178	1892	96,318	40,133
1879	519,125	217,707	1893	41,772	17,400
1880	116,700	48,463			

MANGANESE.

By Joseph D. Weeks.

[The ton used in this report is the long ton of 2,240 pounds, if not otherwise designated.]

The origin and occurrence of the ores of manganese as well as the mining localities and the character of the manganese ores of the United States, have been so thoroughly discussed in previous volumes of Mineral Resources, especially in the report on the production of manganese in 1892, that it is unnecessary here to do more than refer the reader who desires information on these points to the previous volumes of this series.

It is necessary to state, however, that the ores of manganese, or those carrying manganese, will be divided for the purpose of this report into four general classes: First, manganese ores; second, manganiferous iron ores; third, manganiferous silver ores; and, fourth, manganiferous zinc ores. The dividing line between the first two grades is taken at 70 per cent. binoxide of manganese, equal to 44.25 per cent. metallic manganese, this being the standard of shipments to English chemical works. All ores containing at least this amount of manganese are classed as manganese ores; those containing a less percentage of manganese, and containing also more or less iron, are classed as maganiferous iron ore. In the third class are included the manganiferous silver ores of Colorado and Montana, which are utilized chiefly for the silver they contain. They have an added value, however, by reason of the fluxing qualities imparted to them by the presence of manganese and iron. In the fourth class is placed the residuum or clinker from the zinc ores of New Jersey.

PRODUCTION OF MANGANESE ORES IN 1893.

The production of manganese ores in the United States in 1893 aggregated but 7,718 long tons, the smallest production of any year since 1883, when the total production was 6,155 tons, and a reduction from 1892, when 13,613 tons were produced, of 5,895 tons, or 43⅓ per cent. The total value of this 7,718 tons was $66,614, an average of $8.63 a ton. The average value per ton in 1892 was $9.52 and in 1891 $10.21.

The amount and value of the manganese ore produced in the United States in 1892 and 1893 is shown in the following table:

Amount and value of manganese ores produced in the United States in 1892 and 1893.

States.	1892.			1893.		
	Product.	Total value.	Value per ton.	Product.	Total value.	Value per ton.
	Long tons.			*Long tons.*		
Arkansas	6,708	$64,838	$9.67	2,020	$24,240	$12.00
California				400	2,000	5.00
Colorado						
Georgia	826	5,782	7.00	724	5,068	7.00
Indian Territory						
South Dakota						
Tennessee				482	4,504	9.34
Vermont						
Virginia	6,079	58,966	9.70	4,092	30,802	7.53
Total	13,613	129,586	(*a*) 9.52	7,718	66,614	(*a*) 8.63

a Average.

In the year 1893 it will be noted that manganese ores were produced in five states, namely, Arkansas, California, Georgia, Tennessee, and Virginia, while in 1892 but three states produced manganese ores, namely, Arkansas, Georgia, and Virginia. In Arkansas production declined from 6,708 tons in 1892 to 2,020 tons in 1893. The Georgia production declined from 826 tons in 1892 to 724 tons in 1893, and the Virginia production declined from 6,079 tons in 1892 to 4,092 tons in 1893, while California and Tennessee, which produced no manganese in 1892, produced, respectively, 400 tons and 482 tons in 1893.

In the following table is shown the production of manganese ores in the United States from 1880 to 1893, the output of the three chief producing states being reported separately, while the production of the other states, which vary greatly, is consolidated.

Production of manganese ores from 1880 to 1893.

Years.	Virginia.	Arkansas.	Georgia.	Other States.	Total.	Total value.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	
1880	3,661		1,800	300	5,761	$86,415
1881	3,295	100	1,200	300	4,895	73,425
1882	2,982	175	1,000	375	4,532	67,980
1883	5,355	400		400	6,155	92,325
1884	8,980	800		400	10,180	122,160
1885	18,745	1,483	2,580	450	23,258	190,281
1886	20,567	3,316	6,041	269	30,193	277,636
1887	19,835	5,651	9,024	14	34,524	333,844
1888	17,646	4,312	5,568	1,672	29,198	279,571
1889	14,616	2,528	5,208	1,845	24,197	240,559
1890	12,699	5,339	749	6,897	25,684	219,050
1891	16,248	1,650	3,575	1,943	23,416	239,129
1892	6,079	6,708	826		13,613	129,586
1893	4,092	2,020	724	882	7,718	66,614
Total	154,800	34,482	38,295	15,747	243,324	2,418,575

PRODUCTION OF MANGANIFEROUS IRON ORES.

No attempt has been made to collect the statistics of the production of manganese-bearing iron ores except in cases where the manganese has added somewhat to their value.

The following table shows the production of manganiferous iron ores in the United States in 1893:

Production of manganiferous iron ores in the United States in 1893.

Localities.	Product.	Percent. of manganese.	Value per ton.	Total value.
	Long tons.			
Arkansas	160	28	$2.00	$320
Colorado	5,766	30	4.00	23,064
Lake Superior	110,648	4.67 to 22	2.32	257,147
North Carolina	20	20		
Virginia	1,188		2.20	2,697
Total	117,782	4.67 to 30	2.40	283,228

All the manganiferous iron ore reported in 1891 was from the Lake Superior region. In 1892 the production was from Colorado, the Lake Superior region, and Virginia. The total production in 1892 was 153,373 tons, valued at $354,664 or $2.31 a ton, the percentage of manganese running from 4 to 38. In 1893 the production had dropped to 117,782 tons; the average value increased somewhat, being $2.40 a ton, and the percentage of manganese was from 4.67 to 30.

In the following table is shown the total production of manganiferous iron ores in the United States from 1889 to 1893:

Total production of manganiferous iron ores in the United States from 1889 to 1893.

Years.	Total product.	Total value.	Value per ton.
	Long tons.		
1889	83,434	$271,680	$3.26
1890	61,863	231,655	3.74
1891	132,511	314,099	2.37
1892	153,373	354,664	2.31
1893	117,782	283,228	2.40
Total	548,963	1,455,326	2.65

PRODUCTION OF MANGANIFEROUS SILVER ORES.

The manganiferous silver ores produced in the United States in 1893, of which we have any report were chiefly from Colorado from the Leadville district, and some small amounts from Montana.

The total production was 55,962 tons. A value was given only for the Colorado ore, which was valued at $258,695, or $4.75 a ton. Of this ore 12,642 tons contained 20 per cent. of manganese or over, the average being about 25 per cent., while 41,820 tons carried under 20 per cent., averaging 15 per cent. Of the Montana ore 1,255 tons carried 5.9 per cent. to 9.6 per cent. of manganese; the remainder 5 to 7 per cent. The production in 1892 was 62,309 tons, valued at $323,794, or $5.20 a ton.

The total production of manganiferous silver ore in the United States from 1889 to 1893, for which returns have been received, is given in the following table, the entire production being from Colorado, except as noted:

Production of manganiferous silver ores in the United States from 1889 to 1893.

Years.	Containing 20 per cent. and over.	Containing less than 20 per cent.	Total.	Total value.	Average value per ton.
	Long tons.	*Long tons.*	*Long tons.*		
1889	9,987	55,000	64,987	$227,455	$3.50
1890	7,826	44,014	51,840	181,440	3.50
1891	19,560	59,951	79,511	397,555	5.00
1892	17,047	45,262	62,309	323,794	5.20
1893	12,642	(*a*) 43,320	(*a*) 55,962	258,695	4.75

a Including 1,500 tons from Montana for which no value is given.

PRODUCTION OF MANGANIFEROUS ZINC ORES IN THE UNITED STATES.

As has previously been explained by manganiferous zinc ores is meant the residuum or clinker left from the working of the zinc ores at Franklin, New Jersey. The production of this class of manganiferous ores in 1893 was 37,512 tons, as compared with 31,859 tons in 1892. It is difficult to fix a price for this residuum. In some cases it is charged on the furnace books—the furnaces being owned by the zinc producers—at the cost of handling and freight to the furnace, the clinker itself being regarded as of no value. In other cases a value of $1.25 a ton is placed upon the ore. The price assumed in 1892 was 81.4 cents a ton. In view of the above facts it can not be claimed that this is an accurate price, but considering the uncertainty as to what it should be regarded as worth, this is as good a value as any, and has, therefore, been taken as the value of the product of 1893, which gives $30,535 as its value in that year.

In the following table will be found a statement of the product of the manganiferous zinc ores in the United States from 1889 to 1893:

Product of manganiferous zinc ores in the United States from 1889 to 1893.

Years.	Quantity.	Value.
	Long tons.	
1889	43,648	$54,560
1890	48,560	60,700
1891	38,228	57,432
1892	31,859	25,937
1893	37,512	30,535

Imports of manganese.—The following table shows the amount of manganese, including both that classed as manganese ore and oxide of manganese, imported and entered for consumption into the United States in the years 1889 to 1893, these imports being for calendar year.

Manganese imported and entered for consumption into the United States, 1889–1893.

Years.	Ore.		Oxide of.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1889	4, 135	$72, 391	151	$6, 000
1890	33, 998	509, 704	156	7, 196
1891	28, 624	371, 594	201	9, 024
1892	58, 364	830, 006	208	10, 805
1893	67, 717	860, 832	396	19, 406

Imports of manganese ore and oxide for the fiscal year ending June 30, 1893.

AT PHILADELPHIA.

	Value.
Ore from Antwerp and Hamburg	$1, 050
Carrigal, Chile	22, 474
Santiago de Cuba, Cuba	82, 201
Total (16,178,759 pounds)	105, 725
Oxide from Glasgow, Scotland (22,620 pounds)	473

AT BOSTON.

	Pounds.	Value.
Ore from Halifax, Nova Scotia	24, 892	$1, 087
Port Hawkesbury, Nova Scotia	20, 160	293
Hamburg, Germany	132, 055	3, 181
Odessa, Russia	10, 978	79
Total	188, 085	4, 640
Oxide from Glasgow, Scotland	22, 790	491

AT NEW YORK.

	Quantity.	Value.
	Tons.	
Ore from Saint Giron de France	2, 004	....
Yokohoma, Japan	1, 108	....
Batoum, Russia	449	....
St. Johns, New Foundland	70	....
Arnstadt, Germany	129	....
London, England	98	....
Auckland, New Zealand	47	....
Total (8,747,200 pounds)	3, 905	$55, 450
	Pounds.	
Oxide from Bremen, Hamburg, Antwerp, and Leipsic, Germany	274, 680	
London and Liverpool, England	77, 852	
Total	352, 532	$2, 717

AT BALTIMORE (*a*).

From Santiago de Cuba, Cuba	29, 618, 590	....
Poti, Russia	31, 174, 547	....
Milo, Greece	6, 041, 706	....
Coquimbo, Chili	5, 026, 488	....
Liverpool, England	59, 183	....
Huelva, Spain	1, 119, 937	....
Total	73, 040, 451	....

a During the calendar year, 1892.

ALABAMA.

But little manganese ore proper has ever been produced in a commercial way in Alabama, though at times the brown hematite iron ores of this State carry a considerable percentage of manganese. As early as 1875 ore of this character was utilized in the furnaces of the Woodstock Iron Company, at Anniston, Calhoun county, in the manufacture of spiegeleisen. The ores were manganiferous iron ores carrying about 20 per cent. of manganese. Recent analyses do not give so large a percentage of manganese, 12 per cent. being a better average. They occurred in connection with the iron ores of the neighborhood, sometimes as veins or crusts, from 1 to 3 feet in thickness, resting upon the iron ore, in other cases in chimneys or pockets in the ore belt or vein.

Analyses of these ores are as follows:

Analyses of manganiferous iron ores from Woodstock, Alabama.

Constituents.	No. 1.	No. 2.
	Per cent.	*Per cent.*
Metallic iron	38.50	41.76
Metallic manganese	11.44	13.68
Silicon	11.45	24.65
Phosphorus	0.27	0.55
Combined water	11.62	10.66

In a paper on the geology of Alabama, read before the American Institute of Mining Engineers, by Mr. E. J. Schmitz, of New York, the following analyses of manganese are given, but there is no information about the deposits from which the samples were taken:

Analyses of manganese ores from Alabama.

Nos	Varieties.	Formations.	Counties.	Peroxide manganese.	Specific gravity.
				Per cent.	
1	Pyrolusite	Metamorphic	Chilton	71.22	....
2	Psilomelane	Silurian	Talladega	62.73	3.712
3	......do	Metamorphic	Randolph	63.25	3.988

It seems hardly possible that these ores can exist in any quantity in Alabama, or certainly some use would have been made of them in the ten years that have elapsed since attention was called to them.

The only ore shipped from this State of which we have any record was late in 1886, from Stocks Mills, in Cherokee county. The operations showed the existence of a series of small pockets yielding an ore low in phosphorus, analyzing about 45 per cent. of manganese, 0.08 per cent. phosphorus, 5 per cent. iron, and 8 per cent. silica. The total amount mined was only about 75 tons.

The recent report of Dr. E. A. Smith, State Geologist of Alabama, on the geology, minerals, etc., of Murphrees valley, discusses at some length the manganese ores of that section. These ores, he states, are 50 to 150 feet above the black shale, in what is termed the "Lower Siliceous group." Occasionally traces of them are found as high up as the La Grange sandstone. Quite a number of places are described in this Murphrees valley, where manganese has been found. The first prominent exposure of the ores is a little southwest of where the Locust Fork of the Warrior crosses the valley, and on the northwest side of Red mountain. At this point great bowlders of chert and quartz cemented together with intermingled manganese, as well as a great bed of "pulverulent black oxide of manganese, about 4 feet thick and covering about an acre of ground," are found. This "curious black stuff" had been opened up with pits and holes, and showed "numerous small chunks of pyrolusite and manganite," "seldom more than 2 or 3 pounds weight, well rounded and smooth on the surface, lying principally in seams and layers;" "near the bottom of the deposit the ore chunks are more numerous," Mr. Smith suggests that "without washing" this deposit "would not give a high enough percentage of dioxide of manganese to be marketable." Southwest of this, outcrops of pyrolusite were found, and just beyond a deposit of soft manganiferous iron ore of a dark blue color carrying, it was estimated, 20 per cent. of manganese.

The best exposure of pyrolusite is at Dabb's bed, in section 21. The bed seemed to vary from 2½ to 4 feet in thickness; the ore was found in small masses, carrying, it is stated, 60 to 75 per cent. of dioxide of manganese.

Quite a number of other localities that give promise of manganese are noted. Mr. Smith states, as the result of his investigations, that the great bulk of the ores will be found in the Sand valley and on the northwest side of Red mountain, and that the discoveries so far made are in the main accidental, and that probably the larger portion of the deposits that exist are as yet undiscovered.

ARKANSAS.

Nothing can be added to what has been said in previous volumes of Mineral Resources regarding the manganese deposits of Arkansas. No new localities have been discovered. Mining in 1893 was carried on only in the Batesville district, and for the last half of the year operations practically ceased at the mines of this district. One concern reports as the cause for shutting down that they had no market, not being able to sell a pound, but carrying a large proportion of their product for the first half of the year in stock.

The total production of high-grade manganese in Arkansas in 1893 was 2,020 tons. This ore averaged from 50 to 52 per cent. of manganese. In view of the fact stated above that there was but little sale for manganese produced in 1893 it is difficult to place a value upon the product. Our reports give $12 as the price, which is accepted in lieu of more definite figures, though it is regarded as nominal, and not the price at the mines. This would make the value of manganese ore produced in Arkansas in 1893, $24,240.

For the first time in these reports Arkansas appears as a producer of manganiferous iron ore, 160 tons of a 28 per cent. ore having been produced in this State in 1893. This was from a mine that has produced high-grade manganese in the past.

The total production of manganese in Arkansas in 1893 was, therefore, 2,020 tons of high-grade manganese and 160 tons of a 28 per cent. manganiferous iron ore.

In the following table, which gives the production of manganese in Arkansas since the beginning of shipments in 1850, the figures from 1885 to 1893 have been verified by statements of shipments kindly furnished by the officers of the St. Louis, Iron Mountain and Southern railroad:

Production of manganese in the Batesville district of Arkansas to December 31, 1893.

Years.	Authorities.	Long tons.
1850 to 1867	Estimated	400
1868	do	10
1881	Railroad reports of shipments	100
1882	do	175
1883	do	400
1884	do	800
1885	Mineral Resources of the United States	1,483
1886	do	3,316
1887	do	5,651
1888	do	4,312
1889	Census	2,528
1890	Mineral Resources of the United States	5,339
1891	do	1,650
1892	do	6,708
1893	do	(*a*) 2,180

a One hundred and sixty tons manganiferous iron ore.

CALIFORNIA.

But one of the two manganese mines in California was in operation in 1893, the one near Alameda, in Alameda county, which produced 400 tons carrying about 65 per cent. of binoxide of manganese, the value at the mines being $2,000. As has heretofore been stated there is but a small demand for manganese ores on the Pacific coast, chiefly for use in the manufacture of chlorine gas to be used in working sulphuret gold ores. The total amount of manganese produced in California up to the close of 1890 is estimated to be between 6,000 and 6,500 tons. This estimate is made on the basis that 5,000 tons was mined for shipment to England from 1867 to 1874. After 1874 only small amounts were produced each year, none being produced in 1892, and in 1893, as stated above, the product was 400 tons.

As nearly as can be ascertained, the following table represents the production of manganese in California from the beginning of mining to the close of 1893:

Total production of manganese in California to December 31, 1893.

Years.	Tons.
1874 to 1888	6,000
1889	53
1890	386
1891	705
1892	....
1893	400
Total	7,544

COLORADO.

Colorado produces two classes of manganese-bearing ores. First, a manganiferous silver ore carrying not only manganese and iron, but considerable silver. This ore is used as a flux in the smelting of silver-lead ores, and has an additional value because of the manganese it carries. The manganiferous iron ores carry, as a rule, but little silver, though some slags from the blast furnaces of Colorado Fuel and Iron Company, formerly the Colorado Coal and Iron Company at Pueblo, where these manganiferous iron ores are used in the manufacture of spiegeleisen, are so high in silver as to make it profitable to rework them for the recovery of the silver.

The total production of manganiferous iron ores in Colorado in 1893, which was sold as manganese ores, was 5,766 tons, valued at $23,064, or $4 a ton. This ore is a mixture of manganic and ferric oxides with some silica, etc. It occurs with the silver-lead ores in contact deposits between limestone and porphyry in the Leadville region. As is stated above, this ore is used in the manufacture of spiegeleisen at Pueblo. The contract price for the ore at the mines was $3.50 per ton for ore carrying 25 per cent. of manganese, and 10 cents additional for each unit of manganese in excess of 25. The only manganiferous ore produced at Leadville which is offered to the steel works is that containing none of the precious metals. This ore rarely contains more than 7 per cent. of silica. If it does there is a deduction of 10 cents per unit for each unit of silica in excess of seven. The phosphorus must also be low. The manganese and silica are determined on each shipment, and the shipments in 1893, as noted above, carried 30 per cent. of manganese, making the value of the ore $4 a ton.

The second class of manganese ores obtained in Colorado are those that carry some silver and hence are designated as manganiferous silver ores. These have been fully described in previous volumes of Mineral Resources, and briefly in a previous part of this report. The total amount of manganiferous silver ores shipped in 1893 was 54,462 tons. Of this, 12,642 tons contained 20 per cent. and above of manganese, the average being 25 per cent., and 41,820 tons contained under 20 per cent., the average being 15 per cent. The shipments and average value from several mines were as follows:

Shipments of manganiferous silver ore from several mines in Colorado in 1893, with their percentage of manganese and value.

Amounts of shipments.	Percentage of manganese.	Value per ton.
Tons.		
2, 163	18	$3. 68
1, 878	20	3. 50
1, 668	11	3. 98
150	12	3. 50
2, 064	4½	. 45
13, 665	9	. 90

In the last two items in the above table the value is the value of the manganese in the ore. To this value must be added the value of the silver. From the best data obtainable it is assumed that the value of the manganiferous silver ore produced in Colorado in 1893 was $258,695, or $4.75 a ton.

The writer again desires to express his great indebtedness to Mr. Franklin Ballou for assistance in collecting the statistics of production of manganiferous silver ores in Colorado, and to Mr. R. C. Hills, geologist of the Colorado Fuel and Iron Company, for assistance in collecting the statistics of the production of manganiferous iron ore.

The statistics of the production of manganese-bearing ore in Colorado from 1889 to 1893, are as follows:

Production of manganiferous ores in Colorado from 1889 to 1893.

	1889.	1890.	1891.	1892.	1893.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Manganiferous iron ores used for spiegeleisen	2, 075	....	964	3, 100	5, 766
Manganiferous silver ores, with 20 per cent. and over of manganese.	9, 987	7, 826	19, 560	17, 047	12, 612
Manganiferous silver ores with less than 20 per cent. of manganese..	55, 000	44, 014	59, 951	45, 262	41, 820
Total	67, 062	51, 840	80, 475	65, 409	60, 228

GEORGIA.

While Georgia still ranks third among the States in point of production of high grade manganese, the output for 1893 was less than in 1892, being but 724 tons as compared with 826 tons in 1892, and 3,575 tons in 1891. As far as could be ascertained the average value of this ore free on board at mines was $7 a ton, making the total value of the manganese produced in Georgia but $5,068.

This great reduction in production in this State is due chiefly to the pockety character of the deposits, though somewhat to the falling off in the demand for the ore, owing to the character of the market in 1893 and to the discovery and working of the enormous deposits in Russia. Possibly if the demand and price were better, mining would be resumed at many points where no work is now being done and search for additional pockets would be active, resulting no doubt in the discovery of ore in paying quantities.

Practically all the ore mined in Georgia is from the Cartersville district, in which mining began in 1866. The ore varies greatly in character. Much of that mined in 1893 was higher than the average of past years, some mines yielding an ore running as high as 48 per cent. The probability is that the average of the ore shipped from Georgia in 1893 was considerably above the average for previous years.

Descriptions of the manganese belt and methods of mining can be found in the report on manganese in the Mineral Resources, volume for 1892.

The following table shows the production of manganese mined in Georgia since 1866:

Production of manganese ore in Georgia from 1866 to 1893, inclusive.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1866	550	1880	1,800
1867		1881	1,200
1868		1882	1,000
1869		1883	
1870	5,000	1884	
1871		1885	2,580
1872		1886	5,981
1873		1887	9,024
1874	2,400	1888	5,568
1875	2,400	1889	8,208
1876	2,400	1890	749
1877	2,400	1891	3,575
1878	2,400	1892	826
1879	2,400	1893	724

It is exceedingly difficult to ascertain the actual value, as the ore is often sold delivered at certain points, and the transportation expenses to these points vary greatly.

INDIAN TERRITORY.

No manganese was produced in the Indian Territory in 1893, though deposits of considerable extent have been discovered in the Territory. The total production of the Territory, so far as has been ascertained, was 93 tons of black oxide.

LAKE SUPERIOR REGION.

Little can be added to what has been said in previous reports regarding the character of the manganiferous iron ores of the Lake Superior region. Strictly speaking, there are no manganese mines in this region, but a number of iron ore mines produce an ore sufficiently high in manganese to justify its grading usually into three grades, sometimes into two only, one grade being iron ore proper and the other grades those containing 4 per cent. or more of manganese. When a third grading is made it is usually on the basis of a 10 per cent. ore or higher.

During 1893 the Lake Superior region, chiefly the Gogebic and Marquette districts, produced 110,648 tons of manganiferous iron ore carrying from 4.67 to 22 per cent. of manganese, valued at $257,147, or $2.32 a ton.

The production of manganiferous iron ore in the Lake Superior region, so far as it has been ascertained, is as follows:

Production of manganiferous iron ore in the Lake Superior regions from 1886 to 1893.

Years.	Product.	Average per cent. of manganese.
	Tons.	
1886	100,000	2
	157,000	4
Total	257,000	
1887	200,000	4
	10,000	10
Total	210,000	
1888	189,574	4
	11,562	11
Total	201,136	
1889	50,018	6.74
	31,341	9+
Total	81,359	
1890	61,863	....
1891	13,711	4.68–17.96
	11,015	10
	9,213	9.68
	98,572	5.38
Total	132,511	
1892	6,710	4.893
	102,695	5
	7,500	8
	8,272	9.998
	22,254	12.028
Total	147,431	
1893	27,353	4.67
	55,009	7.61
	15,102	7.77
	5,051	10.40
	7,833	14
	300	22
Total	110,648	

MAINE.

No manganese was mined in this State in 1893, though it is expected that the manganese mines near Blue Hill, which have been described in previous volumes of Mineral Resources, will be put in operation in 1894.

MONTANA.

Manganiferous silver ores similar in character to those of Colorado are found in Montana, at Neihart, Meagher county. They occur in the form of black and brown oxides covering the sulphide ores of silver. The ore is associated with sulphate of baryta.

But little account is taken of the manganese, it being shipped to Great Falls to assist in smelting the silver ores. At Castle, Meagher county, are some very large veins of black oxide of a purer quality than that at Neihart. These carry small amounts of lead, but at present they are not worked.

So far as has been ascertained these are the only deposits of manganiferous silver ores in north Montana.

Through the courtesy of Mr. Frank M. Smith, superintendent of the United Smelting and Refining Company's smelter, Montana, we have the following statement regarding the shipments of silver-bearing manganiferous ores from Meagher county, Montana.

"The shipments were practically from one camp, Neihart, and the greater bulk from one mine, the Galt. This ore was all shipped to the United Smelter so that its receipts really represent the total output. The manganese contents are quite small, usually running from 5 to 7 per cent. In lead smelting, manganese is of value to the smelter as a flux and in practice is treated the same as iron. It is also of value to the miner in this way. Smaller prices are charged for treatment according as the percentages of iron and manganese are higher and that of silica lower. In other words, the treatment charges increase with the excess of silica, and therefore the manganese contents are of importance in determining this excess."

The following are a few average analyses of manganiferous silver ore from the Galt mine.

Analyses of manganiferous silver ores from the Galt mine, Montana.

	4 cars, Apr., 1893	5 cars, June, 1893.	5 cars, Oct., 1893.	6 cars. Dec., 1893.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica	18.8	23.2	21.4	26.7
Iron	5.5	6.5	5.8	5.3
Manganese	6.9	9.6	6.7	5.9
Sulphur	5.0	4.2	5.0	3.5
Zinc	6.9			
Barium sulphate	28.3	23.4	25.2	22.2
Alumina (about 6 per cent)				
Lead	8.7	5.6	6.0	9.1
Silver, ounces per ton	128.7	72.0	77.4	105.6

"There were received in 1893 from the Galt Mining company 2,509,432 pounds, or 65 car loads, of ore, amounting therefore to 1,254.7 tons. The receipts of ore from other mines, including the Nevada, Lizzie, and others, which contained from 5 to 7 per cent. of manganese, would probably bring the total output of this character of ore up to 1,500 tons for 1893."

NEW JERSEY.

The only manganese-bearing ores produced in New Jersey are the zinc ores of Sussex county. These ores, which the writer has termed manganiferous zinc ores, are mined primarily for their zinc contents, though carrying from 2 to 20 per cent. of manganese.

The production of these ores since 1889, at which time the statistics of their production were first ascertained, is given elsewhere in this report under the title Production of Manganiferous Zinc Ores, page 122.

SOUTH DAKOTA.

Considerable manganese, varying in richness from 30 to 92 per cent. binoxide and from 0.05 to 0.40 of phosphorus is found in Custer county, South Dakota. But there is little use for it in the neighborhood of the mines, and the cost of transportation to market is too great to justify the shipping of any but the highest grade ore. Arrangements are in progress looking to the mining of some of the highest grade of this ore for shipment to chemical works.

NORTH CAROLINA.

But one shipment of manganese, a sample lot of 20 tons from Gaston county, is reported from North Carolina in 1893. This was from the outcrop of a vein near the surface and had the following composition:

Analysis of manganese from North Carolina.

Constituents.	Per cent.
Silica	3.6
Iron	6.0
Manganese	20.0

The ore had no value.

The production of manganese in this State from 1886 to 1893, so far as it has been ascertained, is as follows:

Production of manganese in North Carolina from 1886 to 1893.

Years.	Long tons.
1886	15
1887	14
1888	50
1889	47
1890	14
1891	....
1892	....
1893	20

SOUTH CAROLINA.

No manganese was produced in this State in any of the years from 1890 to 1893, though there are quite extensive deposits of both manganese and manganiferous iron ores in the State, some of it of a very high grade. One mine near Abbeville, which has not been worked for six or eight years, produced an ore running from 40 to 50 per cent. of manganese, which was shipped to Liverpool for chemical purposes. The price obtained, however, is not sufficient to make the mining and transportation of the ore profitable.

The total production of manganese ore in South Carolina, so far as the same has been ascertained, is given in the following table:

Total production of manganese ore in South Carolina.

Years.	Tons.
1885 and 1886	300
1887	45
1888	50
1889	124
1890	....
1891	....
1892	....
1893	....

TENNESSEE.

For the first time in many years Tennessee appears as a shipper of manganese, 482 tons of a high grade, valued at $4,504, having been produced in the State in 1893.

The shipments were from two sections, the larger amount, some 285 tons, being shipped from a mine at Sweet Water in Monroe county, where the Watts Steel and Iron Syndicate, limited, is operating, and the smaller amount, 197 tons, from two mines in Unicoi county.

The ore from Monroe county showed the following composition:

Analysis of manganese ore from Monroe county, Tennessee.

Constituents.	Per cent.
Iron	3 to 8
Manganese	45 to 55
Phosphorus	0.12 to 0.15

The average analysis of this ore showed 52.393 per cent. of manganese, a most excellent ore.

The ore shipped by the Dent Mining Company, of Unicoi, ran as follows:

Analysis of manganese ore from Unicoi county, Tennessee.

Constituents.	Per cent.
Iron	6.50 to 8.50
Manganese	45 to 47
Phosphorus	0.20 to 0.24

This mine was only opened in October, 1893, and the ore shipped should not be taken as characteristic of the mine. The deposit, like all others in this region, is in pockets, which seem quite large and abundant. Should the demand justify it, large amounts will be shipped in 1894.

There are other deposits in Unicoi county which carry considerable manganese, but are too high in phosphorous to be available at the present time.

The first manganese produced in the United States, so far as has been ascertained, was mined in Tennessee for use in coloring earthenware. The production at this mine was begun in 1837, and it still continues, but has never amounted to more than a few hundred pounds each year. Outside of this, up to 1893, so far as has been ascertained, but 96 tons of manganese have been produced in this state.

The total production of manganese ore from 1886 to 1893, so far as the same has been ascertained, with the exception of that produced for coloring earthenware, is as follows:

Production of manganese in Tennessee from 1886 to 1893.

Years.	Production.
	Tons.
1886	50
1887	0
1888	16
1889	30
1890	0
1892	0
1893	482

VERMONT.

This State, which at one time gave promise of being an important source of manganese, produced no ore either in 1892 or in 1893. The only work being done in the State is at the South Wallingford mines of Bradley and Lyons, where most of the ore produced in the State since 1888 has been mined. At these mines drifts are being run deeper into the mountain in which the ore occurs and new portions of the mine opened.

The ore at this mine occurs between walls, or, as it is described, in a large channel from 100 to 150 feet across. The ore is found on the eastern wall, and appears to be continuous or in the form of a vein. It is believed that the work at present in progress will develop new bodies of ore.

The production of manganese in Vermont since 1888 is given in the following table:

Production of manganese in Vermont from 1888 to 1893.

Years.	Long tons.
1888	1,000
1889	1,576
1890	0
1891	49
1892	....
1893	....

VIRGINIA.

Though there was a material decline in the production of manganese in Virginia in 1893, this State has again resumed the first rank as a producer of manganese ores in the United States, from which it was displaced by Arkansas in 1892. The total production of manganese ores proper in Virginia in 1893 was 4,092 tons as compared with 6,079 tons in 1892. The production of manganiferous iron ores has also fallen from 2,842 tons in 1892 to 1,188 tons in 1893. As was the case in 1892, the chief cause of the decline in production of manganese ores in Virginia was the reduced production at Crimora. The production at this mine in 1893 was but 2,597 tons as compared with 4,389 tons in 1892 and 13,645 tons in 1891. The Crimora mines have not produced as small an amount of manganese since 1882, when the production was 1,652 tons.

The manganese-ore deposits of Virginia have been so thoroughly described in previous volumes of Mineral Resources that it is not necessary to repeat the descriptions here. There have been no new developments of any importance in Virginia in 1893. This State still has more known deposits of this mineral, which are spread over a greater extent of territory than any other State. More localities have been worked and more manganese has been raised here than in any other State. The chief manganese production in this State has been in the Shenandoah valley. In this valley, south of Roanoke, there are very promising indications, but no great amount of ore has been raised. In addition to the manganese ore that is produced in the Shenandoah valley, chiefly from Crimora, manganiferous iron ore is now produced there in the Blue Ridge mountains in Augusta county.

The production of the Crimora mine and the adjoining mine, the Old Dominion, which were worked as one from 1886 to 1890, and from which the larger proportion of the manganese ore mined in Virginia was taken, has been as follows:

Product of the Crimora mine, Virginia.

Years.	Tons.
Prior to 1869	5,684
May, 1869, to February, 1876	280
February, 1876, to December, 1878	2,326
December, 1878, to December, 1879	1,602
1880	2,963
1881	2,495
1882	1,652
1883	5,185
1884	8,804
1885	18,212
1886	19,382
1887	19,100
1888	16,100
1889	12,974
1890	11,332
1891	13,645
1892	4,389
1893	2,597

The total production of manganese in Virginia from 1880 to 1893, inclusive, is shown in the following table:

Production of manganese ore and manganiferous iron ore in Virginia from 1880 to 1893.

Years.	Manganese ore.	Manganiferous iron ore.
	Tons.	*Tons.*
1880	3,661	
1881	3,295	
1882	2,982	
1883	5,355	
1884	8,980	
1885	18,745	
1886	20,567	
1887	19,835	
1888	17,646	
1889	14,616	
1890	12,699	
1891	16,248	
1892	6,079	2,842
1893	4,092	1,188

CANADA.

Most of the manganese mined in Canada is from the deposits of Nova Scotia and New Brunswick, described below, and some small amounts are from time to time mined in Quebec, but the deposits are of comparatively little importance.

According to the reports on the mineral production of Canada published by the Geological Survey Department of Canada, the total production of manganese ore in the Dominion and the value of the same, 1886 to 1893, is as follows:

Production and value of Canadian manganese ore, 1886 to 1893.

Year.	Product.	Value.
	Tons.	
1886	1,789	$41,499
1887	1,245	43,658
1888	1,801	47,944
1889	1,455	32,737
1890	1,328	32,550
1891	255	6,694
1892	115	10,250
1893	228	14,458

New Brunswick.—Two classes of manganese ore are mined in this province, one known locally as "gray ore" or "needle ore," which is pyrolusite, the other a brown ore, known as "blast-furnace ore." The most important deposit in the province is at Markhamville, near the town of Sussex, Kings county. This mine has produced some of the highest-grade manganese found in the world. The ore occurs in the Carboniferous limestone in beds and pockets. The other deposits of this province are of but little importance. Work was practically suspended at the mine in 1893.

The only statements of production are exports, which are regarded as showing the total product. On this basis the production of manganese in New Brunswick since 1868 is as follows:

Production of manganese ores in New Brunswick, 1868 to 1893, and value of same.

Years.	Product.	Value.	Years.	Product.	Value.
	Long tons.			*Long tons.*	
1868	861	$19,019	1881	1,504	$22,532
1869	332	6,174	1882	771	14,227
1870	140	3,580	1883	1,013	16,708
1871	954	8,180	1884	469	9,035
1872	1,075	24,495	1885	1,607	29,595
1873	1,031	20,192	1886	1,377	27,484
1874	776	16,961	1887	837	20,572
1875	194	5,314	1888	1,094	16,073
1876	391	7,316	1889	1,377	26,326
1877	785	12,210	1890	1,729	34,248
1878	520	5,971	1891	233	6,131
1879	1,732	20,016	1892	....	....
1880	2,100	31,707	1893	10	112

Nova Scotia.—Manganese has been mined in this province at least since 1861. The ores, nature, and mode of occurrence of manganese in Nova Scotia are similar to those of New Brunswick, though the production is much smaller than that of the latter province. The ore of Nova Scotia, however, averages a much higher grade than that of New Brunswick. The most important mine in Nova Scotia is on the south shore of Minas basin, midway between Noel and Walton, known as the Teny cape, which, since its discovery in 1862, has been operated more or less extensively. Deposits similar to that at Teny cape have been worked at other places on the south shore of the Minas basin, while on the north shore no important deposits have been noted, though some of the iron ores in the neighborhood of Londonderry are highly manganiferous. This is also the case with many of the iron ores of both Colchester and Pictou counties.

The production of manganese in Nova Scotia since 1861, so far as the figures have been ascertained, is given in the following table.

Production of manganese in Nova Scotia from 1861 to 1893.

Years.	Product.	Value.	Years.	Product.	Value.
	Tons.			*Tons.*	
1861 to 1871	1,500	$10,500	1883	150	$12,462
1872	40	1,400	1884	302	23,830
1873	131	....	1885	354	....
1874	6	12	1886	465	13,349
1875	7	....	1887	665	21,683
1876	21	723	1888	106	6,460
1877	97	5,335	1889	200	....
1878	127	6,505	1890	112	....
1879	145	7,170	1891	41	....
1880	283	14,831	1892	111	8,691
1881	231	18,022	1893	123½	12,409
1882	209	11,520			

CUBA.

The principal Cuban deposits of manganese, which are located in the province of Santiago de Cuba, have already been thoroughly described. The most abundant ores are pyrolusite and psilomelane. The exportation of manganese ore from the mines near Santiago since 1888 is as follows:

Exportation of manganese ores from Santiago district, Cuba, from 1888 to 1893.

Years.	Tons.
1888	1,942
1889	704
1890	21,810
1891	21,987
1892	18.751
1893 (First six months)	10,640
Total	75,834

CHILE.

In the volume of Mineral Resources for 1892 the deposits of manganese ore in Chile and their character were very thoroughly discussed, and the discussion need not be repeated here. The material is of a very high grade, and Chile shares with Russia and Japan in supplying the world's demand for a high-grade ore.

The production of Coquimbo since 1885 and Carrizal since 1886 and the total production of Chile since 1885, in long tons, is as follows:

Production of Chilean manganese, 1885 to 1891.

	Coquimbo.	Carrizal.	Total Chile.
	Long tons.	*Long tons.*	*Long tons.*
1885	4,041	....	4,041
1886	23,701	227	23,928
1887	38,234	9,287	47,521
1888	12,132	6,581	18,713
1889	9,145	19,538	28,683
1890	23,409	24,577	47,986
1891	16,462	18,000	34,462

RUSSIA.

For its supply of manganese the world is depending chiefly upon the mines of Russia, and especially upon those in the Caucasus. Compared with the production of Russia, the production of the other nations of the world can be regarded as exceedingly small.

Manganese is mined to a large extent in three provinces of Russia, namely, the Caucasus, South Russia, and the Urals.

In the Urals, manganese deposits are worked in the government of Perm, in the region of the Nizhni-Taghilsk works, and also in the government of Orenburg.

The deposits in South Russia are in the government of Ekaterinoslav, near Nikopol, where they occur in beds 3½ feet thick in Eocene rocks. Nikopol is in South Russia, some 125 miles north of the western extremity of the sea of Azov, and on the Dneiper river, some 100 miles from its entrance into the gulf of Odessa. These deposits were first worked in 1886. The better class of ores carries some 57 per cent. of manganese. The mines of manganese in the Caucasus region are limited almost exclusively to the Sharopan district of the government of Kutais. These mines are not far from the extreme eastern shore of the Black sea, near Poti, some 26 miles from Kvirili station, on the Trans-Caucasian railway. This ore carries about 56 per cent. of metallic manganese. There are also deposits of manganese ore near the Samtredi and Novo-Senaki railway stations. Manganese ore is also produced to a small extent in other parts of the district of Kutais and in the government of Tiflis.

The most important mines, however, and the ones that are of especial importance to the producers and consumers of manganese in other sections of the world, are those of Sharopan.

British Consul Stevens has lately made a report on the manganese ore of Sharopan, from which we make the following extracts:

"The manganese-ore industry of the district of Sharopan, government of Kutais, is one of the chief sources of Caucasian wealth. Its significance, even in its present early period of existence, is a question of vital importance to the population of the government of Kutais, as also to the whole of the Russian Empire; for Russia, which annually furnishes over 150,000 tons of this ore to other European nations for use in making steel, has become one of the largest exporting countries of the world.

"England takes more than half the quantity she requires from the Caucasus, and is thus one of the largest consumers of this mineral. Many other first-rate European powers use considerable quantities of Trans-Caucasian manganese at their steel works. Within the last few years the already existing great demand for this particular kind of ore has been increased by the fact that America has likewise become a consumer, and there is every prospect that on the completion of the Chiatur branch of the Trans-Caucasian railway a still further augmentation in the demand will take place.

"The manganese-ore industry furnishes labor for the more or less poverty-stricken inhabitants of that province, where the insufficiency of the lands allotted to them and the barren soil are more seriously felt than in other parts of the Caucasus, and where a large proportion of the peasantry has been compelled for some time past, in consequence of the almost total failure of the vine crop, which has been repeatedly destroyed by the phylloxera, to seek for employment in other parts of the country. The industry has, therefore, become a most important factor in the existence of the inhabitants, and during the last few years the population of Imeretia alone has earned over $725,000 per annum for working the mines and transporting the ore to the railway station of Kvirili.

"The ore is obtained exclusively in the district of Sharopan, near the village of Chiatur, about 26½ miles from the village of Kvirili, the administrative and commercial center of the district. Most of the mines are situated in this locality, and they extend over an area of 13 square miles. According to the latest approximate estimate they contain 66,500,000 tons of ore, and it is calculated that at the present rate of activity it will take over two hundred years to exhaust the district.

"Mining was begun in 1879, when 871 tons of ore were produced; in 1880, 4,081 tons were obtained from the mines; five years later, i. e., in 1885, the quantity exported was 20,370 tons; in 1889, 137,097 tons; and this year, 1893, after the completion of the construction of the railway, it is expected that the exports will reach 322,581 tons.

"In the year 1879 the representatives of several large foreign firms, such as Krupp & Co., visited the ore fields, leased several plots of land and commenced to work the ore. Their example was quickly followed by the natives, and several local commercial and enterprising men, who were well acquainted with the conditions of the soil, likewise started to work the mines. They appropriated the best plots of land, and thus became the desperate rivals of the foreigners. The landed proprietors next stepped in, and the foreigners eventually had to give away to the natives, who have ever since continued to work the mines with the most primitive appliances and without much application; for it can safely be said that during these many years only the ore nearer to the outside edge of the mountains has been touched.

"The Chiatur manganese ore fields are situated in a very mountainous and difficult country following the course of the river Kvirili, at a height of from 700 feet to 1,050 feet above the village itself. The mines are distributed in groups from 1½ to 3½ miles distant from the village, and are connected with the latter by narrow cattle tracks which wind in zigzags over rocky ground, vertically placed precipices and projecting rocks, where obstructions are frequently met with. Access to them is therefore rendered dangerous, and the ore has to be transported in small quantities at a time on the backs of pack animals, horses being chiefly used. In wet weather, when these tracks become almost impassable, many accidents occur both with man and beast during the transit of the ore. The industry is therefore entirely dependent on the elements, and in the autumn of the year 1891, which was exceptionally wet, a sensible decline, as compared with the same period of the previous year, was observed in the quantity of ore brought down from the mines to the railway station of Kvirili. The natural result of the defective condition of these tracks is that the prices for transporting the ore fluctuate considerably, and have a very injurious effect on the progress of the industry. In the year 1891 the cost price of the ore at the station of Kvirili was 14 to 18 cents for every pood of 36 pounds avoirdupois weight delivered, whereas in the autumn of the same year the transport from Chiatur to Kvirili alone cost the producers 15 cents for the same weight. It is evident that under these circumstances the industry can not be developed with any advantage to those concerned, and that the narrow gauge branch line which is now being brought to completion will have the good effect of removing the existing abnormal state of affairs, and will give the industry a fresh impetus and a certain amount of stability. It is also certain that at no distant date the difficulties at present experienced in the transport of the ore from the mines to Chiatur will likewise be remedied. Attempts in this direction have already been made by two French engineers who belonged to a manganese ore company which some time ago was trading under the style of 'Terre Noir.' These two gentlemen worked out a project, by which it was proposed to send the ore down from the Rgan mines to the Chiatur valley by means of trucks to be let down the slope of an embankment by an endless chain on blocks which were also to haul up the empty trucks in their descent. All the necessary arrangements for carrying out this project had been made, and the required materials procured, when the company failed and the matter was dropped. The service that the realization of this project would render to the industry is beyond all conception, and the daily limited quantity of ore which is now being brought down to Chiatur could be doubled and trebled with the greatest ease.

"Other drawbacks are experienced in the conditions under which the manganese ore industry of the Caucasus is carried on. Five mountains rise in an almost perpendicular slope from the bed of the river Kvirili, three of which, i. e., Sedorgani-Rgani, Gwimewi, and Darquetti, are situated on its right bank, and two, viz., Shukrutti and Perewissi, on the left, they contain at almost equal distances from the level of the river a layer of manganese ore of considerable depth, which is alternately found between layers of chalk, earth, and other substances. The three mountains on the right and the two on the left banks are detached from each other by rivulets which discharge their waters into the river Kvirili, and those slopes of the five mountains that are nearest to the village of Chiatur have been pierced by the mine owners.

"A perpendicular layer of soil on the slope of the mountain is first removed; and together with the earth, stone, and manganese dust obtained from tunnelling, a sufficiently spacious plateau or unsupported embankment is made, on which sheds, etc., are erected, and along which a road is constructed. Subsequently, by means of a tunnel pierced through the sides, the mountain is entered and a horizontal gallery from which the ore is obtained is excavated. The interior of this gallery seldom or ever reaches a greater longitudinal depth than 35 feet, and only in extreme cases one meets with a pit of medium length. In most cases after the first mentioned length is attained the gallery is abandoned in favor of other similar short ones excavated parallel to the original one at a distance of from 10 feet 6 inches to 28 feet from it. The supports in the galleries are few and far between, and landslips in the mines are of frequent occurrence. It is only in a very few instances, and exclusively in mines owned by wealthier classes, that properly constructed galleries are to be met with, and where operations are carried on with any regard to the generally accepted rules of mining; even here the waste of ore is enormous. A considerable loss is also sustained through not utilizing the dust produced by the ore while being handled, which together with other detached parts go to waste instead of being made up into bricks, etc., and thus profitably turned to account. The work in connection with the production of the ore is heavy, is leased out to the miners by piecework and paid for per cubic 'sajen' of 22½ tons of pure ore. The time occupied by four men to procure this quantity is about twenty days, and the price paid for the workmen, including their tools, petroleum lamps and oil, is about $19.25 per cubic 'sajen' of 22½ tons pure ore. The price for the lease of the land is $9.68 for the same quantity.

"The number of obtainable experienced hands is very limited; most of the men employed come from the neighboring villages to seek labor when pushed to do so by the total absence of work nearer their homes. No permament miners are to be found in the locality, and only a very small proportion of the laborers remain on the premises for a period of eight months out of the year.

"The conditions under which the miners live are bad. No properly constructed barracks are to be found in the vicinity of the mines; they simply have to put up in hovels or in the galleries, which are damp and where they are exposed to the danger of landslips, etc. They eat but little, content themselves with maize cake, a few drops of inferior wine, and it is only on feast days they allow themselves the luxury of eating meat, which is sent them by their families.

"Although the rate paid for the production of the ore is, comparatively speaking, small, yet in view of the scanty requirements of the population it suffices to form a source of support for the short-landed peasantry of the district of Sharopan.

"The transport of the ore from the mines to Chiatur is a matter of essential importance to the population, since it gives a laborer possessing a pack horse the possibility of earning $1.21 per diem for the eight trips which he is able to accomplish between the mines and that village from sunrise to sunset.

"The transport of the ore from Chiatur to Kvirili is not so profitable, the distance is much greater, and under the best circumstances a man with his horse can only gain 38 cents per day; an Imeretian two-wheeled vehicle, commonly called an arba, and drawned by two buffaloes, earns 60 cents; and a Georgian arba, which is of somewhat larger dimensions than the Imeretian cart, gets \$1 for each trip made to the railway station.

"The land owners, as already mentioned, receive payment for the lease or the right of excavating mines on their lands at the rate of \$9.68 per cubic sajen of 22½ tons of pure ore, and it is calculated that at this rate they, on an average, receive 1 cent for every 36 English pounds of ore produced, which, roughly estimated, brings them in an annual income of about \$290,400. From the present year, however, it is supposed that the revenues obtained by the landowners from this source will, at the very least, be doubled, even if the rate paid is allowed to remain at its original figure, which can hardly be hoped for. The immediate result of the construction of the Chiatur line will be the extension of the exports of the ore, compensation to the landowners for their plots, the increase of the area of land now worked, and the swelling of the income of the landowners. Calculating the price for the lease of land to be 1 cent, the cost of procuring ore at the mines 1½ cents, cartage to Chiatur 2½ cents, its transport to Kvirili 10 cents, railway freight from Kvirili to the seaboard 1½ cents, including export duty, and an additional 1 cent for loading and discharging expenses, the cost of the ore delivered at Poti or Batoum is 17½ cents for every 36 pounds avoirdupois weight. Seventeen and one-half cents multiplied by 62 pouds of 36 pounds avoirdupois to the ton is equal to \$10.85 per ton of 50 per cent. metallic contents, which is equivalent to 21.70 cents per unit free on board at Poti, humidity and loss in weight during the transit of the ore excluded. At 22 cents per unit at Poti, humidity and loss included, the producer sustains a loss, and in fact nobody can afford to sell the ore for prompt delivery at these figures; but this rate is only established in view of the impending completion of the railway, which, it is stated, will start traffic along the whole of its length in October, when the price for the transport of the ore from Chiatur to Sharopan (near Kvirili) will be subjected to a reduction of 6 cents per ton.

"All these figures are based on a minimum cost of transport and on the supposition that the ore is procured under the most favorable conditions; but should a rise in the cost of transport from the mines to the village of Chiatur take place, as was the case in the autumn of 1891, in consequence of the defective state of the cattle tracks, or should the railway not be completed in time, the producers will sustain considerable loss. The prices of the ore are determined by England, which, as has already been said, is the largest consumer, and the average rate of freight paid from the Black Sea to the United Kingdom or continent is \$3 to \$3.15 per ton.

"The ore obtained in the Chiatur mines when thoroughly well prepared contains 54 to 55 per cent. of metallic contents, or 83 to 87 per cent. of peroxide when dried at 212° F., and never over 0.16 per cent. of phosphorus. This is the standard quality of the Chiatur ore, but it is brought down to 50 per cent. metallic contents by the admixture of an ore of inferior quality which is obtained at a very low price, and thus enables the producer to dispose of it at a reduced rate.

"Henceforward the Caucasian manganese ore industry will enter a new phase of development. The Chiatur branch railway, which is intended for the exclusive conveyance of the ore from the above village to Sharopan, is approaching completion. At Chiatur the ore will be loaded into trucks and transferred into wagons at Sharopan for further transport to the seaboard, viz., Batoum and Poti. There can be little doubt as to the importance of this railway for the regular development of the ore industry."

The total production of manganese ore in Russia during the last ten years is given in the following tables, reprinted from the report on the Mining Industry of Russia prepared for the World's Columbian Exposition. In making up these tables from the Russian sources we have taken 62.1 pouds as the equivalent of a long ton of 2,240 pounds, the poud being regarded as 36.0678 pounds.

Production of manganese in Russia from 1881 to 1890.

Years.	Caucasus.	Ural.	Ekaterinoslav.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1881	11,048			11,048
1882	12,287	1,900		14,187
1883	15,700	1,063		16,763
1884	20,338	1,422		21,760
1885	58,628	881		59,509
1886	68,311	805	4,026	73,142
1887	52,773	805	3,645	57,223
1888	29,353	1,332	1,443	32,128
1889	68,328	2,885	5,499	76,712
1890	168,568	2,311	8,504	179,383

The following table shows the exports of manganese from Russia from 1882 to 1890:

Exports of manganese ore from Russia from 1882 to 1890.

Years.	Exports.	Years.	Exports.
	Long tons.		*Long tons.*
1882	9,062	1887	59,427
1883	14,034	1888	48,997
1884	20,093	1889	55,400
1885	41,337	1890	130,910
1886	54,805		

The following table shows the exports of manganese ore from Russia to the different countries in 1888, 1889, and 1890. It should be noted that the ore imported to Holland was probably destined for German works, and also that all ores transported by sea to Gibraltar are shown as exported to Great Britain, although some vessels are registered to Gibraltar only, hence the following data can not be regarded as absolutely correct.

Exports of manganese ore from Russia, by countries.

Countries.	1888.	1889.	1890.
	Long tons.	*Long tons.*	*Long tons.*
Great Britain	26, 213	37, 816	84, 944
Holland	12. 367	5, 620	23, 618
France	4, 456	1, 958	8, 237
Germany	4, 034	4, 886	7, 076
United States	....	151	6, 443
Belgium	2, 126	1, 686	1, 688

GREAT BRITAIN.

The manganese ores of Great Britain can be divided into two classes, the oxides and carbonates. Small quantities of manganese ore in the form of psilomelane, with some pyrolusite, occur in the Lower Silurian measures in Devonshire and Cornwall and in the Midlands of England, especially in Derbyshire. Carbonates are found to a considerable extent in Merionethshire. By far the largest portion of the production of manganese in Great Britain are the carbonates from North Wales.

The total production of manganese ore in Great Britain for the years from 1882 to 1893 was as follows:

Production of manganese ores in Great Britain from 1882 to 1893.

Years.	Tons.	Value.
1882	1, 548	$18, 910
1883	1, 287	14, 404
1884	909	....
1885	1, 688	....
1886	12, 763	....
1887	13, 777	53, 772
1888	4, 342	9, 361
1889	8, 852	31, 354
1890	12, 444	32, 588
1891	9, 476	30, 071
1892	6, 078	21, 460
1893	1, 336	....

SPAIN.

In connection with the iron ores produced in Spain, more or less manganese of a high grade is found. The manganese deposits of this country follow the rules of occurrence of all other countries in which the manganese is found in connection with the iron ores. Between 1860 and 1865 Spain produced a large quantity of manganese of a very good quality, which was sent to England, reducing the price of a 70-per cent. ore to 60 shillings a ton. In consequence, however, of the increased demand, notwithstanding the increased exports from Spain, prices of Spanish ore ran in England to £7 or £8 a ton, but again dropped, in 1869, when Weldon's process for the recovery of manganese from the refuse of the chemical works came into use.

The statistics of production of manganese in Spain, so far as we have the same, are as follows, in metric tons:

Production and value of manganese in Spain.

Years.	Product.	Value.
	Metric tons.	*Pestes.*
1874	48,207	....
1886	201	....
1890	832	13,115

PORTUGAL.

But little information has been collected regarding the deposits of manganese ore in Portugal. It is evident, however, from the large exports to Great Britain that they must be of some importance. It was reported that in 1893 ninety mines of this mineral were working in Portugal, the character of the ore being very high. In 1891, 9,906 tons were produced. In 1888, 5,638 tons were exported to Great Britain; in 1891 the exports were 3,105 tons, and in 1892, 4,188 tons. These statements of exports are the only ones we have giving anything of the production of Portugal, and in the absence of more correct figures they may be assumed to represent the production.

FRANCE.

For many years prior to the discovery of the large deposits of manganese in the Caucasus district of Russia considerable manganese ore was produced in France. With these discoveries, however, the production of this mineral declined greatly for awhile. In 1885 it is estimated that the total production was but 3,800 tons. This increased to 7,676 tons in 1886, and has gradually increased since until 1892, when the production was 31,879 long tons.

Most of this ore is from the mines of Grande-Fillon and of Romanèche. The remainder was from the mines of Chaillac and from two small mines in the department of the Aude.

BELGIUM.

The chief center of production of manganese ores in Belgium is in the province of Liege, the ores being chiefly manganiferous iron ores carrying sufficient manganese to be of value for this metal. Manganese ores, as elsewhere, are found associated with hematite iron ore. The production, however, is not sufficient to meet the wants of the furnaces and steel works of Belgium, and considerable quantities are imported from other countries. During late years, however, the production of manganese ore in Belgium has advanced wonderfully, as will be seen from the statement of the production of manganese since 1880. The tons in this table are the metric tons of 2,204 pounds. The value is in francs.

Production of manganese ore in Belgium.

Years.	Product.	Value.
	Tons.	*Francs.*
1880	700	4,000
1881	770	4,000
1882	345	1,750
1883	820	4,100
1884	750	3,750
1885	.....	.....
1886	750	9,000
1887	12,750	155,850
1888	27,787	325,000
1889	20,905	248,000
1890	14,255	176,000
1891	18,498	254,600
1892	.....	.....
1893	.....	.....

GERMANY.

Through the kindness of Dr. Hermann Wedding we are enabled to make the following statement regarding the manganese ores of Germany and their production.

The chief occurrence of manganese ore in Germany is on the right bank of the river Rhine, in the districts of Wiesbaden and Coblentz. Some small amounts are also found in Thuringia (Coburg-Gotha). The principal mining district on the Rhine is at Weilburg, some 25 miles northeast of Wiesbaden.

The production of manganese in Germany in the years named was as follows:

Production of manganese in Germany from 1890 to 1892.

Years.	Metric tons.
1890	41,841
1891	40,335
1892	.....

Of the production of 40,335 tons in 1891, 20,026 tons were from Wiesbaden, 16,382 from Coblentz, and 396 from Coburg-Gotha. The remaining production was in smaller amounts from other localities. Out of the total production in 1891, 4,017 tons were used for the production of oxygen and chlorine, the balance at steel works.

While the above are the only statistics we have of production of manganese in the entire German Empire, the mining reports of Prussia, from which most of the manganese produced in Germany is derived, give quite full statistics of production and prices. These statistics from 1881 to 1892 are as follows:

Production and value of manganese ores mined in Prussia from 1881 to 1892.

Years.	Quantity.		Value.
	Tons.	*Kilos.*	*Marks.*
1881	11,085	719	329,599
1882	4,670	525	140,606
1883	4,573	885	118,430
1884	7,750	911	179,657
1885	14,696	480	338,760
1886	25,045	496	737,773
1887	36,533	942	951,831
1888	27,307	680	613,542
1889	44,006	497	901,589
1890	40,131	236	726,785
1891	36,859	518	727,599
1892	31,388	....	424,348

Besides these true manganese ores many of the iron ores of Germany are manganiferous. This is especially true of the spathose ores of Siegerland, and also of the brown iron ores of Upper Silesia, of Osnabrück, and others. The amount of manganese iron ores from these sources is unknown.

Regarding the imports and exports, Dr. Wedding remarks that, in view of the fact that the characteristic peculiarities of German ores are phosphorus and manganese, it is to be expected that the imports of true manganese ores would be smaller than the exports. The imports for 1891 were 9,347,600 kilograms; the exports were 10,620,300 kilograms. Of these imports and exports 209,800 kilograms were simply in transit. In order, therefore, to arrive at the true imports and exports of manganese ores into and from Germany this latter amount should be subtracted from the figures showing imports and exports.

SWEDEN.

Through the kindness of Mr. K. A. Wallroth, of the Geological Survey of Sweden, we are enabled to make the following statement regarding the manganese ores of that country:

Swedish manganese ores are of three different types: First, pyrolusite with manganite; second, hausmannite with braunite; and third, manganous carbonate and silicates of manganese, accompanying iron ores.

Ores of the first type occur at Bōlet in Vestergotland, at Spexerejd and Hohult in Småland, in the parish of Leksand in Dalarne, and in a few places in Dalsland.

At Bōlet the pyrolusite is found in fissures in a gneiss or gneiss-granitic rock. These fissures, which vary in breadth from a few millimeters to 1.5 to 1.7 meters, are filled with a breccia, and with chlorite, mica, barytes, calcite, and in certain places pyrolusite and manganite, with some braunite and wad, as infiltrating cement. The fissures, among which three may be noticed, are of about 75 meters in length. The inclosing gneiss-granite also contains small grains of pyrolusite. The ore, according to analysis made in 1887, contains 53.17 per cent. of manganese. The amount of ore obtained at Bõlet was, in metric tons:

Product of manganese ores at Bõlet, Sweden.

Years.	Tons.
1888	2,052
1889	1,973
1890	1,655
1891	1,625
1892	1,862

At Spexerejd and Hohult the ore occurs in the same manner as at Bõlet. The ore appears in fissures in a schistic granite, and these fissures are filled with a breccia, which is held together by limestone and the manganese ore. The latter consists of pyrolusite, manganite, and wad. According to analyses made in the years of 1878 to 1889 the ore contains 48.20 per cent. manganese.

The Småland ore is classed in three different grades. The amount obtained in metric tons is:

Product of manganese at Småland, Sweden.

Years.	Tons.
1888	5,573
1889	4,480
1890	6,092
1891	4,231
1892	3,856

In Dalarne and Dalsland the ore is found in such small quantities that it would not be profitable to work it. The ore occurs in small fissures.

Ores belonging to the second type occur at Pajsberg, Långhan, and Nordmarken, including Jakobsberg, in Wermland, and at Sjôgrufuan, in Nerike. The ore consists of hausmannite and braunite mixed, but also contains jacobsite; several silicates of manganese also occur. In all these places the ore is found stratified with limestone or dolomite, usually in the vicinity of strata of iron ore. At Långhan the ore is concentrated by washing; in the other places the ore is graded in two numbers.

The ore from Pajsberg (Harstigsgrufuan) contains 39.10 per cent. of manganese; the ore from Långhan, 41.36 per cent. of manganese; concentrated ore contains 52.77 per cent. of manganese; the ore from Nordmarken contains, ore No. 1, 41.71 per cent. of manganese; ore No. 2 24.50 per cent. of manganese. The ore from Sjôgrufuan contains, on an average, 40.30 per cent. of manganese.

The amount of ores from these fields was in metric tons:

Production of manganese ores in Sweden.

Localities.	1888.	1889.	1890.	1891.	1892.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Pajsberg	134	19	....	....	....
Långban	1,673	2,078	2,885	3,024	2,214
Nordmarken	232	14	67	200	....
Sjögrufuan	25	82	....	....	....

Ores belonging to the third type are iron ores, containing manganese, chiefly magnetite, but some hematite. The manganese minerals consist of manganous carbonate and silicate of manganese, but also oxides of manganese in those ores which are more highly manganiferous, as, for instance, in the ore from Gladkärn. The ores are found in strata mostly in limestone, but mostly in "halleflinta."

The average per centage of manganese in these is, in most fields, not more than 6 per cent., though a higher percentage does occur, as at Robergsfältet in Norberg, with as much as 26 per cent. of manganese; Gladkärn, with 20 per cent. of manganese; Svartberg, with 15 per cent. of manganse; Skinnarang and Knipgrufuan, with about 12 per cent. of manganese; Penning-grufuan and Hillang, with 10 per cent. of manganese; Languik, with 8 per cent. of manganese.

In many fields which produce ores of this type there are collections of manganiferous silicates, as, for instance, knebelite at Dannemora, but no use is made of them.

The products of these manganiferous iron ores in the principal fields in metric tons, runs as follows:

Production of manganiferous iron ores in Sweden.

Localities.	1888.	1889.	1890.	1891.	1892.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Dannemora (1.40 per cent. of manganese)	56,440	61,792	63,584	59,646	61,704
Burangsberg (2.52 per cent. of manganese)	10,364	11,370	8,164	9,050	7,076
Viker (3.27 per cent. of manganese)	4,046	3,214	3,428	1,510	2,564
Klackberg and Kohnigsberg (4.55 per cent. of manganese)	60,995	52,180	53,179	51,489	45,162
Languik (7.84 per cent. of manganese)	7,088	6,338	6,738	10,120	8,622
Hillang (9.97 per cent. of manganese)	1,975	3,869	2,198	2,070	1,810
Svartberg (15.16 per cent. of manganese)	....	1,560	2,640	2,857	2,584
Total	140,908	140,323	139,931	136,742	129,522

The ore from Svartberg, containing knebelite, is used for producing specular iron at Schisshyttan.

The determinations of manganese in the above table have been kindly furnished by Dr. Adolf Tamm.

ITALY.

Though both manganese and manganiferous iron ores are found in many parts of the Kingdom of Italy and are mined to some extent, the chief production of these ores is in Sardinia. The ores are both black and brown, the best grade carrying from 31 to 35 per cent. of metallic manganese and the inferior grade about 20 per cent.

The production of manganese in Italy in the years from 1887 to 1891 is as follows:

Production of manganese in Italy.

Years.	Number of mines.	Product.	Value.
		Tonneaux.	*Lire.*
1887	5	4.434	113,324
1888	8	3,630	78,000
1889	5	2,203	51,801
1890	4	2,147	51,551
1891	5	2,429	64,595

AUSTRIA.

Considerable manganese is produced in Austria, but no information regarding the character of the ore or its occurrence has been obtained. The production of manganese in this country since 1876 is given in the following table, the amounts being in metric centners of 110.23 pounds:

Production of manganese in Austria from 1876 to 1891.

Years.	Product.	Years.	Product.
	Centners.		*Centners.*
1876	67,817	1884	79,423
1877	78,999	1885	61,577
1878	41,836	1886	92,464
1879	34,337	1887	93,108
1880	88,744	1888	65,541
1881	91,097	1889	39,261
1882	84,183	1890	80,068
1883	93,821	1891	52,793

GREECE.

The principal mines of manganiferous iron ore in Greece are at Laurium. The ore is a manganiferous iron ore, containing from 18 to 19 per cent. of manganese and from 34 to 35 per cent. of iron. A manganiferous iron ore from Mazaron shipped to the United States contained from 7.638 to 15.329 per cent. of manganese and from 33.588 to 50 per cent. of iron.

In addition to this manganiferous iron ore, which is very much the larger production of manganese-bearing ores, in Greece some manganese ores are also produced.

In 1892 the production of manganese ores proper in Greece was 11,716 tons, and of manganiferous iron ore, 157,756 tons.

TURKEY.

Considerable manganese is produced in the various provinces of Turkey. The only recent figures we have are for Bosnia and Herzegovinia, in Turkey in Europe. The production of these provinces in 1892 was 7,819 tons of 2,240 pounds. No description of the character of the ore or its occurrence has been received.

JAPAN.

Next to the discoveries of the immense deposits of manganese in Southern Russia, the most important recent find of this mineral, so far as it relates to the United States, is in Japan. We are without information as to the character or occurrence of the ore. The production, however, from 1881 to the close of 1890 is as follows, the amounts being in piculs of about 135 pounds:

Production of manganese in Japan, from 1881 to 1890.

Years.	Product.	Years.	Product.
	Piculs.		*Piculs.*
1881	25	1886	6,698
1882	2,594	1887	5,171
1883	2,508	1888	13,483
1884	2,081	1889	15,667
1885	2,044	1890	43,191

The detailed statistics of production for 1890 is given in the following table:

Production of manganese in Japan in 1890, by provinces.

Provinces.	Prefectures.	Production.
		Piculs.
Ugo	Akita	442
Shimotsuke	Tochigi	12,130
Noto	Ishikawa	645
Tamba	Kioto	28,750
Iyo	Ehime	1,224
Total		43,191

It is stated in a general way that the production of manganese in Japan is chiefly from surface or very shallow workings. The natives gather the ore and take it down the mountains and rivers in small quantities to the dealers, who grade and export it.

NEW SOUTH WALES.

Though manganese ores have been found in considerable quantities in New South Wales they cannot at present be profitably worked to any extent, owing to the cost of carriage to the seaboard. In the annual report of the secretary for mines for the year 1892 quite a number of analyses of manganese ore are given, some containing as much as 53 per cent. of metallic manganese, and a large number from 40 to 50 per cent.

The deposits seem to be of both brown and black oxide. The principal deposits so far found are in the Bathurst and Bendemeer districts.

Up to the close of 1891 the total production of manganese ore in this country is given as 238 tons, worth £665. The production since 1890 seems to have been as follows:

Production and value of manganese in New South Wales, from 1890 to 1892.

Years.	Product.	Value.
	Tons.	
1890	100	£1,573
1891	138	1,646
1892	16	227

SOUTH AUSTRALIA.

In past years considerable manganese has been produced in South Australia. There is no statement regarding the character of the ores or their occurrence, and only the production from 1882 to 1891, which is as follows:

Production and value of manganese in South Australia, from 1882 to 1891.

Years.	Product.	Value.
	Tons.	
1882	136	$3,214
1883	333	10,062
1884	59	1,142
1885	....	4,061
1886	1,550	53,163
1887	1,452	27,801
1888	1,021	16,974
1889	1,596	24,718
1890	2,764	33,991
1891	847	8,349

QUEENSLAND.

Some manganese ores have from time to time been produced in Queensland. The only fact ascertained regarding this ore, however, is its production, which from 1881 to 1891 was, as far as the figures have been ascertained, as follows:

Production and value of manganese in Queensland, from 1881 to 1891.

Years.	Product.	Value.
	Tons.	
1881	87	$1,263
1882	100	1,694
1883	20	290
1884	55	799
1888		
1889	4	87
1890	5	97
1891	10	126

NEW ZEALAND.

According to the handbook of New Zealand mines, published in 1887, the chief kinds of manganese found on this island are braunite and wad, with some pyrolusite. The latter, however, occurs sparingly. Small amounts of rhodonite, which is a silicate of manganese, are also found. The chief source seems to be Napier, where ore containing about 45 per cent. metallic manganese is found on the Bay of Islands.

The statistics of production available are not complete. As little or no manganese ore is consumed in New Zealand, the exports are practically the measure of production. The largest export in any one year for which statistics are given was in 1878, when 2,516 tons were exported.

The production of manganese in New Zealand for the years for which detailed statements have been secured is as follows. These are the exports and declared values. The values, however, seem high.

Production of manganese ore in New Zealand from 1878 to 1892.

Years.	Tons.	Value.
1878	2,516	$50,413
1879	2,140	40,356
1880		
1881	1,271	15,890
1882		
1883		
1884	318	3,911
1885	602	8,305
1886		
1887		
1888	1,085	11,635
1889	1,080	5,227
1890	1,170	12,741
1891	1,153	12,748
1892	521	6,752

WORLD'S PRODUCTION OF MANGANESE.

In the following table will be found a statement of the production of manganese in the various countries which are producers of this mineral, the statement being in long tons of 2,240 pounds and for the latest years for which information has been received. The values are in dollars.

World's production of manganese.

Countries.	Years.	Product.	Value.
North America:		*Long tons.*	
United States, manganese	1893	7,718	$66,614
Manganiferous iron	1893	117,782	283,228
Canada	1893	228	14,458
Cuba	1891	21,987	....
South America:			
Chile	1891	34,464	....
Europe and eastern Asia:			
Russia	1890	179,383	....
Germany	1890	39,715	....
France	1892	31,879	197,825
Belgium	1891	18,206	49,138
Sweden, manganese	1892	7,932	....
Manganiferous iron	1892	58,378	....
Bosnia and Herzegovinia	1892	7,819	....
Great Britain	1893	1,336	....
Portugal	1892	4,188	....
Austria	1891	2,598	29,125
Italy	1891	2,390	12,467
Spain	1890	819	....
Greece, manganese	1892	11,716	....
Manganiferous iron	1892	157,756	....
Oceanica:			
Japan	1890	2,603	....
South Australia	1891	847	8,349
New Zealand	1892	521	6,725
New South Wales	1892	16	227
Queensland	1891	10	126

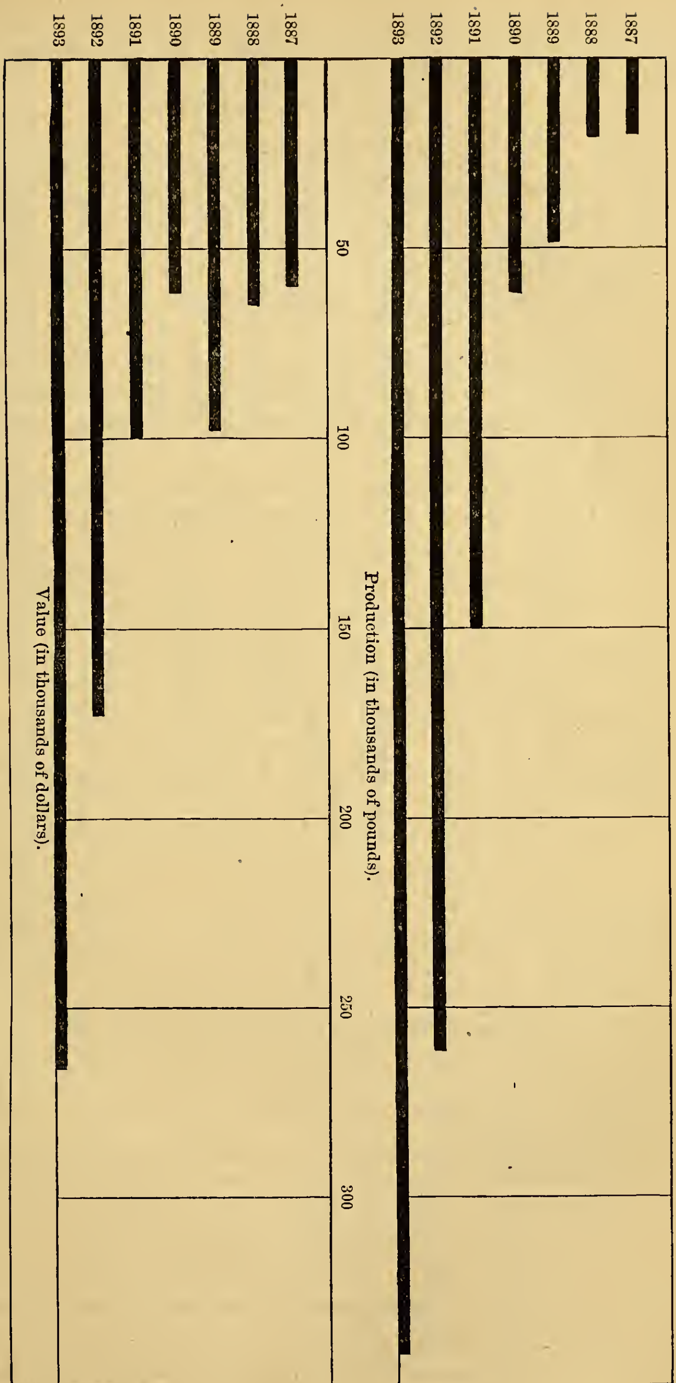
ALUMINUM.

Product.—The total production of aluminum reached 333,629 pounds in 1893, an increase from 259,885 pounds in 1892. A small proportion of this was in the form of aluminum alloys, especially bronze, but a large proportion of the bronze is made from metallic aluminum. The greater part of the product left first hands in the form of ingots for use as an addition to steel. It can be said that nearly all the steel makers use a small proportion of aluminum with the result of less waste in castings. For example, the amount of waste in crop ends on steel rails is lessened profitably. Ingot aluminum also goes to manufacturers of aluminum cooking utensils, and this industry is extending satisfactorily. The remainder of the product goes out as sheet and wire for many purposes, including numberless experimental uses, among them lithographing with aluminum plates instead of zinc or lithgraphic stone. Some experiments in this direction, in the map department of the U. S. Geological Survey, indicate that the transfers obtained on aluminum are superior to those on zinc.

Production of aluminum in the United States.

Years.	Pounds.	Years.	Pounds.
1883	83	1890	61,281
1884	150	1891	150,000
1885	283	1892	259,885
1886	3,000	1893	333,629
1887	18,000		
1888	19,000	Total	892,779
1889	47,468		

Prices.—The demand for aluminum was good during the year compared with other commodities, and prices were well maintained. The price for aluminum ingots in January, 1893, was 65 cents per pound in ton lots; in February this advanced to 70 cents; from February until October it was maintained at 90 cents. In November it was reduced to 70 cents, which held till the end of the year.



Production and Value of Aluminum in the United States During the Years 1887 to 1893, inclusive.

The following price lists for aluminum in various conditions are given to correct the many misconceptions in this regard:

Price list for aluminum ingots.

[Cents per pound.]

	Small lots.	100-pound lots.	1,000-pound lots.	Ton lots.
No. 1, in rolling ingots	85	80	80	78
No. 1, in waffle ingots	80	78	78	75
No. 2	78	75	73	70

No. 1 is aluminum guaranteed to be over 98 per cent. pure.

No. 2 is aluminum guaranteed to be over 94 per cent. pure aluminum, with no injurious impurities, for alloying with iron and steel, and is cast in "waffle" ingots.

Special prices are asked for aluminum, which can be furnished, guaranteed to be over 99 per cent., or over 99.60 per cent. pure.

Price list per pound, for plate and sheet aluminum, B. and S. gauge.

Thickness.	Width, in inches.								
	3 to 12.	12 to 14.	14 to 16.	16 to 18.	18 to 20.	20 to 22.	22 to 24.	24 to 26.	20 to 28.
⅜ inch and heavier	$0.90	$0.92	$0.93	$0.94	$0.95	$0.97	$1.00	$1.05	$1.10
Nos. 00 to 8	.92	.94	.96	.98	1.00	1.05	1.10	1.15	1.25
9 to 16	.95	.98	1.01	1.04	1.07	1.12	1.20	1.30	
17 to 20	1.00	1.03	1.06	1.10	1.15	1.20	1.30		
21 to 24	1.05	1.09	1.13	1.18	1.24	1.30	1.45		
25 and 26	1.10	1.15	1.20	1.25	1.32	1.40			
27 and 28	1.15	1.22	1.30	1.40					
29	1.20	1.30	1.40	1.50					
30	1.25	1.35	1.50						
31	2.00	Not wider than 6 in.							
32	2.25								
33	2.50								
34	2.75								
35 and 36	3.00								
37 to 40	3.25								
.003 to .0015 inch	4.00								
Less than .0015 inch	4.50								

Five cents per pound should be added for plates or sheets cut to exact lengths.

For circles, segments, or patterns of aluminum sheet add 50 per cent. to price of sheet of each gauge.

Cold-rolled or especially hard-rolled aluminum sheet is 5 cents per pound over price of ordinary annealed sheet.

Sheet polished on one side is 3 cents per pound additional to price list for sheet; polished on both sides, 5 cents per pound additional.

Price for slitting metal, add to the list for sheet as follows: Over ½ inch to 2 inches inclusive, numbers 12 to 20 gauges inclusive, 5 cents per pound. Over ¼ inch to ½ inch inclusive, number 12 to 20 gauges inclusive, 10 cents per pound. Over ½ inch to 2 inches inclusive, numbers 21 to 28 gauges inclusive, 10 cents per pound. Over ¼ inch to ½ inch inclusive, numbers 21 to 28 gauges inclusive, 20 cents per pound. Over ½ inch to 2 inches inclusive, numbers 29 and 30 gauges, 15 cents per pound. Over ¼ inch to ½ inch inclusive, numbers 29 and 30 gauges, 30 cents per pound.

Aluminum bars, ordinary size, in orders not less than 100 pounds at a time, are $1.20 per pound.

Aluminum angles, channels, beams, star shapes and other sections, in orders not less than 1,000 pounds at a time, $1.20 per pound.

Round rods from ⅛ inch diameter to ¼ inch diameter, are $1.40 per pound. Hexagon and octagon bars, $1.60 per pound. Half-round rods, from $1.75 per pound to $2 per pound according to section.

Price list for aluminum wire, B. and S. gauge.

Sizes.	Price per pound.
¼ inch to No. 16	$1.30
Nos. 17 and 18	1.33
Nos. 19 and 20	1.36
No. 21	1.39
No. 22	1.42
No. 23	1.48
No. 24	1.54
No. 25	1.60

Flat, square, and half-round wire require 12 cents per pound advance on round wire of same gauges.

Imports.—The imports of crude aluminum are shown below:

Aluminum imported and entered for consumption in the United States from 1870 to 1891.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1870		$98	June 30, 1882	566.50	$6,459
1871		341	1883	426.25	5,079
1873	2.00	2	1884	595.00	8,416
1874	683.00	2,125	1885	439.00	4,736
1875	434.00	1,355	Dec. 31, 1886	452.10	5,369
1876	139.00	1,412	1887	1,260.00	12,119
1877	131.00	1,551	1888	1,348.53	14,086
1878	251.00	2,978	1889	998.00	4,840
1879	284.44	3,423	1890	2,051.00	7,062
1880	340.75	4,042	1891	3,906.00	6,263
1881	517.10	6,071			

The following table gives the detailed imports for the last three years:

Imports of crude and manufactured aluminum for three years.

Calendar years.	Crude.		Leaf.		Manufactures.	Total value.
	Pounds.	Value.	Packs of 100.	Value.		
1891	3,922	$6,266	10,033	$1,135	$1,161	$8,562
1892	43	51	14,540	1,202	1,036	2,289
1893	7,816	4,683	18,700	1,903	1,679	8,265

The following report on the occurrence of bauxite in Alabama and Georgia is the result of the work of Dr. C. Willard Hayes, who has mapped the geology of this region for the U. S. Geological Survey:

BAUXITE.

By C. W. Hayes.

The importance of bauxite as the chief ore of aluminum has been pointed out in previous reports and brief descriptions given of the localities from which it was obtained. No new territory has been developed during the past year, and the production has been confined exclusively to Georgia and Alabama.

Three companies were engaged in mining bauxite during 1893. These were the Republic Mining and Manufacturing Company, which operated mines at Hermitage furnace in Georgia and in the Dyke district in Alabama; the Georgia Bauxite and Mining Company, which operated the Comosena and Barnsley mines in Ridge valley, near Adairsville, Bartow county, Georgia, and the Southern Bauxite Mining and Manufacturing Company, which operated mines in the Dyke district.

The total shipments made during the year were, from Georgia, 2,315 tons, and from Alabama, 6,764 tons.

The total product in 1892 amounted to 9,200 tons. The imports of bauxite in recent years have been as follows:

Imports of bauxite.

Calendar years.	Quantity.	Value.
	Pounds.	
1889	29,945,674	
1890	27,503,730	
1891	17,936,504	
1892	12,804,253	
1893	11,431,678	$28,217

Bauxite has occupied the position of an ore for so short a time that little has been known or written of its mode of occurrence and origin. Information upon these points has the most direct bearing upon the economical development of the deposits, since it affords a basis for estimating the probable extent and value of those already known and a means of directing search for others. Much fruitless prospecting has already been done and still more energy will be wasted as the demand for the ore increases.

Location of the deposits.—Bauxite has thus far been found in commercial quantities in only two localities in the United States. These are in Arkansas and in the Coosa valley in Georgia and Alabama. From the descriptions of Prof. J. C. Branner, State geologist, the Arkansas deposits bear little resemblance in their geological relations to those of the southern Appalachian. The ore is also inferior, containing a somewhat larger percentage both of silica and iron.

The Georgia and Alabama deposits are found irregularly distributed within a narrow belt of country extending from Adairsville, Georgia, southwestward a distance of 60 miles to the vicinity of Jacksonville, Alabama. The only points within this region at which the ore has been worked on a commercial scale are at Ridge valley, in Bartow county, Georgia; at Hermitage furnace, 5 miles north of Rome, Georgia; near Six Mile Station, south of Rome; and in the Dyke district, near Rock Run, Alabama. Only the first two and the last named localities were productive during 1893.

Geological relations of the deposits.—In order to make clear the conditions under which the ore occurs and to explain its probable mode of origin a brief account of the geology of the region will be given.

The rocks of the region range in age from Cambrian to Carboniferous, but only the Upper Cambrian and Lower Silurian need be considered in connection with the original and present associations of the bauxite. The upper portion of the Cambrian consists of fine aluminous shales between 2,000 and 3,000 feet in thickness, more calcareous in their upper portion and passing locally into heavy beds of blue limestone. Above these shales is the Knox dolomite, the most uniform and persistent formation of the southern Appalachian region. It consists of from 3,000 to 4,000 feet of gray, semi-crystalline, siliceous dolomite. The silica is usually segregated in nodules and beds of chert. These remain upon the surface, and with the other insoluble constituents form a heavy residual mantle covering all the outcrops of the formation. It is associated with these residual materials that the extensive deposits of limonite and bauxite are found.

The geologic structure of the region under consideration is exceptionally complicated. In addition to the folds which characterize the entire Appalachian province and whose form is familiar to all, the region is intersected by two series of faults. Its very intimate connection with the bauxite deposits makes a somewhat detailed description of the structure necessary.

In the northern portion of the ore-bearing belt the structure is quite simple; the folds are broad and but little faulted. In the central portion, between Rome and Cave Spring, it is more complicated and the numerous narrow folds are commonly faulted. In the southern portion, particularly between Rome and Mount Weisner, occurs the most complicated structure known in the southern Appalachians.

A line of hills borders the Coosa-Oostanaula valley upon its southeastern side from Calhoun, Georgia, to Mount Weisner. These hills are composed of Rome sandstone dipping toward the southeast and they form the northwestern limit of the ore-bearing belt. East of this line of hills is a valley underlain by Connasauga shales, also dipping toward the southeast, under the Knox dolomite. From Rome southward a number of narrow shale valleys penetrate a few miles within the border of the dolomite. Each of these valleys corresponds in position with a narrow anticlinal fold, in every case faulted upon its western side. Beyond these narrow folds a broad syncline of dolomite extends eastward 15 or 20 miles to the limit of the metamorphic rocks.

In the region between Cave Spring and Rock Run the original folds have been almost entirely obliterated by subsequent faulting. Also in this region folding was in progress during middle Silurian time. The folds then formed were deeply eroded, and across the edges of the tilted strata subsequent formations were laid down. During this and later periods of folding, the massive beds of Cambrian quartzite formed rigid buttresses which themselves resisted folding and against which the less resistant strata were crushed by horizontal pressure. The effects of great compression were thus concentrated within narrow belts. It is in such a belt, along the western base of the Indian mountain, in the vicinity of Rock Run, Alabama, that the largest deposits of bauxite are found.

The faults thus far mentioned are of the ordinary type found in the southern Appalachians. Having been developed from steep or overturned folds by a continuation of the horizontal pressure to which the latter are due, they are all thrust faults hading to the upthrow. The inclination of the fault plane is steep, usually from 40° to 60° with the horizon. They are in this region only from 3 or 4 to a dozen miles in length, and the displacement of corresponding beds on opposite sides of the fault-plane varies from a few feet to several thousand.

Other faults are found in this region, however, which have certain less common features. These have been described elsewhere, and only the main characteristics will be given here. They constitute the principal dislocations of the region, and while they resemble the former class in being the result of horizontal compression they differ in the angle of hade and the amount of displacement. The fault plane is usually nearly horizontal, and in some cases it has been distorted by subsequent folding together with the underlying and overlying strata. When this subsequent folding has placed portions of the overthrust strata in a position where they would be protected from erosion a minimum measure of the horizontal displacement is afforded. In one case in this region the visible displacement is about 4½ miles, and the total displacement is probably very much greater. A fault of this class extends from Rome southwestward to Mount Weisner along the western base of the Rome sandstone hills above mentioned. Following the southeastern border of the Coosa valley, it has been named the Coosa fault. Although its horizontal displacement can not be directly proved to be as great as that of the Rome fault, the influence from observed differences in contemporaneous deposits upon opposite sides is that the displacement is certainly very great. There is also evidence that the minor faults with steep hade are older than the broad major thrusts, and that a considerable period of erosion separated the two systems.

Thus it appears that the region has been the seat of orogenic activity from very early geologic time. In the middle Silurian, folds were formed and their crests were eroded. In late Carboniferous time, during the great Appalachian revolution, a second generation of folds was born and minor faults were developed, their distribution being determined largely by variations in the strata, particularly the resistant masses of Cambrian rocks. And finally, after another long period of erosion, the folded and faulted mass was displaced upon a nearly horizontal thrust plane.

Rock-weathering.—The region shows evidence of having been subjected for a very long time to conditions favoring sub-ærial rock decay, and only moderately active degradation. Hence the surface is deeply covered with a mantle of residual material, consisting of the insoluble portions of the subterranes. This residual mantle is thinnest over areas of shale and slate, thicker over areas of limestone in which the insoluble matter makes up a small portion only of the rock-mass, and thickest over areas of the Knox dolomite. The insoluble constituents of the latter are small quantities of iron and alumina and much larger quantities of silica in the form of chert. Hence the residual mantle is composed of ferruginous clay in which large amounts of chert are imbedded. The deposit often attains a thickness of more than 50 feet, and in some cases reaches 100 feet or more; so that the dolomite itself is rarely seen, except in the stream channels.

Mingled with the residual deposits which characterize each terrane, especially in the vicinity of the high quartzite ridges, are greater or less quantities of foreign débris. Near the base of Indian mountain this frequently masks the characteristic residual deposits to such an extent that it is extremely difficult to determine the areal distribution of the several formations.

A further source of obscurity, in the same region, is the incipient metamorphism which has affected some of the rocks, particularly the chert of the Knox dolomite. The effect generally produced has been a change of the amorphous or chalcedonic silica, composing the chert, into finely granular quartz. The chert loses its coherence and forms a white chalk-like substance, which readily disintegrates at the surface. When the metamorphism has been carried a step further, it results in the secondary deposition of silica, forming a peculiar jaspery rock, in which the original character of the chert is wholly lost. In many cases it is impossible to determine whether this jasper has been derived from chert, sandstone, or quartzite. The metamorphism is intimately associated with the faulting, and was doubtless produced by thermal water, so that it belongs to a class of changes no longer taking place at the surface in this region.

Form of the ore bodies.—The deposits in the Rock Run district are typical of the entire region and will be described in some detail. Four bodies of the ore were being worked in 1893 on a considerable scale, and all show practically the same form. The southernmost of the four, called the Taylor bank, is located 3½ miles northeast of Rock Run, near the western base of Indian mountain. Although the heavy mantle of residual material effectually conceals the underlying rocks, the ore appears to be exactly upon the faulted contact between the narrow belt of Knox dolomite on the northwest and the sandy shales and quartzites of Indian mountain on the southeast. The ore is covered by 3 or 4 feet of red sandy clay in which numerous fragments of quartzite are imbedded. The ore body is an irregularly oval mass, about 40 by

80 feet in size. Its contact with the surrounding residual clay, wherever it could be observed, appeared to be sharp and distinct, and, about the greater portion of its circumference, very nearly vertical. A certain amount of bedding is observable in the ore body, although no trace of bedding can be detected in the surrounding residual material. Upon the northwestern or down-hill side of the ore body this bedding is very distinct. Layers of differently colored and differently-textured ore alternate in regular beds, a few inches in thickness, and above these are thinner beds of chocolate and red material, probably containing considerable kaolin. These beds have a steep dip, somewhat greater than the slope of the hillside, but in the same direction. They are not simply inclined planes, however, but are curved, so as to form a steeply-pitching trough. With increasing distance from the ore body, the lamination becomes less distinct, and the beds pass gradually into a homogeneous mottled clay.

At the Dyke bank, about a mile northeast of the one above described, the stratification is well shown in portions of the deposit. Beds of yellow and gray, fine-grained material, alternate with others of pisolitic ore. The beds dip at an angle of about 40°, and are curved so as to form a steep trough. The compact material also shows distinct cross-bedding; both primary and secondary planes dipping in the same direction.

In the Gain's Hill bank, about 250 yards north of the Dyke bank, the ore-body shows a more regularly oval form than in most of the other deposits, and is also somewhat dome-shaped, swelling out laterally from the surface downward, as far as the working has progressed.

Although some of the workings have gone to a considerable depth (in a few cases 50 feet or more), the bottom of the ore-body has not been reached in any case. The ore varies in composition with depth, but not in a uniform manner, nor more than do different portions at the same depth. The deepest pits have not gone below the base of the surrounding residual mantle, so that no observations have yet been made with regard to the relations between the ore and the country-rock; and nothing has yet been observed which warrants the conclusion that the ore, if followed to sufficient depth, will be found interbedded with the underlying formations, or even that it will be found occupying cavities in the limestone, although the latter is quite possible.

Structure of the bauxite.—The ore shows considerable variety in physical appearance, though it generally has a very characteristic pisolitic structure. The individual pisolites vary in size from a fraction of a millimeter to 3 or 4 centimeters in diameter, although most commonly the diameter is from 3 to 5 millimeters. The matrix in which they are imbedded is generally more compact and also lighter in color. The larger pisolites are composed of numerous concentric shells, separated by less compact substance or even open cavities, and their interior portions readily crumble to a soft powder, In thin sections the ore is seen to be made up of amorphous flocculent grains, and the various structures which it exhibits are produced by the arrangement and degree of compactness of these grains. The matrix in which the pisolites are imbedded may be composed of this flocculent material segregated in an irregularly globular form or in compact oölites, with sharply-defined outlines. Or both forms may be present, the compact oölites being imbedded in a matrix composed of the less definite bodies. In some cases the interstices between the oölites are filled either wholly or in part with silica, apparently a secondary deposition.

The pisolites also show considerable diversity in structure. In some cases they are composed of exactly the same flocculent grains as the surrounding matrix, from which they are separated by a thin shell of slightly denser material. This sometimes shows a number of sharply-defined concentric rings, and is then distinctly separated from the matrix and the interior portion of the pisolite. The latter is also sometimes composed of imperfectly-defined globular masses, and in other cases of compact, uniform, and but slightly granular substance. It is always filled with cracks, which are regularly radial and concentric, in proportion as the interior substance has a uniform texture. Branching from the larger cracks, which, as a rule, are partially filled with quartz, very minute cracks penetrate the intervening portions. Thus the pisolites appear to have lost a portion of their substance, so that it no longer fills the space within the outer shell, but has shrunk and formed the radial cracks; but it is more probable that the shrinking observed is due wholly to desiccation.

Scattered throughout the ground-mass are occasional fragments of pisolites, whose irregular outlines have been covered to varying depths by a deposit of the same material which forms the concentric shells, and thus have been restored to spherical or oval forms.

Origin of the deposits.—The bauxites of France are apparently residual deposits from the decay of basalt. Remains of the constituent minerals of the parent rock appear in the ore, as well as traces of the original rock structure. The ore also occurs disseminated throughout the residual material, and not, as in the case above described, in compact bodies with well-defined limits. The Arkansas deposits, on the other hand, occur as regularly stratified beds in rocks of Tertiary age. They are found only near the contact with certain eruptive rocks, and their origin seems to be closely connected with the latter. In both localities, therefore, the relations of the ore differ so widely from those of the Georgia-Alabama deposits that their origin must be explained on a different theory.

No eruptive rocks, either ancient or modern, are found in the vicinity of the latter, nor are there any rocks in this region which, by weathering, could yield bauxite as a residual product. Hence, any satisfactory explanation of the origin of these deposits must give the source from which the material was derived, the means by which it was transported, and the process of its local accumulation.

As already stated in describing the stratigraphy of the region, the ore is associated with the Knox dolomite or with calcareous sandy shales immediately overlying the dolomite. The Connasauga, consisting of 2,000 feet or more of aluminous shales, invariably underlies the dolomite at greater or less distance beneath the ore-bearing regions, and is probably the source from which the alumina was derived.

The faults of the region have been briefly described. Undoubtedly such enormous dislocations of the strata generated a large amount of heat. The fractures facilitated the circulation of water, and for considerable periods the region was probably the seat of many thermal springs. These heated waters appear to have been the agent by which the bauxite was brought to the surface in some soluble form and there precipitated.

The chemical reactions by which the precipitation was effected are not well understood, and the conditions were not such as can be readily reproduced in the laboratory. Of the few soluble compounds of aluminum which occur in nature, only the sulphate and the double sulphate of potash and alumina need be considered.

The oxygen contained in the meteoric waters percolating at great depths through the fractured strata would readily oxidize the sulphides disseminated in the aluminous shales. Sulphates would thus be formed by a process strictly analogous to that commonly employed in the manufacture of alum. Probably the most abundant product of the process in nature was ferrous sulphate. Some sulphate of aluminum must also have been formed together with the double sulphate of potassium and aluminum, especially in the absence of sufficient potash to form alum with the whole.

In its passage from the underlying shales through several thousand feet of dolomite the heated water must have become highly charged with lime, in addition to the ferrous and aluminous salts already in solution. But calcium carbonate reacts upon aluminum sulphate and to some extent also on alum, forming a gelatinous or flocculent precipitate which consists of aluminum hydroxide and the basic sulphate. This reaction may have taken place at great depth and the resulting flocculent precipitate may have been brought to the surface in suspension. From analogy with pisolitic sinter and travertine now forming, such conditions would appear to be highly favorable for the production of the structures actually found in the bauxite. The precipitate was apparently collected in globular masses by the motion of the ascending water, and constant changes in position permitted these to be coated with successive layers of more compact material. Finally, after having received many such coatings, the pisolites were deposited on the borders of the basin, and the interstices were filled by minute oölites formed in a similar manner or by the flocculent precipitate itself.

Slight differences in the conditions prevailing in the several springs, such as concentration and relative proportion of the various salts in solution, also temperature and flow of the water, would produce the variation in the character of the ore observed at different points.

The bedding observed in the bauxite deposits may have been produced by the successive layers deposited on the steeply inclined outlet of the basin. After the cessation of the spring action, surface creep of the residual mantle from the higher portions of the ridges covered the deposits to varying depths, as they are found at present.

A small portion of the ferrous sulphate was oxidized and precipitated along with the bauxite, but the greater part was carried some distance from the springs and slowly oxidized, forming the widespread deposits of limonite in this region.

This explanation of the origin of these deposits indicates the methods to be pursued in the further development of the field. They are intimately associated with the faults which intersect the strata of the region. All the known deposits are either upon or very close to these faults. Hence the first work of the prospector will be to locate the faults in any new region which he is investigating. This in areas covered by residual material is a difficult matter and can be done only by careful study of the geologic structure of a considerable region. Unlike the iron ore, with which it is so intimately connected in its origin and present association, the bauxite readily disintegrates at the surface so that the largest deposits may be entirely concealed by a few feet of residual soil. More careful search is therefore necessary for locating bauxite than limonite deposits. So far as can be determined theoretically, all the conditions essential for the formation of bauxite deposits similar to those described exist at many points in northwestern Georgia and adjacent portions of Tennessee and Alabama. The ore has been reported from the vicinity of Sommerville, Chattooga county, Georgia, where the geologic conditions are favorable for its occurrence. It has been found by the writer between Gadsden and Jacksonville, in Calhoun county, Alabama, and is also reported from Jacksonville. This region is similar in its geologic relations to that south of Rome.

The southern Appalachian bauxite deposits are by no means inexhaustible, and many exaggerated claims have been made as to the quantity of the ore. As shown above, the ore occurs in local accumulations or "pockets" and not in a continuous bed, nor in anything resembling a vein. Nevertheless, basing an estimate upon the amount of ore in sight in the various workings and the number of localities at which it is known to occur, the quantity of ore is seen to be sufficient for many years to come to supply a much greater demand than now exists.

NICKEL AND COBALT.

Production.—Since the development of the Sudbury, Canada, mines little nickel or cobalt has been produced in the United States. In 1893 the total product from the Gap mine, in Pennsylvania, and from the nickel and cobalt speiss from Mine la Motte, Missouri, amounted to about 49,413 pounds. Of this the Gap product is valued at 47½ cents per pound, and that from Mine la Motte, which was exported as speiss, at 15 cents per pound, making the total value of the product $22,197. The total cobalt oxide product, including that exported in speiss, was 8,422 pounds, worth $10,346. The nickel matte imported from Canada in 1893 amounted to 12,247,986 pounds. Much of this was made into nickel oxide for addition to steel. The remainder became refined nickel and sulphate. The total product of nickel at Sudbury, Canada, in 1893, as determined by the Dominion Geological Survey, was 3,992,982 pounds, which was exported as matte and ore. Most of it, as seen from the above statement of receipts, came into the United States.

Product of the United States, 1876 to 1893.

Years.	Metallic nickel.	Nickel in matte.	Nickel in ore.	Nickel in nickel ammonium sulphate.	Total.	Value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1876	....	....	....	....	201, 367	$523, 554
1877	....	....	....	....	188, 211	301, 138
1878	....	....	....	....	150, 890	165, 979
1879	....	....	....	....	145, 120	162, 534
1880	....	....	....	....	233, 893	257, 282
1881	....	....	....	....	265, 668	292, 235
1882	277, 034	4, 582	....	....	281, 616	309, 777
1883	6, 500	52, 300	....	....	58, 800	52, 920
1884	....	64, 550	....	....	64, 550	48, 412
1885	245, 504	14, 400	18, 000	....	277, 904	179, 975
1886	182, 345	20, 000	5, 600	7, 047	214, 992	127, 157
1887	183, 125	10, 846	....	11, 595	205, 566	133, 200
1888	190, 637	....	1, 000	12, 691	204, 328	127, 632
1889	209, 763	42, 900	....	....	252, 663	151, 598
1890	223, 488	....	....	....	223, 488	134, 092
1891	....	....	....	....	118, 498	71, 099
1892	....	....	....	....	92, 252	50, 739
1893	....	....	....	....	49, 399	22, 197

Production of cobalt oxide in the United States.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
1869	811	1878	4, 508	1887	5, 769
1870	3, 854	1879	4, 376	1888	7, 491
1871	5, 086	1880	7, 251	1889	12, 955
1872	5, 749	1881	8, 280	1890	6, 788
1873	5. 128	1882	11, 653	1891	7, 200
1874	4, 145	1883	1, 096	1892	7, 869
1875	3, 441	1884	2, 000	1893	8, 422
1876	5, 162	1885	8, 423		
1877	7, 328	1886	8, 689		

IMPORTS AND EXPORTS.

Nickel imported and entered for consumption in the United States, 1868 to 1893, inclusive.

Year ending—	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1868	....	$118,058	....	....	$118,058
1869	....	134,327	....	....	134,327
1870	....	99,111	....	....	99,111
1871	17,701	48,133	4,438	$3,911	52,044
1872	26,140	27,144	....	....	27,144
1873	2,842	4,717	....	....	4,717
1874	3,172	5,883	....	....	5,883
1875	1,255	3,157	12	36	3,193
1876	....	....	156	10	10
1877	5,978	9,522	716	824	10,346
1878	7,486	8,837	8,518	7,847	16,684
1879	10,496	7,829	8,314	5,570	13,399
1880	38,276	25,758	61,869	40,311	66,069
1881	17,933	14,503	135,744	107,627	122,130
1882	22,906	17,924	177,822	125,736	143,660
1883	19,015	13,098	161,159	119,386	132,484
1884	....	....	*a* 194,711	129,733	129,733
1885	....	....	105,603	64,166	64,166
Dec. 31, 1886	....	....	277,112	141,546	*b* 141,546
1887	....	....	439,037	205,232	*c* 205,232
1888	....	....	316,895	138,290	*d* 138,290
1889	....	....	367,288	156,331	*e* 156,331
1890	*f* 566,571	260,665	247,299	115,614	376,279
1891	355,455	172,476	*g* 10,245,200	148,687	321,163
1892	....	....	*h* 4,487,890	428,062	428,062
1893	....	....	*h* 12,427,986	386,740	386,740

a Including metallic nickel.
b Including $465 worth of manufactured nickel.
c Including $879 worth of manufactured nickel.
d Including $2,281 worth of manufactured nickel.
e Including $131 worth of manufactured nickel.
f Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.
g Classified as nickel and nickel matte.
h Includes all nickel imports except manufactures.

Cobalt oxide imported and entered for consumption in the United States, 1868 to 1893, inclusive.

Years ending—	Oxide.		Years ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1868	....	$7,208	June 30, 1881	21,844	$13,837
1869	....	2,330	1882	17,758	12,764
1870	....	5,019	1883	13,067	22,323
1871	....	2,766	1884	25,963	43,611
1872	....	4,920	1885	16,162	28,138
1873	1,480	4,714	Dec. 31, 1886	19,366	29,543
1874	1,404	5,500	1887	26,882	39,396
1875	678	2,604	1888	27,446	46,211
1876	4,440	11,180	1889	41,455	82,332
1877	19,752	11,056	1890	33,338	63,202
1878	2,860	8,693	1891	23,643	43,188
1879	7,531	15,208	1892	32,833	60,067
1880	9,819	18,457	1893	28,884	42,694

The latest statistics at hand from New Caledonia are for 1892. The production increased there rapidly in 1891 and 1892, the product of ore (averaging about 7 per cent. nickel) being 22,689 metric tons in 1890, 60,921 tons in 1891, and 83,114 tons in 1892. But from lack of demand only 36,000 tons of ore were exported to France, the balance going to increase the stock, which now amounts to about 80,000 tons. The metallic nickel smelted in France in 1892 amounted to 1,244 tons, or 2,741,776 pounds. The production of Sweden was 33,000 pounds of nickel and 15,000 pounds of cobalt oxide; Norway, 275,000 pounds of nickel in 1892, while Prussia produced 747 tons of nickel and 54 tons of cobalt oxide.

Little has been done in developing such deposits of nickel and cobalt ores as are known in the United States. Some prospecting work was done at Lovelock's station, Nevada. At Riddles, Douglas county, Oregon, considerable money has been spent in development work by the International Nickel Mining Company, including $10,000 spent in 1893, principally for surface improvements, which now embrace a brick engine and boiler house, containing an 18-inch by 48-inch Corliss engine and 300-horse power Sterling water-tube boiler, a sawmill, carpenter shop, blacksmith shop, store, tool house, boarding houses, cottages, etc.; and at the railroad station the company has two dryers, a rock-breaker, a smelting furnace, roasting furnaces, etc. No developments have been made on Josephine creek, Josephine county, Oregon, where josephinite, a natural alloy of nickel and iron, has been found.

GENESIS OF NICKEL ORES.

By R. L. Packard.

Occurrence.—The ores of nickel are at present practically restricted to the silicate and nickel-bearing pyrrhotite. The former is mined in New Caledonia and occurs at Riddles, Oregon, and nickel-bearing pyrrhotite occurs extensively in Sudbury, Canada, Lancaster Gap, Pennsylvania, in Norway and Sweden, and in less quantities at several other places.

Origin.—Nickel in the form of silicate is brought to the earth's surface in the first instance as a constituent of the ferro-magnesian minerals of certain basic eruptive rocks, and the pyrrhotite in which it and its congener, cobalt, occur as sulphides has also been shown to be an original constituent of basic eruptives. The fact that these metals were brought up by basic rather than acid rocks is now stated with full confidence and without comment in recent popular treatises on ore deposits (*see*, e. g., De Launay, "Formation des gites Metallifères"), and the evidence on which such a general statement should be based is here collected and presented.

The nickel ore of New Caledonia is a hydrated silicate of nickel and magnesia (garnierite) which occurs intimately associated with serpentine. The occurrence has been frequently described. The ore occurs partly as a stockwork in the serpentine and partly in veins, and usually near an ocherous clay, which, besides the iron oxide, contains chrome iron ore and cobalt, derived from the serpentine. This clay is abundant on the hills where the deposits occur which are described as consisting of dunite (an olivine rock carrying chromite) and serpentine, and the field observations showed that the nickel silicate is clearly an alteration product of the serpentine which, in turn, is derived from the olivine of the dunite. The serpentine contains chromium also afforded by the dunite. Hot springs have played a conspicuous part in furthering the decomposition of the nickel-bearing serpentine into garnierite and the other products. (D. Levat. Progres de la Metallurgie du nickel. Ann. des Mines 1892, and F. Benoit, referred to in Zeitschr. für prakt. Geologie 1893, 8, p. 322.)

A hydrated nickel magnesian silicate allied to garnierite has been found in large quantities at Riddles, Oregon, associated with serpentine and accompanied by quartz (including chrysoprase), and chrome oxide, and the occurrence has been noticed in former numbers of the Mineral Resources. Mr. J. S. Diller, of the U. S. Geological Survey, made a microscopic examination of thin sections of this mineral and the associated rock, an account of which is given on page 445 of Vol. XXXV of the American Journal of Science for 1888. The examination showed the mineral intimately associated with quartz, and it was evident that both had been deposited from solution. Its genesis was best shown by its intimate intergrowth with serpentine, which is the alteration product of olivine, portions of which latter mineral, still undecomposed but coated with iron oxide and serpentine, were in close proximity to the nickel silicate. Baron H. v. Foullon (Jahrb. der Kaiserl.-Königl. Geol. Reichsanstalt, 1892, 2), who visited the Riddles locality, identified the olivine rock which gave origin to the serpentine and nickel silicate as Harzburgite, which consists of olivine, bronzite, picolite, and some magnetite. This confirms the determination of Mr. G. P. Merrill. (*See* Mineral Resources, 1887.) v. Foullon refers to Mr. Diller's examination and remarks that the field observations show the process of alteration very strikingly. He gives details of this process and described the conversion of the olivine into small blocks of serpentine intersected by irregular fissures, which are bordered by the nickel silicate until the appearance is that of a breccia or conglomerate of pieces of serpentine cemented by the nickel magnesian silicate.

The same author describes the occurrence of a nickel silicate associated with serpentine at Revda, in the Urals, the serpentine being an alteration product of the iron magnesian silicate, pyroxene. Mr. Diller's examination of genthite, the nickel silicate from Webster, North Carolina, showed the same intimate association with serpentine as in the case of the Riddles mineral. The thin section showed the genthite in veins or branches intermingled with the serpentine, so that its ultimate derivation from the nickeliferous olivine of the dunite, which is the source of the serpentine, is unquestionable. Mr. Diller also examined thin sections of the New Caledonian mineral, and the same description would apply to it as to the others. It confirmed the field observations given above.

Dr. Kosmann describes the nickel ore of Frankenstein, in Silesia, as a magnesia nickel silicate occurring between stock-like serpentine masses, and it can be traced to the gabbro of the Eulengebirge. Some of the silica set free, with the magnesia, from the decomposing serpentine, is in the form of chrysoprase,(*a*) as was observed at Riddles by Mr. Biddle.(*b*)

Many analyses of olivine and its derivative serpentine, and of talc, show considerable quantities of nickel; in olivine up to 0.5 per cent., in serpentine to 1.07 per cent., and in talc to 0.4 per cent., while the pyroxenes, amphiboles, and micas contain much less. Basic eruptive rocks, for example olivine-bearing rocks, such as gabbros and diabases, nephelenites, etc., show high percentages of nickel oxide (up to 0.67 per cent.).(*c*)

The nickel oxide in American eruptive rocks, cited in Iddings's Origin of Igneous Rocks, is not so high, the highest reaching 0.19 per cent. The nickel in the above cases was originally present as oxide, forming one of the bases in the silicates of which the basic rock was composed, and subsequently, in the case of olivine, by an alteration of the original mineral, the nickel oxide was enabled to enter into another combination with silica, magnesia, and water. Acid rocks, e. g., granites, so far examined, do not show more than a trace of nickel (up to 0.001 per cent. Vogt).

The second original form in which nickel (and with it cobalt) has been brought to the surface in a sufficiently concentrated form to be commercially valuable is as a constituent of pyrrhotite. This nickel (and cobalt) bearing pyrrhotite has been shown to be a normal constituent of certain basic eruptive rocks (norites, gabbros, gabbro-diorites) in Norway and Sweden, and in Canada, and occurs elsewhere in the same class of rocks. Professor Vogt, in the paper before referred to, gives a comprehensive petrographical description of the Scandinavian occurrences, and briefly describes others in various parts of the world, and is of the opinion that the generally observed association of nickel sulphide ores with basic eruptive rocks forms a definite "world group." A striking feature of this association is the concentration of the nickel-bearing pyrrhotite at the contact of the basic eruptives, and this phenomenon Vogt regards as an instance of magmatic concentration or differentiation which may be explained as follows.

Petrographers regard the molten rock magma as analogous to a saturated solution of different salts, and, from comparing the analyses of many eruptive rocks with those of the crystallized minerals they contain and of their uncrystallized base (Lagorio); or from the analyses of many volcanic and non-volcanic igneous rocks (Rosenbusch) they have been led to suggest a general hypothetical formula for the molten solvent and for the silicated nuclei or fluid (molten) molecules which may crystallize from it as salts do from a solution. Lagorio says: "The

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a Ztschr. für prakt. Geol., 1893, 6, p. 240.

b Mineral Resources, 1886.

c J. H. L. Vogt. Ztschr. für prakt. Geol. 1879, 7.

molten rock magma is therefore nothing else than a supersaturated solution of different silicates which only need a slight impulse in order to crystallize out in the form of one compound or another, according to the degree of saturation. The analogy with a solution of salts is complete."(*a*) Vogt uses this analogy to assist in explaining the separation from the magma of the heavy oxides and sulphides. He remarks that the greater fluidity of basic magmas renders the diffusion of fluid molecules in them easier than in the more viscid magmas of acid rocks, and consequently the concentration of heavy oxides, iron magnesian silicates, and sulphides would meet with less resistance in basic magmas. At any rate, this phenomenon is peculiar to the basic rocks. The hypothetical explanation of the process of magmatic concentration, however, is complicated by many considerations, e. g., chemical affinity, influence of osmotic pressure and gravity, solubility, etc. It is enough for the present purpose to say that Vogt lays stress upon Soret's principle to explain the phenomenon of the concentration of nickel-bearing pyrrhotite at the contact of the basic eruptives.

This principle, briefly stated, is that if different portions of a homogeneous solution of a salt have different temperatures the salt will concentrate after a time in the cooler portions of the solution. Vogt applies this principle, in the first place, to explain the formation of basic contact zones in dikes of intrusive rocks, a phenomenon of frequent occurrence. He uses, as an illustration, dikes of a mica-syenite porphyry, in which the basic iron-magnesian minerals are concentrated at the contact and the less basic toward the interior. The same mineral, feldspar, is the more basic labradorite at the contact and the more acid oligoclase in the middle. This concentration at the cooler portions of the dike he regards as analogous to the concentration of the salt in the cooler portions of a solution. The nickel-bearing pyrrhotite also occurs at the contact of basic eruptive rocks like the other basic minerals, and Vogt regards this circumstance as only another instance of magmatic concentration in the cooler portions.

He demonstrates that the pyrrhotite in the Norwegian basic rocks is not an intrusion, but is a normal constituent of the rock like its other minerals, and he regards the zone of its occurrence as a contact facies of the eruptive magma. The thin sections of the nickel-bearing rock show the pyroxene, olivine, and mica, as well as the plagioclases, with well maintained idiomorphic outlines, only with their angles and edges somewhat rounded, lying porphyritically in the pyrrhotite, which might therefore be compared to the base of a porphyry. The nickel-bearing pyrrhotite therefore solidified after the crystallization of the iron-magnesian silicates and feldspars had taken place. That it was still fluid after their formation is shown by fissures in the

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a Tschermac's Mitthl., 8, 1887.

bent porphyritic minerals, filled with the pyrrhotite. Vogt uses the terms pyrrhotite-norite and pyrrhotite-gabbro to describe this rock. No other occurrence of nickel-bearing pyrrhotite has received such a comprehensive study as the Scandinavian. The others, although of interest as illustrating the origin of the metal, are of little industrial importance except the Sudberry district in Canada, which has become the largest producer of nickel in the world.

This well-known locality has been frequently referred to in the Mineral Resources. Its geology has been described by the geologists R. Bell and v. Foullon, the latter author giving fuller details of the ore-bearing rock itself, which he calls a diorite, although the rock varies in character so that at some points it may be called a gabbro. He says that the varied mixture of sulphides and silicates, the former sometimes appearing as a ground mass, indicates a simultaneous origin of both. At certain periods of the eruption the magma was rich in the substances which made the formation of metallic sulphides possible, and they separated out on cooling. He describes the alteration of diallage to hornblende by ūralitization, which would give a dioritic character to the gabbro. He also describes an increase in quartz near the contact (quartz-mica diorite), which he ascribes to the influence of the quartzite through which the eruptive rock was forced.

Vogt, judging from specimens sent him, regards the ore-bearing rock as the same with the nickel-bearing Swedish "gabbro-diorites." The occurrence of the ore bodies at the contact of the intrusive rock with the quartzite is a well-known feature of the Sudbury district, which in that respect resembles the Swedish, although the petrographical field is different. The pyrrhotite near St. Stephens, New Brunswick, also occurs in diorites. No petrographical details of the occurrence are given. (Geol. Survey of Canada, 1890–'91, II, p. 112, S. S.)

The foregoing summary shows the warrant for the general statement which is becoming common among writers on ore deposits, that nickel was originally brought to the surface by basic rocks rather than acid. As cobalt occurs in the same ores as nickel, but in a subordinate degree, the same statement applies to that metal as well. The other form in which nickel and cobalt occur, viz., in combination with arsenic, is now of minor industrial importance. At Mine la Motte, Missouri, the arsenides accompany the lead deposits in the sedimentary rocks (Whitney), and this is not the form in which the metals first appeared. Elsewhere, also, the arsenides (and arseniates) are vein minerals, and their metals are not in their original combinations.

Metallurgy.—The Mineral Resources for 1889 contained a full account by Mr. E. D. Peters of the process of producing nickeliferous matte at Sudbury. The further treatment of this matte has become the subject of much experimenting, very largely on account of the necessity of obtaining copper-free nickel for the steel plates for navy vessels. D.

Levat(*a*) describes the further treatment of the matte. It is refined either in a reverberatory furnace (English method) or by Bessemerizing (French and German method).

The reverberatory refining requires two operations, each of which includes two phases, viz., roasting and fusion with quartzose sand to scorify the iron. Each furnace treats two tons in twenty-four hours and consumes two tons of coal, or weight for weight of the original matte. Specimens are taken in the course of the operation which lasts eight hours in order to arrest the work as soon as the iron has disappeared so as to prevent the passage of the nickel into the slag. The latter is never thrown away for it contains 2 to 2.5 per cent. nickel, and also makes an excellent flux. The first operation in the reverberatory gives mattes with 2.5 to 3 per cent. iron, the second 0.5 to 0.75 at most. The refined matte should contain at least 16 per cent. of sulphur in order to be easily pulverized for subsequent operations. The matte freed from iron has the following composition:

Ni (+ Co)	75.
S	24.
Fe	.5
Impurities,	.5
	100.0

The total impurities should not exceed 1 per cent., for the subsequent operations only remove sulphur. The matte is crushed to 65 mesh [French system], and is roasted in a large roasting furnace (33 feet long by 8 feet wide, with 4 doors on one side) in which the charge is rabbled along toward the fire bridge. The charge is about 1,400 pounds and the operation lasts eight hours, or less if copper is present. About a ton and a half are treated per twenty-four hours, using a ton of coal. The temperature is kept at a dark red heat to prevent fusion. The operation lasts six hours and produces an oxide with a small proportion (about 1 per cent.) of sulphur and sulphates. This material is subjected to another roasting after crushing to 120 mesh [French system], and the temperature is raised to a bright red. The resulting oxide (or oxides, for copper oxide is not eliminated) which should not contain over .004 per cent. sulphur, is formed into cubes or other desirable shapes with water and flour, and reduced with charcoal in a suitable furnace. The copper must be separated from the nickel by one of the wet methods.

Bessemerizing requires much less time than the reverberatory method. The melted matte is run into the converter (of a ton capacity) and is blown with a pressure of about 40 centimeters of mercury. The temperature rises and a quartzose mixture is thrown on the surface for scorifying the iron. If the matte does not contain more than 36 per cent. of iron the latter can be removed in about one hour and twenty minutes.

a Progrès de la metallurgie du nickel, Ann. des Mines, 1892.

If there is more than this the bath should be skimmed at least once after the first twenty-five minutes and a new proportion of the flux added. After the final skimming and when the nickel is found to be oxidizing in its turn, the refined matte containing 0.5 per cent. of iron is run off. Arsenic, antimony and silver are carried off by the blast or enter into the slag. This slag contains 14 or 15 per cent. of nickel, mostly in the form of prills carried into the pasty mass by the blast. Part of this can be recovered by running the slag into pots and allowing the metal to sink to the bottom. The slag must be returned to the furnace.

It would seem natural to continue the action of the blast in the converter upon the matte freed from iron in order to burn out the sulphur, and so obtain refined nickel, which would then only need to be heated in a reducing atmosphere to reduce the nickel oxide which might be formed, as is done with copper. Numerous attempts have been made for this purpose, but it appears impossible to succeed with nickel in this way. After the iron has been removed the nickel oxidizes with the sulphur and even more easily. Also, after the iron has disappeared the temperature falls, which is easily understood because the combustion of the sulphur, which is lessened by the affinity of sulphur for nickel, does not compensate for the cooling due to the injection of the air. The bath then tends to solidify, and this effect is the more speedy as the uncombined nickel produced can only remain in the liquid state at a very high temperature—near that of molten iron.

Various methods for effecting the separation of the nickel and copper have been patented in the last year or two. In the absence of information in regard to actual adoption of any of these, we can only give a partial list.

T. McFarlane, October 11, 1892, No. 484,033. Roasts the ore or matte with a chloride, dissolves out the chloride formed, precipitates iron by a weak alkali solution, adds a small quantity of sodium sulphide to precipitate copper, and precipitates nickel from the remaining solution by soda.

J. De Coppet, October 25, 1892, 484,875, and November 22, 1892, 486,594–5. After the iron has been slagged off, roasts the refined matte and forms sulphates by using an oxidizing flame. May chloridize during the operation. The sulphates are leached out and if they contain enough copper sulphate this solution may form the attacking liquid, if not, copper sulphate must be added. The residue is reduced to metal and is acted on by copper sulphate, which dissolves cobalt at the ordinary temperature. After the cobalt is removed the same solvent at a higher temperature dissolves nickel, in both cases depositing an equivalent quantity of copper.

R. M. Thompson, patent of January 10, 1893, 489,574–6, smelts ores or mattes with alkaline sulphides in excess, whereby nickel sulphide is formed and sinks to the bottom of the crucible. The "tops" containing alkaline sulphides are used again with crude nickel to form the sulphide. The operation is repeated until the separation is satisfactory. The crude nickel is formed by fusing matte with alkaline carbonates.

Grant and Richardson patent of January 31, 1893 fuse ores with calcium sulphate and silica to remove the sulphur from the iron and slag it off and leave nickel and copper sulphides.

C. C. Bartlett patent of June 13, 1893, 499,314 smelts ore or matte with niter cake, salt cake, or alkaline nitrates or carbonates, whereby nickel sulphide is formed and sinks to the bottom. Repeats the operation until pure nickel sulphide is obtained.

D. de P. Ricketts patent October 3, 1893, 505,846 obtains an acid solution of the copper and nickel as sulphates, adds alkalies or alkaline sulphates, still preserving the acidity of the liquid, in order to precipitate the nickel as a basic sulphate, separates the copper from the acid liquid by electrolysis, and recovers the nickel from the sulphate.

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American Journal of Science, 1888.

Statistics from manufacturers and dealers.

TIN.

The Kings's Mountain locality in North Carolina was prospected again during 1893, and much interesting information developed in regard to the occurrence of cassiterite there.

King's Mountain is in Cleveland county, North Carolina. It is an isolated point in the limestone considerably east of the Appalachian range proper. The village of King's Mountain is near the foot of the mountain on the west side. It is a station on the Richmond and Danville railroad. The fact that crystals of cassiterite could be found in this locality was known as early as 1883, when Dr. Charles W. Dabney, jr., found one on the main street of the village, and others were collected by a student named Claywell. At this time Dr. Dabney and others contributed to a fund for prospecting the region, without, however, finding any significant deposit of tin ore. During 1893, Mr. J. C. Horton recommenced the prospecting with the idea that the earlier developments had been based on a mistaken conception of the arrangement of the mineral-bearing lodes. The evidence developed is that Mr. Horton is correct, as will be seen by the following report of Mr. Titus Ulke, mining engineer, who was sent as an expert agent of the U. S. Geological Survey. His report has particular value because of his careful study of the occurrence of tin ore while assayer for the Harney Peak interests in South Dakota.

THE OCCURRENCE OF TIN ORE AT KING'S MOUNTAIN.

[By Titus Ulke.]

The village of King's Mountain is 1,200 feet in altitude, and is situated nearly on the dividing line between the limestones on the east and the granites on the west. The granite shades into micaceous, hornblendic, and tourmaline schists and then into ferruginous and manganiferous talcose slates and quartzites, thus forming a belt 1 or 2 miles wide and coursing nearly north and south.

In this belt, for some 8 miles above (north of) King's Mountain and some 6 miles or more below it, there are narrow outcrops of greisen or granite, which as a rule do not conform to the bedding of the country rock. It has been previously supposed that they did. On the contrary, they take a course at almost right angles to it. These granite-greisen dikes occur say every 700 to 1,000 feet; sometimes they carry tin stone, and then are from 4 to 7 feet in width, and course from north

28 degrees to 60 degrees west. The slates and schists course north 25 degrees east.

In the tin belt so-called "trap dikes" are frequently found. In several cases these proved to be arms of the main granite or hornblendic granite dikes, parallel to the dikes carrying cassiterite, and when interbedded with the country rock, hornblende and tourmaline schists. The credit belongs to Mr. J. C. Horton for calling the writer's attention to the error of certain geologists in supposing these tin dikes or veins to be bedded deposits, coursing with the country formation. Mr. Horton, acting on a theory more in accordance with the facts, and developing a number of cassiterite outcrops, has discovered what seems to be a very promising tin dike or vein. It is 2 miles from the village of King's Mountain, and is designated as the Chestnut Hill vein. In the shaft sunk upon it the vein is 7 feet wide at a depth of 100 feet, and carries about 3 per cent. of black tin, judging by what Mr. Horton considered an average sample, outside of a very rich streak 14 to 18 inches wide in the middle of the vein, which, according to Mr. Horton, pans 25 per cent. of black tin. The shaft has already been sunk vertically to a depth of 122 feet, and when it is down 130 feet, a crosscut will be driven to the ore.

At the time of the writer's visit the shaft was full of water, so that the vein could not be examined in the shaft, but only the ore on the dump and the outcroppings. The latter were often difficult to detect, and covered by the overlapping slates or decomposed soil, but almost wherever exposed they showed smaller or larger crystals of cassiterite.

The new pump which was ordered for this mine sometime ago is very probably now in place and pumping, so that the mine may again be thoroughly inspected.

Several tin properties in the vicinity of King's Mountain, claimed to be good prospects, were found to consist only of detached bowlders, showing a little scattered cassiterite.

Mineralogical.—The cassiterite, there, is nearly always black, often almost metallic in luster, and occurs chiefly as flattened crystals, with abnormally elongated pyramidal planes. It is found at Chestnut Hill imbedded in a granite, in which the mica—a light, yellowish-green muscovite—is often arranged in narrow feather-striated bands, and the gray-white quartz, mixed with a little white feldspar, possesses a granular structure. The granite at King's Mountain is often stained by iron and manganese oxides, and in some places contains beryl, cyanite, and decomposed spodumene. This latter mineral often replaces the mica and feldspar in the granite dikes, when they are barren of or poor in cassiterite.

The tin ore is to all appearances as free from injurious minerals as that of the Harney Peak district, which it closely resembles mineralogically and geologically.

Outlook.—Regarding the prospects for the production of tin at King's Mountain, the writer has arrived at the following conclusions: Should the dike or vein at the Chestnut Hill mine continue to hold its present richness and width, as claimed, in greater depth and in the stopes, there can be no doubt that, with good management, it will become a profitable investment. The Chestnut Hill mine, however, is the only tin property in the King's Mountain district visited in the very limited time at the writer's disposal which looked at all promising. The developments at King's Mountain have not been sufficient to decide the question whether tin ore in paying quantity exists there or not.

The writer also visited the Cash mine in Rockbridge county, Virginia, and reports as follows:

CASH MINE, NEAR VESUVIUS, VIRGINIA.

The tin ore from this district was first tested by Professor Armstrong, of Washington College, Lexington, Virginia, in 1846; he claimed that the specimen examined contained tin and silver. However, development work was not commenced until Mrs. Martha Cash bought the present tin property at the head waters of Irish creek, and rediscovered tin there in 1882.

The property is located on a granite ridge in the northeastern part of Rockbridge county. Approaching from Vesuvius station on the Chesapeake and Ohio railroad, we leave a limestone valley, and first meet with highly ferruginous and manganiferous sandstones, quartzites, and conglomerates, often altered apparently by pressure into red and green slates. Then a granite area is met, in which the granite is often highly altered and contains, besides quartz and a little hornblende, a pink feldspar and green epidote. At last we come to the granite and gneiss area proper, in which the tin veins occur. This country granite is often rich in tourmaline, is both coarse and fine-grained in structure, and is traversed by dikes of fine-grained altered diabase.

The principal deposits or veins have been opened at the Cash mine. In the best-developed one there is a streak of quartz 8 or 10 inches wide on the foot-wall side of a vein filling, largely granitic, which carries from 1 to 2 inches of cassiterite, associated with a little arsenopyrite. The developments consist of an open cut extending about 60 feet into the face of the hill and a tunnel or adit on the vein, which penetrates some 40 feet farther. There are also several pits and open cuts on other veins.

In the Cash mine the following minerals are found with the cassiterite: Arsenopyrite, quartz, siderite, and brownspar, limonite, chlorite, muscovite, damourite, fluorspar, wolframite, and pyrite.

The cassiterite varies from a peculiar grayish or yellowish white to a blackish brown in color, the small brown translucent crystals often possessing a beautiful adamantine luster, and then resembling the "rosin tin" of the New Cook's Kitchen and Dorothy mines, Cornwall. Generally the cassiterite is found in crystalline masses of a dull gray color, like that of some of the tinstone from the Dolcoath mine, although well formed flat pyramidal crystals of considerable size, like the Cornish "diamond tin," are not uncommon in the Cash mine. Cassiterite with cavities of the exact form of arsenopyrite, from which the arsenopyrite has been completely removed, are also found. The nearly pure white tin ore found at the Cash mine is of extremely rare occurrence and might easily be overlooked in prospecting. It was only the weight, hardness, and slightly resinous luster of such a specimen that caused the writer to suppose it to consist chiefly of massive cassiterite, which view was corroborated by subsequent chemical analysis.

The mineral association and the geological occurrence of the tin here more closely resemble that of Cornwall than do those of any other known tin locality in the United States. In the writer's judgment, the Cash property certainly warrants thorough development. A mill, said to have cost $50,000, was erected on the property several years ago, and about 290 tons of rock, averaging about 3.3 per cent. of metallic tin were tested. About 2,400 pounds of the black tin concentrates were barreled and sent to Boston to be smelted. The concentrates obtained averaged only 43 per cent. of metallic tin, owing, it is said, to the presence of arsenopyrite and ilmenite. The average width of the vein from which the ore was obtained for these tests was 6 to 8 feet. The cassiterite extends out into the granite on each side of the vein, but in such small quantities that it will not pay to work.

It is well known that the development of this property was hindered for years by litigation. At present there is no dispute as to the ownership of the tin-bearing property itself, but the ownership of the mill site and mill is disputed. Regarding the question of title and disposition made of the apparatus for developing the tin mine, the following statement was obtained from the Cash interests and others. Mrs. Cash—owner by purchase—gave a one-half interest in the tin land to a Mr. Massey, who, in turn, gave one-half of his half to a Mr. Henley to have him develop the property. These gentlemen organized a joint-stock company, to which Mrs. Cash subscribed. In 1891 a Boston syndicate consisting of Messrs. Fuller, Ellis, Brooks, Joy, and Knowlton, secured a $200,000 option on the property by paying down $12,000. They put up a $50,000 mill. After making several trial runs (in all running the mill about a month), the option expired; then the syndicate asked for a time extension of two months, which was granted on condition that the mill and machinery be put in bond. At the end of this time the syndicate did not pay for the tin property, and accordingly the above joint-stock company became owner of the mill and machinery. Outside of the cost of building and equipping the concentrating mill only about $5,000, it is said, was spent in developing the tin property.

In regard to the ownership of the mill, which, as already indicated, is in dispute, the following facts are of interest. The original charter of the joint-stock company (the Virginia Tin Mining and Manufacturing Company), specifies that the stock company had privileges of putting up machinery, railroads, and timbers for mining purposes on the land owned by Mr. J. R. Cash. The latter lost this land (the mill site in question) because he failed to make the purchase payment to a Mr. A. D. Grant, who finally brought suit and recovered the land. Mr. Grant then sold the property to a Mr. J. B. Sanford, of Baltimore. Mr. Sanford now claims that the mill belongs to him, and not to the joint-stock company, because the mill was erected on his undisputed property. This is denied by Mr. Cash and the members of the joint-stock company, who claim that the charter of the latter specifies the above privileges, and that Mr. Stanford when he bought the 47 acres of land, upon part of which the mill stands, knew of the existence and provisions of the charter. To sum up the foregoing: There are no adverse claimants to the 125 acres of the Cash mining property (tin lands), but there is an adverse claimant to the mill and concentrating machinery in the person of Mr. J. B. Sanford. Mr. Sanford, according to Mr. Cash, states that he will not oppose any sale or agreement entered into by the Virginia Tin Mining and Manufacturing Company. The concentrating apparatus has been idle since the spring of 1892.

World's supply of tin from 1880 to 1893.

Years.	English production.	Straits shipments to Europe and America.	Australian shipments to Europe and America.	Banca sales in Holland.	Billeton sales in Java.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1880	8,918	11,735	9,177	3,756	4,735	38,321
1881	8,615	11,400	10,100	4,548	4,740	39,403
1882	9,300	11,705	10,067	4,399	4,200	39,671
1883	9,307	16,958	11,121	4,203	4,157	45,746
1884	9,574	17,548	9,337	4,193	3,600	44,252
1885	9,331	17,320	9,088	4,200	3,760	43,699
1886	9,312	19,674	8,064	4,379	4,128	45,557
1887	9,282	23,977	7,750	4,384	4,978	50,371
1888	9,241	23,855	7,975	4,430	5,220	50,721
1889	8,912	28,295	6,800	4,114	4,857	52,978
1890	9,000	27,470	6,415	5,317	5,232	53,434
1891	9,354	31,457	5,991	5,350	5,753	57,905
1892	9,252	38,200	5,250	5,525	5,450	63,677
1893	8,650	39,874	5,579	5,418	5,211	(*a*) 67,232

a Including 2,500 short tons for Bolivia and other South American countries.

Prices of tin in New York, by months, from 1885 to 1893.

[Cents per pound.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1885	16⅝	17.45	17⅜	17.80	18⅝	20⅜	22⅜	21¼	20.95	20.95	20.65	21.00
1886	20⅝	20.70	20.80	20.85	21.30	22¾	22¼	21¾	22.20	22¼	22.40	22¼
1887	20.30	22½	22.55	22½	22.95	23¼	23.35	23.30	23⅛	25⅛	31.05	36⅓
1888	36.95	36.95	36.70	32.95	21.95	18.05	19¼	20¾	22.95	23.35	22.70	22.10
1889	21⅞	21½	21.30	20⅞	20½	20.30	19⅞	20.20	21.30	20.80	21¾	21.30
1890	20.95	20.87	20.39	20.13	21.52	21.53	21.17	21.62	24.00	22.60	21.07	21.21
1891	20.20	19.90	19¾	19½	20.00	21.00	20.20	20.10	20¼	20.10	20.00	19.90
1892	20.50	20.00	20.25	20.50	20.80	22.00	21.00	20.50	20.35	20.50	20.80	20.00
1893	19.97	20.18	20.94	20.67	19.93	19.67	19.06	18.67	20.28	20.85	20.67	20.57

Tin and tin plates imported and entered for consumption in the United States, 1867 to 1893.

Years ending—	In blocks, bars, or pigs, and grain tin.		Tin plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Owts.		*Owts.*		
June 30, 1867..	....	$1, 210, 354. 02	....	$6, 276, 136. 78	$7, 486, 490. 80
1868..	....	1, 454, 327. 36	....	6, 893, 072. 07	8, 347, 399. 43
1869..	80, 811	1, 709, 385. 00	1, 534, 324	8, 565, 432. 56	10, 274, 817. 56
1870..	81, 702	2, 042, 887. 71	1, 333, 150	7, 628, 871. 51	9, 671, 759. 22
1871..	106, 595	2, 938, 409. 82	1, 556, 023	9, 490, 778. 64	12, 429, 188. 46
1872..	102, 006	3, 033, 837. 45	1, 617, 627	10, 736, 906. 59	13, 770, 744. 04
1873..	130, 469	3, 938, 032. 25	1, 854, 956	15, 906, 446. 82	19, 844, 479. 07
1874..	116, 442	3, 199, 807. 07	1, 553, 860	13, 322, 976. 14	16, 522, 783. 21
1875..	102, 904	2, 329, 487. 96	1, 540, 600	12, 557, 630. 75	14, 887, 118. 71
1876..	93, 176	1, 816, 506. 00	1, 767, 210	10, 226, 802. 87	12, 043, 306. 87
1877..	98, 209	1, 783, 765. 00	1, 984, 893	9, 818, 069. 69	11, 601, 834. 69
1878..	128, 849	2, 167, 350. 00	2, 166, 489	9, 893, 639. 61	12, 060, 989. 61
1879..	142, 927	2, 301, 944. 00	3, 487, 007	10, 248, 720. 34	12, 550, 664. 34
1880..	290, 007	6, 153, 005. 68	3, 298, 534	16, 524, 590. 19	22, 677, 595. 87
1881..	171, 146	3, 971, 756. 67	3, 366, 720	14, 641, 057. 87	18, 612, 814. 54
1882..	197, 544	5, 204, 251. 68	3, 926, 311	16, 550, 834. 64	21, 755, 086. 32
1883..	237, 348	6, 106, 250. 37	4, 051, 108	16, 688, 276. 67	22, 794, 527. 04
1884..	(*a*) 26, 081, 992	5, 429, 184. 01	(*a*) 527, 881, 321	18, 931, 072. 70	24, 360, 256. 71
1885 .	23, 947, 523	4, 263, 447. 00	505, 559, 076	16, 610, 104. 56	20, 873, 552. 00
Dec. 31, 1886..	27, 960, 761	5, 873, 773. 00	574, 098, 405	17, 719, 957. 12	23, 593, 730. 12
1887..	29, 645, 531	6, 927, 710. 00	570, 643, 389	16, 883, 813. 95	23, 811, 523. 95
1888..	31, 740, 583	8, 758, 562. 00	632, 224, 296	19, 034, 821. 03	27, 793, 383. 03
1889..	35, 177, 646	7, 045, 939. 00	734, 086, 964	20, 361, 564. 00	27, 407, 503. 00
1890..	33, 800, 729	6, 809, 645. 00	688, 247, 657	21, 923, 754. 00	28, 793, 399. 00
1891..	41, 146, 123	8, 091, 363. 00	734, 425, 267	25, 900, 305. 00	33, 991, 668. 00
1892..	46, 815, 141	9, 415, 880. 00	573, 918, 302	16, 545, 336. 00	25, 961, 216. 00
1893..	38, 304, 008	5, 675, 128. 00	545, 472, 209	15, 127, 736. 00	20, 802, 864. 00

a Pounds in 1884 and following years.

Value of tin manufactures exported from the United States (a).

Years ending—	Value.	Years ending—	Value.
Sept. 30, 1826	$4, 515	June 30, 1860	$39, 064
1827	2, 967	1861	30, 229
1828	5, 049	1862	62, 286
1829	1, 757	1863	41, 558
1830	4, 497	1864	46, 968
1831	3, 909	1865	106, 244
1832	3, 157	1866	79, 461
1833	2, 928	1867	40, 642
1834	2, 230	1868	27, 110
1835	2, 545	1869	18, 994
1836	5, 604	1870	46, 007
1837	10, 892	1871	70, 366
1838	10, 179	1872	67, 244
1839	19, 981	1873	69, 865
1840	7, 501	1874	62, 973
1841	3, 751	1875	48, 194
1842	5, 682	1876	48, 144
1843 (nine months)	5, 026	1877	87, 057
June 30, 1844	6, 421	1878	116, 274
1845	10, 114	1879	103, 467
1846	8, 902	1880	144, 185
1847	6, 363	1881	498, 524
1848	12, 353	1882	198, 608
1849	13, 143	1883	191, 947
1850	13, 590	1884	166, 819
1851	27, 823	1885	162, 304
1852	23, 420	Dec. 31, 1886	157, 724
1853	22, 988	1887	137, 551
1854	30, 698	1888	219, 000
1855	14, 279	1889	255, 100
1856	13, 610	1890	262, 343
1857	5, 622	1891	250, 411
1858	24, 186	1892	204, 429
1859	39, 289	1893	258, 449

a Classed as "tin, and manufactures of," from 1851.

ANTIMONY.

The product of metallic antimony in the United States in 1893 was 250 short tons, worth $45,000 in San Francisco, against 150 short tons, valued at $30,000 in 1892. In 1892, however, there were 386 tons of domestic ore worth $26,466 shipped to England for smelting. This added to the value of the metallic antimony obtained in that year brought the total up to $56,466. No ore was shipped out of the country during 1893. All of the ore produced (about 400 short tons, together with 100 tons from Mexico) was smelted in San Francisco, yielding 250 tons of metal. Of the domestic ore about 350 tons were mined in Nevada, California producing the other 50 tons.

On account of litigation among the owners, the mines in Montana were not operated. The same condition affected the Hutchens property in Nevada, and owing to prevailing low prices the mines at Big creek were closed down. The owners of the Arkansas properties are still waiting the completion of a railroad, which is now reported as building from Texarkana to Fort Smith.

The following is the annual production of antimony in the United States since 1880.

Production of antimony in the United States since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	50	$10,000	1888	100	$20,000
1881	50	10,000	1889	115	28,000
1882	60	12,000	1890	129	40,756
1883	60	12,000	1891	278	47,007
1884	60	12,000	1892:		
1885	50	10,000	Metallic	150	56,466
1886	35	7,000	Ore	380	
1887	75	15,000	1893	250	45,000

Prices.—During January and February prices for antimony were depressed, Cookson's being quoted as low as 10¾ cents, with L. X. at 10½ cents, and Hallett's from 9⅞ to 10¼ cents. In the early part of March a firmer tone prevailed for the cheaper grades, but fell off later in the month with trade dull and lifeless. Prices continued to decline slowly with an apathetic trade throughout the summer until November, when the lowest prices in the year were quoted for the higher grades: Cookson's, 10 cents, L. X, 9¾ cents, and Hallett's, 9¼ to 9⅜. A better tone prevailed in December for Cookson's, which advanced about ⅛ or ¼ cent, but the cheaper grades continued to decline, the year closing with L. X. at $9\frac{1}{2}$ to $9\frac{5}{8}$ cents, and Hallett's at $9\frac{1}{8}$ to $9\frac{1}{4}$. The following table shows the average prices which obtained throughout the year:

Ruling prices for antimony during 1893.

[Cents per pound.]

Kinds.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Cookson's ...	11	$10\frac{3}{4}$	$10\frac{3}{4}$	$10\frac{3}{4}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{3}{8}$	$10\frac{1}{4}$	$10\frac{1}{4}$	$10\frac{1}{4}$	10	$10\frac{1}{8}$ to $10\frac{1}{4}$
L. X	$10\frac{1}{2}$	$10\frac{1}{2}$	10 to 12	$10\frac{3}{8}$	$10\frac{1}{4}$	$10\frac{1}{4}$	$10\frac{1}{8}$	10	10	10	$9\frac{3}{4}$	$9\frac{1}{2}$ to $9\frac{5}{8}$
Hallett's	$10\frac{1}{4}$	$9\frac{7}{8}$ to 10	10	10	10	$9\frac{7}{8}$	$9\frac{7}{8}$	$9\frac{3}{4}$	$9\frac{3}{4}$	$9\frac{3}{4}$	$9\frac{3}{8}$	$9\frac{1}{8}$ to $9\frac{1}{4}$

Foreign sources.—Antimony mining in Great Britain has practically been abandoned. The closing of the mines is said to have been caused by the low price of the metal, the industry ceasing to be profitable. Canada has also ceased to be a producer, and England now draws her supply of antimony from Australia, New South Wales furnishing the larger portion. Among the continental countries antimony is produced in France, Spain, Portugal, Germany, Austria, and Italy. During 1892, the latest year for which figures have been published, France produced 831 short tons of metallic antimony, worth $143,206. Borneo and Japan are also important producers of antimony, the latter country yielding, in 1890, 53,306 piculs, equivalent to 692,978 pounds, or $346\frac{1}{2}$ short tons, of metal.

The Mining Industry of Japan, a volume published by the Mining Bureau of the Department of Agriculture and Commerce of Japan, contains an interesting report on the mining and smelting of antimony ore at one of the principal mines in the country. The output of antimony sulphide from this mine alone is about 150,000 pounds a month.

Reducing antimony ores.—A recent French process for obtaining antimony from its ores is announced, the method consisting in treating sulphide of antimony with certain salts of iron alone or in connection with haloid salts, in an apparatus from which the antimony is deposited electrolytically. The trisulphide of antimony is decomposed in contact with ferric salts of iron alone or in connection with haloid salts sulphur is liberated, and the ferric oxide passes to the state of ferrous oxide, and at the same time antimonious oxide passes into solution. The reaction is rapid, and is complete when it takes place in the presence of free hydrochloric acid, or more favorably in the presence of a haloid salt, such as common salt. The antimonial solution, freed from the sulphur by filtration, is submitted to electrolytic action, and the antimony is precipitated at the negative pole, the iron being oxidized at the positive pole, giving a solution of ferric chloride which may be used for the treatment of fresh quantities of sulphide of antimony. The anode and cathode are composed of lead plate. The bath is heated to about 50° C. and maintained in a state of constant movement. In order to obtain a compact deposit of antimony, it is necessary to employ a current of 40 amperes, or thereabouts, for each square meter of surface of the cathode.

Uses of antimony.—Antimony is chiefly used as an alloy with other metals, its presence adding hardness to the compound. In the manufacture of type metal antimony is largely used. In addition to the greater hardness obtained, the antimony causes the metal to expand at the moment of hardening, which insures a clean, sharp cast to the type face. Alloys of aluminum and antimony, according to the *Chemiker Zeitung*, are combined easily in all proportions. Alloys of less than 5 per cent. antimony are harder and more elastic than pure aluminum. They are of silver white color, lustrous, and unaffected by atmospheric influences. Antimonial salts fill an important field in chemical and medicinal work, tartar emetic being the most common.

Imports.—The imports of antimony continue to be largely in excess of the domestic production. Since 1867 the imports have been as follows:

Antimony and antimony ore imported and entered for consumption in the United States, 1867 to 1893.

Years ending—	Crude and regulus.		Ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1867		$63,919			$63,919
1868	1,033,336	83,822			83,822
1869	1,345,921	129,918			129,918
1870	1,227,429	164,179			164,179
1871	1,015,039	148,264		$2,364	150,628
1872	1,933,306	237,536		3,031	240,567
1873	1,166,321	184,498		2,941	187,439
1874	1,253,814	148,409		203	148,612
1875	1,238,223	131,360	6,460	609	131,969
1876	946,809	119,441	8,321	700	120,141
1877	1,115,124	135,317	20,001	2,314	137,631
1878	1,256,624	130,950	20,351	1,259	132,209
1879	1,380,212	143,099	34,542	2,341	145,440
1880	2,019,389	265,773	25,150	2,349	268,122
1881	1,808,945	253,054	841,730	18,199	271,253
1882	2,525,838	294,234	1,114,699	18,019	312,253
1883	3,064,050	286,892	697,244	11,254	298,146
1884	1,779,337	150,435	231,360	6,489	156,924
1885	2,579,840	207,215	215,913	7,497	214,712
Dec. 31, 1886	2,997,985	202,563	218,366	9,761	212,324
1887	2,553,284	169,747	362,761	8,785	178,532
1888	2,814,044	248,015	68,040	2,178	250,193
1889	2,676,130	304,711	146,309	5,568	310,279
1890	3,315,659	411,960	611,140	29,878	441,838
1891	2,618,941	327,307	1,433,531	36,232	363,539
1892	3,950,864	392,761	192,344	7,338	400,099
1893	2,780,432	243,341	116,495	5,253	248,594

COAL.

BY E. W. PARKER.

INTRODUCTION.

Acknowledgments.—For assistance rendered in the compilation of the statistics of coal production in the United States in 1893, the writer desires first to express his grateful acknowledgments to the owners and operators of coal mines for their coöperation in promptly furnishing statements of their production. Owing to this coöperation on the part of operators, the statistics for the entire country have been compiled and the result was furnished to the press about the 1st of May, 1894, several months earlier that any previous year. Acknowledgments are also due to Mr. John H. Jones and Mr. William W. Ruley, of Philadelphia, Pennsylvania, for the chapter on Pennsylvania anthracite; to Mr. George A. Schilling, Secretary of the Bureau of Labor Statistics of Illinois, for the statistics of production in that State, to Mr. A. S. Bolles, Chief of the Bureau of Industrial Statistics of Pennsylvania, for supplementary information regarding bituminous coal in that State; to various railroad freight agents in checking up statements of coal shipments, and to the secretaries of boards of trade and exchanges at the important centers who have contributed to the review of the coal trade during the year, and whose names appear in connection with their contributions. Reference has also been made to the files of technical journals, due credit being given when availed of. In connection with the report on the consumption of smoke, which will be found on page 224, acknowledgment is made for assistance rendered in its preparation.

With the exception of one State, Illinois, the statistics of production have been compiled from direct returns of operators to the Geological Survey. The actual returns represent about 98 per cent. of the total product. The product of the few mines not reporting has been estimated on the basis of their output in 1893, so that the totals may be considered practically complete and correct.

THE COAL FIELDS OF THE UNITED STATES.

For convenience of description, the coal areas of the United States have been grouped into the Anthracite division and the Bituminous division.

The Anthracite division, in a commercial sense, may be said to include the anthracite districts of Pennsylvania alone, although small amounts of anthracite are mined in Colorado, Arkansas, and New

Mexico. In the New England basin the original coal beds have been metamorphosed into graphite and graphitic coal, which have special uses, although not classified by the coal trade as anthracite.

The Bituminous division includes the following coal fields: (1) The Triassic field, embracing the coal beds of the Triassic or New Red sandstone formation in the Richmond basin in Virginia and in the coal basins along the Deep and Dan rivers in North Carolina; (2) the Appalachian field, which extends from the State of New York on the north to the State of Alabama on the south, having a length northeast and southwest of over 900 miles and a width ranging from 30 to 180 miles; (3) the Northern field, which is confined exclusively to the central part of Michigan; (4) the Central field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the Western field, including the coal areas west of the Mississippi river, south of the forty-third parallel of north latitude and east of the Rocky mountains; (6) the Rocky Mountain field, containing the coal areas in the States and Territories lying along the Rocky mountains; (7) the Pacific coast field, embracing the coal districts of Washington, Oregon, and California. (*See* Mineral Resources of the United States, 1886, for detailed descriptions.)

The following table contains the approximate areas of these coal fields, with the total product of each from 1887 to 1893:

Classification of the coal fields of the United States.

	Area.	Product in—		
		1887.	1888.	1889.
Anthracite.				
New England (Rhode Island and Massachusetts)	*Sq. miles.* 500	*Short tons.* 6,000	*Short tons.* 4,000	*Short tons.* 2,000
Pennsylvania	470	39,506,255	43,922,897	45,544,970
Colorado and New Mexico	15	36,000	44,791	53,517
	985	39,548,255	43,971,688	45,600,487
Bituminous (a).				
Triassic:				
Virginia	180	30,000	33,000	49,411
North Carolina	2,700	....	....	222
Appalachian:				
Pennsylvania	9,000	30,866,602	30,796,727	36,174,089
Ohio	10,000	10,301,708	10,910,946	9,976,787
Maryland	550	3,278,023	3,479,470	2,939,715
Virginia	2,000	795,263	1,040,000	816,375
West Virginia	16,000	4,836,820	5,498,800	6,231,880
Kentucky	10,000	950,903	1,193,000	1,108,770
Tennessee	5,100	1,900,000	1,967,297	1,925,689
Georgia	200	313,715	180,000	225,934
Alabama	8,660	1,950,000	2,900,000	3,572,983
	61,510	55,193,034	60,966,240	62,972,222
Northern:				
Michigan	6,700	71,461	81,407	67,431
Central:				
Indiana	6,450	3,217,711	3,140,979	2,845,057
Kentucky	4,000	982,282	1,377,000	1,290,985
Illinois	36,800	10,278,890	14,655,188	12,104,272
	47,250	14,478,883	19,173,167	16,240,314

a Including lignite, brown coal, and scattering lots of anthracite.

Classification of the coal fields of the United States—Continued.

	Area.	Product in— 1887.	1888.	1889.
Bituminous (*a*)—Continued.				
Western:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*
Iowa	18,000	4,473,828	4,952,440	4,045,358
Missouri	26,700	3,209,916	3,909,967	2,557,823
Nebraska	3,200	1,500	1,500	2,222,443 (Nebraska and Kansas)
Kansas	17,000	1,596,879	1,850,000	
Arkansas	9,100	150,000	276,871	279,584
Indian Territory	20,000	685,911	761,986	752,832
Texas	4,500	75,000	90,000	128,216
	98,500	10,193,034	11,842,764	10,036,256
Rocky mountains, etc.:				
Dakota	....	21,470	34,000	28,907
Montana	....	10,202	41,467	363,301
Idaho	....	500	400	....
Wyoming	....	1,170,318	1,481,540	1,388,947
Utah	....	180,021	258,961	236,651
Colorado	....	1,755,735	2,140,686	2,544,144
New Mexico	....	508,034	626,665	486,463
	....	3,646,280	4,583,719	5,048,413
Pacific coast:				
Washington	....	772,612	1,215,750	1,030,578
Oregon	....	31,696	75,000	64,359
California	....	50,000	95,000	119,820
	....	854,308	1,385,750	1,214,757
Total product sold	....	124,015,255	142,037,735	....
Colliery consumption	....	5,960,302	6,621,667	....
Total product, including colliery consumption	....	129,975,557	148,659,402	141,229,513

	Product in— 1890.	1891.	1892.	1893.
Anthracite.				
New England (Rhode Island and Massachusetts)	*Short tons.*	*Short tons.* 500	*Short tons.*	*Short tons.* ....
Pennsylvania	46,468,641	50,665,431	52,472,504	53,967,543
Colorado and New Mexico	(*b*)	(*b*)	64,963	93,578
	46,468,641	50,665,931	52,537,467	54,061,121
Bituminous (*a*).				
Triassic:				
Virginia	19,346	17,290	37,219	19,878
North Carolina	10,262	20,355	6,679	17,000
Appalachian:				
Pennsylvania	42,302,173	42,788,490	46,694,576	44,070,724
Ohio	11,494,506	12,868,683	13,562,927	13,253,646
Maryland	3,357,813	3,820,239	3,419,962	3,716,041
Virginia	764,665	719,109	637,986	800,461
West Virginia	7,394,494	9,220,665	9,738,755	10,708,578
Kentucky	1,206,120	1,222,918	1,231,110	1,245,785
Tennessee	2,169,585	2,413,678	2,092,064	1,902,258
Georgia	228,337	171,000	215,498	372,740
Alabama	4,090,409	4,759,781	5,529,312	5,136,935
	73,008,102	77,984,563	83,122,190	81,207,168
Northern:				
Michigan	74,977	80,073	77,990	45,979
Central:				
Indiana	3,305,737	2,973,474	3,345,174	3,791,851
Kentucky	1,495,376	1,693,151	1,794,203	1,761,394
Illinois	15,292,420	15,660,698	17,862,276	19,949,564
	20,093,533	20,327,323	23,001,653	25,502,809

a Including lignite, brown coal, and scattering lots of anthracite.
b Included in bituminous product.

Classification of the coal fields of the United States—Continued.

	Product in—			
	1890.	1891.	1892.	1893.
Bituminous (*a*)—Continued.				
Western:	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Iowa	4,021,739	3,825,495	3,918,491	3,972,229
Missouri	2,735,221	2,674,606	2,733,949	2,897,442
Nebraska	} 2,259,922	{ 1,500	1,500	....
Kansas		{ 2,716,705	3,007,276	2,652,546
Arkansas	399,888	542,379	535,558	574,763
Indian Territory	869,229	1,091,032	1,192,721	1,252,110
Texas	184,440	172,100	245,690	302,206
	10,470,439	11,023,817	11,635,185	11,651,296
Rocky mountains, etc.:				
Dakota	30,000	30,000	40,725	49,630
Montana	517,477	541,861	564,648	892,309
Idaho	....	....	....	....
Wyoming	1,870,366	2,327,841	2,503,839	2,439,311
Utah	318,159	371,045	361,013	413,205
Colorado	3,094,003	3,512,632	3,447,967	4,018,793
New Mexico	375,777	462,328	659,230	655,112
	6,205,782	7,245,707	7,577,422	8,468,360
Pacific coast:				
Washington	1,263,689	1,056,249	1,213,427	1,264,877
Oregon	61,514	51,826	34,661	41,683
California	110,711	93,301	85,178	72,603
	1,435,914	1,201,376	1,333,266	1,379,163
Total product, including colliery consumption	157,788,656	168,566,669	179,329,071	182,352,774

a Including lignite, brown coal, and scattering lots of anthracite.

PRODUCT.

The total product of all kinds of coal in 1893 amounted to 162,814,977 long tons, equivalent to 182,352,774 short tons, the value aggregating $208,438,696. This product includes not only the coal shipped and the amount sold to employés and to local trade at the collieries, but embraces also the amount consumed in providing power, heat, and ventilation for operating the mines. The total merchantable product, i. e., excluding the colliery consumption, but including the amount sold to local trade and used by employés, was 154,143,295 long tons, or 176,640,490 short tons. In computing the value of anthracite production the item of colliery consumption is considered as having no value. Only culm or slack is used, which would otherwise be wasted. Operators as a usual thing do not weigh the amount of this consumed, and the statements regarding it are largely estimates.

Anthracite.—During 1893 Pennsylvania produced 48,185,306 long tons or 53,967,543 short tons of anthracite coal, valued at $85,687,078, against 46,850,450 long tons, or 52,472,504 short tons, worth $82,442,000, in 1892. This shows an increase during 1893 of 1,334,856 long tons, or 1,495,039 short tons, and an increase in value of $3,245,078. All of the increase in the production of anthracite coal occurred during the first six months, the latter half of the year, according to the monthly record of shipments, as compiled by Mr. William W. Ruley, Chief of the Bureau of Anthracite Coal Statistics, showing a decrease of 446,909 long tons. The increase of shipments during the first six months in 1893, as compared with the corresponding period of 1892, was 1,643,125 long tons. Deducting the decrease during the latter half of the year, the net increase is shown to have been 1,196,216 long tons.

The following table, furnished by Mr. Ruley, shows the monthly shipments of Pennsylvania anthracite during 1892 and 1893, with increases and decreases in 1893.

Monthly shipments of Pennsylvania anthracite in 1892 and 1893.

Months.	1893.	1892.	Increase.	Decrease.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
January	3,069,579	2,851,487	218,092	
February	3,084,156	3,172,022		87,866
March	3,761,744	3,070,527	691,217	
April	3,284,659	2,939,157	345,502	
May	3,707,082	3,524,728	182,354	
June	4,115,632	3,821,807	293,825	
July	3,275,863	3,648,583		372,720
August	3,308,768	3,691,839		383,071
September	3,614,496	3,754,482		139,986
October	4,525,663	4,052,897	472,766	
November	3,905,487	3,769,711	135,776	
December	3,436,406	3,596,082		159,676
Total	43,089,535	41,893,322	(*a*) 1,196,212	

a Net increase.

The large increase in the first half of the year was undoubtedly due to the very severe weather in the latter part of 1892 and early part of 1893; stocks of coal at different points were almost completely exhausted and about the close of 1892 considerable difficulty was experienced in forwarding coal, particularly to the West. This naturally resulted in a rush to fill orders and renew stocks, which held out during the entire first six months of the year.

About this time, however, the very bad trade conditions began to have their effects, resulting either in the strictest economies or in many cases the entire suspension of business; while, perhaps, in most cases anthracite was not actually used in these industries, the necessary effects of the closing down of manufacturing concerns on the domestic use of anthracite, resulted in a largely decreased consumption for the latter half of the year.

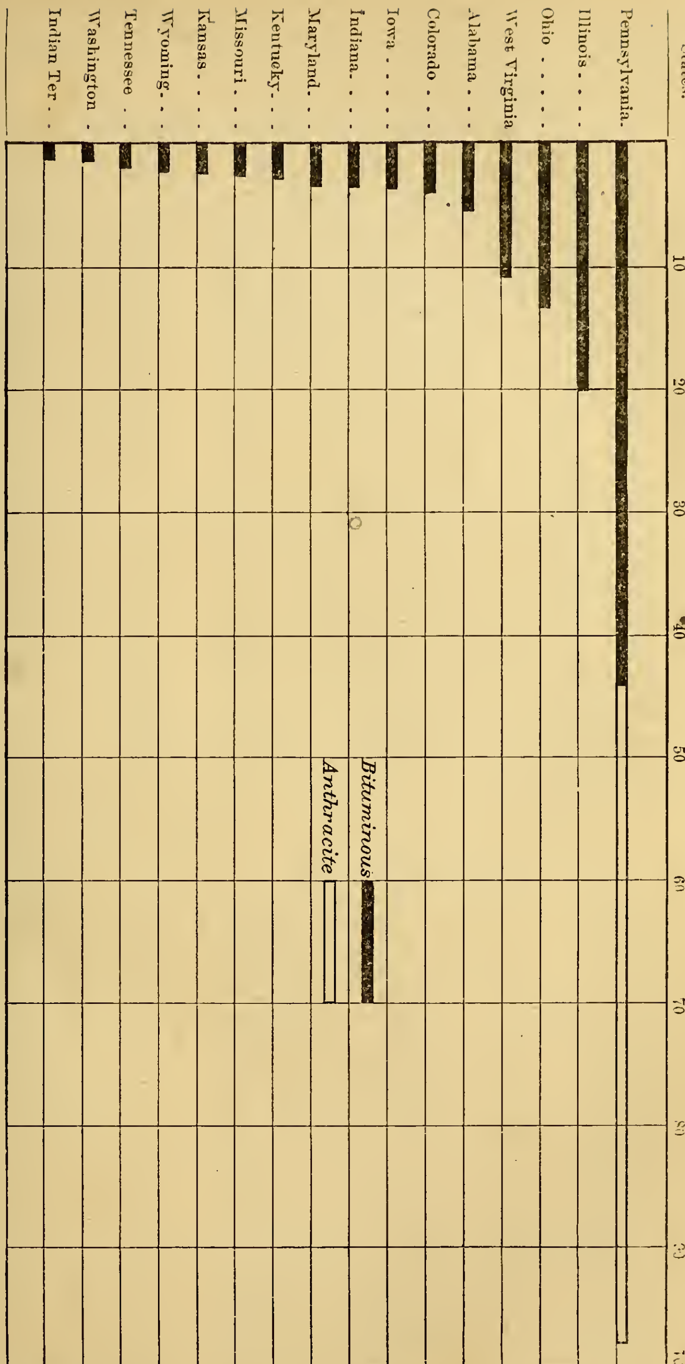
In addition to the anthracite production of Pennsylvania there were 83,446 short tons mined in Colorado; 10,132 short tons from New Mexico, and 616 tons from Virginia, bringing the total production of anthracite coal up to 54,061,737 short tons. Except in the tables on pages 188 to 190 the anthracite product outside of Pennsylvania is included in the bituminous production, and, unless expressly stated to the contrary, reference in this chapter to anthracite production means that of Pennsylvania only.

Bituminous.—The bituminous product in 1893 was 114,629,671 long tons, or 128,385,231 short tons, valued at $122,751,618, compared with 113,264,792 long tons, or 126,856,567 short tons in 1892, valued at $125,124,381. This shows an increase during 1893 of 1,364,879 long tons, or 1,528,664 short tons, but a decrease in value of $2,372,763. There is no way of correctly estimating the monthly movements of bituminous coal, as there is of anthracite, but operators generally report that the business during the latter part of the year was less than the first half. The extremely cold winter of 1892–'93 stimulated production to an unusual extent. Later, when owing to the prevailing depression, the demand fell off, stocks were accumulated at distributing points and at the mines, and prices, as a natural result, declined. This decline was sufficient to cause a decrease in the total value. The average price per ton for the year was 3 cents less than that of 1892, declining from 99 cents to 96 cents.

The total number of employés engaged in and about the mines in 1893 was 363,309 against 341,943 in 1892. The average number of days worked was two hundred and one against two hundred and twelve the preceding year. In this total is included not only those engaged in mining and handling the coal, but embraces also mine superintendents, foremen, mechanics, and clerical assistants at the mines. Coke workers and clerical forces at offices distant from the mines are not included.

Of the total employés there were employed in and about the anthracite mines in Pennsylvania 132,944 men and boys, the average working time being one hundred and ninety-seven days. In 1892, 129,050 employés were engaged for an average of one hundred and ninety-eight days.

In the production of bituminous coal 230,365 employés were engaged in 1893, and the average working time was two hundred and four days. In 1892, 212,893 men were employed for an average of two hundred and nineteen days. These averages are not claimed to be absolutely correct, but are sufficient for practical purposes, such as the comparison of one year with another. From them it is computed that the average bituminous tonnage per day per man in 1892 was 2.72 and in 1893, 2.73. The daily production of anthracite per man in 1892 was 2.05 and in 1893, 2.06. The short ton of 2,000 pounds is used in this computation.



PRODUCTION OF COAL IN THE VARIOUS STATES DURING THE YEAR 1893.

[In millions of tons.]

The following tables exhibit the production of all kinds of coal in the United States in 1892 and 1893, with the distribution of the product for consumption:

Coal product of the United States in 1892, by States.

States.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	3,122,075	37,843	135,627	2,233,767
Arkansas	513,908	7,450	14,200	....
California	73,269	9,679	2,230	....
Colorado	2,938,980	126,748	55,721	389,381
Georgia	52,614	250	3,756	158,878
Illinois (*a*)	14,557,655	2,624,821	675,000	4,800
Indiana	3,088,911	208,220	42,621	5,422
Indian Territory	1,156,603	10,840	18,089	7,189
Iowa	3,459,025	401,855	57,611	....
Kansas	2,756,812	206,038	44,325	101
Kentucky	2,620,556	327,985	33,856	42,916
Maryland	3,385,384	30,955	3,623	....
Michigan	27,200	45,180	5,610	....
Missouri	2,399,605	293,414	40,930	....
Montana	521,521	4,866	1,849	36,412
Nebraska	....	1,500	....	....
New Mexico	645,557	8,776	6,997	....
North Carolina	6,679	....	....	....
North Dakota	38,000	2,725	....	....
Ohio	11,995,256	1,411,642	117,486	38,513
Oregon	31,760	2,353	548	....
Pennsylvania bituminous	32,425,949	2,207,827	356,779	11,704,021
Rhode Island (*b*)	....	....	....	....
Tennessee	1,448,262	55,452	17,037	571,313
Texas	241,005	4,460	225	....
Utah	321,431	6,775	6,509	26,298
Virginia	527,304	20,721	6,611	120,569
Washington	1,150,865	9,802	40,085	12,675
West Virginia	7,560,790	441,159	49,563	1,687,243
Wyoming	2,378,657	27,054	96,128	2,000
Total	99,415,633	8,536,390	1,833,016	17,041,528
Pennsylvania anthracite	46,926,465	1,168,288	4,377,751	....
Grand total	146,372,098	9,704,678	6,210,767	17,041,528

States.	Total product.	Total value.	Average price per ton	Average number of days active.	Total number of employés.
	Short tons.				
Alabama	5,529,312	$5,788,898	$1.05	271	10,075
Arkansas	535,558	666,230	1.24	199	1,128
California	85,178	209,711	2.46	204	187
Colorado	3,510,830	5,685,112	1.62	229	5,747
Georgia	215,498	212,761	.99	277	467
Illinois	17,862,276	16,243,645	.91	219½	34,585
Indiana	3,345,174	3,620,582	1.08	224	6,436
Indian Territory	1,192,721	2,043,479	1.71	211	3,257
Iowa	3,918,491	5,175,060	1.32	236	8,170
Kansas	3,007,276	3,955,595	1.31½	208½	6,559
Kentucky	3,025,313	2,771,238	.92	217	6,724
Maryland	3,419,962	3,063,580	.89	225	3,886
Michigan	77,990	121,314	1.56	195	230
Missouri	2,533,949	3,369,659	1.23	230	5,893
Montana	564,648	1,330,847	2.36	258	1,158
Nebraska	1,500	4,500	3.00	....	....
New Mexico	661,330	1,074,601	1.62	223	1,083
North Carolina	6,679	9,599	1.44	160	90
North Dakota	40,725	39,250	.96	216	54
Ohio	13,562,927	12,722,745	.94	212	22,576
Oregon	34,661	148,546	4.29	120	90
Pennsylvania bituminous	46,694,576	39,017,164	.84	223	66,655
Rhode Island (*b*)	....	....	....	....	....
Tennessee	2,092,064	2,355,441	1.13	240	4,926
Texas	245,690	569,333	2.32	208	871
Utah	361,013	562,625	1.56	230	646
Virginia	675,205	578,429	.86	192	836
Washington	1,213,427	2,763,547	2.28	247	2,564
West Virginia	9,738,755	7,852,114	.80	228	14,867
Wyoming	2,503,839	3,168,776	1.27	225	3,133
Total	126,856,567	125,124,381	.99	219	212,893
Pennsylvania anthracite	52,472,504	82,442,000	1.57	198	129,050
Grand total	179,329,071	207,566,381	1.16	212	341,943

a Distribution estimated on the returns for 1889. *b* None reported.

Coal product of the United States in 1893, by States.

States.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	3,536,935	59,599	96,412	1,443,989
Arkansas	549,504	11,778	13,481	
California	64,733	5,336	2,534	
Colorado	3,345,951	65,386	178,993	512,059
Georgia	196,227		4,869	171,644
Illinois	16,260,463	2,931,846	753,955	3,300
Indiana	3,461,830	252,879	69,797	7,345
Indian Territory	1,197,468	9,234	21,663	23,745
Iowa	3,442,584	449,639	80,006	
Kansas	2,364,810	227,321	60,412	3
Kentucky	2,613,645	281,115	30,969	81,450
Maryland	3,676,137	26,833	13,071	
Michigan	27,787	16,367	1,825	
Missouri	2,525,227	322,754	49,461	
Montana	789,516	27,063	17,960	57,770
New Mexico	636,002	5,618	8,776	14,698
North Carolina	15,000		2,000	
North Dakota	47,968	1,612	50	
Ohio	11,713,116	1,348,743	167,002	24,785
Oregon	37,835	3,594	254	
Pennsylvania	33,322,328	1,934,429	426,122	8,387,845
Tennessee	1,427,219	42,560	20,921	411,558
Texas	300,064	462	1,680	
Utah	350,423	7,649	4,258	50,875
Virginia	714,188	20,578	4,609	80,964
Washington	1,186,109	18,888	48,506	11,374
West Virginia	8,591,962	390,689	46,898	1,679,029
Wyoming	2,280,685	64,188	87,086	7,352
Total	104,675,716	8,526,160	2,213,570	12,969,785
Pennsylvania anthracite	48,266,174	1,202,655	4,498,714	
Grand total	152,941,890	9,728,815	6,712,284	12,969,785

States.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.				
Alabama	5,136,935	$5,096,792	$0.99	237	11,294
Arkansas	574,763	773,347	1.34	151	1,559
California	72,603	167,555	2.31	208	158
Colorado	4,102,389	5,104,602	1.24	188	7,202
Georgia	372,740	365,972	.98	342	736
Illinois	19,949,564	17,827,595	.89	229	35,390
Indiana	3,791,851	4,055,372	1.07	201	7,644
Indian Territory	1,252,110	2,235,209	1.79	171	3,446
Iowa	3,972,229	5,110,460	1.30	204	8,863
Kansas	2,652,546	3,375,740	1.27	147	7,310
Kentucky	3,007,179	2,613,569	.86	202	6,581
Maryland	3,716,041	3,267,317	.88	240	3,935
Michigan	45,979	82,462	1.79	154	162
Missouri	2,897,442	3,562,757	1.23	206	7,375
Montana	892,309	1,772,116	1.99	242	1,401
New Mexico	665,094	979,044	1.47	229	1,011
North Carolina	17,000	25,500	1.50	80	70
North Dakota	49,630	56,250	1.13	193	88
Ohio	13,253,646	12,351,139	.92	188	23,931
Oregon	41,683	164,500	3.57	192	110
Pennsylvania	44,070,724	35,260,674	.80	190	71,931
Tennessee	1,902,258	2,048,449	1.08	232	4,976
Texas	302,206	688,407	2.28	251	996
Utah	413,205	611,092	1.48	226	576
Virginia	820,339	692,748	.84	253	961
Washington	1,264,877	2,920,876	2.31	241	2,757
West Virginia	10,708,578	8,251,170	.77	219	16,524
Wyoming	2,439,311	3,290,904	1.35	189	3,378
Total	128,385,231	122,751,618	.96	204	230,365
Pennsylvania anthracite	53,967,543	85,687,078	1.59	197	132,944
Grand total	182,352,774	208,438,696	1.14	201	363,309

From the above tables it will be observed that there was increased production of bituminous coal in 19 States, namely: Arkansas, Colorado, Georgia, Illinois, Indiana, Indian Territory, Iowa, Maryland, Missouri, Montana, New Mexico, North Carolina, North Dakota, Oregon, Texas, Utah, Virginia, Washington, and West Virginia. The notable increases were in Colorado, 591,559 short tons; Illinois, 2,087,288 short tons; West Virginia, 969,823 short tons; Indiana, 446,677 short tons; Montana, 327,661 short tons; Maryland, 231,669 short tons; Missouri, 163,493 short tons; Georgia, 157,242 short tons; and Virginia, 145,134 short tons. In none of the other States did the increase reach 100,000 tons. The increase in the output of Georgia is worthy of special notice as showing the developments in Walker county, and Virginia's increase is attributable to the Wise county, or Clinch valley fields, which assumed considerable importance during 1893.

In 9 States the output in 1893 was less than in 1892. These were, Alabama, California, Kansas, Kentucky, Michigan, Ohio, Pennsylvania, Tennessee, and Wyoming. Pennsylvania shows the largest decrease in bituminous production, having a loss of 2,523,852 short tons. Alabama's production decreased 392,377 short tons. Ohio's product was 309,281 tons less, and Tennessee's decreased 189,806 tons. The indications are that in each of these States the decrease was due to the closing down of blast furnaces and other factories, thus largely restricting the market. The output in Kansas decreased 354,736, due to an extensive strike which prevailed throughout the State for several months.

Production in previous years.—The following table shows the annual production of anthracite and bituminous coal since 1880. The quantities are expressed both in long tons of 2,240 pounds and in short tons of 2,000 pounds.

Annual production of coal in the United States since 1880.

Years.	Bituminous coal.			Pennsylvania anthracite.		
	Long tons of 2,240 pounds.	Short tons of 2,000 pounds.	Value.	Long tons of 2,240 pounds.	Short tons of 2,000 pounds.	Value.
1880	38,242,641	42,831,758	$53,443,718	25,580,189	28,649,811	$42,196,678
1881	48,179,475	53,961,012	60,224,344	28,500,016	31,920,018	64,125,036
1882	60,861,190	68,164,533	76,076,487	31,358,264	35,121,256	70,556,094
1883	68,531,500	76,755,280	82,237,800	34,336,469	38,456,845	77,257,055
1884	73,730,539	82,578,204	77,417,066	33,175,756	37,156,847	66,351,512
1885	64,840,668	72,621,548	82,347,648	34,228,548	38,335,974	76,671,948
1886	65,810,676	73,707,957	78,481,056	34,853,077	39,035,446	76,119,120
1887	78,470,857	87,887,360	98,004,656	37,578,747	42,088,197	84,552,181
1888	91,106,998	102,039,838	101,860,529	41,624,611	46,619,564	89,020,483
1889	85,383,059	95,629,026	94,346,809	40,714,721	45,600,488	65,879,514
1890	99,392,871	111,320,016	110,420,801	41,489,858	46,468,641	66,383,772
1891	105,268,962	117,901,237	117,188,400	45,236,992	50,665,431	73,944,735
1892	113,237,845	126,826,386	125,195,139	46,850,450	52,472,504	82,442,000
1893	114,572,162	128,320,821	122,694,020	48,170,000	53,950,400	85,684,465

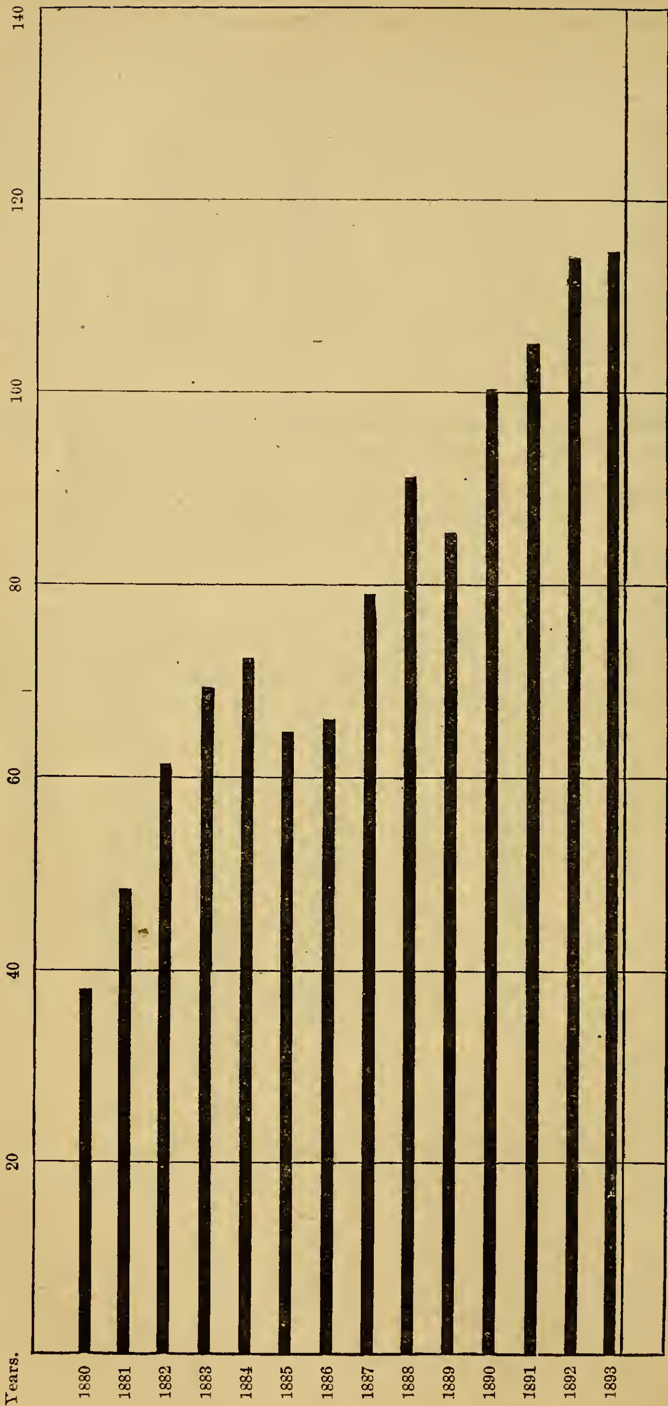
Annual production of coal in the United States since 1880—Continued.

Years.	Total.		
	Long tons.	Short tons.	Value.
1880	63, 822, 830	71, 481, 569	$95, 640, 396
1881	76, 679, 491	85, 881, 030	124, 349, 380
1882	92, 219, 454	103, 285, 789	146, 632, 581
1883	102, 867, 969	115, 212, 125	159, 494, 855
1884	106, 906, 295	119, 735, 051	143, 768, 578
1885	99, 069, 216	110, 957, 522	159, 019, 596
1886	100, 663, 753	112, 743, 403	154, 600, 176
1887	116, 049, 604	129, 975, 557	182, 556, 837
1888	132, 731, 609	148, 659, 402	190, 881, 012
1889	126, 097, 780	141, 229, 514	160, 226, 323
1890	140, 882, 729	157, 788, 657	176, 804, 573
1891	150, 505, 954	168, 566, 668	191, 133, 135
1892	160, 088, 295	179, 298, 890	207, 637, 139
1893	162, 742, 162	182, 271, 221	208, 378, 485

The following table shows the total output, in long tons, from 1880 to 1885, exclusive of colliery consumption, by States and Territories:

Coal produced in the several States and Territories, not including the local and colliery consumption, from 1880 to 1885.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Pennsylvania:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Anthracite	23, 437, 242	28, 500, 016	29, 120, 096	31, 793, 027	30, 718, 293	32, 265, 421
Bituminous	19, 000, 000	20, 000, 000	22, 000, 000	24, 000, 000	25, 000, 000	23, 214, 285
Illinois	4, 000, 000	6, 000, 000	9, 000, 000	10, 350, 000	10, 000, 000	8, 742, 745
Ohio	7, 000, 000	8, 250, 000	9, 450, 000	8, 229, 429	7, 650, 062	6, 978, 732
Maryland	2, 136, 160	2, 261, 918	1, 540, 466	2, 206, 172	2, 469, 051	2, 865, 974
Missouri	1, 500, 000	1, 750, 000	2, 000, 000	2, 250, 000	2, 500, 000	2, 750, 000
West Virginia	1, 400, 000	1, 500, 000	2, 000, 000	2, 805, 565	3, 000, 000	3, 008, 091
Indiana	1, 500, 000	1, 771, 536	1, 976, 470	2, 560, 000	2, 260, 000	2, 120, 535
Iowa	1, 600, 000	3, 500, 000	3, 127, 700	3, 881, 300	3, 903, 458	3, 583, 737
Kentucky	1, 000, 000	1, 100, 000	1, 300, 000	1, 650, 000	1, 550, 000	1, 700, 000
Tennessee	600, 000	750, 000	850, 000	1, 000, 000	1, 200, 000	892, 857
Virginia	100, 000	100, 000	100, 000	225, 000	300, 000	567, 000
Kansas	550, 000	750, 000	750, 000	900, 000	1, 100, 000	1, 082, 230
Michigan	75, 000	100, 000	130, 000	135, 000	135, 000	45, 178
Rhode Island	10, 000	10, 000	10, 000	10, 000	10, 000	....
Alabama	340, 000	375, 000	800, 000	1, 400, 000	2, 000, 000	2, 225, 000
Georgia	100, 000	150, 000	175, 000	200, 000	200, 000	133, 929
Colorado	390, 183	631, 021	947, 749	1, 097, 851	1, 008, 950	1, 210, 769
Wyoming	471, 259	560, 876	631, 932	696, 151	805, 911	720, 828
New Mexico	....	....	146, 421	188, 703	196, 924	271, 442
Utah	225, 000	225, 000	250, 000	250, 000	250, 000	190, 286
California	175, 000	125, 000	150, 000	175, 000	150, 000	63, 942
Oregon	30, 000	30, 000	30, 000	50, 000	50, 000	44, 643
Washington	175, 000	175, 000	225, 000	300, 000	300, 000	339, 510
Texas	....	....	....	100, 000	100, 000	133, 928
Arkansas	....	....	....	75, 000	150, 000	133, 928
Montana	....	....	....	60, 000	60, 000	77, 179
Dakota	....	....	....	50, 000	31, 250	23, 214
Idaho	....	....	....	10, 000	20, 000	893
Indian Territory	....	....	....	175, 000	400, 000	446, 429
Total	65, 414, 844	76, 865, 357	86, 710, 834	96, 823, 198	97, 518, 899	95, 832, 705



PRODUCTION OF BITUMINOUS COAL IN THE UNITED STATES DURING THE YEARS 1880 TO 1893, INCLUSIVE.

[In millions of tons.]

The total amount and value of coal produced in the United States, by States, since 1886, is shown in the following table. The amounts in this table are expressed in short tons of 2,000 pounds.

Amount and value of coal produced in the United States, by States and Territories, from 1886 to 1893.

States and Territories.	1886.		1887.		1888.	
	Product.	Value.	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	1,800,000	$5,574,000	1,950,000	$2,535,000	2,900,000	$3,335,000
Arkansas	125,000	200,000	150,000	252,500	276,871	415,306
California	100,000	300,000	50,000	150,000	95,000	380,000
Colorado	1,368,338	3,215,594	1,791,735	3,941,817	2,185,477	4,808,049
Georgia	223,000	334,500	313,715	470,573	180,000	270,000
Idaho	1,500	6,000	500	2,000	400	1,800
Illinois	9,246,435	10,263,543	10,278,890	11,152,596	14,655,188	16,413,811
Indiana	3,000,000	3,450,000	3,217,711	4,324,604	3,140,979	4,397,370
Indian Territory	534,580	855,328	685,911	1,286,692	761,986	1,432,072
Iowa	4,312,921	5,391,151	4,473,828	5,991,735	4,952,440	6,438,172
Kansas	1,400,000	1,680,000	1,596,879	2,235,631	1,850,000	2,775,000
Kentucky	1,550,000	1,782,500	1,933,185	2,223,163	2,570,000	3,084,000
Maryland	2,517,577	2,391,698	3,278,023	3,114,122	3,479,470	3,293,070
Michigan	60,434	90,651	71,461	107,191	81,407	135,221
Missouri	1,800,000	2,340,000	3,209,916	4,298,994	3,909,967	8,650,800
Montana	49,846	174,460	10,202	35,707	41,467	145,135
Nebraska	....	....	1,500	3,000	1,500	3,375
New Mexico	271,285	813,855	508,034	1,524,102	626,665	1,879,995
North Carolina	....	....	....	....	....	....
North Dakota	25,955	41,277	21,470	32,205	34,000	119,000
Ohio	8,435,211	8,013,450	10,301,708	9,096,848	10,910,946	10,147,180
Oregon	45,000	112,500	31,696	70,000	75,000	225,000
Pennsylvania:						
Anthracite	36,696,475	71,558,126	39,506,255	79,365,244	43,922,897	85,649,649
Bituminous	26,160,735	21,016,235	30,866,602	27,806,941	33,796,727	32,106,891
Rhode Island	....	....	6,000	16,250	4,000	11,000
Tennessee	1,714,290	1,971,434	1,900,000	2,470,000	1,967,297	2,164,026
Texas	100,000	185,000	75,000	150,000	90,000	184,500
Utah	200,000	420,000	180,021	360,042	258,961	543,818
Virginia	684,951	684,951	825,263	773,360	1,073,000	1,073,000
Washington	423,525	952,931	772,612	1,699,746	1,215,750	3,647,250
West Virginia	4,005,796	3,805,506	4,836,820	4,594,979	5,498,800	6,048,680
Wyoming	829,355	2,488,065	1,170,318	3,510,954	1,481,540	4,444,620
Total product sold	107,682,209	147,112,755	124,015,255	173,595,996	142,037,735	204,222,790
Colliery consumption	5,061,194	....	5,960,302	8,960,841	6,621,667	7,295,834
Total	112,743,403	147,112,755	129,975,557	182,556,837	148,659,402	211,518,624

Amount and value of coal produced in the United States, etc.—Continued.

States and Territories.	1889.		1890.		1891.	
	Product.	Value.	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	3, 572, 983	$3, 961, 491	4, 090, 409	$4, 202, 469	4, 759, 781	$5, 087, 596
Arkansas	279, 584	395, 836	399, 888	514, 595	542, 379	647, 560
California	184, 179	434, 382	110, 711	283, 019	93, 301	204, 902
Colorado	2, 544, 144	3, 843, 992	3, 094, 003	4, 344, 196	3, 512, 632	4, 800, 000
Georgia	226, 156	339, 382	228, 337	238, 315	171, 000	256, 500
Idaho						
Illinois	12, 104, 272	11, 755, 203	15, 292, 420	14, 171, 230	15, 660, 698	14, 237, 074
Indiana	2, 845, 057	2, 887, 852	3, 305, 737	3, 259, 233	2, 973, 474	3, 070, 918
Indian Territory	752, 832	1, 323, 807	869, 229	1, 579, 188	1, 091, 032	1, 897, 037
Iowa	4, 095, 358	5, 426, 509	4, 021, 739	4, 995, 739	3, 825, 495	4, 867, 999
Kansas	2, 220, 943	3, 297, 288	2, 259, 922	2, 947, 517	2, 716, 705	3, 557, 303
Kentucky	2, 399, 755	2, 374, 339	2, 701, 496	2, 472, 119	2, 916, 069	2, 715, 600
Maryland	2, 939, 715	2, 517, 474	3, 357, 813	2, 899, 572	3, 820, 239	3, 082, 515
Michigan	67, 431	115, 011	74, 977	149, 195	80, 307	133, 387
Missouri	2, 557, 823	3, 479, 057	2, 735, 221	3, 382, 858	2, 674, 606	3, 283, 242
Montana	363, 301	880, 773	517, 477	1, 252, 492	541, 861	1, 228, 630
Nebraska	1, 500	4, 500	1, 500	4, 500	1, 500	4, 500
New Mexico	486, 463	870, 468	375, 777	504, 390	462, 328	779, 018
North Carolina	(*a*)		10, 262	17, 864	20, 355	39, 365
North Dakota	28, 907	41, 431	30, 000	42, 000	30, 000	42, 000
Ohio	9, 976, 787	9, 355, 400	11, 494, 506	10, 783, 171	12, 868, 683	12, 106, 115
Oregon	(*b*)		61, 514	177, 875	51, 826	155, 478
Pennsylvania:						
Anthracite	*c*45, 598, 487	65, 873, 514	46, 468, 641	66, 383, 772	50, 665, 431	73, 944, 735
Bituminous	36, 174, 089	27, 953, 315	42, 302, 173	35, 376, 916	42, 788, 490	37, 271, 053
Rhode Island	2, 000	6, 000			500	10, 000
Tennessee	1, 925, 689	2, 338, 309	2, 169, 585	2, 395, 746	2, 413, 678	2, 668, 188
Texas	128, 216	340, 620	184, 440	465, 900	172, 100	412, 360
Utah	236, 651	377, 456	318, 159	552, 390	371, 045	666, 045
Virginia	865, 786	804, 475	784, 011	589, 925	736, 399	611, 654
Washington	1, 030, 578	2, 393, 238	1, 263, 689	3, 426, 590	1, 056, 249	2, 437, 270
West Virginia	6, 231, 880	5, 086, 584	7, 394, 654	6, 208, 128	9, 220, 665	7, 359, 816
Wyoming	1, 388, 947	1, 748, 617	1, 870, 366	3, 183, 669	2, 327, 841	3, 555, 275
Total product sold	141, 229, 513	160, 226, 323	157, 788, 656	176, 804, 573	168, 566, 669	191, 133, 135

States and Territories.	1892.		1893.	
	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*	
Alabama	5, 529, 312	$5, 788, 898	5, 136, 935	$5, 096, 792
Arkansas	535, 558	666, 230	574, 763	773, 347
California	85, 178	209, 711	72, 603	167, 555
Colorado	3, 510, 830	5, 685, 112	4, 102, 389	5, 104, 602
Georgia	215, 498	212, 761	372, 740	365, 972
Idaho				
Illinois	17, 862, 276	16, 243, 645	19, 949, 564	17, 827, 595
Indiana	3, 345, 174	3, 620, 582	3, 791, 851	4, 055, 372
Indian Territory	1, 192, 721	2, 043, 479	1, 252, 110	2, 235, 209
Iowa	3, 918, 491	5, 175, 060	3, 972, 229	5, 110, 460
Kansas	3, 007, 276	3, 955, 595	2, 652, 546	3, 375, 740
Kentucky	3, 025, 313	2, 771, 238	3, 007, 179	2, 613, 569
Maryland	3, 419, 962	3, 063, 580	3, 716, 041	3, 267, 317
Michigan	77, 990	121, 314	45, 979	82, 462
Missouri	2, 733, 949	3, 369, 659	2, 897, 442	3, 562, 757
Montana	564, 648	1, 330, 847	892. 309	1, 772, 116
Nebraska	1, 500	4, 500		
New Mexico	661, 330	1, 074, 601	665, 094	979, 044
North Carolina	6, 679	9, 599	17, 000	25, 500
North Dakota	40, 725	39, 250	49, 630	56, 250
Ohio	13, 562, 927	12, 722, 745	13, 253, 646	12, 351, 139
Oregon	34, 661	148, 546	41, 683	164, 500
Pennsylvania:				
Anthracite	52, 472, 504	82, 442, 000	53, 967, 543	85, 687, 078
Bituminous	46, 694, 576	39, 017, 164	44, 070, 724	35, 260, 674
Rhode Island				
Tennessee	2, 092, 064	2, 355, 441	1, 902, 258	2, 048, 449
Texas	245, 690	569, 333	302, 206	688, 407
Utah	361, 013	562, 625	413, 205	611, 092
Virginia	675, 205	578, 429	820, 339	692, 748
Washington	1, 213, 427	2, 763, 547	1, 264, 877	2, 920, 876
West Virginia	9, 738, 755	7, 852, 114	10, 708, 578	8, 251, 170
Wyoming	2, 503, 839	3, 168, 776	2, 439, 311	3, 290, 904
Total product sold	179, 329, 071	207, 566, 381	182, 352, 774	208, 438, 696

(*a*) Product included in Georgia. (*b*) Product included in California.
(*c*) Includes the product of anthracite in Colorado and New Mexico.

IMPORTS AND EXPORTS.

The following tables have been compiled from official returns to the Bureau of Statistics of the Treasury Department, and show the imports and exports of coal from 1867 to 1893, inclusive. The values given in both cases are considerably higher than the average "spot" rates by which the values of the domestic production have been computed.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846 to 1857, 30 per cent. ad valorem; 1857 to 1861, 24 per cent. ad valorem; 1861, bituminous and shale, $1 per ton; all other, 50 cents per ton; 1862 to 1864, bituminous and shale, $1.10 per ton; all other, 60 cents per ton; 1864 to 1872, bituminous and shale, $1.25 per ton; all other, 40 cents per ton; since August, 1872, bituminous coal and shale, 75 cents per ton; anthracite, free of duty. No change has been made in tariff rates since 1872, except for slack, or culm, which, under act of March 3, 1883, was made 30 cents per ton. During the period from June, 1854, to March, 1866, the reciprocity treaty was in force, and coal from the British Possessions in North America was admitted into the United States duty free.

The exports consist both of anthracite and bituminous coal, the amount of bituminous being the greater in the last few years. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to San Francisco, from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

Coal imported and entered for consumption in the United States, 1867 to 1893.

Years ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867			509, 802	$1, 412, 597
1868			394, 021	1, 250, 513
1869			437, 228	1, 222, 119
1870			415, 729	1, 103, 965
1871	973	$4, 177	430, 508	1, 121, 914
1872	390	1, 322	485, 063	1, 279, 686
1873	2, 221	10, 764	460, 028	1, 548, 208
1874	471	3, 224	492, 063	1, 937, 274
1875	138	963	436, 714	1, 791, 601
1876	1, 428	8, 560	400, 632	1, 592, 846
1877	630	2, 220	495, 816	1, 782, 941
1878	158	518	572, 846	1, 929, 660
1879	488	721	486, 501	1, 716, 209
1880	8	40	471, 818	1, 588, 312
1881	1, 207	2, 628	652, 963	1, 988, 199
1882	36	148	795, 722	2, 141, 373
1883	507	1, 172	645, 924	3, 013, 555
1884	1, 448	4, 404	748, 995	2, 494, 228
1885	4, 976	15, 848	768, 477	2, 548, 432
Dec. 31, 1886	2, 039	4, 920	811, 657	2, 501, 153
1887	14, 181	42, 983	819, 242	2, 609, 311
1888	24, 093	68, 710	1, 085, 647	3, 728, 060
1889	20, 652	117, 434	1, 001, 374	3, 425, 347
1890	15, 145	46, 695	819, 971	2, 822, 216
1891	37, 607	112, 722	1, 363, 313	4, 561, 105
1892	65, 058	197, 583	1, 143, 304	3, 744, 862
1893	53, 768	148, 112	*a*1, 082, 993	3, 623, 892

a Including 14,632 tons of slack or culm, valued at $16,906.

Coal of domestic production exported from the United States, 1867 to 1893.

Years ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867	192, 912	$1, 333, 457	92, 189	$512, 742
1868	192, 291	1, 082, 745	86, 367	433, 475
1869	283, 783	1, 553, 115	....	....
1870	121, 098	803, 135	106, 820	503, 223
1871	134, 571	805, 169	133, 380	564, 067
1872	259, 567	1, 375, 342	141, 311	586, 264
1873	342, 180	1, 827, 822	242, 453	1, 086, 253
1874	401, 912	2, 236, 084	361, 490	1, 587, 666
1875	316, 157	1, 791, 626	203, 189	828, 943
1876	337, 934	1, 869, 434	230, 144	850, 711
1877	418, 791	1, 891, 351	321, 665	1, 024, 711
1878	319, 477	1, 606, 843	340, 661	1, 352, 624
1879	386, 916	1, 427, 886	276, 000	891, 512
1880	392, 626	1, 362, 901	222, 634	695, 179
1881	462, 208	2, 091, 928	191, 038	739, 532
1882	553, 742	2, 589, 887	314, 320	1, 102, 898
1883	557, 813	2, 648, 033	463, 051	1, 593, 214
1884	649, 040	3, 053, 550	646, 265	1, 977, 959
1885	588, 461	2, 586, 421	683, 481	1, 989, 541
Dec. 31, 1886	667, 076	2, 718, 143	544, 768	1, 440, 631
1887	825, 486	3, 469, 166	706, 364	2, 001, 966
1888	969, 542	4, 325, 126	860, 462	2, 529, 472
1889	857, 632	3, 636, 347	935, 151	2, 783, 592
1890	794, 335	3, 272, 697	1, 280, 930	4, 004, 995
1891	861, 251	3, 577, 610	1, 615, 869	5, 104, 850
1892	851, 639	3, 722, 903	1, 645, 869	4, 999, 289
1893	1, 333, 287	6, 241, 007	2, 325, 591	6, 009, 801

WORLD'S PRODUCT OF COAL.

In the following table is given the coal product of the principal countries for the years nearest the one under review for which figures could be obtained. For the sake of convenience the amounts are expressed in the unit of measurement adopted in each country and reduced for comparison to short tons of 2,000 pounds. In each case the year is named for which the product is given.

The world's product of coal.

Countries.		Usual unit in producing country.	Equivalent in short tons.
Great Britain (1893)	long tons	164, 325, 795	184, 044, 890
United States (1893)	do	162, 814, 977	182, 352, 774
Germany (1892)	metric tons	*a* 94, 196, 000	103, 851, 090
France (1892)	do	*a* 26, 178, 700	28, 862, 017
Austria (1892)	do	*a* 25, 431, 000	28, 037, 678
Belgium (1892)	do	19, 583, 173	21, 590, 448
Russia (1892)	do	6, 913, 351	7, 621, 969
Canada (1893)	short tons	3, 719, 170	3, 719, 170
Japan (1893)	do	3, 400, 000	3, 400, 000
Spain (1893)	metric tons	1, 531, 810	1, 688, 820
New Zealand (1892)	short tons	673, 315	673, 315
Sweden (1892)	metric tons	382, 000	421, 155
Italy (1892)	do	296, 000	326. 340
Total		....	566, 589, 666
Percentage of the United States		....	32

a Lignite included (metric tons): Germany, 20,555,000; France, 481,500; Austria, 16,190,000.

COAL TRADE REVIEW.

Owing to the financial crisis and general business depression during 1893, it was popularly supposed and predicted that there would be a marked decrease in the production of both anthracite and bituminous coal. There was therefore considerable surprise expressed when the preliminary statement issued from this office showed an increase in the production of each. Since the preliminary statement was compiled, later returns from some of the Western States have added somewhat to the output in 1893, making the increase a little larger. The total increase is not much, comparatively speaking, being less than 1½ per cent. The average annual increase in the preceding three years, or from 1889 to 1892, had been about 11,000,000 long tons. In 1893 the increase was 2,699,735 long tons, or 3,023,703 short tons, distributed nearly equally between the anthracite and bituminous product. In the value the same conditions did not obtain. The value of the anthracite increased in about the same proportion as the product, showing a total gain of $3,245,078. The average price per short ton of bituminous coal decreased from 99 cents to 96 cents, causing a total decrease in value of about $2,500,000. The total increase in value, consequently, was only $872,315.

The increased production was due beyond doubt to the severe winter of 1892–'93, which rapidly exhausted stocks at distributing points and among the retailers. Production was thus stimulated during the early months of 1893 to an unusual degree, and though a strong reaction set in during the summer and latter part of the year, the decrease in production was not sufficient to offset the better conditions which prevailed in the earlier months.

The usual disturbances by strikes took place. The principal difficulty occurred in Kansas, and was stubbornly contested by operators and operatives for several months, and caused a loss to the State in production of several hundred thousand tons. Other strikes were of minor importance.

At the time of writing this report (May, 1894) a strike of unusual dimensions is in progress, without appearance of an early settlement. The strike affects the entire Appalachian bituminous field from Pennsylvania to Alabama, the Northern field in Michigan, and the Central field in Illinois and Indiana. The men were called out on April 26, and at the time of writing it is estimated that 150,000 operatives are out of employment. This represents about two-thirds of the total number of employés in the bituminous mines of the United States, and equivalent to the entire force in Pennsylvania, Ohio, Indiana, Illinois, and Alabama. Of course all the mines are not affected. These figures are quoted to show the dimensions of the strike. As a natural result, manufacturing interests are seriously hampered. Many establishments have been compelled to close for want of fuel, while others have been obliged to use petroleum, natural gas, and anthracite coal. Railroads have been obliged to seize coal in transit for their locomotive fuel, and general distress is reported. It is pertinent at this time to call attention to a prediction made by the writer in the review of the coal trade of 1892. From "Mineral Resources" for that year, page 271, is quoted:

"A spirit of rivalry exists between different sections to outstrip each other in the aggregate tonnage produced, and is almost certain to lead to overproduction, a decline in values, and eventually prove disastrous to the trade."

It was not expected that this prophecy would be so soon fulfilled, but events speak for themselves. There is no doubt that during the months preceding the present strike, the output of our coal mines was more than the market would absorb. It is true that in a number of cases it was with the best intentions of keeping their men employed that operators continued their mines in operation to their full capacity or nearly so; but in order to do this a reduction in the cost of mining was necessary.

In the Cumberland region, for instance, the operators called a meeting with their employés and submitted to them a proposition, the effect of which was that, in order to meet competition with other regions and make contracts for 1894, it was neccessary for them to accept a reduction to 40 cents per ton for mining. Otherwise the mines would have to shut down. The men accepted the proposition, and at the time they went out on a strike they made no grievances of their own, but were ordered out in sympathy with others.

The general strike was ordered for the avowed purpose of compelling operators to return to the original rate. It was at a time when the market was glutted with coal and prices demoralized, so that operators were not able to accede to the demand.

Owing to its unusual magnitude, this strike, however terminated, will be far reaching in its effects. It is to be hoped that some means may be adopted to regulate the production, so that the supply will be kept in some equable proportion to the demand. Operators may then obtain profitable prices for their product, and at the same time allow to their employés a just remuneration for their labor.

A comprehensive understanding of the tendency of trade during 1893 may be obtained from a review of the coal trade at some of the important centers, and of the general movement of coal between the producing districts and the principal markets. The contributions to this feature have been supplied by the secretaries of boards of trade, etc., or obtained from Mr. F. E. Saward's valuable work *The Coal Trade*, from the *Black Diamond*, and from other technical journals.

New York.—Regarding the coal trade at New York during 1893, Mr. Saward, in his report, says:

"One of the special features of interest in connection with the trade of this city is the increased use of the small sizes of anthracite for steam-raising purposes; it is a feature that outweighs many others in importance, for we are informed that with many of the receivers 40 per cent. of the tonnage handled is made up of the smaller coals, such as pea, buckwheat, rice, culm, etc. In this connection we may note that the value of pea coal as a steam producer has long been recognized, but its rapidly-increasing use as a domestic fuel will soon make it too expensive for steam users. It is only within recent years that the buckwheat sizes of coal have become marketable, due in a great measure to the intelligent work of several makers of grates particularly adapted to these sizes, and the great majority of steam users still continue to use large coal through lack of knowledge or appreciation of value to them of No. 1, No. 2, or even No. 3, buckwheat coal. The economy of the small coal is most conclusively proved by the fact that at the collieries throughout the anthracite coal fields they are used for making steam to operate the breakers, and also from the fact that nearly all the railroads tapping the anthracite regions use them on their locomotives with precisely the same results as were formerly obtained by the use of large coal. At the electric-light stations, the power houses for the cable roads, and many of the large office buildings in this city they now use the small anthracite.

"As usual during March the 'opening prices' of the season were made, and they compare as follows for six years. Prices are for free-burning coal:

Opening prices for free-burning coal at New York for six years.

Years.	Broken.	Egg.	Stove.	Chestnut.
1888	$3.75	$4.00	$4.25	$4.25
1889	3.75	3.90	4.15	4.00
1890	3.40	3.50	3.50	3.25
1891	3.50	4.60	3.75	3.50
1892	3.65	3.75	3.90	3.65
1893	3.90	3.90	4.15	4.15

"All these are what are known as circular prices at the loading ports. They were not always realized, however. The higher opening prices in 1893 were a part of effect of the 'combine' effort from the preceding year, and while advances were made through the season and until July 1, the market was a dragging one on account of the large output. Figures at the close for six years, nominally, were:

Closing prices for free-burning coal at New York for six years.

Years.	Broken.	Egg.	Stove.	Chestnut.
1888	$3.95	$4.30	$4.65	$4.65
1889	3.90	4.15	4.40	4.15
1890	3.75	4.00	4.40	3.95
1891	3.75	4.15	4.40	4.15
1892	4.00	4.40	4.75	4.65
1893	3.75	4.00	4.45	4.45

"Soft coal on the market sold at very low prices for certain grades. The tonnage made by certain of the districts tended to demoralize market conditions. The prices were made early in the season at the rate of $2.40 per ton at the lower Atlantic ports, and it is possible that some of the better grades realized this figure on a portion of their shipments. A fair exhibit of the course of prices of the best Georges creek coal is shown below:

Prices for Georges Creek coal at New York for six years.

Years.	Per ton.	Years.	Per ton.
1888	$3.50	1891	$3.50
1889	3.50	1892	3.40
1890	3.50	1893	3.25

"It was possible to buy bituminous coal at from 40 to 50 cents less than these figures at certain times.

"The Retail Exchange has had a fair year, and prices have followed the course of the wholesale market. The rate was nominally $5.50 and $5.75, but this was cut at times, and there was considerable discussion as to short weight being given by those who sold for less than 'standard' price."

Boston, Massachusetts.—The following review of the coal trade of Boston during 1893, with interesting statistics for a series of years, has been prepared by Mr. E. G. Preston, secretary of the Chamber of Commerce.

The receipts of coal at the port of Boston for the past eleven years have been as follows:

Coal receipts at Boston, Massachusetts, for eleven years (not including receipts by rail).

Years.	Domestic.		Foreign.	Total.
	Anthracite.	Bituminous.		
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1883				2,273,068
1884				2,225,740
1885				2,221,220
1886			44,464	2,500,000
1887			13,966	2,400,000
1888	2,057,279	1,004,195	10,081	3,071,555
1889	1,647,348	914,966	5,538	2,567,852
1890	1,740,564	964,857	14,072	2,719,493
1891	2,039,443	1,070,088	5,842	3,115,373
1892	2,163,984	919,815	1,416	3,085,215
1893	2,227,086	1,100,384	17,097	3,344,567

In addition to the above, a small amount of coal (principally bituminous) reaches this city by rail, amounting during 1893 to about 50,000 tons, making the total receipts during the year 3,394,567 tons.

Of this amount, 946,141 tons, or 28 per cent., was forwarded to interior New England points, making the consumption of the city of Boston for the past year 2,448,426 tons.

After making a proper allowance for the receipts by rail in 1892, when those statistics were not compiled, this shows an increase of

185,945 tons, a most satisfactory exhibit considering the general business depression.

Trade during the year has been fair and generally well sustained, notwithstanding the prevailing hard times. The year opened with stove coal free on board New York quoted at $4.10 per ton, from which point it rose by gradual advances to $4.40 in June, suffering a decline in July and August, and then making final advances to $4.60, at which point it remained until the close of the year.

Carriers' rates have covered a wide range, the minimum from Philadelphia being 50 cents, reached in the early part of August, and from New York 35 to 40 cents, reached at various times during the summer.

The following table shows the receipts of coal by months for the past year:

Coal receipts at Boston, Massachusetts, during 1893, by months.

Months.	Domestic.		Foreign.	Total.
	Anthracite.	Bituminous.		
	Tons.	*Tons.*	*Tons.*	*Tons.*
January	71,751	51,791	336	123,878
February	102,981	106,750	3,762	213,493
March	137,501	71,313	592	209,406
April	173,113	136,004	1,947	311,064
May	221,569	117,783	1,928	341,280
June	231,936	71,087	61	303,084
July	228,633	99,710	2,208	330,551
August	165,058	85,999	118	251,175
September	182,239	84,769	118	267,356
October	305,361	100,604	2,342	408,307
November	219,907	107,392	1,826	329,125
December	187,037	67,182	1,859	256,078
Total	2,227,086	1,100,384	17,097	3,344,797

Philadelphia, Pennsylvania.—The wholesale prices for anthracite coal, free on board at Port Richmond, averaged as follows for the past five years:

Average prices of anthracite coal at Port Richmond, from 1889 to 1893.

Kinds of coal.	Broken.	Egg.	Stove.	Chestnut.	Pea.
1889.	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*
Hard white ash	$3.70	$3.85	$4.05	$3.80	$2.10
Free-burning white ash	3.50	3.75	3.95	3.75	2.10
1890.					
Hard white ash	3.65	3.90	4.05	3.70	2.25
Free-burning white ash	3.50	3.75	4.05	3.70	2.25
1891.					
Hard white ash	3.75	3.90	4.05	3.75	2.25
Free burning white ash	3.65	3.90	4.00	3.70	2.25
1892.					
Hard white ash	3.75	4.05	4.35	4.25	2.40
Free-burning white ash	3.70	4.05	4.30	4.20	2.35
1893.					
Hard white ash	3.70	4.00	4.30	4.25	2.25
Free-burning white ash	3.60	3.80	4.20	4.20	2.15

According to the *Coal Trade*, the trade has been quiet enough in the past year, but the great overturn in the Philadelphia and Reading railroad management and the placing of that company in the hands of a receiver is a matter of note. The net result was a very poor one for the company and its coal adjunct, according to the reports for the last fiscal year, in spite of the economies practiced by the receivers.

Baltimore, Maryland.—The coal received at Locust Point for the Baltimore market includes Cumberland, Georges Creek, Myersdale, and the gas coal from the West Virginia mines on the line of the Baltimore and Ohio railroad, and that from the Youghiogheny mines in Pennsylvania on the line of the same road, for local use and for northern shipment. Although the bulk of the coal received in Baltimore comes by the Baltimore and Ohio railroad, the receipts over the Northern Central are not inconsiderable. The receipts over the Baltimore and Ohio in 1893 were 2,044,840 tons, and by the Northern Central about 800,000 tons. Of the latter about 350,000 tons are anthracite. In addition to the above, about 250,000 tons of anthracite are received annually by the Susquehanna canal, and a comparatively small amount of bituminous coal is received over the Baltimore and Potomac railroad.

The three railroads have carried to Baltimore annually since 1883 the following quantities:

Coal receipts at Baltimore.

Years.	Via Baltimore and Ohio railroad.	Via Northern Central railroad.	Via Baltimore and Potomac railroad.
	Tons.	*Tons.*	*Tons.*
1883	1,618,416	693,494	....
1884	2,510,389	767,381	....
1885	2,238,097	850,303	....
1886	2,313,783	818,863	....
1887	2,167,007	765,082	15,338
1888	2,300,000	680,962	16,500
1889	2,000,000	666,972	7,139
1890	2,090,911	735,912	10,000
1891	2,296,735	916,086	....
1892	1,978,967	896,272	....
1893	2,044,840	800,000	....

Foreign shipments of coal from Baltimore.

Years.	Tons.	Years.	Tons.
1883	63,526	1889	27,750
1884	50,289	1890	37,190
1885	71,527	1891	122,818
1886	64,477	1892	97,385
1887	54,455	1893	165,258
1888	33,386		

Buffalo, New York.—The following review of the coal trade of Buffalo in 1893 is obtained from the report of a special correspondent to the *Engineering and Mining Journal:*

"The movement of anthracite coal at Buffalo in 1893 was less than in 1892, while the bituminous figures show a small increase. The average price of anthracite was higher and bituminous lower in 1893 than 1892. Lake freights were much lower; taking the Chicago figures as the basis, the range was 75 to 40 cents in 1892 and 60 to 30 cents in 1893 per short ton, free on and off, a decline of 15 to 10 cents.

"There have been few failures here and westward of our ports among the anthracite dealers the past year, and collections are said to have been uniformly good. Upper lake ports are said to be supplied with coal amply large enough for all the requirements of the trade.

"Natural gas for fuel purposes continues to be used very largely in the principal western resident portions of Buffalo, and extensive additions are nearly completed for supplying a wide area on the east side. The sources of supply are the wells of Pennsylvania, Canada, and many small wells from outlying districts east of Buffalo. This is a great factor in the reduction of the consumption of coal here.

"The bituminous coal trade of Buffalo in 1893 was very unsatisfactory on the whole; starting in with active demand until about the first of July, when trade fell off through the financial troubles and stringency and continued in that shape until the end of the year. Many factories ran on short time or closed entirely. Less traffic on the lakes and railroads and other causes curtailed consumption very materially. There was always plenty of coal on the market, as the Pennsylvania collieries continued to be worked. Prices started in about the same as those ruling at the close of 1892, but gradually dropped off, and coal was furnished consumers for mere cost of production and freight, and in many cases less than cost. No strikes affected the supply, and the output was larger than in 1892.

"The coke trade was much demoralized, owing to the depressed condition of the iron-manufacturing interests. Quite a business has grown up in Buffalo, however, in the sale of coke for domestic purposes."

Mr. William Thurstone, secretary of the Buffalo Merchants' Exchange, has compiled the statistics of the coal trade at that place during 1893, which are given below, together with the figures for a series of years carried forward from the previous volume of Mineral Resources.

The following were the circular prices for anthracite, per long ton of 2,240 pounds, during 1893:

Anthracite wholesale circular prices in 1893.

Date.	Free on board vessels at Buffalo.				On cars at Buffalo and Suspension Bridge.			
	Grate.	Egg.	Stove.	Chestnut.	Grate.	Egg.	Stove.	Chestnut.
January 1	$5.35	$5.60	$5.60	$5.60	$5.05	$5.30	$5.30	$5.30
April 26	4.70	4.95	4.95	4.95	4.40	4.65	4.65	4.65
June 1	4.95	5.20	5.20	5.20	4.65	4.90	4.90	4.90
July 1 to December 31	5.20	5.45	5.45	5.45	4.90	5.15	5.15	5.15

The circular prices for 1892 are given below for comparison:

Anthracite wholesale circular prices in 1892.

Date.	Free on board vessels at Buffalo.				On cars at Buffalo or Suspension Bridge.			
	Grate.	Egg.	Stove.	Chestnut.	Grate.	Egg.	Stove.	Chestnut.
January 1	$4.80	$4.90	$4.90	$4.90	$4.50	$4.60	$4.60	$4.60
March 24	4.55	4.55	4.55	4.55	4.25	4.25	4.25	4.25
May 2	4.80	4.80	4.80	4.80	4.50	4.50	4.50	4.50
June 1	4.80	5.05	5.05	5.05	4.50	4.75	4.75	4.75
July 1	5.05	5.30	5.30	5.30	4.75	5.00	5.00	5.00
September 1 to December 31	5.35	5.60	5.60	5.60	5.05	5.30	5.30	5.30

The retail prices of anthracite per 2,000 pounds, screened, delivered in the city limits, during 1893, were as follows:

Anthracite retail prices at Buffalo in 1893.

Date.	Grate.	Egg.	Stove.	Nut.	Pea.	Blossburg.
January 1	$5.50	$5.75	$5.75	$5.75	$4.25	$4.00
April 26	5.00	5.25	5.25	5.25	3.75	4.00
June 1	5.25	5.50	5.50	5.50	3.75	4.00
July 1 to December 31	5.50	5.75	5.75	5.75	4.00	4.00

The range of prices during 1893 for bituminous, delivered to manufacturers, gas works, propeller lines, tugs, etc., was from $1.40 to $2.75 per short ton, in car lots on track, according to description; the price at retail, for choice for family use, was from $4 to $6 per short ton, delivered.

About 275,000 tons of anthracite and 3,500 tons of bituminous coal were consumed by families in Buffalo during 1893.

The shipping docks and coal pockets at this port are:

Shipping docks and coal pockets at Buffalo, New York.

Names.	Average shipping capacity, daily.	Average capacity of pockets.
	Tons.	*Tons.*
Western New York and Pennsylvania railroad	2,500	3,000
Delaware and Hudson Canal Company	3,500	5,000
Delaware, Lackawanna and Western railroad	3,000	4,000
Reading (Lehigh) docks, Nos. 1 and 2	6,000	12,000
Erie docks (New York, Lake Erie and Western railroad)	2,500	3,000
Pennsylvania Coal Company	3,000	3,300
Reading docks	7,000	6,500
Total	27,500	36,800

The following tables exhibit the receipts and shipments of anthracite, bituminous, and Blossburg (smithing) coal at Buffalo for a series of years.

Coal receipts at Buffalo for several years.

Years.	Anthracite.	Bituminous.	Blossburg.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1842				1,800
1852				57,560
1862				239,873
1872				790,876
1882				3,021,791
1886	2,673,778	1,420,956	30,000	4,124,734
1887	3,497,203	1,776,217	25,000	5,298,420
1888	4,549,015	1,892,823	22,500	6,464,338
1889	4,338,570	2,198,327	22,500	6,559,397
1890	4,500,000	2,200,000	25,500	6,725,500
1891	4,800,000	2,450,000	25,500	7,275,000
1892	4,804,760	2,627,441	25,000	7,457,201
1893	4,770,516	2,896,614	25,000	7,692,160

Lake shipments of anthracite coal from Buffalo.

Years.	Tons.	Years.	Tons.
1883	1,467,778	1889	2,151,670
1884	1,431,081	1890	2,157,810
1885	1,428,086	1891	2,365,895
1886	1,531,210	1892	2,822,230
1887	1,894,060	1893	2,681,173
1888	2,514,906		

Lake shipments of bituminous and Blossburg coal from Buffalo.

Years.	Bituminous.	Blossburg.
	Tons.	*Tons.*
1887	8,706	10,000
1888	7,452	5,000
1889	11,673	5,000
1890	25,872	5,000
1891	34,066	5,000
1892	54,216	5,000

Shipments of bituminous coal by canal.

Years.	Short tons.
1890	25,872
1891	34,060
1892	29,216
1893	19,336

Outside the city limits at Cheektowaga is the stocking coal trestle of the Delaware, Lackawanna and Western, with a capacity of over 100,000 tons storage. In the same place the Lehigh has its trestles and stocking plant of 175,000 tons storage capacity, with a shipping capacity of 3,000 tons daily; and has a transfer trestle for loading box cars with a capacity of 100 cars daily. And at the same point the Erie has a stocking plant, with an average daily capacity of 1,000 tons, and storage capacity of 100,000 tons. The Reading has, at the foot of Georgia street, in the city, a large trestle and pocket for the convenience of the retail trade, and in connection with their docks, with a capacity of 2,000 tons. The Buffalo, Rochester and Pittsburg has terminals on Ganson and Michigan streets, fronting on the Blackwell canal, with a water frontage of 1,100 feet; also a town delivery yard, with a hoisting plant for loading and coaling vessels, used by Messrs. Coxe Bros. & Co.

The distribution of exports of coal by lake from this port, during the years of 1890, 1891, 1892, and 1893, as reported by the Custom House, was as follows:

Clearances of coal at Buffalo for seven years.

Destination.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago	642, 135	784, 462	1, 023, 649	988, 750	952, 280	957, 805	1, 179, 635	1, 180, 245
Milwaukee	376, 615	376, 876	549, 831	497, 895	451, 550	508, 140	715, 975	655, 905
Duluth	157, 420	165, 798	282, 106	160, 430	199, 230	257, 625	318, 580	278, 515
Superior	65, 090	96, 746	120, 000	112, 450	127, 300	162, 075	200, 680	197, 063
Toledo	55, 290	84, 563	83, 850	52, 725	96, 230	64, 620	102, 585	101, 970
Gladstone	....	....	39, 575	36, 520	30, 215	35, 170	52, 500	55, 400
Racine	25, 263	16, 565	29, 695	33, 410	29, 130	30, 510	34, 020	41, 715
Detroit	31, 090	40, 203	35, 330	31, 890	40, 065	24, 560	22, 500	15, 075
Green Bay	23, 870	29, 446	26. 345	25, 050	22, 380	29, 015	35, 300	57, 800
Other places	156, 439	140, 020	179, 525	142, 216	131, 390	295, 375	190, 555	239, 895
Total	1, 531, 212	1, 734, 479	2, 369, 906	2, 081, 336	2, 079, 770	2, 365, 895	2, 852, 330	2, 703, 673

Cleveland, Ohio.—The following review of the coal trade at Cleveland during 1893 has been prepared by Mr. Ryerson Ritchie, secretary of the Chamber of Commerce:

The coal trade of Cleveland opened up in 1893 in a very satisfactory manner. The docks at the upper lake ports were well cleared, prices were stable, and in the opening months of navigation the increase of clearances was very marked. This satisfactory condition continued until June, when the effect of the financial depression was felt. The stringency of the money market, the passing of the Northern Pacific and other roads into the hands of receivers, the curtailment of credits, on the part of the railroads, for carriage, all operated to paralyze the trade, and the output of the year compares poorly with expectations. Adding to the complications were the many failures of the Northwest mining companies, the embarrassment of others and the decreased operations of all, the demand for coal decreasing in like proportion. During the months of August, September, and October, the decreased train service on our railroads, and a recourse to coal on docks, still further decreased the demand; and possibly, in view of the obstacles which the trade faced, the figures of the year, but little less than 1892, may be a matter of congratulation.

Coal and coke receipts and shipments at Cleveland since 1887.

	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Receipts:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bituminous	1,454,744	1,737,781	1,600,000	1,506,208	2,838,586	3,651,080	3,603,984
Anthracite	176,769	181.551	160,000	205,856	201,927	259,150	262,266
Coke	114,924	124,827	150,000	194,527	189,640	351,527	235,248
Total	1,746,437	2,044,159	1,910,000	1,960,591	3,230,153	4,261,757	4,101,498
Shipments:							
Anthracite by rail	20,296	29,735	25,000	29,056	34,910	50,742	49,497
Bituminous by rail Bituminous by lake	703,506	1,000,000	1,100,000	1,200,000	1,525,000	1,728,831	24,128 1,257,326
Total	723,802	1,029,735	1,125,000	1,229,056	1,559,910	1,779,593	1,330,951

In previous volumes of "Mineral Resources," the statements regarding the shipments of bituminous coal by rail from Cleveland have been erroneous. The statements showed the rail shipments to have ranged from 294,453 tons in 1887, to 1,109,707 tons in 1892, whereas the shipments of bituminous coal from Cleveland are comparatively unimportant, amounting in 1893 to 24,128 tons. Mr. Ritchie, in transmitting his review of the coal trade in 1893, calls attention to this error and the corrections have been made in the above table.

The Cuyahoga customs district includes the ports of Cleveland, Ashtabula, Fairport, and Lorain. The following table shows the clearances from this district for the past seven years:

Clearances of coal from the Cuyahoga (Ohio) district for six years.

Years.	Tons.	Years.	Tons.
1887	1,433,035	1891	2,635,461
1888	1,855,260	1892	2,957,988
1889	2,020,996	1893	3,052,342
1890	2,328,663		

Prices of coal at Cleveland, Ohio, in 1892 and 1893.

Kinds of coal.	Price per ton.		Kinds of coal.	Price per ton.	
	1892.	1893.		1892.	1893.
Bituminous:			Bituminous:		
Massillon	$2.40	$2.40	Coshocton	$2.10	$1.95
Palmyra	2.75	2.75	Hocking	1.90	1.90
Pittsburg	2.10	1.75	Anthracite:		
Salineville	1.70	1.55	Grate	5.18	5.75
Kentucky cannel	4.75	4.75	Egg	5.40	6.00
Goshen	1.85	1.65	Stove	5.40	6.00
Sherodsville	1.70	1.60	Chestnut	5.40	6.00
Osnaburg	1.80	1.70			

Toledo, Ohio.—The following review of the coal trade of Toledo is taken from the annual report of Mr. Denison B. Smith, secretary of the Toledo Produce Exchange.

"The coal commerce between the mines of Ohio and the West is increasing. This traffic has grown to its present enormous proportions in a little more than a decade. Of course, the rapid increase in population in the Northwest and the demand for increased supply has been the great stimulating feature of growth in the trade, but cheaper cost of mining, cheaper rail freight, cheaper methods of transfer at the lake ports, and, last of all, cheaper lake freight by the great ships that now transport this coal have all been supplied by the spirit, enterprise, and capital of our citizens in order to meet and extend the demand to wider fields.

"But like commerce and trade in all branches in this country, the coal trade has been adversely affected in price and demand by the money adversities of the year. The demand for propelling machinery has been decreased, and the domestic fuel demand is also lessened.

"Receipts at Toledo have increased 54,590 tons compared with 1892, and there are sufficient reasons for it. The harbor and the straight channel through the bay, admitting the largest vessels that float on the lakes, and the increase in dock and transfer facilities are a sufficient explanation of the increased movement hence."

Coal receipts at Toledo since 1886.

	1886.	1887.	1888.	1889.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Wabash Railroad	12,598	9,637	10,375	8,586
Lake Shore and Michigan Southern Railway	165,382	206,099	201,064	35,693
Cincinnati, Hamilton and Dayton Railroad	8,198	11,741	37,831	51,746
Pennsylvania Company	201,427	330,020	339,750	234,675
Michigan Central Railroad	9,594	13,864	16,504	19,935
Columbus, Hocking Valley and Toledo Railway	1,039,200	955,620	1,358,025	923,745
Toledo, Ann Arbor and North Michigan Railway	1,910	552	24,700	96
Toledo, St. Louis and Kansas City Railroad	3,828	....	1,359	3,287
Toledo and Ohio Central Railway	404,684	590,000	637,000	706,950
Lake	87,120	117,921	140,063	90,282
Wheeling and Lake Erie Railway	391,086	454,813	755,155	763,055
Toledo, Columbus and Cincinnati Railway	15,832	5,446	2,014	2,210
Cincinnati, Jackson and Mackinaw Railroad	....	....	45	54
Total	2,340,859	2,695,810	3,423,780	2,838,314

	1890.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Wabash Railroad	3,620	600	500	....
Lake Shore and Michigan Southern Railway	20,592	8,872	43,252	31,110
Cincinnati, Hamilton and Dayton Railroad	25,753	35,256	82,053	100,000
Pennsylvania Company	214,765	172,325	92,894	141,345
Michigan Central Railroad	3,152	524	420	....
Columbus, Hocking Valley and Toledo Railway	931,716	604,039	394,895	354,740
Toledo, St. Louis and Kansas City Railroad	8,420	6,891	5,041	....
Toledo and Ohio Central Railway	820,049	300,429	450,000	484,000
Lake	133,813	83,800	112,199	134,750
Wheeling and Lake Erie Railway	853,940	1,007,042	1,080,000	1,100,000
Toledo, Columbus and Cincinnati Railway	....	35,064	30,000	....
Cincinnati, Jackson and Mackinaw Railroad	65	....	101	....
Total	3,021,886	2,754,943	2,291,355	2,345,945

Chicago, Illinois.—The following table shows the receipts of coal at and the shipments from Chicago during 1892 and 1893, as collected by the Bureau of Coal Statistics:

Coal and coke receipts at Chicago in 1892 and 1893.

Months.	Anthracite by— Lake.		Anthracite by— Rail.		Total anthracite.		1893.	
	1893.	1892.	1893.	1892.	1893.	1892.	Increase.	Decrease.
January	....	....	48,915	29,406	48,915	29,406	19,509	....
February	....	....	38,921	20,816	38.921	20,816	18,105	....
March	....	....	29,873	31,419	29,873	31,419	....	1,546
April	46,295	63,708	26,418	38,009	72,713	101,717	....	29,004
May	257,122	121,113	34,816	30,113	291,938	151,226	140,712	....
June	182,769	209,142	40,716	43,516	223,485	252,658	....	29,173
July	161,004	167,123	40,929	64,358	201,933	231,481	....	29,548
August	87,316	157,711	38,429	53,436	125,745	211,147	....	85,402
September	162,921	169,385	77,389	83,611	240,310	252,996	....	12.686
October	174,624	249,792	99,386	69,911	274.010	319,703	....	45,693
November	226,952	239,709	113,446	93,465	340,398	333,174	7,224	....
December	125,850	97,554	79,529	91,766	205,379	189,320	16,159	....
Total	1,424,853	1,475,237	668,767	649,826	2,093,620	2,125,063	....	31,443

Months.	Pennsylvania.		1893.		Ohio.		1893.	
	1893.	1892.	Increase.	Decrease.	1893.	1892.	Increase.	Decrease.
January	47,193	25,842	21,351	....	84,856	44,950	39,906	....
February	31,816	23,844	7,972	....	63,419	31,852	31,567	....
March	31,216	26,488	4,728	....	64,296	35,113	29,183	....
April	35,312	29,633	5,679	....	55,560	34,669	20,891	....
May	24,353	27,144	....	2,791	38,777	42,253	....	3,476
June	30,389	38,346	....	7,957	67,860	55,800	12,060	....
July	38,194	34,906	3,288	....	55,617	51,400	4,217	....
August	31,214	28,435	2,779	....	42,966	38,321	4,645	....
September	31,416	32,445	....	1,029	58,226	60,924	....	2,698
October	33,451	31,714	1,737	....	59,728	57,438	2,290	....
November	38,985	41,329	....	2,344	74,935	109,339	....	34,404
December	48,284	54,318	....	6,034	89,557	97,842	....	8,285
Total	421,823	394,444	27,379	....	755,797	659,901	95,896	....

Months.	West Virginia and Kentucky.		1893.		Illinois.		1893.	
	1893.	1892.	Increase.	Decrease.	1893.	1892.	Increase.	Decrease.
January	17,091	10,752	6,339	....	182,012	128,026	53,986	....
February	14,825	8,651	6,174	....	170,925	116,012	54,913	....
March	15,541	6,696	8,845	....	160,358	144,769	15,589	....
April	17,855	9,842	8,013	....	135,142	133,047	2,095	....
May	13,483	11,575	1,908	....	115,673	119,157	....	3,484
June	20,432	13,260	7,172	....	153,171	150,381	2,790	....
July	18,541	10,831	7,710	....	119,563	114,281	5,282	....
August	12,437	13,432	....	995	132,767	146,030	....	13,263
September	19,794	15,735	4,059	....	183,577	191,359	....	7,784
October	18,426	13,474	4,952	....	180,466	168,826	11,640	....
November	22,407	25,238	....	2,831	208,291	204,269	4,022	....
December	25,162	24,785	377	....	203,363	206,223	....	2,860
Total	215,994	164,271	51,723	....	1,945,306	1,822,380	122,926	....

Coal and coke receipts at Chicago in 1892 and 1893—Continued.

Months.	Indiana.		1893.		Coke.		1893.	
	1893.	1892.	Increase.	Decrease.	1893.	1892.	Increase.	Decrease.
January	141,149	102,750	38,399	....	76,618	73,623	5,995	....
February	141,500	111,980	29,520	....	73,518	64,420	9,098	....
March	156,833	146,038	10,795	....	68,221	49,317	18,904	....
April	127,744	134,076	....	6,332	59,328	47,911	11,417	....
May	99,374	118,999	....	19,625	51,417	47,416	4,001	....
June	123,699	133,173	....	9,474	52,673	63,417	....	10,744
July	122,844	116,104	6,740	....	56,913	53,316	3,597	....
August	104,329	138,109	....	33,780	42,813	62,627	....	19,814
September	140,557	145,403	....	4,846	74.186	86,297	....	12,111
October	147,374	151,182	....	3,808	72,316	83,467	....	11,151
November	134,229	162,537	....	28,328	94,307	103,109	....	8,802
December	135,363	125,820	9,453	....	82,333	81,516	817	....
Total	1,574,975	1,586,171	....	11,196	807,643	816,436	....	8,793

SHIPMENTS FROM CHICAGO.

Months.	Anthracite.		1893.		Bituminous and coke.		1893.	
	1893.	1892.	Increase.	Decrease.	1893.	1892.	Increase.	Decrease.
January	54,191	38,557	15,634	....	70,218	73,629	....	3,411
February	30,239	18,127	12,112	....	58,644	44,835	13,809	....
March	38,024	38,612	....	588	71,312	61,236	10,076	....
April	21,539	16,319	5,220	....	60,614	59,466	1,148	....
May	24,718	16,833	7,885	....	39,227	49.457	....	10,330
June	29,456	35,643	....	6,187	40,309	57,889	....	17,580
July	57,314	53,221	4,093	....	51,966	57,819	....	5,853
August	61,668	79,332	....	17,664	52,324	71,058	....	18,734
September	89,537	103,447	....	13,910	76,309	91,005	....	14,696
October	90,006	84,919	5.087	....	73,924	89,204	....	15,280
November	104,249	106,353	....	2,104	68,317	97,678	....	29,361
December	81,336	68,579	12,757	....	56,218	62 306	....	6,088
Total	682,277	659,942	22,335	....	719,382	815,682	....	96,300

Milwaukee, Wisconsin.—Mr. William J. Langson, secretary of the Chamber of Commerce, has kindly furnished the following statement of the receipts and shipments of coal at Milwaukee for a series of years:

"The volume of the coal trade of Milwaukee in 1893 was almost equal to that of the preceding year, which was the largest recorded in the history of that city. The total receipts were 1,249,732 tons, 122,590 tons less than in 1892, and the shipments westward by rail 532,993 tons, being 63,849 tons larger than the reported shipments of 1892. Approximate local consumption, 716,730 tons. The growth of the coal trade of Milwaukee has been very rapid, though somewhat restricted during the last two or three years by a scarcity of railroad cars to supply the Western country reached by the roads extending from this point. This difficulty was partially overcome last year as indicated by the increased westward shipments, and in view of the constant improvement in railroad equipment, shippers will, doubtless, be accorded more liberal facilities every year. The increase in the coal trade of Milwaukee in the past ten years has been over 100 per cent., notwithstanding the enormous quantities distributed from the head of Lake Superior throughout the far Northwest.

The facilities for handling coal at Milwaukee are of the latest and most approved description. The dock room is ample and easily accessible to vessels of the largest class, having in this respect a great advantage over Chicago. Many vessels engaged in the grain trade of Chicago and ore trade of Escanaba, bring return cargoes of coal to Milwaukee. The coal carrying trade is looked upon as one of the most important factors in building up the commerce of Milwaukee.

Receipts of coal at Milwaukee for nine years.

	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
By lake from—	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Buffalo	392, 003	395, 971	464, 972	631, 263	542, 167	510, 598	659, 388	819, 570	629, 243
Erie	50, 915	41, 847	61, 222	74, 610	47, 862	46, 378	55, 202	65, 190	78, 947
Oswego	10, 043	....	1, 153	1, 348	....	2, 408	17, 022	26, 177	46, 065
Cleveland	126, 741	91, 997	78, 259	98, 631	89, 071	135, 413	143, 776	132, 051	189, 539
Ashtabula	35, 360	11, 096	38, 881	23, 105	48, 599	24, 671	22, 726	30, 549	38, 317
Black River	5, 549	....	....	....	....	....	....	....	....
Lorain	19, 452	12, 417	11, 757	13, 533	15, 367	15, 351	3, 983	....	18, 406
Sandusky	19, 307	57, 412	46, 606	19, 733	51, 816	26, 193	10, 692	19, 039	5, 360
Toledo	31, 875	69, 079	14, 115	38, 452	71, 516	59, 305	53, 644	12, 229	64, 548
Charlotte	19, 491	31, 744	2, 781	14, 292	22, 526	6, 120	10, 013	55, 909	763
Fairport	....	....	10, 517	30, 253	5, 552	11, 100	5, 775	5, 359	16, 483
Ogdensburg	....	....	....	7, 700	4, 953	7, 026	5, 179	18, 134	1, 635
Huron, Ohio	....	....	....	8, 244	7, 726	9, 720	12, 307	12, 173	26, 342
Other ports	....	2, 679	4, 331	....	588	*a*49, 375	*a* 6, 949	19, 485	1, 800
Total by lake	710, 736	714, 242	724, 594	961, 164	907, 743	903, 658	1, 006, 656	1, 210, 865	1, 117, 448
By railroad	65, 014	45, 439	118, 385	161, 079	72, 935	92, 999	149, 377	163, 549	132, 284
Total receipts	775, 750	759, 681	842, 979	1, 122, 243	980, 678	996, 657	1, 156, 033	1, 374, 414	1, 249, 732

a Including cargoes from all ports not reported at the custom-house.

Shipments of coal from Milwaukee for the past eleven years.

Shipped by—	1883.	1884.	1885.	1886.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago, Milwaukee and St. Paul railway	146, 295	140, 630	179, 883	177, 286	166, 120
Chicago and Northwestern railway	41, 746	37, 314	56, 591	70, 420	79, 258
Wisconsin Central railroad	6, 725	7, 469	8, 943	11, 745	18, 953
Milwaukee, Lake Shore and Western railway	30, 575	11, 757	12, 804	13, 072	13, 886
Milwaukee and Northern railroad	10, 075	7, 556	10, 872	12, 011	15, 627
Lake	355	335	184	269	1, 595
Total	235, 771	205, 061	269, 277	284, 803	295, 439

Shipped by—	1888.	1889.	1890.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago, Milwaukee and St. Paul railway	283, 269	258, 281	378, 090	406, 455	252, 168	321, 960
Chicago and Northwestern railway	107, 193	97, 207	103, 279	114, 847	163, 063	199, 457
Wisconsin Central railroad	12, 624	11, 727	15, 929	14, 449	14, 930	10, 967
Milwaukee, Lake Shore and Western railway	16, 146	25, 413	5, 884	7, 998	11, 041	....
Milwaukee and Northern railroad	34, 480	20, 556	19, 386	26, 723	27, 185	....
Lake	125	224	50	416	757	609
Total	453, 837	413, 408	522, 618	600, 888	469, 144	532, 993

The Milwaukee, Lake Shore and Western railway became a part of the Chicago and Northwestern railway system, radiating from Milwaukee, and the Milwaukee and Northern railroad was in like manner absorbed by the Chicago, Milwaukee and St. Paul railway, and the traffic of both of these roads for 1893 was merged in that of the larger corporations.

Receipts of coal at Milwaukee by lake and rail annually for thirty years, from 1862 to 1893, inclusive.

Years.	Tons.	Years.	Tons.
1862	21, 860	1878	239. 667
1863	43, 215	1879	350, 840
1864	44, 503	1880	368, 568
1865	56, 369	1881	550, 027
1866	66, 616	1882	593, 842
1867	74, 568	1883	612, 584
1868	92, 992	1884	704, 166
1869	87, 690	1885	775, 750
1870	122, 865	1886	759, 681
1871	175, 526	1887	842, 979
1872	210, 194	1888	1, 122, 243
1873	229, 784	1889	980, 678
1874	177, 655	1890	996, 657
1875	228, 674	1891	1, 156, 033
1876	188, 444	1892	1, 374, 414
1877	264, 784	1893	1, 249, 732

Saint Paul and Minneapolis.—No reliable information regarding the amount of coal received is obtainable. Mr. Saward estimates the local consumption of anthracite at Saint Paul to be about 80,000 tons, and at Minneapolis, 70,000 tons. The bituminous trade is larger, but no estimate is made on the figures. The wholesale prices at the close of the year were:

Wholesale prices for coal at Saint Paul and Minneapolis at the close of 1893.

Kinds of coal.	Per ton.
Anthracite:	
Grate	$7. 10 to $7. 35
Egg, stove, and nut	7. 35 7. 60
Bituminous:	
Brier Hill	5. 25
Cumberland	5. 25
Blossburg	5. 25
Mansfield, Pittsburg, and Youghiogheny	4. 00 4. 25
West Virginia, steam, Hocking and Wheeling Creek	4. 00 4. 10

Receipts of coal at Duluth, Minnesota, in 1892, by companies.

Companies.	Tons.
Northwestern Fuel Company	640, 000
Ohio Coal Company	375, 000
Lehigh Coal and Iron Company	370, 000
Pioneer Coal Company	250, 000
Philadelphia and Reading Coal and Iron Company	150, 000
Youghiogheny and Reading Coal Company	90, 000
Saint Paul and Western Coal Company	90, 000
Total	1, 965, 000

Coal receipts at Duluth, Minnesota, and Superior, Wisconsin.

Years.	Tons.	Years.	Tons.
1878	31,000	1887	912,000
1881	163,000	1888	1,535,000
1882	260,000	1889	1,205,000
1883	420,000	1890	1,780,995
1885	595,000	1891	1,776,000
1886	736,000	1892	1,965,000

Cincinnati, Ohio.—Receipts of coal at Cincinnati during the past thirteen years have been as follows:

Coal receipts at Cincinnati, Ohio.

Years.	Tons.	Years.	Tons.
1881	1,492,817	1888	2,551,415
1882	2,197,407	1889	2,318,055
1883	2,025,859	1890	2,452,253
1884	2,092 551	1891	2,608,923
1885	2,008,850	1892	2,718,809
1886	2,130,354	1893	2,905,071
1887	2,350,026		

The Survey is indebted to Mr. Charles B. Murray, superintendent of the Chamber of Commerce, for the statement of coal receipts at Cincinnati since 1891. Statistics for previous years were furnished by the former superintendent, Col. S. D. Maxwell. Prior to 1892 the statistics in the following table were collected for fiscal years ending August 31. The figures for 1892 and 1893 are for calendar years. The receipts in 1891 from September 1 to December 31 are stated separately.

Receipts of coal at Cincinnati since September 1, 1871.

Years.	Pittsburg (Youghiogheny.)	Kanawha.	Ohio River.	Canal.	Anthracite.	Other kinds.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
1871–'72	19,254,716		*b*10,359,906	1,104,003	72,171		30,790,796
1872–'73	24,962.373		*b*11,075,072	1,162,052	75,000		37,274,497
1873–'74	24,014,681		*b*10,398,153	710,000	112,000		35,234,834
1874–'75	24,225,602	4,476,619	4,277,327	565,352	248,750	1,597,260	35,390,310
1875–'76	27,017,592	6,004,675	4,400,792	409,358	282,578	2,068,322	40,183,317
1876–'77	28,237,572	3,631,823	5,141,150	322,171	376,125	1,913,793	39,622,634
1877–'78	26,743,055	6,386,623	3,288,008	380,768	439,350	1,654,425	38,892.229
1878–'79	20,769,027	6,134,039	4,068,452	333,549	768,750	2,136,850	34,210,667
1879–'80	31,750,968	8,912,801	4,268,214	202,489	712,075	2,351,699	48,198,246
1880–'81	23,202,084	10,715,459	3,151,934	67,684	770,525	2.336,752	40,244,438
1881–'82	37,807,961	13,950,802	3,560,881	77,336	779,925	3,090,715	59,267,620
1882–'83	33,895,064	13,260,347	3,309,534	180,621	977.250	2,997,216	54,620,032
1883–'84	32.239,473	15,926,743	2,956,688	293,010	1,085,350	3,910,795	56,412,059
1884–'85	32,286,133	14.588,573	3,007,078	314,774	1,257,900	2,683,864	54,138,322
1885–'86	34,933,542	17,329,349	939,746	205,717	1,287,925	2,720,250	57,416,529
1886–'87	37,701,094	20,167,875	338,435	129,503	1,314,775	3,693,850	63,345,532
1887–'88	41,180,713	20,926,596	1,533,358	26,098	1,328,225	5,710,649	70,705,639
1888–'89	36,677,974	23,761,853	544,940	12,129	1,020,525	3,075,000	65,092,421
1889–'90	42,601,615	19,221,196	454,385		1,001,175	4,709,775	67,988,146
1890–'91	43,254,460	19,115,172	1,479,670	15,111	1,118,671	7,362,698	72,345,782
1891–4 mos.	13,766,390	6,288,442	234,940		402,528	4,437,139	25,129,439
1892 *a*	42,272,348	19,214,704	768,588		1,268,170	13,335,006	76,858,816
1893 *a*	28,643,562	24,971,261	405,202		759,626	25,832,374	80,612,025

a Calendar years. *b* Including Kanawha coal.

Saint Louis, Missouri.—The following summary of the coal trade of Saint Louis for the year 1893 has been furnished by Mr. James Cox, secretary of the local bureau of information:

"The most significant feature of the coal trade of St. Louis for the year 1893 was an increase of more than 7 per cent. in the consumption of coal, which is remarkable in view of the general manufacturing depression reported throughout the country. The report of the State labor commissioner, published in December, stated that a larger number of men were employed in Saint Louis factories than at any previous ous date, and the fact that nearly 88,000,000 bushels of coal were received bears out his statement. The Baltimore and Ohio, the Toledo, Saint Louis and Kansas City, and the Saint Louis and Eastern railroads all hauled into the city very much more coal than in any previous year, and the only falling off was in the receipts from the Ohio river, which fell from 2,000,000 to 500,000 bushels. The railroad returns show that there was great activity in the Illinois coal fields, whence nearly all the soft coal used in the Saint Louis factories is obtained. The price of soft coal at the close of the year was remarkably low, being but $1 per ton delivered at East Saint Louis, or between $1.25 and $1.30 per ton on the switches of the manufactories in Saint Louis proper. The highest price for the year was about $2. The higher grades of Illinois coal for family use sold at the close of the year at $1.57, East Saint Louis delivery, or about $1.80 to $1.85 delivered on the west side of the river. The actual receipts of soft coal really show a much larger increase than 7 per cent., because there was a decrease in the hard coal receipts, motives of economy doubtless leading to more soft coal being used for family use than in more strictly boom years.

"The hard coal receipts for 1892 showed an increase over the repceding year of nearly 50,000 tons, but the receipts for 1893 show a falling off from the record breaking of 1892 of about 14,000 tons. Anthracite prices have ruled lower than in 1892, when they closed at $7.75 and $7.50. The highest for 1893 was $7.50 for small sizes and $7.35 for large egg. The December figures ranged only from $6.70 to $6.85. Coke also sold cheaper than in 1892. The closing for the latter year, $5.65 per ton, is the highest for 1893, for Connellsville coke, the closing quotations for which were $4.80 to $4.85. New River coke sold from 15 to 35 cents cheaper. The total receipts of coke were 7,807,000 bushels, about a million less than 1892 and a million more than 1891.

"The agitation against smoke has made great progress during the year, the Citizen's Smoke Abatement Association having secured the conviction of several offenders. Householders in one expensive neighborhood have been working under an agreement not to burn coal of any kind in their houses, and it is believed that this policy will extend and result in a great increase in the local consumption of coke. Anthracite coal is very popular, but the high price seems to deter its general use for household purposes, although the public is certainly being educated rapidly in this direction."

The following are the receipts of coal and coke during the last four years:

Coal and coke receipts at Saint Louis since 1890.

	1890.	1891.	1892.	1893.
Soft coal..........bushels..	69, 477, 225	72, 078, 225	82, 302, 228	87, 769, 375
Hard coal..........tons..	124, 335	139, 050	187, 327	173, 653
Coke..........bushels..	9, 919, 850	6, 924, 250	8, 914, 400	7, 807, 000

The following are the prices per ton of the most used grades of coal in Saint Louis in 1893.

Prices of coal at Saint Louis during 1893.

	Highest.	Closing.
Standard Illinois..........	$1.95	$1.25
High grade Illinois..........	2.05	1.85
Anthracite:		
Large egg..........	7.35	6.60
Small..........	7.50	6.85
Connellsville coke..........	5.65	4.90
New river coke..........	5.25	4.75
Indiana coke..........	4.00	3.75
Kentucky coke..........	3.90	3.75
Gas coke..........	5.10	4.50

Mobile, Alabama.—Mr. A. C. Danner, president of the Mobile Coal Company, has kindly prepared a statement of the coal receipts at this port for the year 1893: Considerable difficulty has been experienced in doing so, as no one keeps a record of them, and there is a disposition upon the part of some not to impart the information. The officials at the custom-house no longer keep a record of the anthracite coal received here, so the information had to be obtained through the dealers. The figures given below are not guaranteed to be accurate, but they are very nearly so.

Coal received at Mobile for the year 1893.

	Tons.
Bituminous coal from Alabama mines received here by railroads, consigned to dealers and shippers..........	90,000
Amount used by the various railroads in their shops and on locomotives coaling here..........	38,000
Total..........	128,000
Anthracite coal received from Pennsylvania..........	4,130

No foreign coal was received here during the year.

This shows an increase in the receipts of coal. This is brought about by the increased amount of bunker coal called for by steamers, and by the coal exported from here. The deepening of the channel to the city of Mobile brought about by the Government work has caused more steamers to come here than heretofore. These steamers find the Alabama coal to be excellent as a bunker coal, and take more and more of it.

Receipts of coal at Mobile, Alabama, for ten years.

Years.	Alabama coal. (*a*)	Anthracite and English.	Total.
	Tons.	*Tons.*	*Tons.*
1883	25,304	1,229	26,533
1884	17,808	891	18,699
1885	40,301	775	41,076
1886	30,310	2,022	32,332
1887	39,232	910	40,142
1888	38,785	648	39,433
1889	43,620	1,454	45,074
1890	39,320	1,327	40,647
1891	51,267	1,775	53,042
1892	70,298	1,500	71,798
1893	90,000	4,130	94,130

a This does not include the amount of coal used by the railroads on their locomotives and at their shops.

Parties engaged in selling coal for export succeed in disposing of more of it, and there is quite an increase in that business over the previous year. This increase promises to be steady and continuous. Export and bunker coal was reduced in price some during 1893, and during the latter part of that year such coal was sold f. o. b. vessels at coaling dock here at from \$2.25 to \$2.40 per ton of 2,000 pounds, owing to quality. Through the efforts of the Louisville and Nashville Railroad Company, the only railroad running into Pensacola, considerable shipments of Alabama coal and coke have been made from Pensacola.

About 2,000 tons a month goes through this port to Galveston, Texas. Other than this very little coal is shipped, prices on export coal being too high. It is hoped that with the appropriations made for the purpose, the improvement of the upper Warrior by locks and dams will be rushed to completion. This will give water transportation and consequently cheaper freight rates from the Warrior coal fields and enable dealers to sell coal at a lower rate than at present.

Norfolk, Virginia.—The following statement of coal handled at Lambert's Point coal piers has been furnished this office by the Chamber of Commerce of Norfolk:

Coal shipments from Lambert's Point piers in four years.

Years.	Foreign.	Bunkers.	Coastwise.	Local.	Total.
1890	37,723	102,755	941,019	71,010	1,152,507
1891	27,997	135,112	1,215,028	90,606	1,468,743
1892	25,653	129,627	1,400,984	98,034	1,654,298
1893	34,969	125,688	1,512,931	100,453	1,774,041

Foreign shipments are to Mexico and Central American ports. During the Great Britain coal strikes in 1893 one cargo of 3,543 tons was shipped to Las Palmas, Africa. Bunker coal taken by steamers en route are cleared at the Norfolk custom-house for ports of destination, hence exports appear for distant countries when coal is consumed on the passage. Of the total coastwise shipments in 1893, 1,063,283 tons were to New England ports. The total freight paid American vessels during the year was $938,805. No coastwise shipments are allowed in foreign vessels.

San Francisco, California.—Mr. J. W. Harrison reports the trade for the year as follows:

The quotations for coal this year have been very steady; the highest and lowest values have not varied over 50 cents per ton. Importers have profited by last year's experience, and at no time has the market been overloaded by the arrival of unsold cargoes. Business for the moment has come to a standstill, and will show no vitality until we shall ascertain whether bituminous coal shall remain dutiable or not.

The following table of prices will show the monthly fluctuations of foreign coal for "spot" cargoes. The average price is given for each month:

Monthly prices of coal at San Francisco in 1893.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Australian (gas)	$6.37	$6.50	$6.50	$6.75	$6.75	$6.75	$6.75	$6.75	$6.75	$6.50	$6.50	$6.50
English steam	6.50	6.50	6.50	6.75	6.75	6.75	6.80	7.00	7.00	6.75	6.50	6.50
Scotch splint	7.00	7.20	7.20	7.25	7.25	7.25	7.25	7.25	7.25	7.00	7.00	7.00
West Hartley	7.50	7.75	7.62	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50

The various sources from which the supplies have been derived are as follows:

Sources of coal consumed in California.

Sources.	1890.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*	*Tons.*
British Columbia	441,759	652,657	554,600	588,527
Australia	194,725	321,197	314,280	202,017
English and Welsh	35,662	168,586	210,660	151,269
Scotch	1,610	31,840	24,900	18,809
Eastern (Cumberland and anthracite)	32,550	42,210	35,720	18,960
Franklin, Green River, and Cedar River	216,760	178,230	164,930	167,550
Carbon Hill and South Prairie	191,109	196,750	218,390	261,435
Mount Diablo and Coos Bay	74,210	90,684	66,150	63,460
Japan, etc	13,170	20,679	4,220	7,758
Total	1,204,555	1,702,833	1,593,850	1,479,785

To arrive at a correct statement of the entire consumption of the State, all the arrivals (by water) at San Pedro, Port Los Angeles, and San Diego, amounting to 169,919 tons, have been included.

THE CONSUMPTION OF SMOKE. (*a*)

The abatement of what is known as the "smoke nuisance" in large cities where bituminous coal is the principal fuel is no longer a difficult question to solve. In fact it has been thoroughly established that, except in a few cases mentioned later on, the emission of heavy gray or dense black smoke from furnace stacks is not only as unnecessary as it is objectionable, but that its abatement is of direct advantage to the owners of the furnaces. It is not proposed in this report to enter into any prolonged discussion of the subject, but rather to show by what has actually been accomplished its practicability and economy. Some attempt will be made to explain how the consumption of smoke is effected. Mention will also be made of such devices for preventing smoke as have come under the writer's notice in the course of a recent investigation, and how much has actually been done towards abating the nuisance in different cities, together with such ordinances as have been passed and put in force. These will be taken up in order.

Practicability.—In order to obtain more satisfactory and practical knowledge of the subject than could be gathered from the items appearing from time to time in the trade journals or from papers prepared for technical societies, the writer has recently visited a number of the larger Western cities where more or less effort has been made to purify the atmosphere from this pollution. The cities visited were, in order, Cincinnati, Ohio; Louisville, Kentucky; Saint Louis, Missouri; Chicago, Illinois; Cleveland, Ohio; and Pittsburg, Pennsylvania. In testimony as to the practicability of preventing smoke, Saint Louis makes the best witness and brings conclusive evidence by the present almost unsullied condition of the atmosphere, whereas two years ago the city was continually covered by a heavy pall of smoke. Cincinnati comes second with a very creditable showing; but owing either to lack of proper ordinances, or the non-observance of those in force, little had been accomplished in the other cities at the time of the writer's visit. Interest is being aroused, however, and it may confidently be expected that within a few years at most a marked improvement will be shown. What is most needed in order to accomplish satisfactory results is the united efforts of the citizens themselves. This once obtained, the remainder will be found a comparatively easy task. Saint Louis may be taken, for example. An association was formed having for its members about 1,800 of the prominent public-

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a The writer desires first of all to make proper acknowledgment and give due credit to Mr. Robert M. Van Horne, smoke inspector of Cincinnati, and to Prof. William B. Potter and Mr. William H. Bryan, of the Saint Louis Smoke Commission, for most of the practical knowledge contained in this article, and also for many courtesies extended to him on the occasion of his visit to those cities, when collecting material and information on the subject. The reports of Mr. Van Horne and of the Saint Louis Smoke Commission, as well as that of a special committee appointed by the Citizens' Association of Saint Louis to investigate the question, have been liberally drawn upon in the preparation of this report. The conscientious work which these gentlemen have performed and the success they have attained in abating the smoke nuisance in those cities, in the face of numberless difficulties, is deserving of the warmest praise.

spirited citizens, who paid $5 initiation fees and $1 annual dues. Through their efforts ordinances were passed and proper means adopted for their enforcement. The result speaks for itself. The work of this association, its special committee on prevention of smoke, and of the Saint Louis smoke commission will be more fully discused farther on in this article. In Cincinnati, the labor has devolved principally upon one man, Mr. Robert M. Van Horne, supervising engineer. Mr. Van Horne had to carry on his work hampered by defective State laws regulating city ordinances, and under many other difficulties, but he has done his work conscientiously and well as will be seen hereafter. With the knowledge of what has been so successfully accomplished in two cities, and with their experience to profit by, there is no reason why other cities should long postpone favorable action. With proper devices for consuming smoke bituminous coal should be able to replace anthracite in some of the Eastern cities, where, as in New York, its use under boilers is at present prohibited.

Economy.—The prevention of smoke implies thorough combustion of the fuel, as the smoke really consists of minute particles of unconsumed distillation products of the coal. The percentage of coal in the smoke, however, is so small that its combustion adds comparatively little to the heat value. In fact, it may not be considered at all in the line of economy. The practical saving is effected in two ways. First, by the ability to use with the proper device the smaller sizes and consequently cheaper grades of coal, such as nut and slack, instead of lump, and with equal efficiency. In fact, with automatic stokers the use of small sizes of coal is compulsory, and it is safe to estimate that from 30 to 40 per cent. is saved to the consumer in his fuel bill from this cause alone. Second, by careful firing. In order to prevent the smoke, whether the firing is done by hand or by automatic stokers, care must be taken that coal is fed to the fire only as often, or as rapidly, and in such quantity as required. Let too much fresh coal be added to the fire and smoke will issue from the stack no matter what device be employed. The economy effected by the exercise of proper care in firing the furnaces is considerable. It would seem advisable in preparing ordinances against smoke emission to include a provision compelling all engineers and firemen to have licenses, and to revoke the license of any engineer or fireman whose stack emits heavy gray or dense black smoke, excepting, of course, at such times when it is impossible to prevent it; namely, when stirring the fire bed, removing clinker, or building a new fire.

How smoke consumption is effected.—As before stated, the prevention of smoke from bituminous coal is accomplished by the thorough combustion of the fuel. When fresh coal is fed to the fire hydrocarbons immediately begin to volatilize, part of the hydrocarbons are decomposed and part of the carbon set free, and this, if unconsumed before leaving the firebed or if not checked in the stack, passes into the air as smoke. It can readily be seen that, in order to consume this carbon, what is done must be done quickly. First, a high temperature is necessary, consequently the amount of fresh coal fed at one time must be small or the fire will become too cool to accomplish it. Second, sufficient air must be supplied to effect combustion. Third, some device must be employed other than the ordinary style of furnace. This brings us to the discussion of devices and appliances designed for the purpose of preventing smoke.

Steam jets.—Steam jets are considered first, not because of their superiority, but because they are now popularly known, and are usually of simple construction and easily understood if not always easily managed. There are so many different inventions of this kind, some patented and some not, that it is inadvisable to give more than a general idea of their action. They are arranged to inject the steam from over the door, from the sides or from the bridge wall. These are the objects to be accomplished by the steam jet: (1) to force or syphon additional air over the fire bed; (2) to agitate the gases so as to allow the air to mingle with them quickly, and (3) to decompose the steam into hydrogen and oxygen, the latter with the freed carbon forming carbon monoxide, which burns to carbon dioxide when air is admitted over the grate. The hydrogen also burns to water, and is carried in the form of steam out of the stack. In all devices of this kind it is advisable in order to accomplish the result that additional air be admitted over the grate, whether by a duct connected with the steam jet, at the sides or bridge wall, or by the door. Frequently an air vent is made in the door, and this, from what the writer has observed, is to be preferred. There is no doubt but that some of these devices perform the work to entire satisfaction. But unfortunately a large number of cheaply constructed patterns have been put in use, the comparatively low cost of installation recommending them to furnace owners, and have proven so unsatisfactory that they have had to be replaced. The worst effect of these has been to prejudice a large number of furnace users against all manner of smoke preventers. It frequently occurs that a steam jet device will do very effective work in a furnace of a certain make and yet prove utterly worthless in the same kind of furnace when slightly different conditions in draft and stack obtain. There are other causes for failures also. The jet may not be set at the proper angle, and the steam strikes the bed where it has no more effect than to partly cool the fire, or not strike it at all. Then the intelligence and carefulness of the fireman enter as important factors. The best device will prove unsatisfactory with a careless fireman, and with the cheaper ones the case is aggravated. Not only should the fresh fuel be fed in small quantities, but for at least five minutes after firing the extra supply of air over the grate should be admitted. Mr. Van Horne, supervising engineer, or "smoke inspector" of Cincinnati, recommends that the supply of air and steam should be controlled by an automatic device. These are in use at a number of places. Before putting in a steam jet device a furnace user should be thoroughly convinced of its efficiency. Having once installed a device and found that he is as badly off as ever, a man is naturally averse to making any more experiments, and is apt to be opposed to the entire scheme of smoke prevention.

The preceding remarks must not be taken as condemnatory of the general plan of steam jets, but it is only fair to all concerned to warn furnace owners against cheap makeshifts. In many cases the steam jets are to be commended, particularly when the demands upon the boilers are light, pretty steadily maintained and the boilers do not have to be forced.

Automatic stokers.—Automatic stoking devices probably come second in the number in use. Like the steam jets there are a great many patterns, but the general principle is about the same in all, though the styles differ materially. The coal is fed regularly in small quantities and the usual scheme is to have the gases from the fresh fuel pass over or through the bed of incandescent coal. They are thus consumed while the fresh coal is practically being coked and thus rendered smokeless. The grates are usually inclined either from front to back or from sides to center, or they are movable and are arranged to carry the coal backward by their own motion. The coal is fed from hoppers either by screw or ram attachment, or by the movement of the grate. Small sizes of coal are necessary for this style of device. Nearly all of them have some special points of merit to recommend them. The chief objection to be argued against their use is that forcing the boilers is impracticable. In this way their capacity is limited, but this may be overcome by having sufficient boiler capacity in the first place. Brief descriptions of some of these devices will be given further on.

Under feed.—But one device of this nature has come under the writer's notice. Briefly, the coal is fed by a ram, worked by hand, under the grate. From a hopper in front of the boiler the coal falls in in front of the ram and a stroke forces it into the fire box. The fresh coal coming up from below is coked, the gases passing through the incandescent bed above. The draft is altogether forced and the safety point of the boiler is the only measure of its capacity. It is claimed for this device that it can be used under any style of boiler. It is especially adapted to industrial plants, where forcing the boilers is at times necessary or expedient, but the noise and vibration occasioned by the fan of the force draft render it objectionable for use in hotels or office buildings.

Down-draft furnaces.—Among the more important of the other inventions are what are known as "down-draft furnaces." In these the back of the fireplace is closed. The draft is admitted from above the grate at the feed door and the flame is carried down through the fire bed. In this device the effect of consuming the gases is obtained in the same manner as with the underfeed mentioned above, but in the opposite direction. On account of the intense heat to which the grate is subjected, it is necessary to have it made of water tubes. These are so arranged that the water from the mains to the boiler passes through them and hot water instead of cold enters the boiler. The principal objection to be urged against this form of device is that the grate bars, in order to allow sufficient vent for draft, have to be set further apart than with the ordinary grate, and the heavy draft is apt to force considerable quantities of small unconsumed coal through the spaces. This waste may be prevented by using coal which cakes in burning. Coals which disintegrate instead of fusing are objectionable for this reason. In one respect this device varies from all others; it is fed by hand, but there is very little danger of throwing on too much fuel to allow of the consumption of the smoke. Care must be taken, however, in stirring the fire. The fire bed should never be tossed or broken up so that larger holes are made in it, for in that case the gases escape through them, carrying the unconsumed smoke which is then emitted from the stack. The special committee appointed by the citizens' association in Saint Louis to investigate the smoke problem and devices for its suppression, reports very favorably upon this method of combustion, which it says, "is effected in a far more rational way than on the ordinary fire bed. The fresh coal is as usual charged on the top of the bed, but the air enters from the top, and therefore, cooler part, quickly gaining heat from contact with the heated coal, and passes with the smoke and distilling volatile matter through the bed of incandescent coke below.

"The separated carbon and all gaseous products thus become intensely heated. The moisture of the coal and the combined water of the volatile matter are decomposed into hydrogen and carbon monoxide gases, which, with the aid of additional air supplied below the grate, burn with useful effect, while the separated carbon disappears into invisible carbon dioxide gas."

Other devices.—Many other devices have been invented. Among them may be mentioned (1) fire brick arches and checkerwork; (2) hollow walls in the furnace for heating the air before it reaches the fire bed. (3) Coking chambers in the forward part of the grate where the fresh coal is charged. The gases then pass over the incandescent bed in the rear, and when the coal in the front is itself in an incandescent condition it is pushed back to the rear and new fuel added. (4) Double chambers, into which fresh fuel is fed alternately, and by arrangement of drafts the gases from the fresh firing are passed under and through the glowing bed of the other chamber. (5) Syphon attachment to stack. This arrangement necessitates an artificial draft. The plan consists of a large sheet-iron pipe inserted in the stack and branching outward and upward at an angle of about 45°. At a short distance from the stack it curves downward and enters the draft pipe at about the same angle and in the direction of the draft. (6) A plan in use in England, but not to the writer's knowledge, adopted in this country, consists of passing the gases through a tank of water. The unconsumed carbon is precipitated in the water and is used for other purposes.

Stability, space, and particularly the intelligence and skill of the fireman, enter as potent factors into the use of these devices. Whether their merits overcome the objections is a question to be solved by practical demonstration in individual instances. Those interested in the subject are referred to the report of the special committee of the Saint Louis citizens' association. From this report regarding the requirements necessary for a successful smoke-preventing device, the writer quotes as follows:

"To prove successful under the conditions, which as outlined above commonly exist in the boiler practice of this city, a smoke-preventing device must satisfy three sets of requirements:

"1. *Efficiency.*—This includes (*a*) the development of such a high temperature and oxidizing action as to insure the combustion of the free or separated carbon which forms the visible smoke; (*b*) regularity of action under varying conditions, such as are induced by charging fresh coal, cleaning fires, inattention of firemen, etc.; (*c*) not susceptible to derangement under conditions likely to obtain, as carelessness of fireman, inferior water, bad clinker, etc.; (*d*) small, if any, increase in the cost of operating.

"2. *Capacity.*—This must be such that efficient action will be secured not only when the boiler is working up to its full rated capacity, but even when forced in order to meet extraordinary demands.

"3. *General applicability.*—Under this head may be included (*a*) ready adjustment to all forms of boilers and boiler settings; (*b*) application where space is already limited; (*c*) comparative low cost; (*d*) repairs, small in amount, easily made, and of low cost; (*e*) operation without injury to boiler or other accessions."

LIST OF SMOKE-CONSUMING DEVICES.

The following partial list of smoke-consuming devices is furnished for the benefit of those who may desire to inquire into their merits. No recommendations or criticisms are made. All of these devices are at present in use, some in Saint Louis, some in Cincinnati, some in Chicago, and some in two or all of these cities. The Saint Louis smoke commission has published official reports of tests made on a few of these devices. The fact of a test of the device having been made is stated in connection with the brief description given.

STEAM JETS.

Mullen's automatic smoke preventer.—This is a steam-jet device by which at the opening of the doors for firing the steam is turned on automatically, and at the same time a small flap door in the front door for admiting air over the fire bed is opened. After firing the front doors are closed, and the steam and air are kept on for about five minutes, when they are shut off automatically by a gravity device, controlled by a cylinder and piston valve. The steam jets are set over the front door. Patented.

Chicago smoke preventer.—In this device one jet is set over each door and the steam discharged so as to strike the fire where the grate meets the bridge wall. The lower part of the front door consists of a flap, which opens inward and is kept open by a ratchet. The steam is kept on all the time and the flap is opened and shut by hand. Patented.

The G. A. Gray Company's device.—This device is somewhat similar to the one last mentioned, but is provided with an automatic shut off for the steam jet, by which the steam is stopped at from three to six minutes after firing. It is not patented.

Ohio Improvement Company's device.—In this device the steam is injected from the sides of the furnace wall by numerous perforations in a cast-iron brick. This device has been patented, but the patent is reported to have expired.

Western smoke preventer.—In connection with the steam jet in this device is a pipe for supplying extra air, which is siphoned into the furnace by the force of the steam jet. The jets are set downward and backward and enter over the front door.

Another siphon device used locally in Cincinnati to some extent under tubular boilers with forward breeching has the air heated as it passes into the furnace. It is not patented.

The William Corry device.—This device is also used locally in Cincinnati and is not patented. The jets are applied in the customary manner over the front door, while fresh air is supplied through the bridge wall, which is built hollow.

All of the foregoing devices are more fully described in the report of Mr. R. M. Van Horne, smoke inspector of Cincinnati, together with a list of places in that city where they may be seen in operation.

The National smoke preventer.—This device is very similar to the Chicago smoke preventer, having a flap door that opens inward and is controlled by hand. The flap is opened and the steam turned on just before firing, and upper draft and steam both shut off after the new coal is incandescent.

In addition to the above there are a number of steam-jet devices, all of similar construction, which are used locally in different cities. In many cases, where the engineer is of an inventive turn, he applies a contrivance of his own construction, and these, in many instances, prove quite efficient, more so, indeed, than some of the patented ones, for the engineer is then able to study his own furnace and apply his device to the best advantage. But this only goes to prove how much of the personal equation of the engineer enters into the success of nearly all, if not all, the smoke-consuming devices.

AUTOMATIC STOKERS.

Standard smokeless furnace.—The Saint Louis smoke commission has tested this furnace, and in its report to the board of public improvement says:

"This device belongs to the mechanical feeder or stoker class, whose principal feature is the delivery of the fuel to the grate bars and the manipulation of the fuel bed by mechanical action in place of hand labor. The main object in view is to secure the regular and gradual feeding of fuel to the front of the fire, so that the fresh fuel will at no time give out excessive quantities of smoke gases, or such as can escape more complete combustion in passing over the bed of incandescent fuel beyond. * * * With the best of hand firing it is impossible to prevent the charging of excessive quantities of fresh coal or to avoid a frequent admission of great volumes of cold air when firing. By substituting mechanical action for hand labor these difficulties are easily overcome, as the fuel is fed continuously, at a comparatively slow rate, and without having to open the furnace doors. The fuel is therefore prepared in each stage for the succeeding one, and no cold air need enter the fireplace at any time."

The foregoing may be taken as a general principle governing all self-stoking devices. They vary greatly in plan and construction, but the general object is about the same. With the Standard the coal is fed into hoppers in front of and a little above the furnace, whence it passes into shoots leading to each side of the fire. From there it is forced by rams driven by a slowly revolving shaft into what are termed coking boxes, so arranged as to drop the coked coal on to the fire bars in continuous and regular quantities. The grate bars are movable, and are brought forward alternately by means of cams, and then go back altogether, carrying the coal gradually to the back. The grate bars are made with the upper side in steps three-eighths inch each to facilitate working the coal backwards. On the highest step at the front of the grate there are no spaces between the bars, so that none of the unconsumed coal is lost, but the other three steps or divisions have one-fourth-inch spaces between the bars. The connections are so arranged that the speed of feeding coal to the fire bed may be increased or lessened independently of the movement of the grate bars. More detailed description of this device with comparative tests in economy, etc., will be found in the report of the smoke commission referred to.

Murphy automatic stoker.—In this device the magazines of fuel are on the sides instead of at the front of the furnace. The grate bars are inclined from the sides to the center, the fresh coal falling slowly to the hot fire at the bottom.

Roney stoker.—In this device the grate is inclined from front to back. The coal is fed into a hopper at the front and above the grate bar, and is pushed forward by a moving feed plate beneath. The grate bars are rocked gently with each movement of the feed plate and the coal is thus kept moving slowly down the grate, and the ashes and clinker drop at the rear. Small doors are set at the sides of the feed plate so that the grate bar may be raked when necessary. In several places where this furnace is used the coal is carried to a large magazine high above the furnace by means of an endless chain arrangement and from there by long sheet-iron pipes into the hoppers, so that absolutely no handling of the coal is required.

Brightman stoker.—This is similar in construction to the Roney stoker, the difference being in some unimportant details. Somewhat similar also is the Tharp and Meredith stoker, an unpatented device used in Cincinnati. Both of these devices have dumping grates in the rear.

Chain grate.—In the boiler house of the new union depot in Saint Louis there are three or four large boilers furnished with a chain-grate furnace. This device is rather difficult to describe briefly. The grate bars, if such they may be called, are in links about 6 inches long, are kept moving slowly from front to back, revolving over drums at the front and back of the furnace. The fresh coal is fed from a hopper extending along the entire front of the furnace, and as it burns is carried slowly back, the ashes and clinker dropping into the ash pit at the rear. The amount of coal and the speed of the grate's movement may be regulated automatically.

The Jones underfeed.—This is a mechanical stoker, but not automatic. It is the only one of the kind that has come under the writer's notice. A short description of it is given on page 227.

OTHER DEVICES.

Keene smoke consumer.—This device has been reported on by the Saint Louis Smoke Commission. It consists of a forced draft, the pipe of which is connected with the flue of the furnace, by which it is supposed to siphon the gases and distillation products out of the stack and passed again through the firebed. That it does take in some of the gases and thus heat the air is possible, but, as the commission in its report says, the combustion is effected by the increased quantity of air, and it is the commission's opinion that the same result would be obtained without the siphon attachment; that the heat derived from the flue gases is neutralized by the inert nitrogen, carbonic acid gas, and water in form of vapor, which are in the gases, and which, to a certain extent, retard combustion.

The Hawley down draft.—This plan of smoke consumer consists in diverting the draft. Instead of the draft entering below the grate and passing upward to the flues, it enters from the feed doors, and the back of the furnace being bricked up, the draft passes down through the grate and under the bridge wall to the boiler flues. It is more fully described on page 227.

The Gallagher furnace.—In this furnace an extra supply of air is given to the flame at the sides of the furnace above the grate and at the bridge wall. The air is heated by passing through ducts in the side walls, the air supplied at the sides being carried from the front to the rear and then back to near the front of the grate. Patented.

Murray brick arch furnace.—This furnace is constructed with a brick arch low and long so that the gases are confined in a chamber whose walls and covering are intensely heated until the gases are consumed. Firing is done by hand, and in this, as in all of its class, great care must be taken in charging. The following devices are also made with the brick arch, and while differing in some minor details are sufficiently alike as to render longer description unnecessary.

Kieffer Brothers' furnace.—Additional air at bridge wall. Patented.

The McGinnis furnace.—Swinging door in feed door to augment draft. Bridge wall of brick built high and having square openings through which flame is passed. Patented.

Charles Rink and Son's furnace.—This furnace, in addition to arch, has hot air at the bridge wall and steam jet over front door. Patented.

The J. K. Rugg device.—The arch is supported by iron water pipes, through which water from boiler circulates. Patented.

The David Sinton furnace.—The arch is in three sections, each lower than the other toward the rear. The grate is high in front and low at the rear. It is not patented.

James M. Glenn furnace.—This is the ordinary furnace with the bridge wall built close up to the boiler, and having two openings through which flame passes, and additional air is supplied by ducts at these openings. The design is not patented.

The foregoing list, as stated, is but a partial one, but is sufficient to give an idea of the many types of smoke consumers. In order to indicate what a variety of devices has been invented it is but necessary to state that the special committee appointed at a meeting of Boston soft-coal users to investigate the subject of smoke consumption, advertised in the newspapers for the submission of smoke-consuming devices, and forty-eight devices were submitted.

Some information as to how the subject is being considered by municipal authorities may be obtained from the following abstracts from city ordinances, etc.:

CITY ORDINANCES REGULATING SMOKE CONSUMPTION.

Saint Louis, Missouri.—As the best results in the suppression of smoke have been accomplished in Saint Louis, the ordinances under which the work has been carried on in that city are given precedence and special prominence in this report. There are two ordinances, Nos. 17049 and 17050. They were both approved February 17, 1893, but the first number (17049) did not go into effect until six months after its approval by the mayor, whereas the latter took effect at once. The reason for this will be readily understood upon reading the ordinances, which are as follows:

"No. 17049. SECTION 1. The emission into the open air of dense black or thick gray smoke within the corporate limits of the city of Saint Louis is hereby declared to be a nuisance. The owners, occupants, managers, or agents of any establishment, locomotives, or premises from which dense black or thick gray smoke is emitted or discharged shall be deemed guilty of a misdemeanor and, upon conviction thereof, shall pay a fine of not less than ten nor more than fifty dollars. And each and every day wherein such smoke shall be emitted shall constitute a separate offense.

"SEC. 2. This ordinance shall take effect at the expiration of six months after its approval by the mayor."

"No. 17050. An ordinance authorizing and providing for the making of regulations limiting and defining permissible smoke emissions, and for the testing of smoke prevention devices, and for the making of such tests and experiments as may be deemed advisable with a view to the abatement or suppression of the smoke nuisance.

"Be it ordained by the municipal assembly of the city of Saint Louis, as follows:

"SECTION 1. The president of the board of public improvements is hereby authorized and directed to appoint, with the approval of the mayor, a commission composed of three competent persons, who shall not be directly or indirectly interested in the manufacture, sale, or construction of any furnace or other article having practical relation to the production or prevention of smoke. Said commission shall ascertain by a thorough canvass of the city, and report to the board of public improvements within four months after their appointment, the conditions and liabilities under which manufacturing and other parties can not wholly or reasonably prevent the occasional production and emission of dense visible smoke. Such ascertained conditions and liabilities, when approved by the board of public improvements and mayor, shall be published, and thereafter shall constitute instructions to guide and limit the officials charged with the enforcement of smoke suppression ordinances. And it shall be a valid and sufficient defense against any complaint that the offense charged comes within such recognized conditions and liabilities.

"Said commission shall conduct and make practical tests of all devices for the prevention or suppression of smoke which shall be submitted to them, in accordance with the conditions hereinafter set forth, and shall prepare detailed reports, stating the facts and conclusions based thereon, as to the efficiency of such device, the conditions of its successful operation, and the limitations to its efficiency. Said report shall be made promptly, when any test is completed, to the board of public improvements, which report may be rejected by said board if found to be unfair or untrue. If accepted by said board, the report shall be published for the information of the public.

"Said commission shall also be called upon by the president of the board of public improvements to make such tests and experiments as may, in his judgment, be needed to determine the applicability of special or smokeless fuels to domestic, locomotive, or other uses with a view to the abatement or suppression of smoke, and shall prepare detailed reports of the results, together with such conclusions and recommendations as in their judgment may be warranted by the facts, said reports to be made promptly and printed for the information of the public.

"Sec. 2. The commissioners authorized by the preceding section shall receive, in compensation for their services in ascertaining, by a thorough canvass of the city, and reporting the conditions and liabilities of smoke suppression, the sum of $1,000 each, payable upon the certificate of the president of the board of public improvements that such report has been made to and accepted by the board of public improvements. For their services in conducting tests of devices, and making reports thereon, they shall each receive the sum of $75 for each device tested and reported, and for conducting the special tests and experiments, as provided in the preceding section, $100 for each series of tests or experiments, together with a full report of the same. Said respective sums to be paid on the certificate of the president of the board of public improvements that the report of such test has been received and accepted by said board.

"Incidental and necessary expenses for the above-described investigations shall be allowed and paid for as other expenses of the office of the president of the board of public improvements.

"Sec. 3. Any party having, or claiming to have, a plan or device whereby smoke can be prevented or suppressed, and desiring to have the same subjected to a practical test and determination, may do so on the following conditions:

"First. He or they shall notify, in writing, the president of the board of public improvements that such a test is desired, and with such notice shall file a full and complete description of the device, with all necessary drawings to show its character, construction, and mode of operation. Accompanying such notice shall be a certificate of the city treasurer that there has been deposited with him to the account of the fund for testing smoke-prevention devices, the sum of four hundred dollars, and said sum of four hundred dollars shall thereupon absolutely become the property of the city of Saint Louis, and no claim shall hereafter be made or allowed to refund the same or any part thereof; and upon the presentation of the treasurer's certificate to that effect, the president of the board of public improvements shall order the commission to make the test.

"Second. The party or parties submitting a device shall erect the same at such place as the commission may approve, at their own cost and expense, under their own supervision, with such provisions for the attachment of instruments as the commission may require, and when fully ready shall deliver the premises and equipment to the commission.

"Third. If, after test is begun, alterations or improvements are desired to be made, the party interested must proceed as if submitting a new plan or device. Unless the several commissioners shall each consent to such alterations, and waive all claim for compensation for a partial test.

"SEC. 4. Whenever the mayor shall be of the opinion that the public interest does not warrant the further testing and reporting on devices, under the authority of the city of Saint Louis, he shall notify the president of the board of public improvements to that effect, in which event the existence of the commission, hereby authorized, shall terminate when tests already in hand shall have been completed and reported as herein provided.

"SEC. 5. When the commission created by the preceding sections of this ordinance shall have made its report, as provided in section one, and shall have found that there are practicable methods of appliances by which the emission of black or thick gray smoke may be prevented, and such report shall have been approved, as hereinbefore provided; and, also, when an ordinance declaring the emission of black or thick gray smoke to be a nuisance, and to provide for the suppression thereof, shall have come into full force and effect, then the president of the board of public improvements is hereby authorized and directed to appoint, with the approval of the mayor, such inspectors, not exceeding three in number, as may be necessary to carry out the provisions of the following section of this ordinance. Said inspectors shall receive a salary of one hundred dollars a month each, payable monthly.

"SEC. 6. The inspectors shall have a right to enter in the performance of their duties, at reasonable hours, upon all premises other than dwelling houses occupied by less than four families or tenants. They shall collect evidence of the facts in the cases of the violation of this ordinance, declaring the emission of black or thick gray smoke to be a nuisance and to provide for the suppression thereof, and, with the approval of the president of the board of public improvements, shall report the same to the city attorney for prosecution. The inspectors shall be guided in the performance of their duties by instructions given by the board of public improvements from time to time."

These ordinances are rigidly enforced, as many as nine convictions out of ten cases tried being obtained on one day while the writer was in the city, and the one who escaped owed his deliverance to a serious scalding accident which befell his engineer and delayed the reforms upon which he was engaged.

Chicago, Illinois.—The ordinances in this city have been on the statute books for a number of years, but owing to their enforcement devolving upon the health department, already crowded, they have only been partially complied with. On March 1, 1894, however, a new office of smoke inspector was established, and Mr. F. U. Adams appointed to the office. His plan of campaign, as signified to the writer, will be to first take a police census of furnace-users in the city. After that is done, due notice will be given to install some efficient device for suppressing the smoke in places where such do not at present exist, and upon failure to comply revoke the licenses of the engineer and fireman, besides bringing suit against the proprietor. The ordinances provide that the emission of dense smoke from the smokestack of any boat or locomotive or from any chimney anywhere within the city is declared to be a public nuisance, but providing that chimneys of buildings used exclusively for private residences shall not be deemed within the provisions of the ordinance. The penalty upon conviction is a fine of not less than $5 or more than $50, and operates against the owner or lessee of the furnace and also against the fireman or engineer.

Cleveland, Ohio.—The ordinance in this city was passed on February 1, 1892, and approved by the mayor on the following day; but up to the time of the writer's visit, in March, 1894, was practically inoperative, on account of opposition exerted by manufacturing interests along the river front. The ordinance provides, in addition to the suppression of smoke, for the prevention of noxious gases and offensive odors from any factory, building, or premises, and imposes a fine of not less than $10 nor more than $100 for each offense. The enforcement of the ordinance devolves upon the health officer of the police department.

Pittsburg, Pennsylvania.—Pittsburg's ordinance applies only to the residence portion of the city and to smoke from bituminous coal used in connection with stationary boilers. The penalty attached is a fine of not less than $10 nor more than $50. The chief of the board of public works is empowered to enforce the ordinance.

Columbus, Ohio.—The ordinance in this city is of loose construction, providing that steam-boiler furnaces shall be "so constructed or altered or have attached thereto such sufficient smoke preventive as to produce the most perfect combustion of fuel or other material from which smoke results, and so as to prevent the production and emission of smoke therefrom, so far as the same is possible." It then states against whom the ordinance operates (owner, lessee, employés, etc.), and imposes a fine of not less than $20 nor more than $50 for the first offense, and for each subsequent offense a fine of not less than $50 nor more than $100. In spite of the rather loose wording of the ordinance, a general compliance with its provisions is reported, and no prosecutions have been made to enforce it.

Minneapolis, Minnesota.—The ordinance regarding smoke in Minneapolis declares that the emission of dense smoke from any smokestack or locomotive within the fire limits, as now established or may be established, to be a public nuisance and prohibited. Owners, lessees, engineers, and the general managers, yard masters, and superintendents in railroad employ are made jointly and severally responsible. A fine of not more than $100 is imposed as a penalty, with imprisonment not exceeding ninety days until fine is paid. The commissioner of health and the superintendent of police are empowered to enforce the ordinance. This ordinance was passed on February 9, 1894, approved February 16, and was to take effect June 1.

Brooklyn and Buffalo, New York.—The ordinances of these two cities are nearly identical, and include the removal of ashes, rubbish, the suppression of noxious gases and offensive odors, and the prevention of smoke. The Buffalo enactment provides for a fine of not less than $10 nor more than $50. No special penalty is attached to the Brooklyn ordinance, the general ones applying to public nuisances being effective. There have been no convictions in either city.

Omaha, Nebraska.—An ordinance, passed May 16 and approved May 19, 1893, declares the emission of dense smoke from smokestacks or chimneys of buildings within the corporate limits of this city to be a public nuisance, but providing that the ordinance shall not be deemed to apply to buildings used exclusively for private residences.

The ordinance was made operative after the expiration of ninety days and imposed a fine of not less than $5 nor more than $50 upon conviction for the first offense, and for each subsequent offense a fine of not less than $50 nor more than $100. The inspector of buildings is authorized and instructed to enforce the ordinance, and, although it has been observed to considerable extent, no vigorous attempt has been made to enforce it because of the uncertainty in the minds of the city officials as to efficacy of smoke-consuming devices.

Denver, Colorado.—An ordinance was passed in this city and approved June 21, 1890, in which the emission of dense smoke is prohibited, but not declared to be a public nuisance. Proprietors who have installed a device, whether it be efficient or not, are excepted under its provisions, as are also buildings where boilers, whether single or in batteries, have a capacity of 75 horse power. The ordinance was made to take effect October 7, 1890. It is still on the statute books, but is practically a dead letter, as in testing it in the courts the city was beaten, a consummation which, considering the language of the act, was rather to be expected.

Boston, Massachusetts.—On May 7, 1892, an ordinance was passed by the city council of Boston prohibiting the use of bituminous coal for generating steam in any building unless the furnace is provided with "some effectual device for consuming its own smoke." The effort to enforce this ordinance was attended with some embarrassment, owing to the general lack of knowledge on the subject and inability to select proper methods and devices. Accordingly, a meeting of soft-coal consumers was held on September 16, 1892, and a committee appointed to investigate the subject. The committee consisted of Messrs. F. A. Gilbert, F. S. Pearson, and Moses Williams. The first two gentlemen, in company with the assistant inspector of buildings, visited a number of Western cities, and the result of their investigations is embodied in a report submitted to the chairman of the meeting of September 16, 1892, and by him transmitted to the mayor and city council. One immediate effect of this investigation, which was carried on in a thorough, systematic, and intelligent manner, was the passage of an act by the legislature of the State, which is as follows:

"SECTION 1. In cities of over 300,000 inhabitants no person shall, after the 1st day of July, in the year 1893, use bituminous coal for the purpose of making steam in boilers in any building, unless the furnace in which said coal is burned is so built, managed, arranged, or equipped that at least 75 per cent. of the smoke from said coal is consumed or otherwise prevented from entering the atmosphere, the degree of suppression being determined by the quantity of such smoke emitted, as shown by the density and color of the issuing smoke and the length of time which it is visible, the maximum standard of comparison being a continuous discharge of dense, dark smoke during the time the furnace is in active operation.

"SEC. 2. The mayor of any city to which this act applies shall, within one month from its passage, designate some proper person from among the city officials, who shall be charged with its enforcement. And such designation shall thereafter be made annually in the month of January, but shall be subject to change at any time.

"SEC. 3. Whoever violates any provision of section 1 of this act shall be punished by a fine of not less than $10 nor more than $100 for each week during which such violation shall continue. [Approved May 15, 1893.]"

Rochester, New York.—An ordinance was passed by the common council of this city in 1886. There were no convictions under it, and as no attempt has been made to enforce it its operation was suspended in 1892. The reason assigned for the suspension was that an attempt to enforce it would work hardships upon manufacturers, and a disposition towards compelling compliance with its provisions had been manifested by some of the city officials.

Newark, New Jersey.—The health board of this city brought action against a manufacturer some time ago for the suppression of smoke under the general ordinance defining anything detrimental to health as a public nuisance. The city was beaten.

Saint Paul, Minnesota.—This city has passed two or three smoke ordinances, but the supreme court of the State has upon various grounds declared them unauthorized and invalid, and there is not at present any valid ordinance upon the statute books.

Other cities.—In addition to the foregoing, inquiries were addressed to the officials of a number of other cities, most of which have no ordinances against smoke. Among these are Philadelphia, Pennsylvania; Baltimore, Maryland; Kansas City, Missouri; Indianapolis, Indiana (uses natural gas); Syracuse, New York; and Milwaukee, Wisconsin. The city last mentioned has an ordinance applying to sparks, the principal fuel being sawdust, chips, and shavings.

DETAILED COAL STATISTICS BY STATES.

In the following pages a detailed statement is given of coal production in the several States by counties, with the distribution for consumption. The tables showing the production in each State and county in previous years have been brought forward to the close of 1893. In stating the amount of coal made into coke, only that portion is included which is coked by the operators themselves. It frequently occurs that coal is shipped to distant points and made into coke by the purchasers. Under such conditions the amount would be included in the shipments, and not in the amount reported as made into coke.

ALABAMA.

Total product in 1893, 5,136,935 short tons; spot value, $5,096,792.

The product of coal in Alabama during 1892 was 5,529,312 short tons, valued at $5,788,898, indicating a decrease in 1893 of 392,377 short tons or 7 per cent. in quantity and $692,106, or 12 per cent. in value. The decrease was due chiefly to the shutting down of furnaces in the vicinity of Birmingham, thus cutting off an important outlet for the mines. The decreases were noticeable in the two largest producing counties, Jefferson and Walker, the former's product decreasing 305,997 short tons, and the latter 176,263 short tons. Bibb county shows a small increase, while Saint Clair about trebled its output, and Shelby's product was not quite doubled. The latter two are comparative small producers. Two counties, De Kalb and Winston, appear as producers for the first time, the product for the two counties aggregating 3,240 tons. The average price per ton decreased from $1.05 to 99 cents per ton, due to the slackened demand. The decrease in price was noted in each county. The total number of employés increased from 10,075 in 1892 to 11,294 in 1893, but the average working time decreased from 271 to 237 days.

The following tables show the coal production of Alabama in 1892 and 1893, by counties, together with the distribution and value:

Coal product of Alabama in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bibb	637, 656	1, 732	22, 806	131, 275	793, 469	$860, 509	$1. 08	290	1, 500
Jefferson	1, 415, 569	15, 450	98, 606	1, 869, 649	3, 399, 274	3, 504, 925	1. 03	289	5, 860
Saint Clair	20, 000	350	600	4, 000	24, 950	27, 445	1. 10	200	75
Shelby	27, 968	....	....	....	27, 968	73, 092	2. 61	225	150
Tuscaloosa	112, 395	4, 195	4, 463	46, 986	168, 039	179, 130	1. 07	261	281
Walker	908, 487	4, 116	9, 152	181, 857	1, 103, 612	1, 125, 797	1. 02	217	2, 209
Small mines	....	12, 000	....	....	12, 000	18, 000	1. 50	....	....
Total	3, 122, 075	37, 843	135, 627	2, 233, 767	5, 529, 312	5, 788, 898	1. 05	271	10, 075

Coal product of Alabama in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bibb	688, 846	1, 783	27, 744	87, 841	806, 214	$802, 487	$1. 00	216	1, 280
Jefferson	1, 818, 313	28, 391	44, 922	1, 201, 651	3, 093, 277	3, 012, 268	. 98	258	7, 033
De Kalb	40	....	....	....	40	40	1. 00	20	2
Saint Clair	60, 300	1, 200	3, 500	7, 000	72, 000	76, 600	1. 06	198	135
Shelby	53, 339	....	2, 000	....	55, 339	101, 028	1. 82½	200	255
Tuscaloosa	106, 449	7, 644	2, 260	51, 163	167, 516	175, 997	1. 05	247	412
Walker	806, 448	8, 581	15, 986	96, 334	927, 349	907, 172	. 98	187	2, 158
Winston	3, 200	....	....	....	3, 200	3, 200	1. 00	165	19
Small mines	....	12, 000	....	....	12, 000	18, 000	1. 50	....	....
Total	3, 536, 935	59, 599	96, 412	1, 443, 989	5, 136, 935	5, 096, 792	. 99	237	11, 294

The following table shows the annual output of coal in the State since 1870, with the exception of 1871 and 1872, for which no statistics were obtained:

Annual coal product of Alabama since 1870.

Years.	Short tons.	Value.	Average price per ton.
1870	13, 200	....	....
1873	44, 800	....	....
1874	50, 400	....	....
1875	67, 200	....	....
1876	112, 000	....	....
1877	196, 000	....	....
1878	224, 000	....	....
1879	280, 000	....	....
1880	380, 800	....	....
1881	420, 000	....	....
1882	896, 000	....	....
1883	1, 568, 000	....	....
1884	2, 240, 000	....	....
1885	2, 492, 000	....	....
1886	1, 800, 000	$2, 574, 000	$1. 43
1887	1, 950, 000	2, 535, 000	1. 30
1888	2, 900, 000	3, 335, 000	1. 15
1889	3, 572, 983	3, 961, 491	1. 10
1890	4, 090, 469	4, 202, 469	1. 03
1891	4, 759, 781	5, 087, 596	1. 07
1892	5, 529, 312	5, 788, 898	1. 07
1893	5, 136, 935	5, 096, 792	. 99

From the above table it is seen that the State has shown an increase in production each year since 1886 until 1893, when it fell off 392,377 short tons.

Distributed by counties the product of Alabama for the past five years is shown in the following table, together with the increases or decreases in each county during 1893 as compared with 1892.

Coal product of Alabama, by counties, since 1889.

Counties.	1889.	1890.	1891.	1892.	1893.	Increase.	Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Bibb	500,525	521,811	619,809	793,469	806,214	12,745	
De Kalb					40	40	
Jefferson	2,437,446	2,665,060	2,905,343	3,399,274	3,093,277		305,997
Saint Clair	40,557	33,653	66,096	24,950	72,000	47,050	
Shelby	84,333	25,022	34,130	27,968	55,339	27,371	
Tuscaloosa	16,141	65,517	142,184	168,039	167,516		523
Walker	488,226	767,346	980,219	1,103,612	927,349		176,263
Winston					3,200	3,200	
Small mines	5,255	12,000	12,000	12,000	12,000		
Total	3,572,983	4,090,409	4,759,781	5,529,312	5,136,935		*a* 392,377

a Net decrease.

Coal fields of Alabama.—The coal fields of Alabama, as at present known, are fully described in an article by Prof. Eugene A. Smith, of the University of Alabama, in Mineral Resources for 1892.

Bibb county.—Coal produced in 1893, 806,214 short tons; total value, $802,487.

Bibb county ranks third in point of coal production. The output in 1893 was 12,745 short tons more than in 1892, but the value decreased $58,022, the average price per ton declining from $1.08½ in 1892, to 99½ cents in 1893, an average net loss of 9 cents per ton.

Coal product of Bibb county, Alabama, since 1886.

Years.	Short tons.	Value.	Average price per ton.
1886	199,206		
1887	230,000		
1888	(*a*)		
1889	500,525	$604,230	$1.20
1890	521,811	574,419	1.10
1891	619,809	724,094	1.17
1892	793,469	860,509	1.08½
1893	806,214	802,487	.99½

a Not published by counties.

It will be seen from the above table that the coal product of Bibb county has increased each year since 1886. The value, however, in comparison has shown a general decreasing tendency, the average price in 1893 being the lowest on record.

Jefferson county.—Coal produced in 1893, 3,093,277 short tons; total value, $3,012,268.

Jefferson county is by far the most important coal-producing county in the State, contributing more than 60 per cent. of the total output. The product in 1893 was 305,997 short tons or about 9 per cent. less than in 1892. The value decreased $492,657 or 14 per cent. The average price per ton declined from $1.03 to 98 cents, a net loss of 5 cents per ton. The total number of employés increased from 5,860 to 7,033, while the average working time decreased from 289 days, in 1892, to 258 days, in 1893. Of the total output in 1893, 1,201,651 short tons, or about 40 per cent. made into coke, used chiefly at the iron furnaces at Birmingham and Bessemer. In 1892 the coal made into coke was 1,869,649 short tons, showing a decrease in the amount of coal coked of 667,998 short tons, or something more than one-third.

Coal product of Jefferson county, Alabama, since 1886.

Years.	Short tons.	Value.	Average price per ton.
1886	1,238,114	....	....
1887	1,384,000	....	....
1888	(*a*)	....	....
1889	2,437,446	$2,618,777	$1.07
1890	2,655,060	2,669,226	1.00
1891	2,905,343	3,024,703	1.04
1892	3,399,274	3,504,925	1.03
1893	3,093,277	3,012,268	.98

a Not reported.

Saint Clair county.—Coal produced in 1893, 72,000 short tons; total value, $76,600.

One of the largest producing mines in Saint Clair county was idle for about eleven months during 1892, bringing the product for that year down to 24,950 tons, against 66,096 tons in 1891. Resumption of active operations during 1893 brought the product up to 72,000 short tons.

The average price per ton has shown a steadily declining tendency since 1889, when $1.25 per ton was received until 1893, when the price had fallen to $1.06. The following table shows the annual product of coal in Saint Clair county for seven years.

Coal product of Saint Clair county, Alabama, for seven years.

Years.	Short tons.	Value.	Average price per ton.
1886	71,950	....	....
1887	53,000	....	....
1889	40,557	$50,518	$1.25
1890	33,653	39,855	1.18
1891	66,096	75,423	1.14
1892	24,950	27,445	1.10
1893	72,000	76,600	1.06

Shelby county.—Coal produced in 1893, 55,339 short tons; total value, $101,028.

The amount of coal produced in Shelby county in 1893 was about double that of the preceding year owing to the opening of a new mine. The value, however, increased only 38 per cent. considerably less in proportion to the increased product. The average price per ton declined from \$2.61 in 1892 to \$1.82½. The annual output of the county for seven years was as follows:

Coal product of Shelby county, Alabama, for seven years.

Years.	Short tons.	Value.	Average price per ton.
1886	52,000		
1887	54,153		
1889	84,833	\$152,166	\$1.79
1890	25,022	62,550	2.50
1891	34,130	88,678	2.60
1892	27,968	73,092	2.61
1893	55,339	101,028	1.82½

Tuscaloosa county.—Coal produced in 1893, 167,516 short tons; total value, \$175,997.

The product of Tuscaloosa county in 1893 was about the same as in 1892, the difference being only 523 tons, or less than one-third of 1 per cent. The value also differed but slightly, being \$175,997 in 1893 against \$179,130 in 1892, a decrease of \$3,133, or about 2 per cent. The average price per ton has not varied much in the past four years, ranging from \$1.03 in 1891 to \$1.07 in 1892. The price in 1893 averaged \$1.05, which was about the general average for the four years. The total annual product and value since 1886, with the exception of 1888, is shown in the following table:

Coal product of Tuscaloosa county, Alabama, for seven years.

Years.	Short tons.	Value.	Average price per ton.
1886	7,363		
1887	9,000		
1889	16,141	\$19,796	\$1.23
1890	65,517	68,795	1.05
1891	142,184	147,036	1.03
1892	168,039	179,130	1.07
1893	167,516	175,997	1.05

Walker county.—Coal produced in 1893, 927,349 short tons; total value, \$907,172.

In importance of coal production Walker county ranks second in the State. The output in 1893 was 176,263 short tons, or 16 per cent. less than in 1892, while the value fell off \$218,625 or nearly 19 per cent., the average price per ton declining from \$1.02 to 98 cents. The number of employés decreased from 2,209 to 2,158, and the average number of days worked, from 217 to 187.

The statistics of production in Walker county since 1886 have been as follows:

Coal product of Walker county, Alabama, for seven years.

Years.	Short tons.	Value.	Average price per ton.
1886	179,350	....	....
1887	222,000	....	....
1889	488,226	$506,726	$1.04
1890	767,346	768,624	1.00
1891	980,219	1,008,642	1.03
1892	1,103,612	1,125,797	1.02
1893	927,349	907,172	.98

Other counties.—De Kalb and Winston counties appear for the first time as coal producers in 1893. The aggregate output was 3,240 short tons, worth $1 per ton at the mines.

ARKANSAS.

Total product in 1893, 574,763 short tons; spot value, $773,347

Compared with 1892 the coal product of Arkansas in 1893 showed an increase of 39,205 short tons, or a little less than 7 per cent. The value of the product increased from $666,230 to $773,347, a gain of $107,117, or about 14 per cent. The average price per ton showed an advance of 10 cents, or from $1.24 in 1892 to $1.34 in 1893. The total number of employés increased from 1,128 in 1892 to 1,559 in 1893, but this large increase, in comparison with the increase in product, was overcome by a decrease in the average number of working days from 199 to 151.

In the tables below the statistics of coal production in Arkansas in 1892 and 1893 are shown, together with the distribution of the product for consumption:

Coal product of Arkansas in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Johnson	89,110	950	1,900	91,960	$122,486	$1.33	203	210
Pope	12,000	500	5,000	17,500	40,500	2.31	288	75
Sebastian	412,798	....	7,300	420,098	491,244	1.17	190	843
Small mines	....	6,000	....	6,000	12,000	2.00	....	....
Total	513,908	7,450	14,200	535,558	666,230	1.24	199	1,128

Coal product of Arkansas in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Franklin	9,629	250	....	9,879	$11,269	$1.14	77	70
Johnson	90,702	4,531	2,500	97,733	191,799	1.96	114	372
Pope	10,000	250	2,000	12,250	45,000	3.67	225	70
Sebastian	439,173	747	8,981	448,901	513,279	1.14	164	1,047
Small mines	....	6,000	....	6,000	12,000	2.00	....	....
Total	549,504	11,778	13,481	574,763	773,347	1.34	151	1,559

The coals of Arkansas are classed as bituminous, semi-bituminous, and semi-anthracite. The latter term is sometimes carelessly applied to all Arkansas coals. The physical appearance of the different varieties is similar, which, together with the fact that they merge into each other by insensible gradations, has rendered confusion in nomenclature excusable. In appearance they are similar to soft bituminous coals with a cuboidal fracture, and do not approach the hard, glistening anthracite with the semi-conchoidal fracture. Still, upon the basis of fuel rates and mode of burning, there are some which deserve to be classed as semi-anthracite. For a full description of the coals and coal fields of Arkansas, the reader is referred to a report by Dr. J. C. Branner, in Mineral Resources for 1892, page 303.

The following table exhibits the annual coal product of Arkansas by counties since 1887:

Coal product of Arkansas since 1887, by counties.

Counties.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Franklin	....	....	....	....	....	....	9,879
Johnson	81,900	106,037	105,998	89,000	80,000	91,960	97,733
Pope	8,200	10,240	6,014	4,000	5,000	17,500	12,250
Sebastian	39,500	160,594	165,884	300,888	451,379	420,098	448,901
Small mines	....	....	(*a*)1,688	6,000	6,000	6,000	6,000
Total	129,600	276,871	279,584	399,888	542,379	535,558	574,763

a Product of Franklin county according to Eleventh Census.

According to the Tenth Census of the United States (1880) the coal output of Arkansas was 14,778 short tons, worth at the mines $33,535. No statistics were obtained in 1881. Since 1882 the statistics of production, as far as have been ascertained, have been as follows:

Annual producton of coal in Arkansas since 1882.

Years.	Short tons.	Value.	Average price per ton.	Average number of days worked.	Total number of employés.
1882	5,000	....	....	....	....
1883	50,000	....	....	....	....
1884	75,000	....	....	....	....
1885	100,000	....	....	....	....
1886	125,000	$200,000	$1.60	....	....
1887	129,600	194,400	1.50	....	....
1888	276,871	415,306	1.50	....	978
1889	279,584	395,836	1.42	....	677
1890	399,888	514,595	1.29	214	938
1891	542,379	647,560	1.19	214	1,317
1892	535,558	666,230	1.24	199	1,128
1893	574,763	773,347	1.34	151	1,559

Franklin county.—Coal produced in 1893, 9,879 short tons; total value, $11,269.

The production of 9,879 short tons of coal in Franklin county, is the first reported since 1889, when 1,688 short tons were mined

During the intervening years the output was inconsiderable and was included in the estimated production of small mines and country banks.

Johnson county.—Coal produced in 1893, 97,733 short tons; total value, $191,799.

The product of coal in Johnson county not only increased in 1893, but the value was augmented to a notable degree, the average price per ton increasing from $1.33 to $1.96. No cause is assigned for this increase in value, though it was doubtless due to the prolonged strike in Kansas, which afforded a more lucrative market for this coal.

Coal product of Johnson county, Arkansas, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Total number of employés.
1887	71,900				
1888	106,037				
1889	105,998	$156,067	$1.48		(*a*) 172
1890	89,000	130,927	1.47	215	215
1891	80,000	112,000	1.40	193	185
1892	91,960	122,486	1.33	203	210
1893	97,733	191,799	1.96	114	372

a Including Pope county.

During the year the Western Coal and Mining Company purchased the Stiewell mine at Coal Hill, formerly operated by Stiewell & Co., of Little Rock.

Pope county.—Coal produced in 1892, 12,250 short tons; total value, $45,000.

Compared with 1892, the output of coal in Pope county decreased by 5,250 short tons, or just 30 per cent., while the value increased $4,500, or about 11 per cent. The coal is a semi-anthracite of excellent quality. It is consumed principally in Little Rock and Fort Smith for domestic purposes.

The following table gives the production of coal in Pope county since 1887:

Coal product of Pope county, Arkansas, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Total number of employés.
1887	8,200				
1888	10,240				
1889	6,014	$11,491	$1.91		(*a*)
1890	4,000	8,000	2.00	200	40
1891	5,000	15,000	3.00	100	40
1892	17,500	40,500	2.31	288	75
1893	12,250	45,000	3.67	225	70

a Included in Johnson county.

Sebastian county.—Coal produced in 1893, 448,901 short tons; total value, $513,279.

About 75 per cent. of the total output of Arkansas is from Sebastian county. The product in 1893 was 28,803 short tons in excess of the previous year, but was still 2,478 tons less than the output in 1891, when the largest yield in the history of the county was obtained. The value of the product in 1893 was, however, larger than in any previous year.

The average price per ton in 1893 was less than in 1892, but a little in advance of that of 1891. There was an increase in the number of employés in 1893 of 204 as compared with 1892, but the average working time decreased from 190 to 164 days.

Coal product of Sebastian county, Arkansas, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Total number of employés.
1887	39, 500	....	....	....	....
1888	160, 594	....	....	....	....
1889	165, 884	$224, 153	$1. 35	....	505
1890	300, 888	363, 668	1. 20	214	683
1891	451, 379	508, 560	1. 13	222	1, 092
1892	420, 098	491, 244	1. 17	190	843
1893	448, 901	513, 279	1. 14	164	1, 047

CALIFORNIA.

Total product in 1893, 72,603 short tons; spot value, $167,555.

Coal production in California has shown an annual decrease since 1889. In that year the output reached 121,820 short tons. In 1893 it was a little less than 60 per cent. of the product of 1889. This decrease may be attributed to the fact that California coals are generally of inferior quality and consumers prefer to use coals brought from a distance, even at a much higher price, owing to their superior heat-producing capacity. California coals are usually high in moisture or ash, sometimes in both. The greater the percentage of moisture the less heating capacity there is in the coal, and large quantities of ash are always objectionable.

Considerable interest has been excited in the State by reports of discoveries of extensive coal deposits of good quality in Mendocino county. Coal has been known to exist in the county for a number of years, but no attempt has been made to develop the property. The coal recently reported is said to be on land adjoining that on which it was previously known to exist. The coal from Mendocino county shows by analysis from 8.14 to 8.6 per cent. water and from 5.05 to 7.66 per cent. ash; volatile combustible matter 45.5 to 48.5 per cent., and fixed carbon from 37.5 to 38.67 per cent. Some of the other coals of the State show a higher percentage of fixed carbon, but also show more water and ash. There is ample home market in California for all the coal she could produce. Statistics compiled by Mr. J. W. Harrison, of San Francisco, show that about 1,500,000 tons of coal are consumed in California yearly. About one-third of this is imported from British Columbia; another third comes from England

and Wales; a small amount of Cumberland and anthracite comes from the East, and the remainder is made up by coal from Japan, Scotland, the States of Oregon and Washington, and the comparatively small local product.

Comparing the statistics of production in 1893 with 1892 it is seen that the product decreased 12,575 short tons, the value fell off $42,156, the average price per ton declined from $2.46 to $2.31, and while the average working time increased from 204 to 208 days the total number of employés decreased from 187 to 158.

The following tables show the statistics of production during 1892 and 1893:

Coal product of California in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Amador	25,118	500	....	25,618	$38,427	$1.50	284	26
Contra Costa	39,424	336	1,680	41,440	114,250	2.76	164	110
Fresno	5,400	4,780	550	10,730	39,855	3.71	297	32
Monterey	336	224	....	560	2,250	4.02	80	7
San Bernardino	2,991	3,839	....	6,830	14,929	2.18	230	12
Total	73,269	9,679	2,230	85,178	209,711	2.46	204	187

Coal product of California in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Amador	21,546	333	750	22,629	$33,944	$1.50	266	30
Contra Costa	35,016	899	1,064	36,979	97,161	2.63	173	82
Fresno	5,240	....	720	5,960	20,860	3.50	265	30
Monterey	....	560	....	560	2,000	3.57	60	5
San Bernardino } San Diego }	2,931	3,544	....	6,475	13,590	2.10	220	11
Total	64,733	5,336	2,534	72,603	167,555	2.31	208	158

The following table shows the total output of California since 1883, with the value for such years as it has been reported, and the statistics of the number of employés and the average working time during the past four years:

Coal product of California since 1883.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Total number of employés.
1883	76,162	....	....	....	....
1884	77,485	....	....	....	....
1885	71,615	....	....	....	....
1886	100,000	$300,000	$3.00	....	....
1887	50,000	150,000	3.00	....	....
1888	95,000	380,000	4.00	....	....
1889	121,820	288,232	2.36	....	....
1890	110,711	283,019	2.56	301	364
1891	93,301	204,902	2.20	222	256
1892	85,178	209,711	2.46	204	187
1893	72,603	167,555	2.31	208	158

Amador county.—Coal produced in 1893, 22,629 short tons; total value, $33,944.

Amador county is the second county in coal-producing importance, though the product in 1892 reached only 22,629 short tons. The product in this county has followed closely the decreasing tendency in the State's total, the decline being very regular each year since 1889. The coal is a lignite, containing a large percentage of moisture, but fairly small ash. The following table shows the statistics of production in the county since 1889:

Coal product of Amador county, California, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	40,900	$75,075	$1.84	....	57
1890	33,610	55,215	1.64	291	47
1891	29,502	48,803	1.65	284	34
1892	25,618	38,427	1.50	284	26
1893	22,629	33,944	1.50	266	30

Contra Costa county.—Coal produced in 1893, 36,979 short tons; total value, $97,161.

Contra Costa county produces about 50 per cent. of the State's total output. In 1893 the product was 36,979 short tons, 4,461 short tons less than in 1892. The value of the product decreased from $114,250 to $97,161. The average price per ton declined from $2.76 to $2.63. There was a slight increase in the number of working days, from 164 to 173, but the total number of employés was reduced from 110 to 82.

The statistics of production for the past five years are shown in the following table:

Coal product of Contra Costa county, California, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	64,945	$161,190	$2.48	....	149
1890	66,974	193,804	2.89	305	247
1891	56,335	136,600	2.42	260	162
1892	41,440	114,250	2.76	164	110
1893	36,979	97,161	2.63	173	82

Fresno county.—Coal produced in 1893, 5,960 short tons; total value, $20,860.

The product of Fresno county was but little more than half that of 1892. The coal is of lignite variety, rather high in moisture and ash. It is shipped over the Southern Pacific railroad to points adjacent to the mines, for domestic use.

Coal product of Fresno county, California, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	8,100	$17,859	$2.20	....	21
1890	5,000	20,000	4.00	312	30
1891	180	360	2.00	90	18
1892	10,730	39,855	3.71	297	32
1893	5,960	20,860	3.50	265	30

Monterey county.—There is but one producing mine in Monterey county, and it is not operated steadily throughout the year. The product in 1892 and 1893 was about the same, but the value in 1893 showed a decrease. Following is a statement of the annual production since 1889:

Coal product of Monterey county, California, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	672	$3,600	$5.36	....	17
1890	125	1,000	8.00	....	30
1891	1,000	5,000	5.00	50	30
1892	560	2,250	4.02	80	7
1893	560	2,000	3.57	60	5

San Diego and San Bernardino counties.—The combined product of these two counties in 1893 was 6,475 short tons, valued at $13,590. In 1892, San Bernardino county produced 6,830 short tons, valued at $14,929. No output was reported for San Diego county prior to 1893.

Coal product of San Bernardino county, California, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	5,203	$13,008	$2.50	....	12
1890	5,000	13,000	2.60	216	10
1891	6,284	14,139	2.25	249	12
1892	6,830	14,929	2.18	230	12
1893	*a* 6,475	13,590	2.10	220	11

a Includes San Diego county.

COLORADO.

Total product in 1893, 4,102,389 short tons; spot value, $5,104,602.

It is gratifying to record that notwithstanding the shock which many of the industrial industries of Colorado sustained by reason of legislation adverse to her great silver interests, in addition to the widespread business depression, her coal-mining industry not only held its own, in amount of coal produced but far surpassed any previous year. The total production in 1893 exceeded that of 1892 by 591,559 short tons, or about

17 per cent, though the value decreased $580,510, the average price declining from $1.62 to $1.24.

Colorado now stands sixth in the coal-producing States, having superseded Iowa in 1892. She is the banner coal producing State west of the Mississippi river, and is exceeded on the eastern side of it by Pennsylvania, Illinois, Ohio, West Virginia, and Alabama, in their order. The most important increase in 1893 was in the largest producing county, Las Animas, the product in 1893 exceeding that of the previous year by 416,269 short tons. Boulder county, the next in importance, increased 117,657 short tons, and Pitkin county, which produced no coal in 1892, is credited with an output of 99,211 short tons in 1893. The principal decrease was in Garfield county, where the product was 64,876 short tons less than in 1892. The increases and decreases in the other counties were of minor importance.

On account of the closing down of many silver smelters in the West, a very important market for Colorado coal was shut off, and operators had to find another outlet for their product. Texas was already a consumer of considerable importance, and the increasing demand in that State has been fairly well maintained; but not satisfied with that, Colorado producers have been shipping their product as far as Shreveport, Louisiana, coming into competition with Alabama coal, as they were already with coal from the Indian Territory in Texas.

The coals of Colorado include lignite, bituminous, semi-bituminous, and anthracite. The latter is mined exclusively in Gunnison county, and the semi-bituminous product is entirely from Fremont county.

The following tables exhibit the statistics of coal production in Colorado during 1892 and 1893, with the distribution of the product for consumption:

Coal product of Colorado in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Arapahoe		654			654	$1,308	$2.00	150	2
Boulder	465,004	58,459	22,100		545,563	744,515	1.36	193	1,128
Delta		200			200	300	1.50	100	2
Douglas		200			200	200	1.00	80	3
El Paso	23,014				23,014	28,768	1.25	200	40
Fremont	480,803	39,915	18,169		538,887	1,037,152	1.92	195	1,040
Garfield	267,335			10,459	277,794	555,588	2.00	248	423
Gunnison	141,944			83,316	225,260	413,383	1.84	259	368
Huerfano	541,733				541,733	1,083,466	2.00	253	947
Jefferson	7,018	12,501	1,700		21,219	41,943	1.90	233	50
La Plata	80,160	1,160	180		81,500	143,698	1.76	288	124
Las Animas	863,342	8,599	4,022	295,106	1,171,069	1,433,897	1.22	246	1,450
Mesa	2,000	2,500	50	500	5,050	12,500	2.48	125	12
Montezuma		30			30	45	1.50	15	3
Park	66,027	495	9,500		76,022	183,213	2.40	266	140
Rio Blanco		100			100	100	1.00	40	2
Routt		330			330	626	1.90	27	9
Weld	600	1,605			2,205	4,410	2.00	300	4
Total	2,938,980	126,748	55,721	389,381	3,510,830	5,685,112	1.62	229	5,747

Coal product of Colorado in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Arapahoe	....	633	....	....	633	$766	$1.21	150	2
Boulder	579,222	15,565	68,433	....	663,220	851,444	1.28	142	1,143
Delta	200	2,380	....	....	2,580	8,310	3.22	167	6
Douglas	....	200	....	....	200	400	2.00	75	3
El Paso	16,385	900	2,200	....	19,415	25,308	1.20	143	88
Fremont	482,649	9,840	44,298	....	536,787	860,182	......	182	1,268
Garfield	208,814	608	3,496	....	212,918	253,659	1.19	121	300
Gunnison	168,097	1,465	5,534	83,443	258,539	431,553	1.67	168	576
Huerfano	491,248	2,316	27,641	....	521,205	600,651	1.15	172	999
Jefferson	1,834	61	....	....	1,895	4,738	2.50	250	7
La Plata	95,771	6,476	795	1,950	104,992	152,748	1.45	235	152
Las Animas	1,208,507	18,131	23,965	336,735	1,587,338	1,610,366	1.01½	229	2,243
Mesa	17,000	100	....	1,000	18,100	41,250	2.28	249	23
Montezuma	....	90	....	....	90	450	5.00	75	3
Park	38,692	403	....	....	39,095	97,738	2.50	236	185
Pitkin	8,602	52	1,626	88,931	99,211	110,932	1.12	211	115
Routt	....	816	....	....	816	1,597	1.96	54	10
Weld	29,000	5,350	1,005	....	35,355	52,510	1.49	217	79
Total	3,345,951	65,386	178,993	512,059	4,102,389	5,104,602	1.24	188	7,202

There are four counties in the State whose product both in 1892 and 1893 exceeded half a million tons, and in one (Las Animas) the output in 1893 was more than a million and a half tons. In the table below is shown the total product of the State, by counties, since 1887, with the increases and decreases in 1893 as compared with 1892.

Coal product of Colorado since 1887, by counties.

[Short tons.]

Counties.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	Increase.	Decrease.
Arapahoe	16,000	1,700	823	700	1,273	654	633	....	21
Boulder	297,338	315,155	323,096	425,704	498,494	545,563	663,220	117,657	....
Dolores	1,000	200	....	800	3,475	....	....	....	....
El Paso	47,517	44,114	54,212	25,617	34,364	23,014	19,415	....	3,599
Fremont	417,326	438,789	274,029	397,418	545,789	538,887	536,787	....	2,100
Garfield	30,000	115,000	239,292	183,884	191,994	277,794	212,918	....	64,876
Gunnison	243,122	258,374	252,442	229,212	261,350	225,260	258,539	33,279	....
Huerfano	131,810	159,610	333,717	427,832	494,466	541,733	521,205	....	20,528
Jefferson	12,000	9,000	10,790	10,984	17,910	21,219	1,895	....	19,324
Las Animas	506,540	706,455	993,534	1,154,668	1,219,224	1,171,069	1,587,338	416,269	....
La Plata	22,880	33,625	34,971	43,193	72,471	81,500	104,992	23,492	....
Mesa	....	300	1,100	1,000	5,000	5,050	18,100	13,050	....
Park	23,421	46,588	41,823	49,594	52,626	76,022	39,095	....	36,927
Pitkin	4,000	28.113	....	74,362	91,642	....	99,211	99,211	....
Weld	39,281	28,054	28,628	46,417	22,554	2,205	35,355	33,150	....
Routt	....	....	1,491	705	....	330	816	486	....
Larimer	....	....	100	1,500	....	....	....	....	....
Douglas	3,500	400	260	700	....	200	200	....	....
San Miguel	....	....	1,800	1,500	....	....	....	....	....
Delta	....	....	1,357	775	....	200	2,580	2,380	....
Montezuma	....	....	816	238	....	30	90	60	....
Rio Blanco	....	....	2,900	200	....	100	....	....	100
Total	1,795,735	2,185,477	2,597,181	3,077,003	3,512,632	3,510,830	4,102,389	*a* 591,559	....

a Net increase.

The State is separated for sake of convenience into four geographical divisions, known respectively as the northern, central, southern, and western. The first mentioned contains the counties of Arapahoe, Boulder, Jefferson, Larimer, Routt, and Weld. The central division embraces Douglas, El Paso, Fremont, and Park counties. The southern division contains the counties of Dolores, Huerfano, La Plata, and Las Animas, while Delta, Garfield, Gunnison, Mesa, Montezuma, Pitkin, Rio Blanco, and San Miguel counties lie in the western district.

The following table shows the annual product of coal in Colorado since 1864, that for the years previous to 1867 being given by counties and subsequent to 1878 by districts:

Coal product of Colorado from 1864 to 1893.

Years.	Localities.	Product.	
		Short tons.	
1864	Jefferson and Boulder counties		500
1865	do		1,200
1866	do		6,400
1867	do		17,000
1868	do		10,500
1869	do		8,000
1870	do		13,500
1871	do		15,600
1872	do	14,200	
	Weld county	54,340	
			68,540
1873	Jefferson and Boulder counties	14,000	
	Weld county	43,790	
	Las Animas and Fremont counties	12,187	
			69,977
1874	Jefferson and Boulder counties	15,000	
	Weld county	44,280	
	Las Animas and Fremont counties	18,092	
			77,372
1875	Jefferson and Boulder counties	23,700	
	Weld county	59,860	
	Las Animas and Fremont counties	15,278	
			98,838
1876	Jefferson and Boulder counties	28,750	
	Weld county	68,600	
	Las Animas and Fremont counties	20,316	
			117,666
1877			160,000
1878	Northern division	87,825	
	Central division	73,137	
	Southern division	39,668	
			200,630
1879	Northern division	182,630	
	Central division	70,647	
	Southern division	69,455	
			322,732
1880	Northern division	123,518	
	Central division	136,020	
	Southern division	126,403	
	Western division	1,064	
	Unreported mines	50,000	
			437,005
1881	Northern division	156,126	
	Central division	174,882	
	Southern division	269,045	
	Western division	6,691	
	Unreported mines	100,000	
			706,744
1882	Northern division	300,000	
	Central division	243,694	
	Southern division	474,285	
	Western division	43,500	
			1,061,479
1883	Northern division	243,903	
	Central division	396,401	
	Southern division	501,307	
	Western division	87,982	
			1,229,593
1884	Northern division	253,282	
	Central division	296,188	
	Southern division	483,865	
	Western division	96,689	
			1,130,024
1885	Northern division	242,846	
	Central division	416,373	
	Southern division	571,684	
	Western division	125,159	
			1,356,062

Coal product of Colorado from 1864 to 1893—Continued.

Years.	Localities.	Product.	
		Short tons.	
1886	Northern division	260, 145	
	Central division	408, 857	
	Southern division	537, 785	
	Western division	161, 551	
			1, 368, 338
1887	Northern division	364, 619	
	Central division	491, 764	
	Southern division	662, 230	
	Western division	273, 122	
			1, 791, 735
1888	Northern division	353, 909	
	Central division	529, 891	
	Southern division	899, 690	
	Western division	401, 987	
			2, 185, 477
1889	Northern division	364, 928	
	Central division	370, 324	
	Southern division	1, 362, 222	
	Western division	499, 707	
			2, 597, 181
1890	Northern division	486, 010	
	Central division	473, 329	
	Southern division	1, 626, 493	
	Western division	491, 171	
			3, 077, 003
1891	Northern division	540, 231	
	Central division	632, 779	
	Southern division	1, 789, 636	
	Western division	549, 986	
			3, 512, 632
1892	Northern division	569, 971	
	Central division	638, 123	
	Southern division	1, 794, 302	
	Western division	508, 434	
			3, 510, 830
1893	Northern division	701, 919	
	Central division	694, 708	
	Southern division	2, 213, 535	
	Western division	492, 227	
			4, 102, 389

NORTHERN DIVISION.

Arapahoe county.—The product of Arapahoe county is from one mine at Scranton, operated by the Colorado Eastern Railway Company. The coal is bituminous, and is consumed by the railroad company's locomotives. The product since 1886 has been as follows:

Coal product of Arapahoe county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	11, 000	1890	700
1887	16, 000	1891	1, 273
1888	1, 700	1892	654
1889	823	1893	633

Boulder county.—Coal produced in 1893, 663,220 short tons; spot value, $851,444.

The product of Boulder county in 1892 was 545,563 short tons, valued at $744,515, indicating an increase in 1893 of 117,657 short tons and $106,929. The average price per ton decreased from $1.36 to $1.28. The coal of Boulder county is a lignite, and of inferior quality to the bituminous coals of the southern and western part of the State, but on account of its close proximity to Denver and the excellent railroad facilities, there is a good demand for the coal, especially for domestic use. As will be seen from the following table, the product has increased each year since 1886:

Coal product of Boulder county, Colorado, since 1886.

Year.	Short tons.	Year.	Short tons.
1886	220, 287	1890	425, 704
1887	297, 338	1891	498, 494
1888	315, 155	1892	545, 563
1889	323, 096	1893	663, 220

Jefferson county.—The total product of Jefferson county in 1893 was 1,895 short tons, worth $4,738. In 1892 the output was 21,219 short tons. The decrease was due to depressed condition of trade in manufacturing industries. The coal is lignite and used for manufacturing and domestic purposes at Golden and vicinity. The product for the county since 1886 was as follows:

Coal product of Jefferson county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	9, 928	1890	10, 984
1887	12, 000	1891	17, 910
1888	9, 000	1892	21, 219
1889	10, 790	1893	1, 895

Routt county.—Coal is mined in a small and irregular way in Routt county to supply ranchmen and miners. The county is sparsely settled, and there is no railroad transportation. In 1893 the product was 816 short tons valued at $1,516, against 330 tons valued at $626 in 1892. No product was reported from this county in 1891, and no records exist of any product prior to 1889, since which year the output has been as follows:

Coal product of Routt county, Colorado, since 1889.

Years.	Short tons.	Years.	Short tons.
1889	1, 491	1892	330
1890	705	1893	816
1891	....		

Weld county.—Coal produced in 1893, 35,355 short tons; total value, $52,510.

The product of Weld county in 1892 was only 2,205 tons, due to the principal producing mine being idle. The product in 1893, while larger than that of 1891 and 1892, did not equal the output in 1890. The output for the county since 1886 has been as follows:

Coal product of Weld county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	20,450	1890	46,417
1887	39,281	1891	22,554
1888	28,054	1892	2,205
1889	28,628	1893	35,355

CENTRAL DIVISION.

Douglas county.—Coal mining in Douglas county is conducted on a very small scale to supply a limited local demand. The output in 1887 was reported at 3,500 tons, but this was probably exaggerated. In only one year since that time has the product exceeded 400 tons and that was in 1890, when 700 tons were produced.

Coal product of Douglas county, Colorado, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	3,500	1891	....
1888	400	1892	200
1889	260	1893	200
1890	700		

El Paso county.—The product in El Paso county in 1893 was 19,415 short tons, valued at $25,308, against 23,014 short tons, valued at $28,768, in 1892. It is not probable that the coal output of El Paso county will increase very materially. It is of lignite variety, and can not compete successfully with the better coals of the State.

Coal product of El Paso county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	53,000	1890	25,617
1887	47,517	1891	34,364
1888	44,114	1892	23,014
1889	54,212	1893	19,415

Fremont county.—Coal produced in 1893, 536,787 short tons; total value, $860,182.

Fremont county ranks third in the State in amount of coal production. The output in 1893 was only 2,100 tons less than in 1893, but the value declined from $1,037,152 to $860,182, a loss of $176,970. The decreased value is due largely to the closing down of silver smelters, causing the coal to find a distant market. Some of the Fremont county coal was shipped as far as Shreveport, Louisiana, in 1893.

Coal product of Fremont county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	332,024	1890	397,418
1887	417,326	1891	545,789
1888	438,789	1892	538,887
1889	274,029	1893	536,787

Park county.—The Union Pacific Coal Company, the only producing company in the county, opened a new mine, Como No. 7, in 1893, but the output was small. The output of Como No. 5, operated by the same company, was also reduced, being less than half that of 1892. The total product of the county in 1893 was 39,095 short tons, worth $97,738.

Coal product of Park county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	23,823	1890	49,594
1887	23,421	1891	52,626
1888	46,588	1892	76,022
1889	41,823	1893	39,095

SOUTHERN DIVISION.

Dolores county.—No production of coal has been reported from Dolores county since 1891.

Huerfano county.—There are four producing mines in Huerfano county, all owned and operated by the Colorado Fuel and Iron Company. In 1893 the output was 521,205 short tons, valued at $600,651 against 541,733 short tons, valued at $1,083,466 in 1892. The same conditions which affected the value in Fremont county obtained also in Huerfano county. Until 1893 coal production in the county had shown an uninterrupted increase since 1886, as shown in the following table:

Coal product of Huerfano county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	89,913	1890	427,832
1887	131,810	1891	494,466
1888	159,610	1892	541,733
1889	333,717	1893	521,205

La Plata county.—The annual output of coal in La Plata county has shown a continuous increase since 1886. The product in 1893 was 23,492 short tons in excess of the preceding year. The value increased less in proportion from $143,698 to $152,748, a gain of only $9,058. Sympathizing with the general declining tendency of prices throughout the State the average price per ton declined from $1.76 to $1.45.

Coal product of La Plata county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	18,166	1890	43,193
1887	22,880	1891	72,471
1888	33,625	1892	81,500
1889	34,971	1893	104,992

Las Animas county.—This is the most important coal-producing county in the State, yielding in 1893 more than 38 per cent. of the total product. Its output in 1893 was 1,587,338 short tons, an increase of 416,269 tons over the product of 1892. In value the increase was, however, only $176,469, the average price per ton declining from $1.22 to $1.01½. The coal is bituminous, possessing good coking qualities, 336,735 tons being made into coke in 1893.

The following table shows the annual output of Las Animas county since 1886:

Coal product of Las Animas county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	429,706	1890	1,154,668
1887	506,540	1891	1,219,224
1888	706,455	1892	1,171,069
1889	993,534	1893	1,587,338

WESTERN DIVISION.

Delta county.—More coal was mined in Delta county in 1893 than in all the previous years of which there is any record, amounting to 2,580 short tons. The increase is due principally to the opening up of a new mine at Delta, by Winton & Roberts. This opening is said to be on a vein 11 feet thick, but the mine is 16 miles from railroad transportation, and until railroad facilities are rendered more acces sible the product will be necessarily restricted largely to local trade.

Coal product of Delta county, Colorado, since 1889.

Years.	Short tons.	Years.	Short tons.
1889	1,357	1892	200
1890	775	1893	2,580
1891	....		

Garfield county.—Garfield county produced in 1893, 212,918 short tons of bituminous coal, worth $253,659, against 277,794 short tons, valued at $555,588. The decline in value prevailing throughout the State was more than usually pronounced in this county, the average price per ton falling from $2 in 1892 to $1.19 in 1893.

Coal product of Garfield county, Colorado, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	30,000	1891	191,994
1888	115,000	1892	277,794
1889	239,292	1893	212,918
1890	183,884		

Gunnison county.—Coal produced in 1893, 258,539 short tons; total value, $431,553.

In 1892 the product of Gunnison county was 225,260 short tons, valued at $413,383, showing an increase in 1893 of 33,379 short tons, but of only $18,170 in value, the price declining from $1.84 to $1.67.

Coal product of Gunnison county, Colorado, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	159,951	1890	229,212
1887	243,122	1891	261,350
1888	258,374	1892	225,260
1889	252,442	1893	258,539

Gunnison county is the only county in the State producing anthracite coal, of which in 1893 there were mined 83,446 short tons. In 1892 the production of anthracite amounted to 62,863 short tons.

Mesa county.—Coal production in Mesa county assumed considerable importance in 1893, amounting to 18,100 short tons. The largest product in any previous year was in 1892, when 5,050 short tons were mined.

Coal product of Mesa county, Colorado, since 1888.

Years.	Short tons.	Years.	Short tons.
1888	300	1891	5,000
1889	1,100	1892	5,050
1890	1,000	1893	18,100

Montezuma county.—A small amount of coal is mined in the vicinity of Cortez to supply a local demand. The output in 1893 was only 90 tons, and but 30 tons were mined in 1892.

Pitkin county.—The old spring gulch mine formerly operated by the Grand River Coal and Coking Company, and which was idle during 1892, was acquired by the Colorado Fuel and Iron Company in 1893, and produced during the year 99,211 short tons. The coal makes an excellent coke and nearly 90 per cent. of the output during 1893 was made into coke for blast furnace use.

Coal product of Pitkin county, Colorado, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	4,000	1891	91,642
1888	28,113	1892	....
1889	....	1893	99,211
1890	74,362		

GEORGIA.

Total product in 1893, 372,740 short tons; spot value, $365,972.

The largely increased product of coal in Georgia in 1893 was due to the very considerable output of Walker county, which in itself amounted to nearly one-half the total product. The following table exhibits the statistics of production in the State during the past five years:

Coal product in Georgia since 1889.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
1889	46,131	158	15,000	164,645	225,934	$338,901
1890	57,949	....	....	170,388	228,337	238,315
1891	15,000	1,000	5,000	150,000	171,000	256,500
1892	52,614	250	3,756	158,878	215,498	212,761
1893	196,227	....	4,869	171,644	372,740	365,972

During 1892 the total number of men employed in coal mines in Georgia was 467, who made an average of two hundred and seventy-seven working days. In 1893, 736 men were employed and the average number of working days was three hundred and forty-two.

A new coal field in Georgia is reported as having been discovered in Cobb county, near Austell. It is claimed that the coal presents characteristics similar to anthracite, and further developments will be looked for with interest.

Coal product of Georgia from 1884 to 1893.

Years.	Short tons.	Years.	Short tons.
1884	150,000	1889	225,934
1885	150,000	1890	228,337
1886	223,000	1891	171,000
1887	313,715	1892	215,498
1888	180,000	1893	372,740

ILLINOIS. (a)

This report contains the twelfth annual compilation of the statistics of the coal industry in Illinois. It includes all the general features of former reports, and presents the yearly aggregation of facts concerning the industry gathered by the five State inspectors of mines, under

(a) Abstract from advance sheets of the report of Mr. George A. Schilling, secretary of the Bureau of Labor Statistics of Illinois.

direction of the bureau, and conformable to a provision in the general mining law of the State.

The detailed particulars concerning each mine in its operation during the year are reported to the inspectors on blanks specially prepared by the bureau and filled in by the owners or operators of the different mines from the records of their offices; therefore, all statements relating to the industry comes from the highest and best authority, and forms the ground-work for all inferences and conclusions contained in the report.

The entire coal industry of this State for the year 1893 is comprehensively presented in the following summaries of totals and averages:

Summary of the coal industry in Illinois in 1893.

Number of counties in which coal has been mined	56
Number of mines and openings of all kinds	788
Number of tons of coal of all grades mined	19,949,564
Number of tons of lump coal (2,000 pounds)	16,112,899
Number of tons of other grades of coal	3,836,665
Number of tons of nut coal included in other grades	576,965
Number of acres worked out—estimated	3,109.07
Number of employés of all kinds	35,390
Number of miners	26,145
Number of employés, including boys	9,245
Number of boys over 14 years of age under ground	854
Number of employés under ground	31,584
Number of employés above ground	3,806
Average number of days of active operations, shipping mines	229.4
Aggregate home value of total product	$17,827,595
Aggregate home value of lump coal	$16,517,960
Aggregate home value of other grades of coal	1,314,635
Average value of lump coal per ton at the mines	$1.025
Average value of other grades of coal per ton at the mines	$0.3427
Average price paid per ton for hand mining	$0.7145
Average price paid for hand mining—summer	$0.6739
Average price paid per ton for hand mining—winter	$0.722
Number of tons of lump coal mined by hand	8,146,646
Number of tons mined by hand and paid for by the day	1,775,211
Number of tons mined by hand and paid gross weight	5,961,289
Number of mining machines in use	310
Number of tons of all grades mined by machines	4,729,749
Number of tons of lump coal mined by machines	3,631,029
Number of tons of other grades mined by machines	1,098,720
Number of kegs of powder used	353,772
Number of men killed	69
Number of wives made widows	32
Number of children made fatherless	106
Number of men injured so as to lose time	403
Number of tons of coal mined for each life lost	289,124
Number of tons of coal mined for each man injured	49,503
Number of employés for each life lost	513
Number of employés for each man injured	88
Number of new mines opened and old mines reopened	70
Number of mines closed or abandoned	120

The number of counties contributing to the product in 1893 is one more than in 1892; the counties in the first, second, and third districts producing coal are the same as reported in 1892, and for the past ten years; the fourth district adds two, Cumberland and Jasper, but with a very small tonnage from each; while the fifth district drops out Johnson county. Although 56 counties are reported as producing coal, almost the entire output comes from 48 counties. In the fourth district 5 counties, Cumberland, Effingham, Jasper, Pike, and Richland report only 520 tons, and 3 counties in the fifth district, Franklin, Hamilton, and Jefferson add only 454 tons; the total product of these counties being less than 1,000 tons, their entire omission would not materially affect the total tonnage.

There has been a marked decrease in the number of mining places during the past four years. In 1890 the number of mines reported in the State was 936; this was a gain of 82 over the previous year, and the largest number ever reported. This increase seemed to be reasonable, as the output of coal for the year had increased over one and a quarter million tons. In 1891 the number of mines had decreased by 18, but the product had increased 385,971 tons. In 1892 the decrease in the number of mines was greater than in any other year, the number being 79 less than reported for 1891, while the increase in output was 2,201,578 tons. The records for 1893 show a further decrease in the number of mines, being 51 less than 1892, yet the product increases 2,087,288 tons.

Notwithstanding the number of mining places this year is 148 less than 1890, the output of coal is over four and a half million tons in excess of that year, and seems to point conclusively to the abandonment of the smaller mines as undesirable and unprofitable, and to the concentration of the business to the larger and improved class of plants.

The unprecedented output of the year over all previous years is prominent in this report, aggregating, as it does, 19,949,564 tons of 2,000 pounds each. Of this product 16,112,899 tons were lump coal, and 3,836,665 tons of other grades. Of the latter there is reported from the first, second, fourth, and fifth districts, 576,965 tons as being nut coal; this is nearly 18 per cent. of the other grades reported from these districts.

The lump coal had an average value in 1893 essentially the same as the year before, $1.03 per ton; the computation of last year having the decimal of a cent in its favor. The price paid for hand mining is practically on a level with that of last year, being 71.45 cents, and is computed on screened tons, mined exclusively by hand and paid for by the ton. The number of tons on which this price is based is 6,061,413, or only a little over 37 per cent. of the total tons of screened coal. The diverse methods adopted in recent years for paying for mining coal has rendered the foregoing average of little significance, as a basis on which to estimate the earnings of miners generally.

The number of employés in and about the mines exceeds that of all previous years, and was 1,758 more than reported in 1892, and 2,439 more than 1891. To this can be added the record of 229.4 days of active operations for all mines designated as shipping mines. This is a greater number of days than has been reported for the past decade.

Mining coal by machine seems to be steadily increasing; the number of machines reported in 1893 is 310; in 1892 the number was 300, and the year before 241. The number of tons cut by machines during the year was 4,729,749; this is an increase over 1892 of 836,460 tons, and 1,702,444 tons more than reported for 1891.

The increase in the consumption of powder during the year has been quite marked; a total of 353,772 kegs, of 25 pounds each, of this explosive power has been used. This is 54,305 kegs more than reported for last year, and 92,380 more than used in 1891.

The number of men killed has, unfortunately, exceeded that of any year in the history of coal mining in the State, since the exceptional calamities of 1883, when by two accidents 79 men lost their lives, 69 by the flooding of a mine at Braidwood, and 10 others by an explosion in a mine at Coulterville. The number of fatal casualties reported for the year is 69; this is 12 more than in 1892, and 9 more than given for 1891. The large increase in the tonnage and in the number of the employés the past year would in consequence augment the number of fatalities. However, an examination reveals the fact that while the tonnage of 1893 has increased 12 per cent. over that of 1892, and the number employed 5 per cent., the fatal casualties have increased 21 per cent. The number of men employed to 1 man killed is 513. This is the smallest proportion in ten years, excepting one year, 1886, when the number was 497. The number of tons mined to 1 life lost is 289,124; the year before there was 1 death for every 313,373 tons, and in 1891, 1 for every 261,011 tons.

The estimated number of acres from which coal has been removed during the year is 3,109; this is over 100 acres more than reported last year, and 375 acres more than was worked out in 1891.

The year 1893 has been one of marked activity; all of the inspectors report extensive and valuable improvements in the larger plants throughout the State, both in buildings and machinery on the surface, as well as the betterment of the conditions under ground. Very little friction has arisen during the year affecting the relations between the operators and men employed; in this regard it has been a year of comparative quiet, and naturally of unusual prosperity in the coal industry.

Number and rank of mines.—Some noticeable changes are presented in the following division and grouping of mines arranged as to product of lump tons; those of the same classes for the two previous years are similarly placed with those of 1893:

Classification of Illinois coal mines according to output.

Districts.	Number of mines producing in the years 1891, 1892, and 1893—																	
	Less than 1,000 tons.			From 1,000 to 10,000 tons.			From 10,000 to 50,000 tons.			From 50,000 to 100,000 tons.			Over 100,000 tons.			Total number of mines.		
	1891	1892	1893	1891	1892	1893	1891	1892	1893	1891	1892	1893	1891	1892	1893	1891	1892	1893
First	13	11	12	19	21	23	17	13	15	12	12	10	9	13	11	70	70	71
Second	169	148	131	76	72	71	13	12	12	2	3	4	4	5	6	264	240	224
Third	125	108	96	91	82	74	45	49	52	9	13	11	3	4	3	273	256	236
Fourth	39	27	21	34	28	29	26	20	14	16	22	26	11	12	14	126	109	104
Fifth	59	41	25	43	39	40	61	60	53	18	19	29	4	5	6	185	164	153
The State	405	335	285	263	242	237	164	154	146	55	69	80	31	39	40	918	839	788
Increase	....	....	....	....	....	....	....	....	....	....	14	11	....	8	1	....	22	12
Decrease	....	70	50	....	21	5	....	10	8	....	....	....	....	....	....	....	101	63
Per cent. increase	....	....	....	....	....	....	....	....	....	....	25.6	15.9	....	25.8	2.6	....	....	....
Per cent. decrease	....	17.3	14.9	....	8	2.1	....	6.1	5.2	....	....	....	....	....	....	....	8.6	6.08

Dividing the groups into two classes, it is observed that the number of mines whose output is less than 50,000 tons has decreased 63, and that the number of mines producing more than 50,000 tons has increased 12; the ratio of increase in 1892 was considerably in excess of the past year. Taking the last two years together, it is shown that the decrease in the number of smaller mines has been 166 from the number reported in 1891; of these 120 produce 1,000 tons or less each, and are mainly reported in the second, third, and fifth districts.

The number of mines of the greater output has increased 36, of which 9 are mines producing over 100,000 tons; 29, or 80 per cent. of the latter class are reported in the fourth and fifth districts. The net decrease in the number of mines in the State has been 130 in the last two years. To further demonstrate the diminution in the number of smaller mines and the increase in the larger and better class of plants, the following table is presented for the past eleven years:

Classification of Illinois coal mines by annual output since 1883.

Years.	Number of mines producing—					
	Less than 1,000 tons.	From 1,000 to 10,000 tons.	From 10,000 to 50,000 tons.	From 50,000 to 100,000 tons.	Over 100,000 tons.	Total number of mines.
1883	209	233	133	39	25	639
1884	262	273	148	38	20	741
1885	286	290	143	40	19	778
1886	316	280	135	44	14	789
1887	320	278	141	42	20	801
1888	327	271	151	47	25	822
1889	321	316	139	55	23	854
1890	398	301	155	54	28	936
1891	405	263	164	55	31	918
1892	335	242	154	69	39	839
1893	285	237	146	80	40	778
Increase	76	4	13	41	15	139
Per cent. of increase	36.4	1.7	9.8	10.5	60	21.8

It will be observed that the number of mines comprising the class producing 50,000 tons and over, for the years represented, has largely increased in the past two years, and is now more than double the number reported ten years ago. In 1890 there were 82 mines in this class, this year 120, an increase of 38; of these, 12 are mines producing over 100,000 tons. During the same time the smaller mines have decreased in nearly like proportion, the number in 1890 being 854, and this year 668, a decrease of 186; of these, 113 are mines reporting an output of less than 1,000 tons.

The development of the larger and better class of mines is made more apparent in the following table:

Classification of the lump-coal product of Illinois during 1893.

Districts.	Mines producing—								Total number of mines and tons.	
	Over 10,0000 tons lump coal.		From 50,000 to 100,000 tons.		From 10,000 to 50,000 tons.		Less than 10,000 tons.			
	No.	Short tons.	No.	Short tons.	No.	Short tons.	No.	Short tons.	No.	Short tons.
First	11	1, 613, 701	10	746, 284	15	456, 895	35	96, 264	71	2, 913, 144
Second	6	924, 448	4	301, 726	12	238, 436	202	244, 299	224	1, 708, 909
Third	3	459, 365	11	806, 376	52	1, 288, 553	170	306, 005	236	2, 860, 299
Fourth	14	2, 265, 649	26	1, 764, 297	14	395, 413	50	83, 023	104	4, 508, 382
Fifth	6	748, 308	29	1, 933, 574	53	1, 299, 942	65	140, 341	153	4, 122, 165
The State	40	6, 011, 471	80	5, 552, 257	146	3, 679, 239	522	869, 932	788	16,112,899
Percentage, 1893	5. 1	37. 3	10. 2	34. 5	18. 5	22. 8	66. 2	5. 4	....	....
Percentage, 1892	4. 6	37. 6	8. 2	31. 8	18. 4	24. 3	68. 8	6. 3	....	....
Percentage, 1891	3. 4	33	6	29. 6	17. 9	29. 1	72. 8	8. 3	....	....
Mines and averages, 1893	40	150, 287	80	69, 443	146	25, 200	522	1, 667	788	20, 448
Mines and averages, 1892	39	142, 077	69	67, 787	154	23, 272	577	1, 610	839	17, 558
Mines and averages, 1891	31	137, 855	55	69, 745	164	23, 015	668	1, 564	918	14, 118

Continuing the division of the mines into the two classes it is observed that 668, or 85 per cent. of the mines whose output is less than 50,000 tons each, contributed only 28 per cent. of the tonnage; in 1892 on the same division the percentages were 87 and 30.6 respectively. Of the class of smaller mines, there are 522 or 66 per cent. of the whole that have produced less than 10,000 tons each or only 5.4 per cent. of the total product, thus awarding to 266 mines, or 34 per cent. of the whole, the yielding of 94.6 per cent. of the total tonnage of the State. The conclusion to be reached from the facts set forth in this table for 1893, viewed in connection with those of 1891–'92, points conclusively to the unequaled showing of the year in these particulars. The increase as shown by the percentages of mines and tonnage, is with the higher grade of mines and a corresponding decrease in the lower grades, and a like proportion is seen in the average products of all the classes.

Extending the comparison, the following table of the two classes of mines for seven years is presented:

Annual lump-coal product of Illinois since 1887.

Years.	Mines producing over 50,000 tons of lump coal.					Mines producing less than 50,000 tons of lump coal.				
	Number of mines.	Short tons.	Average number of tons per mine.	Per cent of whole number of mines.	Per cent of total product.	Number of mines.	Short tons.	Average number of tons per mine.	Per cent of whole number of mines.	Per cent of total product.
1887	62	5,949,894	95,966	7.74	57.90	739	4,328,996	5,858	92.26	42.10
1888	72	7,188,507	99,840	8.76	60.64	750	4,666,681	6,222	91.25	39.36
1889	78	7,235,577	92,764	9.13	62.39	776	4,362,386	5,622	90.87	37.61
1890	81	8,011,777	98,911	8.65	63.39	855	4,626,587	5,411	91.35	36.61
1891	86	8,109,485	94,296	9.37	62.57	832	4,850,739	5,883	90.63	37.43
1892	108	10,218,279	94,614	12.87	69.37	731	4,512,684	6,173	87.13	30.63
1893	120	11,563,728	96,364	15.23	71.77	668	4,549,171	6,810	84.77	28.23
Averages	87	8,325,321	96,009			764	4,556,749	6,148		
Percentages				10.19	64.63				89.81	35.37

Here is demonstrated the steady increase in the number of larger mines and their product during the series of years, and a like decrease in the smaller mines. The increase in the better class of mines and their output in the past two years is very marked; this year 15.23 per cent. of the whole number of mines produced over 50,000 tons, and 71.77 per cent. of the entire product. Seven years ago there was only 7.74 per cent. of this class of mines and delivering but 57.90 per cent. of the product. The ratio of decrease in the number and product of the class producing less than 50,000 tons has been in like proportion.

There is another division of the mines of the State, designated as shipping mines, doing a local business; this classification presents the rank and commercial importance of the mines from which the greater proportion of the product is transported to market, as shown in the following table:

Statistics of production by shipping mines in 1893, by districts.

District.	Shipping mines.						
	Number.	Total output all grades.	Total lump coal.	Per cent. of whole number of mines.	Per cent. of total product.	Average number of tons of lump coal per mine.	Average number of days worked.
		Short tons.	*Short tons.*				
First	38	3,300,663	2,824,219	53.5	97.2	74,322	219
Second	27	1,776,853	1,485,098	12.1	88.8	55,003	223
Third	84	3,163,629	2,626,495	35.6	93.1	31,268	208
Fourth	59	5,722,159	4.445,713	56.7	98.9	75,351	242
Fifth	102	5,294,378	4,049,037	66.7	98.6	39,696	237
The State	310	19,257,682	15,430,562	39.3	96.5	49,776	225

The prominent feature brought out in this table is that 310 shipping mines, or 39.3 per cent. of the whole number, employ 91.8 per cent. of the men and produce and handle 96.5 per cent. of the total tonnage of the State, and show an average of a fraction less than 50,000 tons each. A similar table follows of the local mines, which shows relatively the unimportance of this class of mines when compared with the former. Here it is found that 478 mines produce on an average only 1,427 tons each, while their aggregate product is only 3.5 per cent. of the total output of the State:

Statistics of production by local mines in 1893, by districts.

Districts.	Local mines.						
	Number.	Total output, all grades.	Total lump coal.	Per cent. of whole number of mines.	Per cent. of total product.	Average number of tons of lump coal per mine.	Average number of days worked.
		Tons.	Tons.				
First	33	94,023	88,925	46.5	2.8	2,695	186
Second	197	223,811	223,811	87.9	11.2	1,136	156
Third	152	233,804	233,804	64.4	6.9	1,538	156
Fourth	45	62,707	62,669	43.3	1.1	1,538	173
Fifth	51	77,537	73,128	33.3	1.4	1,434	171
The State	478	691,882	682,337	60.7	3.5	1,427	161

In order to show that the foregoing proportions are not remarkable, the following similar statement is presented for the past four years:

Percentage of product by shipping and local mines for four years.

Years.	Shipping mines.				Local mines.			
	Number of mines.	Per cent. of whole number of mines.	Per cent. of total product.	Average number of lump tons per mine.	Number.	Per cent. of whole number of mines.	Per cent of total product.	Average number of lump tons per mine.
			Tons.				Tons.	
1890	327	34.9	93.6	34,176	609	65.1	6.4	1,328
1891	327	35.6	95.5	37,850	591	64.4	4.5	987
1892	309	36 8	95.1	45,356	530	63.2	4.9	1,295
1893	310	39.3	96.5	49,776	478	60.7	3.5	1,427

The prominent feature here is the steady gain of the number and volume of the commercial compared with the local mines. The percentage of product of shipping mines has increased from 93.6 in 1890 to 96.5 in 1893; the percentage from local mines has decreased from 6.4 to 3.5.

The output for the year.—During 1893 the total product of the mines of the State has been 19,949,564 tons. Of this aggregation 16,112,899 tons are reported as lump coal, and 3,836,665 tons as other grades; of the latter, 576,965 tons are given as nut coal. However, it is understood that a large portion of all grades of sizes of coal is put upon the market, so that it may be claimed that the entire product should be classed as merchantable coal. In order to continue parallel comparisons with former years, the following table of lump tons is presented by districts for five years:

Annual output of lump coal, with gains and losses, for five years, by districts.

Districts.	Output of lump coal by districts.					Gains and losses.			
	1889.	1890.	1891.	1892.	1893.	1891–'92.		1892–'93.	
						Gain.	Loss.	Gain.	Loss.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
First......	2, 530. 453	2, 303, 326	3, 701 652	2, 965, 067	2, 913, 144	263, 415	....	....	51, 923
Second....	1, 087, 848	1, 002, 600	1, 215, 883	1, 461, 224	1, 708, 909	225, 341	....	247, 685	....
Third.....	2, 050, 349	2, 375, 970	2, 336, 500	2, 711, 574	2, 860, 299	375, 044	....	148, 725	....
Fourth....	3, 164, 835	3, 716, 464	3, 532, 233	4, 090, 921	4, 508, 382	558, 688	....	417, 461	....
Fifth......	2, 764, 478	3, 240, 004	3, 173, 956	3, 502, 177	4, 122, 165	328, 221	....	619, 988	....
The State	11, 597, 963	12, 638, 364	12, 960, 224	14, 730, 963	16, 112, 899	1, 750, 739	....	1. 433, 859	51, 923
Net gain.	....	1, 040, 401	321, 860	1, 770, 739	1, 381, 936	1, 750, 739	....	1, 381, 936	....

It will be noticed that four of the districts show gains over last year, and that one, the first, a loss; this latter is perhaps attributable alone to the excessive flooding, reported by the inspector, in several of the mines in the district, not an unusual barrier with which to contend in this field. The net gain in 1893 in the State over 1892 is somewhat less than the gain of last year over 1891; however, the total gain in four years is made to aggregate over 4,500,000 tons. To show the gains and losses by percentages the following table is given for five years.

Percentages of increase and decrease in tonnage of lump coal, for five years, by districts.

Districts.	1889.		1890.		1891.		1892.		1893.		Five years.	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
First	....	13. 73	....	9. 86	17. 29	....	9. 75	....	....	1. 78	1. 23	....
Second	....	18. 14	....	8. 5	21. 27	....	18. 53	....	16. 95	....	32. 15	....
Third.......	....	6. 91	15. 88	....	....	1. 26	16. 05	....	5. 48	....	30. 57	....
Fourth	10. 88	....	17. 43	....	....	5. 22	15. 82	....	10. 2	....	57. 94	....
Fifth	4. 81	....	17. 2	....	....	2. 08	10. 34	....	17. 7	....	56. 28	....
The State.	....	2. 22	8. 97	....	2. 55	....	13. 51	....	9. 38	....	35. 93	....

The increase of the output of lump coal in the State for the years since 1888 is shown to be 35.93 per cent. In 1893 the increase for four years was 24.26 per cent. The first district, after a successive increase for the past two years, shows a small percentage of loss; this decline was caused by water in several mines, so that working had to be abandoned. In the other districts gains have been made; the fifth district shows the largest percentage of increase, and greater than in any of the previous years, bringing the gain in this district in the five years to 56.28 per cent.; the second district shows the next highest per cent. of gain, which, with the notable gain of the two previous years, makes the gain for the five years 32.15 per cent.; while the fourth district follows with a gain for the year of 10.2 per cent., making the increase in this district for the five years 57.94 per cent.; the smallest per cent. of gain was in the third district. The increase in the State over 1892 was 9.38 per cent. It should be noticed that the preceding statements are based on tons of lump coal, and while all large contracts for the product of the more extensive establishments of the State are perhaps based on tons of lump coal, yet the remarkable increase in the tonnage of screened coal would seem to indicate that there is comparatively a very small percentage of the total output left to be classed as unsalable.

This is the third year that the inspectors have secured and reported the total tonnage, including all grades of sizes of coal. The following table presents the total product by districts with the percentages of lump and other grades derived from the returns:

Product and percentage of lump and other grades of coal in Illinois for three years, by districts.

Districts.	Total product, 1891.	Percentage of—		Total product, 1892.	Percentage of—		Total product, 1893.	Percentage of—	
		Lump grades.	Other grades.		Lump grades.	Other grades.		Lump grades.	Other grades.
	Tons.			*Tons.*			*Tons.*		
First	3,082,915	87.63	12.37	3,458,066	85.74	14.26	3,394,686	85.81	14.19
Second	1,440,266	82.73	17.27	1,733,608	84.29	15.71	2,000,664	85.42	14.58
Third	2,794,004	83.54	16.46	3,260,951	83.15	16.85	3,397,433	84.19	15.81
Fourth	4,428,109	79.61	20.40	5,117,600	79.94	20.06	5,784,866	77.93	22.07
Fifth	3,915,404	81.06	18.94	4,292,051	81.60	18.40	5,371,915	76.73	23.27
The State	15,660,698	82.76	17.24	17,862,276	82.47	17.53	19,949,564	80.77	19.23

From this it will be seen that the proportion of lump coal, as reported during the year, has slightly declined; this, however, should not be considered to imply that the percentage of other grades of coal has increased; for the reason that the tons reported as other grades are not determined by weighing, but are estimated without thought of being taken as the accurate tonnage.

The proportion of other grades as reported is shown in the table to be 19.23 per cent. of the total product of coal of the State. However, deducting the 576,965 tons reported and included in other grades, which are reported elsewhere as being nut and other sizes less than lump, gives 16.34 per cent. as the proportion of the smaller grades. For the two preceding years it was substantially 17 per cent. In the first, second, and third districts the percentages have decreased, while in the fourth and fifth districts they have increased. Taking some of the large individual mines in the two latter districts, it is found that they report other grades as ranging from 25 to 50 per cent., when in fact a very small per cent. of the total product should be excluded from the lump tonnage. This proportion applied to the total product of the State for this and previous years is presented in the following table with the total number of mines and men employed:

Total number of mines, men, and product, lump and other grades, for twelve years.

Years.	Number of mines.	Number of employés.	Total product.	Lump coal.	Other grades.
			Short tons.	*Short tons.*	*Short tons.*
1882	704	20,290	11,017,069	9,115,653	1,901,506
1883	639	23,939	12,123,456	10,030,991	2,092,465
1884	741	25,575	12,208,075	10,101,005	2,170,070
1885	778	25,946	11,834,459	9,791,874	2,402,585
1886	787	25,846	11,175,241	9,246,435	1,928,806
1887	801	26,804	12,423,066	10,278,890	2,144,176
1888	822	29,410	14,328,181	11,855,188	2,472,993
1889	854	30,076	14,017,298	11,597,963	2,419,335
1890	936	28,574	15,274,727	12,638,364	2,636,363
1891	918	32,951	15,660,698	12,960,224	2,700,474
1892	839	33,632	17,062,276	14,730,963	3,131,313
1893	788	35,390	19,949,564	16,112,899	3,836,665

There were 21 counties in 1893 distinguishable for their importance as yielding the greater proportion of coal of the State; each has contributed over 200,000 tons; the combined product being 18,151,117 tons, or 91 per cent. of the total, leaving 9 per cent. distributed in the other 35 coal-producing counties. In 1892 20 counties were in the list, and the year before 21. The following table gives these counties for three years arranged as to output, with the number of the district in which situated:

Counties which have produced more than 200,000 tons of coal, arranged in order of their rank, for the years 1891, 1892, and 1893.

Districts.	Year 1891.			Districts.	Year 1892.			Districts.	Year 1893.		
	Counties.	Rank.	Total product.		Counties.	Rank.	Total product.		Counties.	Rank.	Total product.
			Tons.				*Tons.*				*Tons.*
5	St. Clair	1	1,595,839	4	Macoupin	1	1,823,136	5	St. Clair	1	2,133,870
4	Macoupin	2	1,461,344	5	St. Clair	2	1,759,822	4	Macoupin	2	1,988,069
1	La Salle	3	1,378,168	1	La Salle	3	1,544,311	1	La Salle	3	1,494,826
4	Sangamon	4	1,051,604	1	Grundy	4	1,175,084	4	Sangamon	4	1,410,346
1	Grundy	5	921,907	4	Sangamon	5	1,091,014	1	Grundy	5	1,186,919
3	Vermilion	6	880,466	3	Vermilion	6	972,589	2	Bureau	6	1,143,270
4	Madison	7	719,308	2	Bureau	7	943,446	3	Vermilion	7	996,768
4	Christian	8	718,326	4	Madison	8	873,770	4	Madison	8	951,894
2	Bureau	9	701,064	5	Jackson	9	869,514	5	Jackson	9	926,242
5	Jackson	10	681,859	4	Christian	10	767,354	5	Perry	10	860,151
5	Perry	11	604,152	3	Fulton	11	666,473	4	Christian	11	839,650
3	Peoria	12	564,119	3	Peoria	12	632,939	3	Fulton	12	772,498
3	Fulton	13	484,117	1	Livingston	13	532,667	3	Peoria	13	620,149
1	Livingston	14	458,329	5	Perry	14	461,068	1	Livingston	14	542,516
5	Marion	15	421,652	5	Marion	15	376,519	5	Marion	15	480,529
2	Mercer	16	314,360	2	Mercer	16	328,542	5	Williamson	16	418,426
1	Will	17	233,603	5	Williamson	17	322,486	2	Mercer	17	363,206
3	McLean	18	230,129	3	Menard	18	285,695	3	Menard	18	281,635
4	Macon	19	207,286	4	Macon	19	227,020	4	Macon	19	280,233
5	Williamson	20	206,452	3	McLean	20	222,372	5	Clinton	20	255,095
3	Menard	21	204,583					3	McLean	21	204,827
					Total	....	15,875,871				
	Total	....	13,938,667						Total	....	18,151,117

St. Clair county heads the list in 1893 with 2,133,870 tons; this is the first time in the history of coal production in the State that a single county has attained a record of 2,000,000 tons; Macoupin county follows with nearly 2,000,000 tons; both counties have increased more than 500,000 tons over their output of 1891. La Salle county maintains its position of third in rank, which it has held for the past five years, and has, with the exception of one year, 1886, a continuous record for twelve years of over 1,000,000 tons output. Sangamon county again takes fourth place, where it has been for three years in succession, previous to 1892, when it surrendered to Grundy county, which ranks as fifth. Bureau county advances to sixth in rank, and records for the first time over 1,000,000 tons. Will county is out of the list in 1893, and was also out the previous year. Clinton county takes a place in this list for the first time, with an output of over 250,000 tons.

The following table presents the total product of all the coal-producing counties for the past seven years, with the tons of lump coal and other grades for the last three years:

Output of coal in Illinois, by counties, for six years.

Districts.	Output of lump coal. 1887.	1888.	1889.	1890.	1891.	1891.—Output, all grades.	1892.—Output. Lump coal.	Other grades.	All grades.	1893. Lump coal.	Other grades.	All grades.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
First district	2, 686, 829	2, 877, 794	2, 530, 453	2, 303, 326	2, 701, 652	3, 082, 915	2, 965, 067	492, 999	3, 458, 066	2, 913, 144	481, 542	3, 394, 686
Counties:												
Grundy	792, 954	862, 866	698, 033	654, 017	861, 507	921, 907	1, 108, 419	66, 665	1, 108, 419	1, 106, 574	80, 345	1, 186, 919
Kankakee	97, 000	82, 000	67, 380	62, 460	84, 808	90, 908	81, 793	10, 365	92, 158	83. 700	5, 000	88, 700
Lasalle	1, 125, 235	1, 090, 435	1, 039, 703	926, 214	1, 174, 961	1, 378, 168	1, 261, 467	282, 844	1, 541, 311	1, 242, 566	252, 260	1, 494, 826
Livingston	387, 600	495, 388	382, 965	372, 504	355, 890	458, 329	404, 491	128, 176	532, 667	402, 370	140, 146	542, 516
Will	284, 040	347, 105	342, 372	288, 131	224, 576	233, 603	108, 897	4, 949	113, 846	77, 934	3, 791	81, 725
Second district	1, 069, 027	1, 293, 187	1, 087, 848	1, 002, 600	1, 215, 883	1, 440, 266	1, 461, 224	272, 384	1, 733, 608	1, 708, 909	291, 755	2, 000, 664
Counties:												
Bureau	459, 580	635, 097	493, 730	372, 701	612, 292	701, 064	809, 009	134, 487	943, 496	976, 572	166, 698	1, 143, 270
Hancock	6, 208	6, 515	6, 028	6, 948	6, 740	6, 740	5, 380	....	5, 380	5, 060	....	5, 060
Henry	117, 533	108, 831	101, 716	98, 734	116, 173	131, 986	142, 762	13, 974	156, 736	148, 324	7, 937	156, 261
Knox	64, 324	57, 013	57, 588	51, 653	44, 974	44, 974	43, 137	....	43, 137	49, 808	....	49, 808
Marshall	73, 928	87, 013	59, 784	56, 574	53, 319	65, 219	64. 276	14, 300	78, 576	78, 700	13, 444	92. 144
McDonough	110, 103	104, 274	98, 386	83, 401	73, 596	81, 732	82, 001	9, 126	91. 127	92, 096	10, 830	102, 926
Mercer	127, 708	167, 931	175, 690	238, 290	222, 237	314, 360	233, 244	95, 298	328, 542	273, 390	89, 816	363, 206
Rock Island	85, 282	57, 872	47, 363	39, 696	38, 654	41, 540	34, 017	2, 092	36, 109	34, 058	250	34, 308
Schuyler	22, 686	34, 403	16, 243	21, 836	15, 369	20, 122	13, 685	3, 107	16, 792	15, 955	2, 780	18, 735
Stark	17, 865	18, 690	19, 171	18, 672	20, 157	20, 157	22, 349	....	22, 349	23, 070	....	23, 070
Warren	13, 810	15, 518	12, 149	14, 095	12, 372	12, 372	11, 364	....	11, 364	11, 876	....	11, 876
Third district	1, 781, 395	2, 192, 121	2, 050, 349	2, 375, 970	2, 336, 500	2, 794, 004	2, 711, 574	549, 377	3, 260. 951	2, 860, 299	537, 134	3, 397, 433
Counties:												
Cass	2, 325	7, 300	4, 414	4, 050	5, 680	6, 466	13. 270	2, 060	15, 330	21, 370	1, 780	23, 150
Fulton	337, 215	461, 589	366, 577	404, 417	391, 721	484, 117	535, 288	131, 185	666, 473	610, 854	161, 643	772, 497
Logan	159, 000	174, 330	138, 700	164, 650	155, 048	176, 052	163, 002	24, 354	187, 356	157, 699	31, 620	189, 319
McLean	141, 700	117, 110	129, 322	173, 492	184, 629	230, 129	170, 912	51, 460	222, 372	153, 027	51, 800	204, 827
Menard	155, 621	181, 075	181, 621	230, 662	171, 784	204, 583	237, 419	48, 276	285, 695	230, 296	51, 339	281, 635
Peoria	452, 123	533, 817	454, 731	482, 725	498, 601	564, 119	541, 659	91, 280	632, 939	537, 928	82, 221	620, 149
Tazewell	51, 847	59, 324	67, 973	81, 141	85, 692	107, 252	94, 190	25, 966	120, 156	113. 597	15 360	128, 957
Vermilion	359, 119	499, 076	537, 411	704, 509	728, 156	880, 466	827, 893	144, 696	972, 589	873. 597	123, 171	996 768
Woodford	122, 445	158, 500	169, 600	129, 724	115, 189	140, 820	127, 941	30, 100	158. 041	161. 931	18, 200	180, 131

Fourth district	2,568,291	2,854,540	3,164 835	3,716,464	3,532,233	4,428,109	4,090,921	1,026,679	5,117,600	4,508,382	1,276,484	5,784,866
Counties:												
Bond	36,076	38,200	59,724	66,746	76,067	102,535	92,308	29,504	121,812	56,120	22,480	78,600
Calhoun	....	1,036	1.078	1,468	2,773	2,773	4,637	....	4,637	4,584	....	4,584
Christian	149,973	147,030	249,774	439,451	513,315	718,326	525,746	241,608	767,354	593,602	246,048	839,650
Coles	34,612	27,210	....	....	....	....	....	....	....	....	....	....
Effingham	....	....	....	796	(a) 487	(a) 487	(a) 302	....	302	520	....	520
Green	12,578	14,494	19,048	11,714	16,442	16,442	19,870	....	19,870	10,995	....	10,995
Jasper	....	....	....	152	(b)	(b)	(b)	....	....	(b)	(b)	(b)
Jersey	2,684	3,949	4,040	7,500	4,252	4,252	3,378	....	3,378	5,904	....	5,904
Macon	118,183	280,805	233,309	179,050	126,569	207,286	198,275	28,645	227,020	237,442	42,791	280,233
Macoupin	926,588	1,016,624	1,202,187	1,369,919	1,149,380	1,461,344	1,434,021	389,115	1,823,136	1,509,594	478,475	1,988,069
Madison	521,705	512,948	490,181	646,228	600,294	719,308	703,980	169,790	873,770	758,288	193,606	951,894
Montgomery	10,220	14,295	24,425	58,617	94,975	107,190	119,850	28,020	147,870	123,920	51,792	175,712
Morgan	6,669	12,545	13,019	16,601	6,584	7,610	4,266	....	4,266	2,142	....	2,142
Pike	....	....	....	135	(b)	(b)	(b)	....		(b)	(b)	(b)
Richland	....	....	....	154	(b)	(b)	(b)	....	....	(b)	(b)	(b)
Sangamon	730,391	764,970	846,012	879,888	912,643	1,051,604	951,517	139,497	1,091,014	1,170,854	239,492	1,410,346
Scott	9,802	12,491	15,028	20,022	14,255	14,755	17,006	500	17,506	22,157	600	22,757
Shelby	8,810	7,943	7,010	18,023	14,197	14,197	15,665	....	15,665	12,260	1,200	13,460
Fifth district	2,173,348	2,637,546	2,764,478	3,240,004	3,173,956	3,915,404	3,502,177	789,874	4,292,051	4,122,165	1,249,750	5,371,915
Counties:												
Clinton	55,238	66,463	121,557	170,416	146,903	174,166	156,376	35,497	191,873	174,994	80,101	255,095
Franklin	....	....	....	700	200	200	200	....	200	120	....	120
Gallatin	31,437	45,374	30,044	52,383	31,119	34,462	13,782	720	14,502	14,972	2,485	17,457
Hardin	....	....	....	40	24	24	....	....	....	....	....	....
Hamilton	....	....	....	450	280	280	220	....	220	244	....	244
Johnson	28,000	28,210	3,000	12,110	424	424	2,200	....	2,200	....	....	....
Jackson	375,718	445,575	477,474	580,521	477,330	681,859	674,161	195,353	869,514	674,943	251,299	926,242
Jefferson	....	....	....	2,100	1,104	1,104	100	....	100	90	....	90
Marion	98,915	156,975	180,777	218,499	251,283	321,652	306,019	70,500	376,519	352,793	127,736	480,529
Perry	319,552	306,235	381,347	497,768	457,431	604,152	362,926	98,142	461,068	620,502	239,649	860,151
Randolph	74,263	167,321	98,202	134,699	162,717	172,321	160,532	8,447	168,979	161,565	9,490	171,055
Saline	19,518	32,550	35,496	45,845	38,729	54,269	41,992	19,610	61,602	24,929	11,507	36,436
Saint Clair	1,018,149	1,184,579	1,198,100	1,332,978	1,389,429	1,595,839	1,519,472	240,350	1,759,822	1,778,787	355,083	2,133,870
Washington	40,220	43,600	36,220	25,160	56,500	68,200	54,183	8,783	62,966	63,500	8,700	72,200
Williamson	112,338	160,664	202,261	166,335	160,483	206,452	210,014	112,472	322,486	254,726	163,700	418,426
State totals	10,278,390	11,855,188	11,597,963	12,638,364	12,960,224	15,660,698	14,730,963	3,131,313	17,862,276	16,112,899	3,836,665	19,949,564

a Includes Jasper, Pike, and Richland counties.

b Included in Effingham county.

The number of employés.—The total number of men employed in the labor of coal mining in the State for the year is reported as 35,390. Of this number 31,584 are miners proper and others working underground, engaged in the various capacities incident to dislodging and handling the coal and sending it to the surface; 3,806 men are given as employed above the ground. The number underground includes 854 boys over 14 years of age. This is a less number of boys than ever heretofore reported, and is 99 less than 1892, and 141 less than reported for the year before. The following table gives the total number of employés in and about the mines, by districts and the State, for eleven years:

Total number of employés in and about the mines by districts and years.

Years.	First district.	Second district.	Third district.	Fourth district.	Fifth district.	The State.
1883	7,566	3,211	4,070	4,417	4,675	23,939
1884	8,013	3,616	5,018	4,781	4,147	25,575
1885	7,463	3,391	5,213	4,950	4,429	25,446
1886	7,613	3,599	4,870	5,197	4,567	25,846
1887	7,915	4,068	4,903	4,934	4,984	26,804
1888	8,623	4,914	5,250	5,086	5,537	29,410
1889	9,014	4,498	5,117	5,679	5,764	30,076
1890	8,258	4,099	5,171	5,685	5,361	28,574
1891	9,128	5,089	6,458	5,881	6,395	32,951
1892	9,572	4,865	6,453	6,542	6,200	33,632
1893	8,831	5,794	6,964	7,021	6,780	35,390
Net increase	1,265	2,583	2,894	2,904	2,105	11,451

Days of active operations.—The coal mine, as well as the manufacturing establishment, to be successfully operated, both for the employer and the employed, must depend largely on being worked uninterruptedly. The mining industry has, perhaps, more reverse conditions to contend with, affecting the working time, than any other of like magnitude. The causes interposing may come from numerous sources, the breaking or accidents to machinery, both on the surface and under ground, insufficient transportation, the condition of the weather, which has a controlling power on the market, wage controversies, fires, and floods, all go to retard continuous operation.

The number of days of running time of all mines for all the years has been furnished by the operators, hence may be considered the maximum working time of the employés during each year. In 1892 and the year before the basis of calculation for the number of days of operation was made on the record of the shipping mines, also with all mines which had produced 1,000 tons or more of lump coal and running 100 days or more; the same basis governs in the present calculation, and gives for 301 shipping mines an average of 329.6 days, and for 496 mines of both classes an average of 225.5 days.

The following table for the past three years gives, by districts, the results obtained from computations for both classes:

Average working time at Illinois coal mines in 1891, 1892, and 1893.

Districts.	Shipping mines.						All mines producing 1,000 tons or more, and working 100 days or more.					
	1893.		1892.		1891.		1893.		1892.		1891.	
	Number of mines.	Average number of days.	Number of mines.	Average number of days.	Number of mines.	Average number of days.	Number of mines.	Average number of days.	Number of mines	Average number of days.	Number of mines.	Average number of days.
First	38	220	35	218.3	34	207.6	60	213	59	207.5	53	200.9
Second	26	228	29	214.8	56	214.6	92	225	91	208	90	215.4
Third	80	215	84	203.8	88	193	136	213	144	239.9	148	201
Fourth	56	251	55	239.9	54	238.8	80	249	81	240	86	233.5
Fifth	101	233	96	221.8	106	225	128	223	120	227.7	124	227.8
The State	301	229.6	299	219.5	308	215.6	496	225.5	495	217.7	501	215.8

The correctness of successive data compiled in each district is shown in the following table of these mines for three years:

Number of mines and average working time in Illinois in 1891, 1892, and 1893.

Years.	Shipping mines.		Mines in local trade.		Both classes of mines.	
	Number of mines.	Average number days.	Number of mines.	Average number days.	Number of mines.	Average number days.
1891	308	215.6	193	216.1	501	215.8
1892	299	219.5	196	215.2	495	217.7
1893	301	229.6	195	219.5	496	225.5

It may be claimed, therefore, that this showing fully demonstrates that the collieries designated as shipping mines may be considered the true index as to the days of active operation of the mines of the State; they may also, as well, be regarded as the reflex of the industry as to employés and the product.

For 1893 the showing is better than for any former year, 301, or 38 per cent. of the mines, giving work to 90.7 per cent. of the number employed, running 229.6 days, produced 95.9 per cent. of the total output of this staple commodity.

Average value of coal.—The importance of the yearly compilation of the average value of the product of the mines of the State, as reported by the owners to the inspectors, and based on merchantable coal, is appreciated equally by the employer and the employed. On the basis of the value of the product must rest the compensation of the workmen, also the capability of the mine owner or operator to maintain the running expenses of the plant. It does not matter whether the men are paid by the net or gross ton, by the yard or the foot, by the box or the car, or by the day, week, or month; in other words it is inevitably true that the wages paid for the labor of mining and handling coal must be largely determined by its selling price.

The following table gives the total tons of lump coal and its average value per ton, by districts, for twelve years:

Average value of lump coal in Illinois per short ton at the mines.

Years.	Total tons lump coal.	First district.	Second district.	Third district.	Fourth district.	Fifth district.	The State.	Increase, cents.	Decrease, cents.
1882	9,115,653	$1.75	$1.87	$1.43	$1.33	$1.31	$1.51	....	....
1883	10,030,991	1.59	1.97	1.45	1.32	1.26	1.48	....	3
1884	10,101,005	1.49	1.75	1.31	1.09	.961	1.26	....	22
1885	9,791,874	1.41	1.71	1.25	.985	.894	1.17	....	9
1886	9,246,435	1.32	1.57	1.16	.969	.862	1.10	....	7
1887	10,278,890	1.316	1.497	1.095	.887	.823	1.085	....	1.5
1888	11,855,188	1.369	1.473	1.138	.947	.857	1.123	3.8	....
1889	11,597,963	1.355	1.432	1.104	.965	.867	1.078	....	4.5
1890	12,638,364	1.302	1.477	1.065	.873	.811	1.019	....	5.9
1891	12,960,224	1.208	1.426	1.032	.853	.757	1.008	....	1.1
1892	14,730,963	1.323	1.432	1.053	.836	.817	1.029	2.1	....
1893	16,112,899	1.333	1.455	1.074	.836	.803	1.025	....	.4
Net decrease—cents	*a* 6,997,246	.417	.415	.357	.494	.507	.485	5.9	54.4
Per cent. decrease	*a* 76.8	31.4	28.5	33.2	59.1	63.2	47.3	....	....

a Increase.

Reviewing this compilation of values for the twelve years, it is found that in nine of the years there has been a total decline of 54.4 cents per ton, while in two of the years, 1888 and 1892, a total increase of 5.9 cents, leaving a net decline of 48.5 cents per ton, or 47.3 per cent., during the eleven years.

The average value in 1893 is found to be $1.025 per ton. This is the decimal of a cent less than 1892. Considered by districts, an increase in average value is shown in the first, second, and third districts, or northern field, where higher values have been uniformly maintained, while in the fourth district, or middle part of the State, the value is the same as 1892, and less than in any previous years, and in the fifth district, or southern field, there has been a decrease of 1.4 cents from last year, which is the lowest point ever reported for the district, excepting that in 1891, when the average value was 75.7 cents.

Referring to the column of tons, on which the average values are based, it is found that the volume of product has increased in the twelve years 6,997,246 tons, or nearly 77 per cent.

The total tonnage of lump coal produced for the last five years and its aggregate value, based on the values reported, together with the aggregate valuation of the total product of all grades of coal mined in the State for the past three years, is presented as follows:

Years.	Total product, in tons, of lump coal.	Average value of lump coal, per ton, at the mine.	Aggregate value of total product of lump coal at the mine.	Aggregate value of total product at the mine.
1889	11,597,963	$1.0775	$12,496,885	....
1890	12,638,361	1.0194	12,882,936	....
1891	12,960,224	1.0084	13,068,854	$14,237,094
1892	14,730,963	1.0291	15,158,430	16,243,645
1893	16,112,899	1.025	16,517,960	17,827,595

INDIANA.

Total product in 1893, 3,791,851 short tons; spot value, $4,055,372.

Indiana's coal product in 1893 was the largest in the history of the industry in the State. The increase in 1893 over 1892 was 446,677 short tons or 13 per cent. The value increased from $3,620,582 to $4,055,372, a gain of $434,790, or 12 per cent. The percentage of increase in value was one less than the percentage of increase in product, and the average price per ton in 1893 was 1 cent less than in 1892. There was a falling off in the average working time from 225 to 201 days, but this was compensated for in an increase in the number of employés from 6,436 to 7,644.

The product in 1893 was from 16 counties, 1 more than in 1892, Dubois county being again added to the list of coal producers. Clay county is by far the most important in point of coal production, having an output equal to nearly one-third the entire product of the State and 2½ times the output of Parke county, the second in importance.

In the following tables will be seen the statistics of production in Indiana during 1892 and 1893, together with the distribution of the product for consumption.

Coal product of Indiana in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	1,131,662	9,845	5,390	....	1,146,897	$1,431,949	$1.25	239	2,707
Daviess	171,360	3,000	200	....	174,560	192,123	1.11	224	403
Fountain	13,440	....	448	....	13,888	12,400	.89	315	30
Greene	206,874	15,700	6,000	....	228,574	191,858	.84	227	335
Knox	14,314	....	....	....	14,314	12,166	.84	138	28
Owen	7,500	500	200	....	8,200	10,250	1.25	240	22
Parke	384,104	3,511	6,720	....	394,335	429,480	1.09	228	639
Perry	28,675	8,731	390	....	37,796	32,626	.86	227	88
Pike	76,260	300	1,000	1,200	78,760	68,446	.87	163	160
Spencer	7,776	50	600	....	8,426	6,809	.80	310	13
Sullivan	296,461	8,121	8,089	4,222	316,893	280,967	.89	242	522
Vanderburg	80,406	99,092	10,848	....	190,346	202,542	1.06	262	282
Vermilion	299,213	1,525	325	....	301,063	289,453	.96	164	545
Vigo	296,358	9,044	1,711	....	307,113	351,615	1.14	217	491
Warrick	74,508	8,801	700	....	84,009	67,998	.81	141	171
Small mines	....	40,000	....	....	40,000	40,000	1.00	....	....
Total	3,088,911	208,220	42,621	5,422	3,345,174	3,620,582	1.08	225	6,436

Coal product of Indiana in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	1, 163, 142	17, 626	28, 935	....	1, 209, 703	$1,559,339	$1. 29	196	2, 976
Daviess	313, 312	4, 110	2, 365	....	319, 787	310, 692	. 97	213	553
Dubois	....	9, 172	970	....	50, 142	13, 691	1. 35	300	18
Fountain	3, 500	200	300	....	4, 000	4, 000	1. 00	150	18
Greene	251, 730	2, 000	6, 200	....	259, 930	215, 666	. 83	203	391
Knox	13, 357	....	....	....	13, 357	14, 693	1. 10	183	37
Owen	5, 785	....	....	....	5, 785	5, 258	. 91	135	27
Parke	478, 086	6, 307	7, 454	....	491, 847	563, 930	1. 16	202	1, 091
Pike	238, 372	1, 181	4, 000	....	243, 353	185, 482	. 76	211	365
Perry	28, 512	7, 400	340	....	36, 252	42, 758	1. 13	198	100
Spencer	6, 834	613	200	....	7, 647	6, 398	. 84	170	29
Sullivan	252, 840	22, 578	7, 719	7, 345	290, 482	254, 284	. 88	221½	460
Vanderburg	55, 372	121, 412	9, 269	....	186, 053	200, 705	1. 08	250	357
Vermilion	262, 179	500	1, 545	....	264, 224	253, 219	. 96	158	507
Vigo	339, 643	10, 500	....	....	350, 143	332, 859	. 95	217	579
Warrick	49, 166	9, 280	500	....	58, 946	52, 398	. 89	129	136
Small mines	....	40, 000	....	....	40, 000	40, 000	1. 00	....	....
Total	3, 461, 830	252, 879	69, 797	7, 345	3, 791, 851	4, 055, 372	1. 07	201	7, 644

In the following table is shown the total annual product of coal in the State since 1873:

Product of coal in Indiana from 1873 to 1893.

Years.	Short tons.	Years.	Short tons.
1873	1, 000, 000	1884	2, 260, 000
1874	812, 000	1885	2, 375, 000
1875	800 000	1886	3, 000, 000
1876	950, 000	1887	3, 217, 711
1877	1, 000, 000	1888	3, 140, 979
1878	1, 000, 000	1889	2, 845, 057
1879	1, 196, 490	1890	3, 305, 737
1880	1, 500, 000	1891	2, 973, 474
1881	1, 771, 536	1892	3, 345, 174
1882	1, 976, 470	1893	3, 791, 851
1883	2, 560, 000		

Previous to 1889 the statistics of production by counties were not obtained. The following table shows the annual product by counties since that year, with a statement of the increase or decrease in each county in 1893 as compared with 1892:

Coal product of Indiana since 1889, by counties.

[Short tons.]

Counties.	1889.	1890.	1891.	1892.	1893.	Increase in 1893.	Decrease in 1893.
Clay	695, 649	1, 161, 730	980, 921	1, 146, 897	1, 209, 703	62, 806	
Daviess	191, 585	189, 696	155, 358	174, 560	319, 787	145, 227	
Dubois	15, 848	13, 994	7, 700		10, 142	10, 142	
Fountain	41, 141	24, 000	23, 700	13, 888	4, 000		9, 888
Gibson	1, 267						
Greene	185, 849	197, 338	161, 965	228, 574	259, 930	31, 356	
Knox	9, 040			14, 314	13, 357		957
Martin	710						
Owen	3, 958		12, 600	8, 200	5, 785		2, 415
Parke	357, 434	345, 460	307, 382	394, 335	491, 847	97, 512	
Perry	40, 050	40, 201	35, 400	37, 796	36, 252		1, 544
Pike	154, 524	115, 836	122, 066	78, 760	243, 553	164, 793	
Spencer	18, 456	11, 656	15, 340	8, 426	7, 647		779
Sullivan	317, 252	286, 323	181, 434	316, 893	290, 482		26, 411
Vanderburg	183, 942	192, 284	205, 731	190, 346	186, 053		4, 293
Vermilion	187, 651	173, 000	228, 488	301, 063	264, 224		36, 839
Vigo	371, 903	429, 160	400, 255	307, 113	350, 143	43, 030	
Warren	2, 160						
Warrick	66, 638	89, 059	96, 134	84, 009	58, 946		25, 063
Small mines		36, 000	36, 000	40, 000	40, 000		
Total	2, 845, 057	3, 305, 737	2, 973, 474	3, 345, 174	3, 791, 851	446, 677	

The following table is of interest as showing the total amount and value of coal produced in the State from 1886 to 1893, and the total number of employés, and average number of working days in each year since 1889:

Statistics of coal production in Indiana since 1886.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1886	3, 000, 000	$3, 450, 000	$1. 15		
1887	3, 217, 711	4, 324, 604	1. 03		
1888	3, 140, 979	4, 397, 370	1. 40		
1889	2, 845, 057	2, 887, 852	1. 02		6, 448
1890	3, 305, 737	3, 259, 233	. 90	220	5, 489
1891	2, 973, 474	3, 070, 918	1. 03	190	5, 879
1892	3, 345, 174	3, 620, 582	1. 08	225	6, 436
1893	3, 791, 851	4, 055, 372	1. 07	201	7, 644

Clay county.—Coal produced in 1893, 1,209,703 short tons; total value, $1,559,339.

Clay county stands preeminent as a coal-producing county in the State, its annual output averaging about 33⅓ per cent. of the total product of the State. The product in 1893 was 62,806 tons more than that of 1892, and the value increased $127,390. The coal is what is well and favorably known as Indiana block, an excellent quality of non-coking, bituminous coal. The following table shows the statistics of production in Clay county since 1889:

Coal product of Clay county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	695, 649	$795, 140	$1. 14		2, 592
1890	1, 161, 730	1, 177, 666	1. 01	218	2, 179
1891	980, 921	1, 124, 459	1. 15	181	2, 346
1892	1, 146, 897	1, 431, 949	1. 25	239	2, 707
1893	1, 209, 703	1, 559, 339	1. 29	196	2, 976

Daviess county.—Coal produced in 1893, 319,787 short tons; total value, $310,692.

Daviess county advanced from eighth to fourth place in rank of coal-producing importance during 1893. The product increased from 174,560 short tons in 1892 to 319,787 tons in 1893, a gain of 145,227 tons, or 83 per cent. The increase, however, was not without a sacrifice in price, which fell off from $1.11 to 97 cents, the total increase in value being $128,569, or 67 per cent. The total number of employés increased from 403 to 553. The average working time was 224 days in 1892 and 213 days in 1893.

The statistics of production in Daviess county since 1889 have been as follows:

Coal product of Daviess county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	191,585	$195,793	$1.02	....	455
1890	189,696	197,696	1.04	231	280
1891	155,358	174,701	1.12	217	359
1892	174,560	192,123	1.11	224	403
1893	319,787	310,692	.97	213	553

Dubois county.—Coal produced in 1893, 10,142 short tons; total value, $13,691.

No product was reported from this county in 1892. In 1891 an output of 7,700 tons was reported, against 13,994 tons in 1890 and 15,848 tons in 1889.

Fountain county.—Coal produced in 1893, 4,000 short tons, worth $4,000.

One mine at Silverwood produced the entire output of this county. Production has been decreasing annually since 1889. In May, 1893, this mine was closed down, the coal having been exhausted. The following table shows the statistics of production in the county for the past five years:

Coal product of Fountain county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	41,141	$53,218	$1.29	....	85
1890	24,000	24,000	1.00	260	48
1891	23,700	23,400	.99	252	40
1892	13,888	12,400	.89	315	30
1893	4,000	4,000	1.00	150	18

Greene county.—Coal produced in 1893, 259,930 short tons; total value, $215,666.

The quantity of coal mined in Greene county in 1893 was the largest on record, being 31,356 tons, or nearly 14 per cent. more than in 1892.

The value of the product increased from $191,858 to $215,666, a gain of $23,808, or 12½ per cent. The following table shows the statistics of coal production since 1889:

Coal product of Greene county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	185,849	$169,595	$0.91	....	296
1890	197,338	186,294	.94	218	250
1891	164,965	150,000	.91	154	300
1892	228,574	191,858	.84	227	335
1893	259,930	215,666	.83	203	391

Knox county.—Knox county produced 13,347 short tons in 1893, valued at $14,693, against 14,314 short tons, worth $12,166, in 1892. Previous to 1892 no product was reported from this county since 1889, when a total of 9,040 short tons, valued at $10,405, was obtained.

Owen county.—The product of this county is inconsiderable, being 5,785 short tons, valued at $5,258, in 1893, against 8,200 short tons, valued at $10,250, in 1892, and 12,600 tons, worth $15,750, in 1891.

Parke county.—Coal produced in 1893, 491,847 short tons, valued at $563,930.

Parke county ranks second in coal-producing importance, Clay county coming first. The product in 1893 was 97,512 short tons, or more than 25 per cent. in excess of that of 1892. The value increased $134,450, or more than 30 per cent., the average price per ton advancing from $1.09 to $1.16.

Coal product of Parke county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	357,434	$377,324	$1.05	....	591
1890	345,460	378,033	1.09	254	558
1891	307,382	347,707	1.13	255	510
1892	394,335	429,480	1.09	228	639
1893	491,847	563,930	1.16	202	1,091

Perry county.—Coal produced in 1893, 36,252 short tons; total value, $42,728.

In 1892 the product of Perry county amounted to 37,796 short tons, valued at $32,626, indicating a decrease in output during 1893 of 1,544 short tons, but an increase in value of $10,132. During 1892 considerable difficulty was experienced in shipping the coal produced in this county, owing to low water in the Ohio river, and prices were depressed in consequence. The following table shows the tendency of production during the past five years:

Coal product of Perry county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	40,050	$47,175	$1.18		109
1890	40,201	42,201	1.05	250	100
1891	35,400	38,975	1.10	190	95
1892	37,796	32,626	.86	228	88
1893	36,252	42,758	1.13	198	100

Pike county.—Coal produced in 1893, 243,553 short tons; total value, $185,482.

The returns for Pike county for 1892 were very incomplete and a comparison for the two years is not practical. The following table shows the total product of the county since 1889 so far as the same has been ascertained:

Coal product of Pike county, Indiana, for five years.

Years.	Short tons.	Years.	Short tons.
1889	154,524	1892	78,760
1890	115,836	1893	243,553
1891	122,066		

Spencer county—Coal produced in 1893, 7,647 short tons; total value, $6,398.

The product of Spencer county is from three mines, two of which are of minor importance. The tonnage in 1893 was 779 less than the preceding year, but owing to a slight advance in price the value was only $411 less.

The production since 1889 was as follows:

Coal product of Spencer county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	18,456	$21,207	$1.15		29
1890	11,650	11,116	.96	261	39
1891	15,340	13,525	.88	204	46
1892	8,426	6,809	.80	310	13
1893	7,647	6,398	.84	170	29

Sullivan county.—Coal produced in 1893, 290,482 short tons; total value $254,284.

The product of Sullivan county was 26,411 short tons less than in 1892. The value decreased $26,583. On account of the decreased production, and to an increased product in both Daviess and Vigo county, Sullivan county falls from third to fifth place in the State. There was a decrease from 522 to 460 in the number of employés and from 242 to 221½ in the average number of days worked.

Coal product of Sullivan county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	317,252	$299,286	$0.94	....	556
1890	286,323	268,525	.94	181	588
1891	181,434	184,115	1.01	130½	544
1892	316,893	280,867	.89	242	522
1893	290,482	254,284	.88	221½	460

Vanderburg county.—Coal produced in 1893, 186,053 short tons; total value, $200,705.

Compared with 1892, the product of coal in 1893 shows a decrease of 4,293 short tons in quantity and $1,837 in value. The coal is consumed principally by the local trade of Evansville and vicinity, 121,412 short tons, or about two-thirds of the total product in 1893 being thus disposed of. The statistics of labor employed show an increase from 282 men in 1892 to 357 in 1893, but a decrease in working time from 262 to 250 days.

The following table shows the annual production of coal in Vanderburg county since 1889:

Coal product of Vanderburg county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	183,942	$212,572	$1.16	....	318
1890	192,284	197,224	1.02	244	307
1891	205,731	224,033	1.09	228½	338
1892	190,346	202,542	1.06	262	282
1893	186,053	200,705	1.08	250	357

Vermilion county.—Coal produced in 1893, 264,224 short tons; total value, $253,219.

The output of Vermilion county in 1893 was 36,839 short tons less than the preceding year. The average price per ton remained the same, the value decreasing in proportion to the product $36,234. The number of employés decreased from 545 to 507 and the average number of working days from 164 to 158.

Coal product of Vermilion county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	187,651	$167,590	$0.89	....	276
1890	173,000	203,000	1.17	161	280
1891	228,488	224,159	.98	147	380
1892	301,063	289,453	.96	164	545
1893	264,224	253,219	.96	158	507

Vigo county.—Coal produced in 1893, 350,143 short tons; total value, $332,859.

With an increase of 43,030 short tons in the product as compared with 1892, Vigo county advanced from fourth to third place in rank of producing importance, and though there was an actual decrease of $18,756 in the value, it maintains a relative position in this regard. The working time remained the same as in 1892, but there was an increase in the number of employés from 491 to 579. The production of the county for the past five years has been as follows:

Coal product of Vigo county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	371,903	$330,205	$0.88	....	629
1890	429,160	341,998	.80	262	454
1891	400,255	320,056	.80	244	487
1892	307,113	351,615	1.14	217	491
1893	350,143	332,859	.95	217	579

Warrick county.—The product of Warrick county decreased from 84,009 short tons, valued at $67,998 in 1892 to 58,946 tons worth $52,398 in 1893, showing a decrease of 25,063 tons and $15,600. There was an advance of 8 cents in the average price and a decrease both in the number of employés and the average working time.

Coal product of Warrick county, Indiana, for five years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1889	66,638	....	....	....	....
1890	89,059	....	....	....	....
1891	96,134	$73,870	$0.77	199	161
1892	84,009	67,998	.81	141	171
1893	58,946	52,398	.89	129	136

INDIAN TERRITORY.

Total product in 1893, 1,252,110 short tons; spot value, $2,205,209.

Compared with 1892 the product of the Indian Territory shows an increase of 59,389 short tons, or about 5 per cent. The value increased $191,730 or nearly 10 per cent. The number of employés increased from 3,257 to 3,446, but a decrease is observed in the average days worked from 211 to 171. The statistics of production for the past three years have been as follows:

Coal product of the Indian Territory in 1891, 1892, and 1893.

Distribution.	1891.	1892.	1893.
	Short tons.	*Short tons.*	*Short tons.*
Loaded at mines for shipment	1,026,932	1,156,603	1,197,468
Sold to local trade and used by employés	9,405	10,840	9,234
Used at mines for steam and heat	22,163	18,089	21,663
Made into coke	32,532	7,189	23,745
Total	1,091,032	1,192,721	1,252,110
Total value	$1,897,037	$2,043,479	$2,235,209
Total number of employés	2,891	3,257	3,446
Average number of days worked	222	211	171

The coal fields of the Indian Territory are all in the Choctaw Nation, and are reached by four lines of railroad, the Missouri, Kansas and Texas, the Saint Louis and San Francisco, the Denison and Washita Valley and the Choctaw Coal and Railroad Company's railroads. The last mentioned, however acts really as a feeder to the Missouri, Kansas, and Texas and the Saint Louis and San Francisco lines, its own line not being completed to marketing points. The Territory coals are bituminous of excellent quality. They are consumed largely in Texas, going as far south as Houston and San Antonio. The output has shown an almost steady increase since 1885, the only exception being 1889. The following table shows the annual production since 1885:

Product of coal in the Indian Territory from 1885 to 1893, inclusive.

Years.	Short tons.	Value.	Average price per ton.	Number of employés.	Number of days active.
1885	500,000				
1886	534,580	$855,328	$1.60		
1887	685,911	1,286,692	1.88		
1888	761,986	1,432,072	1.89		
1889	752,832	1,323,807	1.76		1,862
1890	869,229	1,579,188	1.82	238	2,571
1891	1,091,032	1,897,037	1.71	222	2,891
1892	1,192,721	2,043,479	1,71	211	3,257
1893	1,252,110	2,235,209	1,79	171	3,446

IOWA.

Total product in 1893, 3,972,229 short tons; spot value, $5,110,460.

The coal product in Iowa during 1892 was 3,918,491 short tons, valued at $5,175,060, showing an increase in 1893 of 53,738 short tons and a decrease in the value of $64,600. There was little occurring during the year to remark upon, the principal feature being the decline in value due to general business depression and a mild winter. The labor statistics show a rather remarkable uniformity of increase in the number employed and decrease in the working time. This was doubtless due to an influx of miners from Kansas who were thrown out of employment by the strike in that State, and thus employment was given in Iowa to more men, but the working time had to be cut down in order to accommodate the supply of coal to the demand.

The following tables show the statistics of production during 1892 and 1893:

Coal product of Iowa in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Appanoose	391, 293	14, 356	6, 338	411, 987	$622, 004	$1. 51	184	1, 213
Boone	107, 874	28, 594	3, 352	139, 820	250, 586	1. 80	189	534
Dallas	21, 881	3, 269	1, 400	26, 559	43, 073	1. 71	242	89
Greene	35, 375	5, 400	2, 585	43, 360	76, 765	1. 76	214	120
Jasper	153, 736	2, 770	7, 354	163, 860	210, 027	1. 28	274	426
Jefferson	600	400	....	1, 000	1, 400	1. 40	175	3
Keokuk	339, 502	13, 191	8, 540	361, 233	460, 812	1. 28	285	610
Mahaska	1, 113, 783	17, 569	9, 779	1, 141, 131	1, 310, 582	1. 15	238	1, 818
Marion	119, 100	14, 640	660	134, 400	157, 459	1. 17	244	267
Monroe	494, 434	7, 428	5, 244	507, 106	639, 731	1. 26	233	1, 112
Polk	277, 728	102, 562	8, 300	388, 590	608, 868	1. 57	268	938
Taylor	10, 154	5, 050	....	15, 204	30, 408	2. 00	223	54
Van Buren	23, 462	5, 176	308	28, 946	38, 280	1. 32	226	92
Wapello	219, 366	12, 974	2, 132	234, 472	301, 393	1. 29	260	445
Warren	1, 800	1, 744	56	3, 600	6, 300	1. 75	250	7
Wayne	39, 313	22, 064	701	62, 078	92, 191	1. 49	232	140
Webster	109, 624	4, 668	862	115, 154	185, 180	1. 61	247	302
Small mines	....	140, 000	....	140, 000	140, 000	1. 00	....	....
Total	3, 459, 025	401, 855	57, 611	3, 918, 491	5, 175, 060	1. 32	236	8, 170

Coal product of Iowa in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Average number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Appanoose	470, 842	12, 611	6, 467	489, 920	737, 949	$1. 51	151	1, 793
Boone	140, 101	29, 936	2, 033	172, 070	321, 137	1. 87	208	577
Dallas	11, 186	2, 275	....	13, 461	24, 509	1. 82	159	55
Greene	15, 000	2, 800	200	18, 000	36, 000	2. 00	150	60
Jasper	151, 836	10, 736	67	162, 639	208, 909	1. 28	253	284
Jefferson	120	360	2	482	723	1. 50	120	3
Keokuk	126, 848	14, 186	11, 063	152, 097	104, 375	1. 21	155	528
Mahaska	1, 306, 536	71, 071	42, 323	1, 419, 930	1, 570, 537	1. 11	258	2, 209
Marion	101, 933	8, 932	280	111, 145	134, 304	1. 21	193	292
Monroe	554, 350	10, 948	5, 607	570, 905	638, 085	1. 12	214	1, 103
Polk	170, 261	95, 454	6, 016	271, 731	468, 933	1. 73	211	697
Taylor	7, 530	3, 445	15	10, 990	22, 279	2. 02	228	29
Van Buren	19, 295	3, 337	335	22, 867	31, 021	1. 36	178	69
Wapello	215, 911	11, 139	3, 410	230, 460	293, 683	1. 27	174	603
Warren	1, 000	2, 000	....	3, 000	5, 250	1. 75	100	15
Wayne	43, 195	21, 416	825	65, 436	95, 940	1. 47	205	155
Webster	106, 640	9, 093	1, 363	117, 096	196, 826	1. 67	194	391
Small mines	....	140, 000	....	140, 000	140, 000	1. 00	....	....
Total	3, 442, 584	449, 639	80, 006	3, 972, 229	5, 110, 460	1. 30	204	8, 863

The State is divided into three inspection districts, known, respectively, as the first or southern, the second or northeastern, and the third or northwestern. The following table shows the annual production according to districts since 1883:

Total production of coal in Iowa, by districts, from 1883 to 1893, inclusive.

Districts.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
First	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841
Second	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978
Third	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671
Small mines	....	....	....	....	....
Total	3, 979, 946	3, 902, 291	3, 582, 656	3, 853, 374	3, 994, 490

Districts.	1888.	1889.	1890.	1891.	1892.	1893.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
First	1, 528, 967	1, 497, 685	1, 536, 978	1, 229, 512	1, 398, 793	1, 505, 205
Second	1, 974, 352	1, 720, 727	1, 626, 193	1, 814, 910	1, 666, 224	1, 734, 666
Third	918, 503	876, 946	718, 568	641, 073	713, 474	592, 358
Small mines	....	....	140, 000	140, 000	140, 000	140, 000
Total	4, 421, 822	4, 095, 358	4, 021, 739	3, 825, 495	3, 918, 491	3, 972, 229

The counties composed in each district and the product of each county since 1883 are shown in the following table:

Product of coal in the first inspection district of Iowa from 1883 to 1893, inclusive.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Appanoose	128, 896	158, 986	245, 896	150, 000	160, 351
Adams	3, 891	3, 981	3, 896	9, 581	19, 851
Cass	....	....	....	....	....
Davis	527	1, 207	33, 655	1, 000	1, 800
Jefferson	38, 887	8, 172	1, 116	1, 083	10, 397
Lucas	487, 821	410, 729	439, 956	530, 759	472, 998
Marion	90, 985	97, 085	100, 011	141, 694	212, 695
Monroe	93, 435	98, 427	101, 517	117, 700	183, 505
Montgomery	....	....	....	....	....
Page	748	1, 009	1, 819	1, 550	1, 780
Taylor	94	127	617	8, 585	12, 180
Van Buren	1, 678	1, 778	1, 193	8, 038	26, 331
Wapello	237, 821	240, 720	187, 911	237, 111	272, 073
Warren	12, 828	13, 727	12, 825	23, 332	24, 796
Wayne	1, 892	4, 947	25, 812	34, 000	28, 084
Total	1, 099, 503	1, 040, 895	1, 156, 224	1. 264, 433	1, 426, 841

Counties.	1888.	1889.	1890.	1891.	1892.	1893.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Appanoose	210, 263	285, 194	284, 560	409, 725	411, 984	489, 920
Adams	18, 817	13, 457	(*a*)	(*a*)	(*a*)	(*a*)
Cass	....	280	(*a*)	(*a*)	(*a*)	(*a*)
Davis	1, 800	3, 825	(*a*)	(*a*)	(*a*)	(*a*)
Jefferson	9, 387	8, 123	351, 600	800	1, 000	482
Lucas	364, 969	339, 229				
Marion	230, 652	145, 180	153, 506	165, 867	134, 400	111, 145
Monroe	233, 896	258, 401	324, 031	393, 227	507, 106	570, 905
Montgomery	....	1, 040	(*a*)	(*a*)	(*a*)	(*a*)
Page	3, 430	2, 768	(*a*)	(*a*)	(*a*)	(*a*)
Taylor	8, 002	9, 736	(*a*)	10, 500	15, 204	10, 990
Van Buren	25, 960	39, 258	47, 464	36, 166	28, 946	22, 867
Wapello	380, 395	359, 199	341, 932	165, 827	231, 472	230, 460
Warren	17, 103	14, 515	8, 470	2, 000	3, 600	3, 000
Wayne	24, 293	17, 480	25, 415	45, 000	62, 078	65, 436
Total	1, 528, 967	1, 497, 685	(*b*)1, 536, 978	(*b*)1, 229, 512	(*b*)1, 398, 793	(*b*)1, 505, 205

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the second inspection district of Iowa from 1883 to 1893.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mahaska	927,387	932,714	762,785	851,362	1,025,548
Keokuk	500,040	430,940	372,816	545,304	599,007
Jasper	45,883	46,336	90,425	286,034	142,039
Scott	3,714	3,821	5,937	3,000	8,634
Marshall	...	...	...	400	200
Hardin	...	...	...	2,000	450
Muscatine	...	...	...	100	100
Total	1,477,024	1,413,811	1,231,963	1,688,200	1,775,978

Counties.	1888.	1889.	1890.	1891.	1892.	1893.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Mahaska	835,981	1,056,477	1,103,831	1,231,405	1,141,131	1,419,930
Keokuk	541,966	455,162	349,318	316,303	301,233	152,097
Jasper	275,179	199,152	173,044	267,202	163,860	162,639
Scott	9,080	9,446	(*a*)	(*a*)	(*a*)	(*a*)
Marshall	...	...	...	...	...	...
Harding	1,000	490	(*a*)	(*a*)	(*a*)	(*a*)
Muscatine	...	...	...	...	...	...
Total	1,663,206	1,720,727	(*b*)1,626,193	(*b*)1,814,910	(*b*)1,666,224	(*b*)1,734,666

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the third inspection district of Iowa from 1883 to 1893.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Boone	466,981	473,073	458,191	294,970	167,068
Dallas	38,208	37,185	32,986	21,986	40,420
Greene	88,851	96,327	89,587	117,538	105,894
Guthrie	...	5,187	4,596	17,194	18,305
Hamilton	1,998	1,878	918	3,312	6,669
Polk	558,821	619,921	462,895	337,964	305,094
Webster	248,560	214,014	145,296	107,777	146,221
Story	...	...	...	...	2,000
Total	1,403,419	1,447,585	1,194,469	900,741	791,671

Counties.	1888.	1889.	1890.	1891.	1892.	1893.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Boone	140,142	174,392	153,229	151,659	139,820	172,070
Dallas	48,622	67,055	33,466	48,710	26,550	13,461
Greene	106,042	51,438	45,192	53,215	43,360	18,000
Guthrie	18,680	12,275	(*a*)	(*a*)	(*a*)	(*a*)
Hamilton	6,480	...	...	...	...	...
Polk	300,669	434,047	367,852	309,467	388,590	271,731
Webster	159,715	137,739	118,829	78,022	115,154	117,096
Story	2,000	...	...	...	...	...
Total	785,350	876,946	(*b*) 718,568	(*b*) 641,073	(*b*) 713,474	(*b*) 592,358

a Included in product of small mines. *b* Exclusive of product of small mines.

Résumé.—In the following table the total product of the State is given, in short tons, since 1883, with the total value since 1886, and a statement of the number of men employed since 1889:

Product of coal in Iowa from 1883 to 1893.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of employés.
1883	4,457,540				
1884	4,370,566				
1885	4,012,575				
1886	4,312,921	$5,391,151	$1.25		
1887	4,473,828	5,991,735	1.34		
1888	4,952,440	6,438,172	1.30		
1889	4,095,358	5,426,509	1.32		9,247
1890	4,021,739	4,995,739	1.24	213	8,130
1891	3,812,495	4,807,999	1.27	224	8,124
1892	3,918,491	5,175,060	1.32	236	8,170
1893	3,972,229	5,110,460	1.30	204	8,863

The coal fields of Iowa.—The coal fields of Iowa are fully described in a report by Dr. Charles R. Keyes, then assistant State geologist, in Mineral Resources of the United States, 1892.

Appanoose county.—Coal produced in 1893, 489,920 short tons; total value, $737,949.

Thirty-seven mines contributed to the output of coal in Appanoose county in 1893. The product exceeded that of 1892 by 77,933 short tons, or nearly 19 per cent. The value increased $115,945, in exact proportion to the product, the average price per ton being the same in both years.

Coal product of Appanoose county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	144,364	1889	235,194
1884	178,064	1890	284,560
1885	275,403	1891	409,725
1886	168,000	1892	411,987
1887	179,593	1893	489,920
1888	235,495		

The labor statistics show that 1,793 men were employed in the coal mines of the county during 1893, and that the average working time was 151 days, against 1,213 men for 184 days in 1892.

Boone county.—The product in 1893 was 172,070 short tons, valued at $321,137, against 139,820 short tons, valued at $250,586, in 1892. Business in this county seems to have been very satisfactory, on the whole, though, owing to mild weather during November and Decemberthe winter trade was comparatively poor. Still, taking the entire year, business was considerably better than in 1892. There was an increased product, an advance in the average price per ton from $1.80 to $1.87, the number of employés increased from 534 to 577, and the average working days from 189 to 208.

Coal product of Boone county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	523,019	1889	174,392
1884	529,842	1890	153,229
1885	513,174	1891	151,659
1886	330,366	1892	139,820
1887	187,116	1893	172,070
1888	156,959		

Dallas county.—Dallas county produced 13,461 short tons of coal in 1893, valued at $24,509, against 26,550 short tons, valued at $43,073, in 1892. The decreased product was attributed to slack demand from steam-users and mild weather during the winter months.

Coal product of Dallas county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	42,793	1889	67,055
1884	41,647	1890	33,466
1885	36,944	1891	48,710
1886	24,614	1892	26,550
1887	45,270	1893	13,461
1888	54,457		

Greene county.—Coal produced in 1893, 18,000 short tons; total value, $36,000. The product in 1893 was 25,300 tons less than in 1892, due to the closing down of the Craig Coal Company's mine at Angus.

Coal product of Greene county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	96,513	1889	51,438
1884	107,886	1890	45,192
1885	100,337	1891	53,215
1886	131,643	1892	43,360
1887	118,601	1893	18,000
1888	118,767		

Jasper county.—Coal produced in 1893, 162,639 short tons; total value, $208,909, against 163,860 short tons, valued at $210,027, showing a decrease of 1,221 tons in quantity and $1,118 in value.

Coal product of Jasper county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	51,389	1889	199,152
1884	51,996	1890	173,044
1885	101,276	1891	267,202
1886	320,358	1892	163,860
1887	159,084	1893	162,639
1888	318,200		

Jefferson county.—There is but one mine in this county outside of the country banks, and the output of this mine has been of comparatively little importance for several years. In 1893 the product was only 482 short tons, worth $723, against 1,000 tons, valued at $1,400, in 1892.

Coal product of Jefferson county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	43,553	1889	8,123
1884	9,153	1890	1,600
1885	1,250	1891	800
1886	1,213	1892	1,000
1887	11,645	1893	482
1888	10,513		

Keokuk county.—Coal produced in 1893, 152,097 short tons; total value, $184,375. Coal produced in 1892, 361,233 short tons; value, $460,812. Four mines were worked out and abandoned in Keokuk county in 1893. These were the American Coal Company's mine, the Crescent Nos. 1 and 2, of the Crescent Coal Company, and Shaft No. 1, of the What Cheer Coal Company, all at What Cheer. This accounts for the greatly reduced product in 1893.

Coal product of Keokuk county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	560,040	1889	455,162
1884	482,653	1890	349,318
1885	417,554	1891	316,303
1886	610,740	1892	361,233
1887	670,888	1893	152,097
1888	607,002		

Mahaska county.—Total product of coal in 1893, 1,419,930 short tons; value, $1,570,537. Total product in 1892, 1,141,131 short tons; value, $1,310,583.

Mahaska county is the largest coal-producing county in the State, contributing 36 per cent. of the total product in 1893. In 1892 it produced 29 per cent.; in 1891, 32 per cent.; and in 1890, 26.5 per cent. The product in 1893 was the largest in the history of the county; being 278,799 tons larger than in 1892. The value increased $259,954, the average price per ton declining from $1.15 to $1.11. The mines gave employment to 2,209 men for an average of 258 days, against 1,818 men for 238 days in 1892.

Coal product of Mahaska county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	1,038,673	1889	1,056,477
1884	1,044,640	1890	1,103,831
1885	854,319	1891	1,231,405
1886	953,525	1892	1,141,131
1887	1,148,614	1893	1,419,930
1888	936,299		

Marion county.—Marion county produced 111,145 short tons of coal in 1893, valued at $134,304, being a decrease as compared with 1892 of 23,255 tons and $23,155.

Coal product of Marion county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	101,903	1889	145,180
1884	108,735	1890	153,506
1885	112,012	1891	165,867
1886	158,697	1892	134,400
1887	238,218	1893	111,145
1888	258,330		

Monroe county.—Monroe county is the second county in the State in the production of coal. Its product in 1893 was 570,905 short tons, valued at $638,085, against 507,106 short tons, valued at $639,731 in 1892. The average price per ton declined from $1.26 in 1892, to $1.12 in 1893. The number of men employed in 1893 was 1,103, averaging 214 days, against 1,112 men for 233 days.

Coal product of Monroe county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	104,647	1889	258,401
1884	110,238	1890	324,031
1885	113,699	1891	393,227
1886	131,824	1892	507,106
1887	207,526	1893	570,905
1888	261,964		

Polk county.—Coal produced in 1893, 271,731 short tons; total value, $468,933. Compared with the preceding year the product in 1893 shows a decrease of 116,859 short tons, with a loss in value of $139,935. With the exception of 1889 and 1892 the product of Polk county has decreased annually since 1884.

Coal product of Polk county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	625,880	1889	434,047
1884	695,312	1890	367,852
1885	518,442	1891	309,467
1886	378,520	1892	388,590
1887	341,605	1893	271,731
1888	333,749		

Taylor county.—The coal product in 1893 was 10,990 short tons; value, $22,279. Decrease as compared with 1892, 4,214 short tons and $8,129.

Coal product of Taylor county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	105	1889	9,736
1884	142	1890	(*a*)10,000
1885	691	1891	10,500
1886	9,615	1892	15,204
1887	13,642	1893	10,990
1888	8,962		

a Estimated.

Van Buren county.—Total product in 1893, 22,867 short tons; value, $31,021. Product in 1892, 28,946 short tons; value, $38,280. Decrease in 1893, 6,079 short tons, with a loss in value of $7,259.

Coal product of Van Buren county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	1,879	1889	39,258
1884	1,991	1890	47,464
1885	1,336	1891	36,166
1886	9,002	1892	28,946
1887	29,591	1893	22,867
1888	29,065		

Wapello county.—The production of coal in Wapello county was about the same as the preceding year, being 230,460 short tons, valued at $293,683, against 234,472 short tons, valued at $301,393. The number of employés increased from 445 to 603, but the average working time decreased from 260 to 174 days.

Coal product of Wapello county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	266,360	1889	359,199
1884	269,606	1890	341,932
1885	210,460	1891	165,827
1886	263,193	1892	234,472
1887	304,722	1893	230,460
1888	426,042		

Warren county.—A small amount of coal is produced in Warren county, chiefly to supply the local trade at Summerset.

Coal product of Warren county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	14,367	1889	14,515
1884	15,374	1890	8,470
1885	13,364	1891	2,000
1886	26,132	1892	3,600
1887	27,772	1893	3,000
1888	19,155		

Wayne county.—The production increased slightly from 62,078 tons in 1892 to 65,436 tons in 1893. There was a slight decline in the price from $1.49 to $1.47. The number of employés increased from 140 to 155, which was offset by a decrease in the average number of working days from 232 to 205.

Coal product of Wayne county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	2,119	1889	17,480
1884	5,541	1890	25,415
1885	28,909	1891	45,400
1886	38,080	1892	62,078
1887	31,454	1893	65,436
1888	27,208		

Webster county.—The product of Webster county was also slightly increased in 1893, 1,942 short tons, the value increasing a little more in proportion, or $11,646. As was usually the case throughout the State, the number of employés increased and the average working time decreased, the former from 302 to 391, the latter from 247 to 194.

Coal product of Webster county, Iowa, since 1883.

Years.	Short tons.	Years.	Short tons.
1883	278,387	1889	137,739
1884	239,696	1890	118,829
1885	162,732	1891	78,022
1886	120,710	1892	115,154
1887	163,768	1893	117,096
1888	178,881		

KANSAS.

Total product in 1893, 2,652,546 short tons; spot value, $3,375,740.

The coal-mining interests in Kansas were seriously upset during 1893 by a strike among the operatives, which lasted from May 19 to September 1. The effects, bearing as they do upon the production, are worthy of note. Compared with the preceding year, there was a loss in product of 354,730 short tons, or 11 per cent., and in value of $579,855, or about 15 per cent.

There are eight counties in the State producing coal. More than 90 per cent. of the total product is from four counties—Cherokee, Crawford, Leavenworth, and Osage—and of these Crawford county produces nearly as much as the other three combined. In all of them the effects of the strike were felt. Cherokee's product decreased from 825,531 tons to 697,521 tons, a loss of 128,010 tons, or about 15 per cent. Crawford county's product fell from 1,309,246 tons to 1,195,568 tons, a decrease of 113,378 tons, or nearly 9 per cent. Leavenworth's decrease was 20,929 tons, or about 6 per cent., and Osage county decreased 93,638 tons, or about 25 per cent. Of the other producing counties, Coffey county decreased from 3,664 tons to 1,720 tons, a loss of something over 50 per cent. A small increase from 11,150 tons to 11,768 tons occurred n Franklin county, and from 43,913 tons to 46,464 tons in Linn county. The product of Labette county is an unimportant factor, being about 800 tons annually in the past three years, and is mined only for a small local trade.

Comparing the statistics of labor employed in 1893 with 1892, it is shown that the average working time decreased from 208½ days to 147 days. There was an increase in the total number of employés from 6,559 to 7,310. This increase in number of employés was due to the importation of miners from other States to take the places of the strikers, and upon the termination of the strike a larger force than usual was kept upon the rolls of the mining companies in order to supply the market, which had run short during the time the strike was in force.

In the following tables the production of coal in Kansas during 1892 and 1893 is shown by counties, together with the distribution of the product for consumption:

Coal product of Kansas in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	798,434	8,489	18,608	....	825,531	$1,009,524	$1.22	183	1,777
Coffey	2,240	1,424	....	....	3,664	6,800	1.85	128	23
Crawford	1,289,060	9,597	10,589	....	1,309,246	1,413,423	1.08	213	2,249
Franklin	7,300	3,800	50	....	11,150	20,671	1.85	180	57
Labette	....	800	....	....	800	2,000	2.50	100	6
Leavenworth	272,149	44,656	13,260	101	330,166	528,307	1.60	247½	1,020
Linn	37,570	5,880	463	....	43,913	55,645	1.27	237	115
Osage	350,059	21,392	1,355	....	372,806	759,225	2.04	202	1,312
Small mines	....	110,000	....	....	110,000	160,000	1.45	....	....
Total	2,756,812	206,038	44,325	101	3,007,276	3,955,595	1.31½	208½	6,559

Coal product of Kansas in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	673,810	10,257	13,454	....	697,521	$805,525	$1.15	106	1,978
Coffey	....	1,720	....	....	1,720	3,765	2.19	150	6
Crawford	1,160,601	14,151	15,716	....	1,195,868	1,321,489	1.10	163	2,883
Franklin	7,084	4,684	....	....	11,768	21,650	1.84	162	57
Labette	....	800	....	....	800	2,000	2.50	250	5
Leavenworth	216,678	62,160	30,396	3	309,237	477,914	1.55	208	1,145
Linn	43,512	2,602	350	....	46,464	56,853	1.22	194	136
Osage	257,725	20,947	496	....	279,168	526,544	1.85	145	1,100
Small mines	....	110,000	....	....	110,000	160,000	1.45	....	....
Total	2,364,810	227,321	60,412	3	2,652,546	3,375,740	1.27	147	7,310

The following table shows in condensed form the statistics of coal production in Kansas since 1880. It will be noted that the first decrease in the amount of coal produced as compared with former years occurred in 1893.

Coal product of Kansas for fourteen years.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1880	550,000				
1881	750,000				
1882	750,000				
1883	900,000				
1884	1,100,000				
1885	1,212,057	$1,485,002	$1.23		
1886	1,400,000	1,680,000	1.20		
1887	1,596,879	2,235,631	1.40		
1888	1,850,000	2,775,000	1.50		
1889	2,221,043	3,296,888	1.48		5,956
1890	2,259,922	2,947,517	1.30	210	4,523
1891	2,716,705	3,557,305	1.31	222	6,201
1892	3,007,276	3,955,595	1.31½	208	6,559
1893	2,652,546	3,375,740	1.27	147	7,310

Distributed by counties, the product since 1885 has been as follows:

Coal product of Kansas since 1885, by counties.

[Short tons.]

Counties.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Cherokee	371,930	375,000	385,262	450,000	549,873	724,861	832,289	825.531	697,521
Coffey					18,272	12,200	1,218	3,664	1,720
Crawford	221,741	250,000	298,049	425,000	827,159	900,464	997,759	1,309,246	1,195,868
Franklin	14,518	15,000	18,080	25,000	37,771	9,045	10,277	11,150	11,768
Labette					2,541	4,000	800	800	800
Leavenworth	120,561	160,000	195,480	210,000	245,616	319.866	380,142	330,166	309,237
Linn	5,556	8,900	12,400	17,500	25,345	10,474	38,934	43,913	46,464
Osage	370,552	380,000	393,608	415,000	446,018	179,012	355,286	372,806	279,168
Small mines	107,199	211,100	294,000	307,500	68,448	100,000	100,000	110,000	110,000
Total	1,212,057	1,400,000	1,596,879	1,850,000	2,221,043	2,259,922	2,716,705	3,007,276	2,652,546

Cherokee county.—Coal produced in 1893, 697,521 short tons; total value, $805,525.

Cherokee county is the second largest producing county in the State, having an output something over 25 per cent. of the State's total in 1893. Compared with 1892, there was a decrease in 1893 of 128,010 short tons in quantity and of $203,999 in value, the average price per ton declining from $1.22 to $1.15. The number of employés increased from 1,777 to 1,978, but the average working time decreased from 183 to 107 days. The statistics of production since 1885 are shown in the following table:

Coal product of Cherokee county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	371,930				
1886	375,000				
1887	385,262				
1888	450,000				
1889	549,873	$662,858	$1.20		1,196
1890	724,861	882,186	1.22	186	1,413
1891	832,289	989,785	1.19	180	1,609
1892	825,531	1,009,524	1.22	183	1,777
1893	697,521	805,525	1.15	106	1,978

Coffey county.—The product of Coffey county in 1893 was 1,720 tons, valued at $3,765, against 3,664 tons, valued at $6,8[illegible]0 in 1892. The coal is all consumed locally.

Crawford county.—Coal produced in 1893, 1,195,868 short tons; total value, $1,321,489.

Crawford county is the leading coal-producing county in the State, its output in 1893 being about 45 per cent. of the State's total. Like Cherokee county, its product in 1893 was for the first time less than the preceding year, and for the same reason. The production since 1885 has been as follows:

Coal product of Crawford county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	221,741				
1886	250,000				
1887	298,049				
1888	425,000				
1889	827,159	$991,857	$1.20		1,629
1890	900,464	1,114,701	1.24	198	1,447
1891	997,759	1,090,540	1.09	202	1,785
1892	1,309,246	1,413,423	1.08	213	2,234
1893	1,195,868	1,321,489	1.10	163	2,883

As will be seen from the above statement the amount of coal produced in 1893 was 113,378 short tons less than in 1892, while the value declined $91,934. An increase of 649 is noted in the number of employés, and a decrease of 50 in the average working days.

Franklin county.—The product in 1893 was about the same as in 1892, being 11,768 short tons, valued at $21,650, against 11,150 tons, valued at $20,671. Since 1885 the production has been as follows:

Coal product of Franklin county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	14,518				
1886	15,000				
1887	18,080				
1888	25,000				
1889	37,771	$82,499	$2.18		75
1890	9,045	18,130	2.00	224	47
1891	10,277	19,528	1.90	207	48
1892	11,150	20,671	1.85	180	57
1893	11,768	21,650	1.84	162	57

Labette county.—The only coal mined in Labette county is to supply the local trade at Oswego. The product is reported at 800 tons for the past three years, and sold for $2.50 per ton.

Leavenworth county.—Coal produced in 1893, 309,237 short tons; total value, $477,914.

Leavenworth county did not suffer as seriously from the strike as did the other large producing counties. Four of the five producing mines were affected, but the loss sustained by them was made up in part by increased production at the mines owned by the State and operated by the convicts in the State prison at Lansing. The annual output of the county since 1885 has been as follows:

Coal product of Leavenworth county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	120,561				
1886	160,000				
1887	195,480				
1888	210,000				
1889	245,616	$415,751	$1.69		937
1890	319,866	490,224	1.60	273	745
1891	380,142	530,681	1.40	245	1,073
1892	330,166	528,307	1.60	247	1,020
1893	309,237	477,914	1.55	208	1,145

Linn county.—Three mines contributed to the output of Linn county, which in 1893 was 46,464 tons, valued at $58,853, against 43,913 tons, valued at $55,645, in 1892, an increase of 2,551 tons and $1,208. The annual production since 1885 has been as follows:

Coal product of Linn county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	5,556				
1886	8,900				
1887	12,400				
1888	17,500				
1889	25,345	$33,665	$1.32		62
1890	10,474	14,078	1.34	164	60
1891	38,934	47,901	1.23	236	94
1892	43,913	55,645	1.27	237	115
1893	46,464	56,853	1.22	194	136

Osage county.—Coal produced in 1893, 279,168 short tons; total value, $526,544.

There is only one mine in this county whose product exceeded 25,000 tons in 1893, and this mine produced nearly one-half the total. There were only five other mines producing more than 10,000 tons. A large part of the product is made up from small mines producing from 100 to 1,000 tons, and whose output is used to supply the local trade of Carbondale and Burlingame.

The following table exhibits the annual production of the county since 1885:

Coal product of Osage county, Kansas, since 1885.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1885	370,552				
1886	380,000				
1887	393,608				
1888	415,000				
1889	446,018	$903,602	$2.03		2,032
1890	179,012	242,198	1.35	209	804
1891	355,286	724,232	2.04	270	1,581
1892	372,806	759,225	2.04	202	1,312
1893	279,168	526,544	1.85	145	1,100

KENTUCKY.

Total product in 1893, 3,007,179 short tons; spot value, $2,613,569.

In 1892 the amount of coal produced in Kentucky was 3,025,313 short tons, valued at $2,771,238, which was the largest output in the history of the State. The product in 1893 was only 18,134 tons less than that of 1892, but the value decreased $157,669, due to a decline in the average price from 92 cents to 86 cents. There is a decrease noted in the number of employés from 6,724 to 6,581, and in the average number of days worked from 217 to 202.

Mr. C. J. Norwood, State mine inspector, in his report for 1892 calls attention to some misdirected efforts on the part of some operators to cheapen the cost of mining. Mr. Norwood says:

"Observations for the past year show that in some parts of the coal fields, especially in the eastern one, too much gouging is done (and too little attention paid to drainage), in order to get cheap coal. There is too great a tendency to assume that a certain piece of coal must be worked in just any way—the best way we can—to get it, on account of swags. But it is not the best way, and the consequence is a butchered piece of work; lost coal, because of crushed pillars, or falls of top; wretched conditions for the miner to work under, with respect both to air and drainage, and, in the end, most costly coal. The secret of this, occasionally, is the manager's desire to get a large output at a small cost during his term, without regard for the future. He does not expect to remain after the evil effects of his policy begin to appear, and costly coal comes in; he expects to let his successor bear the odium of costly coal. His successor may contend with the miserable drainage, the crushing pillars, the caving roofs, lost room, etc., and endeavor to recover the lost blocks, and just when success is about to smile upon his efforts, the directors oust him because he is too costly."

Comparing the statistics of production by counties in 1893 with 1892, it will be seen that most of them maintain the same relative positions. Hopkins county, with a slightly reduced product, holds first place, its output exceeding 700,000 tons. Whitley county's output is also slightly decreased, but retains second place, and Ohio county comes third. Each of these counties produced more than 300,000 tons in both years. Muhlenberg's output nearly reached the latter figure, and comes fourth. Laurel fell below 200,000 tons, but did not lose its position. Boyd county ranks sixth, and was nearly tied by Knox county, which replaced Carter county as the seventh in importance. Union county also surpassed Carter county, and Henderson county follows closely.

A comprehensive description of the coal fields of Kentucky, by Prof. John R. Procter, will be found in "Mineral Resources" for 1892.

The statistics of production by counties during 1892 and 1893 are shown in the following tables:

Coal product of Kentucky in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bell	726	355	50	6,840	7,971	$11,957	$1.50	136	30
Boyd	193,270	1,000	200		194,470	146,000	.74	285	300
Butler	18,751	200			18,951	37,902	2.00	192	65
Carter	132,846	4,693	1,812		139,351	179,312	1.29	276	375
Christian	43,870	2,525	1,500		47,895	45,280	.95	210	135
Daviess		8,064			8,064	9,000	1.12	240	10
Hancock	13,393				13,393	33,483	2.50	275	100
Henderson	62,382	17,079	1,200		80,661	69,404	.86	231	150
Hopkins	664,531	18,159	12,113	36,076	730,879	510,340	.70	228	1,292
Johnson	24,343	200			24,543	58,095	2.37	291	157
Knox	102,061	3,600	370		106,031	84,121	.79	185	225
Laurel	228,553	11,166	1,410		241,129	227,385	.94	177	775
Lawrence	95,000	1,000	1,000		97,000	111,550	1.15	295	325
Muhlenberg	269,603	4,902	3,360		277,865	246,364	.89	219	555
Ohio	300,640	6,075	3,574		310,289	256,137	.83	169	818
Pulaski	10,520	370	100		10,990	13,188	1.20	135	45
Rock Castle	9,624	150			9,774	10,556	1.08	120	100
Union	76,038	44,770	6,417		127,225	128,245	1.00	191	313
Webster	35,570	2,437	200		38,207	33,697	.86	194	64
Whitley	338,825	1,240	550		340,615	359,222	1.05	216	890
Small mines		200,000			200,000	200,000	1.00		
Total	2,620,556	327,985	33,856	42,916	3,025,313	2,771,238	.92	217	6,724

Coal product of Kentucky in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bell	16,829	2,001	242	24,599	43,671	$38,006	$0.87	177	194
Boyd	161,706	1,000			162,706	134,144	.82	225	275
Butler	14,134	8,585			22,719	28,399	1.25	224	45
Carter	102,605	2,623	616		105,844	131,315	1.24	222	476
Christian	31,560	1,800	1,200		34,560	33,550	.97	182	143
Daviess		7,546			7,546	10,994	1.46	188	18
Greenup	1,964				1,964	6,004	3.05	100	12
Hancock	5,000				5,000	12,500	2.50	150	25
Henderson	77,624	23,683	2,332		103,639	87,594	.85	185	194
Hopkins	619,618	23,491	13,849	56,851	713,809	468,519	.66	232	1,264
Johnson	6,073	132			6,205	16,357	2.64	281	27
Knox	160,286	1,200	500		161,986	137,097	.85	240	275
Laurel	183,133	9,717	772		193,622	173,114	.89	223	654
Lawrence	93,807	550	875		95,232	131,096	1.38	244	380
McLean									
Muhlenberg	283,181	4,173	2,916		290,270	218,303	.75	173	597
Ohio	304,422	5,011	3,225		312,658	243,120	.78	170	590
Pike									
Pulaski	31,000	21,897			52,897	56,292	1.06	180	108
Rock Castle	9,010				9,010	9,032	1.00	114	70
Union	141,782	13,170	3,242		158,194	150,835	.95	181	332
Webster	34,953	2,646	400		37,999	28,095	.74	215	52
Whitley	334,958	1,890	800		337,648	349,203	1.03	163	850
Small mines		150,000			150,000	150,000	1.00		
Total	2,613,645	281,115	30,969	81,450	3,007,179	2,613,569	.86	202	6,581

The following table exhibits the annual product of the State since 1873.

Annual coal product of Kentucky since 1873.

Years.	Short tons.	Years.	Short tons.
1873	300,000	1884	1,550,000
1874	360,000	1885	1,600,000
1875	500,000	1886	1,550,000
1876	650,000	1887	1,933,185
1877	850,000	1888	2,570,000
1878	900,000	1889	2,399,755
1879	1,000,000	1890	2,701,496
1880	1,000,000	1891	2,916,069
1881	1,100,000	1892	3,025,313
1882	1,300,000	1893	3,007,179
1883	1,650,000		

Bell county.—Bell county's product in 1893 amounted to 43,671 short tons, valued at $38,006, against 7,971 short tons in 1892, valued at $11,957. Most of the product is consumed in the manufacture of coke, 24,599 tons being so used in 1893.

Boyd county—Coal produced in 1893, 162,706 short tons; total value, $134,144.

Boyd county's product is consumed principally by manufacturing establishments at Ashland. During 1893 many of these were closed for part of the year and the output of coal was reduced accordingly. Since 1887 the production has been as follows:

Coal product of Boyd county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	145,945				
1888	(*a*)				
1889	163,124	$179,385	$1.10		
1890	179,600	151,176	.84	281	287
1891	179,350	145,112	.81	287	300
1892	194,470	146,000	.74	285	300
1893	162,706	134,144	.82	225	275

a Not reported.

Butler county.—The amount of coal produced in Butler county in 1893 was 22,719 short tons, valued at $28,399, against 18,951 short tons, valued at $37,902, in 1892. Coal-mining on a commercial scale in Butler county began in 1889. The product is shipped by boats on Green river, there being no railroad communication to the mines.

Carter county.—Coal produced in 1893, 105,844 short tons; total value, $131,315.

Compared with the preceding year, the product of Carter county shows a decrease of 33,507 short tons, with a decrease in value of $47,997, the price declining from $1.29 to $1.24. There was an increase in the number of employés from 375 to 476, but a decrease in the number of working days from 276 to 222.

Coal product of Carter county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	158,021	....	....	....	....
1888	(*a*)	....	....	....	....
1889	172,776	$196,892	$1.14	....	432
1890	179,379	197,027	1.10	237	459
1891	145,937	151,406	1.04	227½	437
1892	139,351	179,312	1.29	276	375
1893	105,844	131,315	1.24	222	476

a Not reported.

Part of the product of Carter county is cannel coal, whose price ranges from $4 to $4.50 per ton at the mines. The output of cannel coal in 1893 was 8,620 tons, against 9,248 tons in 1892.

Christian county.—The product of coal in Christian county during 1893 was 13,335 short tons less than in 1892, the value decreasing $11,730. The following table shows the annual production since 1887:

Coal product of Christian county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	24,507	....	....	....	....
1888	(*a*)	....	....	....	....
1889	27,281	$34,348	$1.26	....	....
1890	35,339	30,271	.86	155	125
1891	34,060	39,373	1.16	187	125
1892	47,895	45,280	.95	210	135
1893	34,560	33,550	.97	182	143

a Not reported.

Daviess county.—The product of coal in Daviess county during 1892 was 7,546 short tons, valued at $10,944, against 8,064 short tons, valued at $9,000, in 1892. All of the product is used to supply the local trade of Greensboro.

Coal product of Daviess county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	35,243	....	....	....	....
1888	(*a*)	....	....	....	....
1889	30,870	$40,231	$1.30	....	....
1890	6,392	8,181	1.27	300	12
1891	6,711	7,149	1.07	264	12
1892	8,064	9,000	1.12	240	10
1893	7,546	10,994	1.46	188	18

a Not reported.

Greenup county.—Greenup county appears for the first time as a coal producer in 1893, with an output of 1,964 short tons of cannel coal, valued at $6,004, or $3.05 per ton.

Hancock county.—The product of Hancock county, with the exception of a small amount of bituminous coal from country banks, is cannel, and amounted in 1893 to 5.000 short tons, valued at $12,500, against 13,393 short tons, worth $33,483, in 1892.

Henderson county.—Coal produced in 1893, 103,639 short tons, valued at $87,594.

The product of Henderson county in 1893 was 22,978 tons more than in 1892, the value increasing $18,190. The annual production since 1887 has been as follows:

Coal product of Henderson county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	50, 912				
1888	(*a*)				
1889	65, 682	$82, 457	$1. 26		148
1890	87, 240	77, 300	. 89	251	131
1891	124, 021	114, 535	. 92	249	231
1892	80, 661	69, 404	. 86	231	150
1893	103, 639	87, 594	. 85	185	194

a Not reported.

Hopkins county.—Coal produced in 1893, 713,809 short tons; total value, $468,519.

Hopkins county ranks first in the State as a coal producer, having about 25 per cent. of the total output. Compared with 1892, the product in 1893 shows a decrease of 17,070 short tons in amount and of $41,821 in value, the average price per ton declining from 70 cents to 66 cents. The number of employés decreased from 1,292 to 1,264, while the average working time increased from 228 to 232 days. The following table shows an annual increase in production since 1887 until 1892, and a steady decline in the price from 1889 to 1893:

Coal product of Hopkins county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	487, 916				
1888	(*a*)				
1889	555, 119	$434, 606	$0. 78		904
1890	604, 307	461, 177	. 76	231	1, 104
1891	680, 386	494, 939	. 73	244	1, 203
1892	730, 879	510, 340	. 70	228	1, 292
1893	713, 809	468, 519	. 66	232	1, 264

a Not reported.

Johnson county.—Coal produced in 1893, 6,205 short tons; total value, $16,357.

Nearly the entire product of Johnson county is cannel coal, but the output has been comparatively limited. The large decrease in 1893 is due to the fact that one mine heretofore credited to Johnson county is reported in 1893 from Lawrence county. The opening is near the boundary line between the two counties.

Coal product of Johnson county, Kentucky, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	(a) 32,347	$54,178	$1.67		
1890	21,222	45,234	2.13	267	110
1891	21,522	49,250	2.28	280	153
1892	24,543	58,095	2.37	291	157
1893	6,205	16,357	2.64	288	27

a Includes 7,555 tons produced from county banks.

Knox county.—Coal produced in 1893, 161,986 short tons; total value, $137,097.

There is but one mine of commercial importance in Knox county. It began operations in 1889, and the product has increased each year since that time.

Coal product of Knox county, Kentucky, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	47,503	$41,000	$0.84		
1890	90,000	69,600	.77	240	200
1891	100,000	100,000	1.00	200	215
1892	106,031	84,121	.79	185	225
1893	161,986	137,097	.85	240	275

Laurel county.—Coal produced in 1893, 193,622 short tons; total value, $173,114.

Compared with the preceding year the product of Laurel county decreased 47,507 short tons, with a decline in value of $54,271, the average price falling from 94 cents to 89 cents per ton.

Coal product of Laurel county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	226,617				
1888	(a)				
1889	280,451	$251,122	$0.90		799
1890	291,178	276,718	.95	225	680
1891	308,242	308,019	1.00	233	798
1892	241,129	227,385	.94	177	775
1893	193,622	173,114	.89	223	654

a Not reported.

Lawrence county.—Coal produced in 1893, 95,232 short tons; total value, $131,696.

The output of Lawrence county was 1,768 short tons less than in 1892, but, owing to an increased production of cannel coal, which commands a higher price, the value increased $19,546. The number of employés increased from 325 to 380, but a decrease is noted in the average number of working days from 295 to 244.

Coal product of Lawrence county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	46,598				
1888	(a)				
1889	79,787	$107,103	$1.34		
1890	100,200	125,000	1.25	280	200
1891	80,848	80,848	1.00	289	300
1892	97,000	111,550	1.15	295	325
1893	95,232	131,096	1.38	244	380

a Not reported.

Muhlenberg county.—Coal produced in 1893, 290,270 short tons; total value, $218,303.

Muhlenberg county ranks fourth in the State as a coal producer. The product has increased annually since 1887, the increase in 1893 over 1892 being 12,405 short tons. The value, however, decreased from $246,364 to $218,303, a loss of $28,061, due to depressed condition of market, a production greater than the demand, and consequent competition for trade at lower prices.

Coal product of Muhlenberg county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	189,511				
1888	(a)				
1889	206,855	$180,654	$0.87		
1890	240,983	193,330	.80	213	495
1891	260,315	219,695	.84	215	586
1892	277,865	246,364	.89	219	555
1893	290,270	218,303	.75	173	597

a Not reported.

Ohio county.—Coal produced in 1893, 312,658 short tons; total value, $243,120.

Ohio county is third in importance of coal production in the State. The product in 1893 was 2,369 more than in 1892, but, as in Muhlenberg county, the value decreased, a decline of 5 cents per ton being noted in the price. During the year strikes of two months' duration occurred at two of the five mines in the county.

Coal product of Ohio county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	150,578				
1888	(a)				
1889	246,253	$200,497	$0.81		
1890	267,736	208,072	.78	236	520
1891	322,411	253,378	.79	225	625
1892	310,289	256,137	.83	169	818
1893	312,658	243,120	.78	170	590

a Not reported.

Pulaski county.—Two mines produced coal in Pulaski county in 1893 and only one in 1892. The product increased from 10,990 short tons, valued at $13,188, in 1892, to 52,897 short tons, worth $56,292.

Rock Castle county.—The product of Rock Castle county is from one mine and amounted to 9,010 short tons in 1893, valued at $9,032, against 9,774 short tons, valued at $10,556, in 1892.

Union county.—Coal produced in 1893, 158,194 short tons; total value, $150,835.

The amount of coal produced in Union county has increased annually since 1887. The product in 1893 was 30,969 short tons more than in 1892, while the value increased $22,590. The average price declined 6 cents per ton, from $1.01 to 95 cents.

Coal product of Union county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	47, 130				
1888	(*a*)				
1889	56, 556	$63, 803	$1. 13		
1890	67, 763	72, 999	1. 08	189	131
1891	86, 678	109, 598	1. 26	161	289
1892	127, 225	128, 245	1. 01	191	313
1893	158, 194	150, 835	. 95	181	332

a Not reported.

Webster county.—Coal produced in 1893, 37,999 short tons; total value, $28,095.

The annual coal product of Webster county has not changed materially in the past five years. The output in 1893 was 208 tons less than in 1892. The value, owing to a decline of 12 cents in the price, decreased $5,602.

Coal product of Webster county, Kentucky, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	32, 729	$26, 379	$0. 80		
1890	33, 016	24, 860	. 78	214	65
1891	33, 883	29, 670	. 88	226	67
1892	38, 207	33, 697	. 86	194	64
1893	37, 999	28, 095	. 74	215	52

Whitley county.—Coal produced in 1893, 337,648 short tons; total value, $349,203.

Whitley county, Kentucky, and Campbell county, Tennessee, form what is known as the Jellico coal field, which produces the well-known coal of that name. It is very popular as a steam producer, is used extensively by railroad locomotives, and considerable quantities are shipped to Savannah, Brunswick, and other seaports for steamboat use. Whitley county is the second largest producing county in Kentucky

The product in 1893 was 2,967 tons less than in 1892, and the value $10,019 less.

The following table shows the annual production of the county since 1887:

Coal product of Whitley county, Kentucky, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	223,337				
1888	(*a*)				
1889	184,874	$203,264	$1.10		
1890	262,541	286,724	1.09	204	625
1891	265,516	315,235	1.19	190	680
1892	340,615	359,222	1.05	216	890
1893	337,648	349,203	1.03	163	850

a Not reported.

Other counties.—In addition to the coal-producing counties before mentioned there are a number of counties whose product is entirely from country banks. There are about 1,800 or 2,000 of these mines. Their individual production is small, but the aggregate output is considerable. Among the counties whose output is limited to country banks are Breathitt, Clay, Edmonson, Elliott, Floyd, Grayson, Harlan, Jackson, Knott, Lee, Leslie, Letcher, McLean, Madison, Magoffin, Martin, Menifee, Morgan, Owsley, Perry, Pike, Powell, Todd, Wayne, and Wolfe.

MARYLAND.

Total product in 1893, 3,317,983 long tons, or 3,716,041 short tons, spot value, $3,267,313. The coal product of Maryland in 1893 exceeded that of 1892 by 264,445 long tons, or 296,079 short tons, but did not come up to the output in 1891, when the total yield was 3,410,928 long tons, or 3,820,239 short tons. The value, however, exceeded that of 1891 by $184,802, and was the largest amount ever reached, except in 1888, when a total of $3,293,070 was obtained. In 1892, owing to a general depression in prices, which prevailed in 1891, the operators in Maryland curtailed their production in order to keep the supply within the demand and by not crowding the market obtain a fair remuneration for their output. The beneficial effects of this action was observed in an advance from 80 cents per ton in 1891 to 89 cents in 1892. The product in 1892 was about 400,000 short tons less than in 1891, but the value remained practically the same. The principal feature of the year's business in 1893 was the placing of the Franklin Consolidated Coal Company in the hands of receivers. The property of the company was afterwards sold for the benefit of creditors, Messrs. Henry G. Davis & Bro., of Baltimore.

According to the statement of the "Cumberland Coal Trade," the output from the mines in Maryland in 1893 was 3,316,010 long tons. Mr.

Frank J. McMahon, State Mine Inspector, gives the product at 3,327,749 long tons. The returns to the survey show a total of 3,317,983 long tons. The differences are so small that they are not worth mentioning.

The following table shows the statistics of production in Maryland since 1889. The figures are reduced to short tons for the sake of uniformity throughout the report.

Coal product of Maryland since 1889.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2, 885, 336	44, 217	10, 162	2, 939, 715	2, 517, 474	$0. 86	....	3, 702
1890	3, 296, 393	52, 621	8, 799	3, 357, 813	2, 899, 572	. 86	244	3, 842
1891	3, 771, 584	36, 959	11, 696	3, 820, 239	3, 082, 515	. 80	244	3, 891
1892	3, 385, 384	30, 955	3, 623	3, 419, 962	3, 063, 580	. 89	225	3, 886
1893	3, 676, 137	26, 833	13, 071	3, 716, 041	3, 267, 317	. 88	240	3, 935

The following table shows the annual output of coal in Maryland since 1883:

Product of coal in Maryland from 1883 to 1893.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1883	2, 476, 075				
1884	2, 765, 617				
1885	2, 833, 337				
1886	2, 517, 577	$2, 391, 698	$0. 95		
1887	3, 278, 023	3, 114, 122	. 95		
1888	3, 479, 470	3, 293, 070	. 95		
1889	2, 939, 715	2, 517, 474	. 86		3, 702
1890	3, 357, 813	2, 899, 572	. 86	244	3, 842
1891	3, 820, 239	3, 082, 515	. 80	244	3, 891
1892	3, 419, 962	3, 063, 580	. 89	225	3, 886
1893	3, 716, 041	3, 267, 317	. 88	240	3, 935

The following tables, showing the shipments from the various mines in Maryland since 1883, and of the total shipments from the Cumberland field (including the West Virginia mines in the field) since 1842, are obtained from the official reports of the Cumberland coal trade. The Maryland mining laws compel the use of the long ton as a basis of measurement, and the quantities in these tables are so expressed:

Shipments of coal from Maryland mines from 1883 to 1893.

[Long tons.]

Companies.	1883.	1884.	1885.	1886.	1887.
Consolidation Coal Co	456,238	689,212	710,064	675,652	936,799
New Central Coal Co	210,850	210,140	203,814	149,561	181,906
Georges Creek Coal and Iron Co	257,490	266,042	257,343	265,942	394,012
Maryland Union Coal Co	137,105	117,180	98,095	116,771	148,523
Borden Mining Co	151,665	162,057	179,537	137,747	192,636
Maryland Coal Co	235,854	295,736	365,319	288,742	316,518
American Coal Co	190,055	194,330	220,339	211,305	259,632
Potomac Coal Co	139,723	169,463	196,280	156,757	209,793
Hampshire and Baltimore Coal Co	194,534	36,416	....	....	....
Atlantic and Georges Creek Coal Co. (Pekin mine)	69,000	75,467	64,938	7,321	....
Swanton Mining Co	34,905	28,620	52,862	42,688	61,610
Blæn Avon Coal Co	84,721	100,961	69,192	65,830	11,934
Piedmont Coal and Iron Co	4,619	1,250	32	1,678	....
Union Mining Co	5,024	5,310	5,641	6,824	7,500
National Coal Co	38,998	42,680	48,307	62,637	117,775
Davis and Elkins mine	....	74,437	58,002	58,382	82,667
James Ryan	....	....	....	....	3,608
George M. Hansel	....	....	....	....	1,989
Total	2,210,781	2,469,301	2,529,765	2,247,837	2,926,902

Companies.	1888.	1889.	1890.	1891.	1892.	1893.
Consolidation Coal Co	1,023,349	871,463	956,031	910,977	912,787	907,559
New Central Coal Co	169,484	118,885	218,169	206,813	201,428	223,504
Georges Creek Coal and Iron Co	437,992	311,258	351,310	356,927	297,632	345,791
Maryland Union Coal Co	106,620	....	....	....	....	....
Borden Mining Co	212,520	206,549	290,055	300,268	253,629	367,725
Maryland Coal Co	340,866	268,438	366,839	406,464	280,946	356,820
American Coal Co	287,058	297,537	386,731	449,631	384,681	443,963
Potomac Coal Co	208,777	205,212	217,232	184,706	137,738	121,258
Atlantic and Georges Creek Coal Co. (Pekin mine)	6,375	3,884	752	....	....	....
Swanton Mining Co	58,383	40,748	41,401	33,029	5,162	....
Blæn Avon Coal Co	....	....	....	....	....	....
Union Mining Co	6,396	3,734	17,933	179,232	176,996	205,210
National Coal Co	76,592	72,571	60,206	....	....	....
Davis and Elkins mine	98,443	18,089	....	....	....	....
James Ryan	....	....	....	....	....	....
George M. Hansel	3,559	113	....	....	....	....
Barton and Georges Creek Valley Co	69,857	123,429	175,838	201,124	201,365	193,545
Enterprise mine	399	288	11	....	....	....
Franklin Consolidated Coal Co	....	71,837	66,644	76,593	72,117	57,598
Big Vein Coal Co	....	21,310	52,917	62,832	66,683	63,940
Piedmont-Cumberland Coal Co	....	2,493	29,003	42,439	14,564	17,869
Anthony Mining Co	....	....	115	9,725	10,665	11,228
Total	3,106,670	2,637,838	3,231,187	3,420,760	3,016,393	3,316,010

Total shipments from the Cumberland coal field in

Years.	Frostburg region. Cumberland and Pennsylvania railroad. By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Total.	Cumberland Coal and Iron Company's railroad. By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1842	757	....	....	757	951	....	951
1843	3,661	....	....	3,661	6,421	....	6,421
1844	5,156	....	....	5,156	9,734	....	9,734
1845	13,738	....	....	13,738	10,915	....	10,915
1846	11,240	....	....	11,240	18,555	....	18,555
1847	20,615	....	....	20,615	32,325	....	32,325
1848	36,571	....	....	36,571	43,000	....	43,000
1849	63,676	....	....	63,676	78,773	....	78,773
1850	73,783	3,167	....	76,950	119,023	875	119,898
1851	70,893	51,438	....	122,331	103,808	31,540	135,348
1852	128,554	46,357	....	174,891	139,925	19,362	159,287
1853	150,381	84,060	....	234,441	155,278	70,535	225,813
1854	148,953	63,731	....	212,684	173,580	92,114	265,694
1855	93,691	77,095	....	170,786	97,710	100,691	198,401
1856	86,994	80,387	....	167,381	121,945	105,149	227,094
1857	80,743	55,174	....	135,917	88,573	54,000	142,573
1858	48,018	166,712	....	214,730	66,009	87,539	153.548
1859	48,415	211,639	....	260,054	72,423	86,203	158,626
1860	70,669	232,278	....	302,947	80,500	63,600	144,100
1861	23,878	68,303	....	92,181	25,983	29,296	55,279
1862	71,745	75,206	....	146,951	41,096	23,478	64,574
1863	117,796	173,269	....	291,065	111,087	43,523	154,610
1864	287,126	194,120	....	481,246	67,676	64,520	132,198
1865	384,297	285,295	....	669,592	104,651	57,907	162,558
1866	592,938	291,019	....	883,957	52,251	52,159	104,410
1867	623,031	385,249	....	1,008,280	40,106	72,904	113,010
1868	659,115	424,406	....	1,083,521	100,345	57,919	158,264
1869	1,016,777	573,243	....	1,590,020	130,017	78,908	208,925
					2,092,660	1,192,224	3,284,884
					Cumberland Branch.		
1870	909,511	520,196	....	1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085	....	1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641.220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,646	170,884	1,399,808	63,181	111,350	174,531
1878	823,801	486,038	145,864	1,455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76.140	275,323
1883	851,985	302,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	299,884	124,718	414,602
1885	1,091,904	171,460	206,227	1,469,591	289,407	117,829	407,236
1886	1,131,949	115,531	141,520	1,389,000	243,321	113,791	357,112
1887	1,584,114	132,177	176,241	1,892,532	332,798	125,305	458,103
1888	1,660,406	155,216	193,046	2,208,668	374,888	95,191	470,079
1889	1,430,381	26,886	177,152	1,634,419	368,497	26,407	394,904
1890	1,511,418	....	291,704	1,803,122	522,334	....	522,334
1891	1,628,574	9,070	289,232	1,926,876	463,142	39,294	502,436
1892	1,426,994	93,705	214,011	1,734,710	349,207	170,116	519,323
1893	1,332,634	135,409	360,807	1,828,850	341,321	201,947	543,268
Total	33,314,636	11,269,772	3,892,026	48,476,434	5,226,934	2,961,428	8,188,362

Maryland and West Virginia from 1842 to 1893.

Frostburg region.				Piedmont region.		Total.			
Georges Creek and Cumberland railroad.									
By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Local and Baltimore and Ohio.	Total.	Georges Creek railroad.	Hampshire railroad, by Baltimore and Ohio railroad.	Baltimore and Ohio railroad and local.	Chesapeake and Ohio canal.	Pennsylvania railroad.	Aggregate.
Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
......	......	......	......	......	......	1,708	......	......	1,708
......	......	......	......	......	......	10,082	......	......	10,082
......	......	......	......	......	......	14,890	......	......	14,890
......	......	......	......	......	......	24,653	......	......	24,653
......	......	......	......	......	......	29,795	......	......	29,795
......	......	......	......	......	......	52,940	......	......	52,940
......	......	......	......	......	......	79,571	......	......	79,571
......	......	......	......	......	......	142,449	......	......	142,449
......	......	......	......	......	......	192,806	4,042	......	196,848
......	......	......	......	......	......	174,701	82,978	......	257,679
......	......	......	......	......	......	268,459	65,719	......	334,178
......	......	......	......	73,725	......	376,219	157,760	......	533,979
......	......	......	......	181,303	......	503,836	155,845	......	659,681
......	......	......	......	227,245	65,570	478,486	183,786	......	662,272
......	......	......	......	269,210	42,765	502,330	204,120	......	706,450
......	......	......	......	252,368	51,628	465,912	116,574	......	582,486
......	......	......	......	218,318	63,060	395,405	254,251	......	649,656
......	......	......	......	257,740	47,934	426,512	297,842	......	724,354
......	......	......	......	289,298	52,564	493,031	295,878	......	788,909
......	......	......	......	85,554	36,660	172,075	97,599	......	269,674
......	......	......	......	69,482	36,627	218,950	98,684	......	317,634
......	......	......	......	266,430	36,240	531,553	216,792	......	748,345
......	......	......	......	......	44,552	399,354	258,642	......	657,996
......	......	......	......	......	71,345	560,293	343,202	......	903,495
......	......	......	......	......	90,964	736,153	343,178	......	1,079,331
......	......	......	......	......	72,532	735,669	458,153	......	1,193,822
......	......	......	......	......	88,658	848,118	482,325	......	1,330,443
......	......	......	......	......	83,724	1,230,518	652,151	......	1,882,669
				2,190,673					
				Empire and West Virginia mines.					
......	......	......	......	28,035	60,988	1,112,938	604,137	......	1,717,075
......	......	......	......	81,218	96,453	1,494,814	850,339	......	2,345,153
......	......	......	......	85,441	121,364	1,517,347	816,103	22,021	2,355,471
......	......	......	......	77,582	103,793	1,780,710	778,802	114,589	2,674,101
......	......	......	......	57,492	109,194	1,576,160	767,064	67,671	2,410,895
......	......	......	......	63.537	90,800	1,302,237	879,838	160,698	2,342,773
......	......	......	......	108,723	7,505	1,070,775	632.440	131,866	1,835,081
......	......	......	......	......	......	818,450	584,996	170,884	1,574,339
......	......	......	......	......	998	924,254	609,204	145,864	1,679,322
......	......	......	......	......	51	1,075,198	501,247	154,264	1,730,709
......	......	......	......	66,573	......	1,319,589	603,125	213,446	2.136,160
83,136	125,097	4,947	213,180	88,722	......	1,478,502	504,818	278,598	2,261,918
78,298	93,861	31,436	203,595	277,929	......	1,085,249	269,782	185,435	1,540,466
215,767	202,223	77,829	495.819	338,001	......	1,444,766	680,119	419,288	2,544,173
69,765	156,959	283,336	510,060	466,928	......	2,233,928	344,954	356,097	2,934,979
79,455	214,518	291,685	585,658	403,489	......	2,076,485	368,744	420,745	2,865,974
53,480	98,371	348,196	500,047	346,308	......	2,069,774	282,802	239,891	2,592,467
4,863	153,230	418,057	576,150	449,011	......	2,724,347	262,345	389,104	3,375,796
112	286,787	341,024	627,923	564,397	......	2,669,216	286,700	715,151	3,671,067
......	365,029	243,487	608,516	576,047	......	2,357,585	57,459	798,842	3,213,886
......	677,593	228,138	905,731	774,904	......	2,723,341	......	1,282,748	4,006,091
......	763,845	229,766	993,111	959,673	......	2,855,225	51,121	1,474,087	4,380,433
......	568,003	236,314	804,317	971,214	......	2,557,177	266,901	1,205,486	4,029,564
......	741,954	201,938	943,892	1,031,797	......	*a* 2,423,159	338,107	1,586,541	4,347,807
584,876	4,447,470	2,935,653	7,967,999	7,717,021	1,475,969	52,759,368	16,110,668	10,533,316	79,403,352

a Includes 108,331 tons used on line of Cumberland and Pennsylvania railroad and its branches, and at Cumberland and Piedmont; also 327,031 tons used by the Baltimore and Ohio railroad in locomotives, rolling mills, etc.

MICHIGAN.

Total product in 1893, 45,979 short tons; spot value, $82,462.

The product of coal in Michigan during 1893 was 32,011 short tons less than in 1892, the value decreasing $38,852. The coal fields of Michigan are not favorable to economic mining. The seams are interstratified with beds of shale, sandstone, and clay. It is only in a few places that a seam of workable thickness exists. In fact there is, so far as known, only one seam that is of workable thickness, ranging from a few inches to 4 feet. Some mining is carried on at Jackson, in Jackson county, and at Grand Ledge, in Clinton county, principally to supply the local trade at those points. Owing to the relative high cost of mining as compared with regions where more favorable conditions exist, the market is restricted to local demand. The production for 1892 and 1893 was as follows:

Coal product of Michigan in 1892 and 1893.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons	*Short tons*	*Short tons*	*Short tons*				
1892	27,200	45,180	5,610	77,990	$121,314	$1.56	230	195
1893	27,787	16,367	1,825	45,979	82,462	1.79	154	162

In the following table is shown the annual product of coal in Michigan since 1887. The largest product was in 1882 when 135,339 tons were mined. Two of the principal mining companies found the business unprofitable and ceased producing in 1883, reducing the product nearly 50 per cent. Since 1883 the output has attained a total of 80,000 tons only twice, in 1888 and 1891.

Product of coal in Michigan from 1877 to 1893.

Years.	Short tons.	Years.	Short tons.
Previous to 1877	350,000	1885	45,178
1877	69,197	1886	60,434
1878	85,322	1887	71,461
1879	82,015	1888	81,407
1880	129,053	1889	67,431
1881	130,130	1890	74,977
1882	135,339	1891	80,307
1883	71,296	1892	77,990
1884	36,712	1893	45,979

MISSOURI.

Total product in 1893, 2,897,442 short tons; spot value, $3,562,757.

The product in 1892 was 2,733,949 short tons, valued at $3,369,659, showing a decrease in 1893 of 163,493 short tons, or 6 per cent. in quantity and of $192,098 in value. The general average in the price of coal for the State was the same as in 1892, although it varied considerably in individual instances and in the county averages.

The coal mining industry of Missouri was only slightly disturbed during the year, except by the general financial depression, which in addition to mild winter weather, caused the decrease in production. It will be observed that there was a considerable increase in the number of employés from 5,893 to 7,375, while the number of working days decreased. This condition was probably due to the same cause as affected the industry in Iowa—the influx of miners from Kansas, thrown out of employment in that State, augmenting the supply of labor and decreasing the number of working days.

An attempt was made to organize a general strike throughout the State in sympathy with the one in Kansas. It was not successful. The men were ordered out on August 7, but they refused to obey the order, except in one or two mines of lesser importance in Bates and Vernon counties, and before the close of the month the strike was declared off. The men in Missouri had no grievance of their own, and very wisely refrained from striking. The places of the men who went out in Bates and Vernon counties were filled by others, so that the mine-owners suffered comparatively little inconvenience.

The coal fields of Missouri were fully described in a paper by Prof. Arthur Winslow, then State Geologist, in "Mineral Resources" for 1892.

Production by counties.—The following tables show the statistics of production of coal in Missouri, by counties, in 1892 and 1893:

Coal product of Missouri in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adair	11,000	38	100	11,138	$19,491	$1.75	300	40
Audrain	10,040	12,748	224	23,012	34,518	1.50	224	60
Bates	561,660	3,510	7,560	572,730	574,622	1.00	207	663
Barton	49,667	204	690	50,561	64,989	1.29	179	149
Boone	10,622	5,014	....	15,636	23,956	1.53	273	38
Caldwell	22,560	6,471	1,775	30,806	67,789	2.20	244	158
Callaway	1,600	20,002	108	21,710	33,831	1,56	243	97
Cooper	1,278	282	160	1,720	3,440	2.00	150	6
Grundy	200	25,275	1,825	27,300	55,965	2.05	275	140
Henry	79,626	9,638	505	89,769	126,393	1.41	219	246
Johnson	4,660	1,020	....	5,680	8,912	1.57	142	25
Lafayette	305,655	16,613	2,580	324,848	520,389	1.60	233	949
Linn	36,968	3,648	6	40,622	63,528	1.56	249	135
Macon	657,776	2,900	7,470	668,146	694,381	1.04	252	1,489
Montgomery	356	15,971	362	16,689	22,750	1.36	195	40
Morgan	....	40	8	48	120	2.50	15	2
Putnam	131,560	1,658	3,840	137,058	187,184	1.37	241	393
Randolph	143,010	4,355	2,243	149,608	160,748	1.07	227	371
Ray	220,044	11,163	4,091	235,298	363,303	1.54	206	694
Saint Clair	6,000	500	....	6,500	9,750	1.50	250	12
Vernon	145,323	2,364	7,383	155,070	158,600	1.02	166	186
Small mines	....	150,000	....	150,000	175,00	1.17	....	....
Total	2,399,605	293,414	40,930	2,733,949	3,369,659	1.23	230	5,893

Coal product of Missouri in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons	*Short tons*	*Short tons*		*Short tons*				
Adair	20,358	192	343	....	20,893	$31,180	$1.49	188	81
Audrain	9,297	27,739	950	....	37,986	53,028	1.40	184	101
Barton	41,600	300	460	....	42,360	47,530	1.12	116	207
Bates	396,476	8,893	4,450	....	409,819	414,806	1.01	162	771
Boone	9,000	2,550	100	....	11,650	18,925	1.62	203	32
Caldwell	14,325	3,078	699	....	18,102	35,849	1.98	223	74
Callaway	1,000	23,240	26	....	24,266	37,333	1.54	218	127
Clay	11,523	315	886	New.	12,724	20,995	1.65	240	55
Cooper	1,461	91	80	....	1,632	3,264	2.00	204	5
Grundy	403	35 230	2,000	....	37,633	77,148	2.05	300	130
Henry	91,700	7,709	1,006	....	100,415	145,754	1.45	225	279
Jasper	....	604	....	New.	604	1,098	1.82	60	7
Johnson	10,100	797	112	....	11,009	15,872	1.44	285	26
Lafayette	321,948	13,550	4,170	....	339,668	516,573	1.52	226	1,148
Linn	80,084	12,039	1,084	....	93,207	151,442	1.62	233	290
Macon	664,461	8,621	15,397	....	688,479	728,900	1.06	232	1,833
Moniteau	20	450	50	New.	520	1,000	1.96	125	3
Montgomery	....	12,000	....	....	12,000	16,200	1.35	200	48
Morgan	....	....	....	....	....	....	......	......	......
Putnam	134,267	1,581	3,734	....	139,582	189,273	1.36	236	460
Randolph	209,808	2,942	1,740	....	214,490	236,571	1.10	191	523
Ray	212,559	6,390	1,469	....	220,418	333,563	1.51	196	636
Saint Clair	336	....	....	....	336	525	1.56	150	2
Vernon	294,501	4,443	10,705	....	309,649	310,928	1.01	126	537
Small mines	....	150,000	....	....	150,000	175,000	......	......	......
Total	2,525,227	322,754	49,461	....	2,897,442	3,562,757	1.23	206	7,375

Coal product of Missouri since 1889, by counties.

Counties.	1889.	1890.	1891.	1892.	1893.	Increase in 1893.	Decrease in 1893.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Adair	18,592	16,000	10,940	11,138	20,893	9,755	....
Audrain	26,194	20,261	8,772	23,012	37,986	14,974	....
Barton	61,167	28,500	85,002	50,561	42,360	....	8,201
Bates	755,989	751,702	628,580	572,730	409,819	....	162,911
Boone	31,405	17,000	16,340	15,636	11,650	....	3,986
Caldwell	13,594	21,599	61,065	30,806	18,102	....	12,704
Callaway	16,053	5,331	22,458	21,710	24,266	2,556	....
Clay	....	....	....	....	12,724	12,724	....
Cooper	996	....	....	1,720	1,632	....	88
Grundy	23,401	24,000	30,000	27,300	37,633	10,333	....
Henry	180,118	109,768	102,866	89,769	100,415	10,646	....
Jasper	720	....	....	....	604	604	....
Johnson	12,841	5,950	4,500	5,680	11,009	5,329	....
Lafayette	348,670	347,688	277,393	324,848	339,668	14,820	....
Linn	6,992	1,300	26,994	40,622	93,207	52,585	....
Mason	446,396	540,061	592,105	668,146	688,479	20,333	....
Moniteau	....	....	....	....	520	520	....
Montgomery	12,300	13,584	16,129	16,689	12,000	....	4,689
Morgan	2,000	650	220	48	....	....	48
Putnam	83,774	108,514	122,666	137,058	139,582	2,524	....
Randolph	221,463	269,372	274,520	149,608	214,490	64,882	....
Ray	220,530	278,118	213,539	235,298	220,418	....	14,880
St. Clair	6,880	5,050	2,500	6,500	336	....	6,164
Vernon	39,420	13,385	48,017	155,070	309,649	154,579	....
Other counties and small mines	28,328	157,388	140,000	150,000	150,000	....	....
Total	2,557,823	2,735,221	2,674,606	2,773,949	2,897,442	163,493	....

Adair county.—Coal produced in 1893, 20,983 short tons; value, $31,180. The product of Adair county in 1893 was 9,755 short tons more than in 1892, while the value increased $11,689.

Coal product of Adair county, Missouri, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	18,592	$30,860	$1.66	....	....
1890	(a) 16,000	27,200	1.70	280	48
1891	10,940	19,175	1.75	300	40
1892	11,138	19,491	1.75	300	40
1893	20,893	31,180	1.49	188	81

a Estimated.

Audrain county.—The output in 1893 was 14,974 short tons more than in 1892, the value increasing $18,510. Of the total output in 1893, 20,800 tons were sold to the Chicago and Alton railroad for locomotive use and 626 tons were used at the mines in making brick.

Coal product of Audrain county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	102,032	....	....	....	....
1888	(a)	....	....	....	....
1889	26,194	$38,490	$1.47	....	....
1890	20,261	32,688	1.61	205	70
1891	8,772	13,723	1.57	180	33
1892	23,012	34,518	1.50	224	60
1893	37,896	53,028	1.40	184	101

a Not reported.

Barton county.—Barton county produced 42,360 short tons in 1893, valued at $47,530, a decrease from 1892 of 8,201 short tons in quantity and $17,459 in value.

Coal product of Barton county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	132,275	....	....	....	....
1888	(a)	....	....	....	....
1889	61,167	$82,655	$1.35	....	182
1890	28,500	30,200	1.06	231	90
1891	85,002	103,780	1.22	221	263
1892	50,561	64,989	1.29	179	149
1893	42,360	47,530	1.12	116	207

a Not reported.

Bates county.—The coal product of Bates county has shown a steady decrease since 1887. The output in 1893 was 162,911 short tons less than in 1891, the value decreasing $159,816. The number of employés increased from 663 to 771, but the average number of working days decreased from 207 to 162.

Coal product of Bates county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	1,071,106	....	....	....	....
1888	(a)	....	....	....	....
1889	755,989	$857,060	$1.14	....	1,500
1890	751,702	767,542	1.02	215	1,315
1891	628,580	654,160	1.04	235	1,077
1892	572,730	574,622	1.00	207	663
1893	409,819	414,806	1.01	162	771

a Not reported.

Boone county.—There are only two mines of commercial importance in Boone county, the product of which in 1893 was 11,650 short tons, valued at $18,925, against 15,636 tons, worth $23,956, in 1892.

Coal product of Boone county, Missouri, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	31,405	$48,244	$1.54	....	82
1890	17,000	25,500	1.50	290	46
1891	16,340	24,510	1.50	257	53
1892	15,636	23,956	1.53	273	38
1893	11,650	18,925	1.62	203	32

Caldwell county.—The product in 1893 was from three mines and amounted to 18,102 short tons, valued at $35,849, a decrease from 1892 of 12,704 short tons and $31,940.

Coal product of Caldwell county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	26,000	....	....	....	....
1888	(a)	....	....	....	....
1889	13,594	$26,810	$1.97	....	....
1890	21,599	42,706	1.98	294	77
1891	51,065	110,008	2.15	230	194
1892	30,806	67,789	2.20	244	158
1893	18,102	35,849	1.98	223	74

Clay county.—Clay county appears in 1893 for the first time as a coal producer, with a product of 12,724 short tons, valued at $20,995.

Callaway county.—The greater part of the product of Callaway county is consumed in the town of Fulton in making brick and for domestic use. The output in 1893 was 24,266 short tons, worth $37,333, against 21,710 short tons the preceding year, valued at $33,831.

Coal product of Callaway county, Missouri, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	16,053	$28,727	$1.79	....	....
1890	5,331	7,996	1.50	218	11
1891	22,458	32,661	1.42	230	90
1892	21,710	33,831	1.56	243	97
1893	24,266	37,333	1.54	218	127

Cooper county.—The product is from one mine, and amounted in 1893 to 1,632 short tons, valued at $3,264, against 1,720 tons in 1892, valued at $3,440.

Grundy county.—The product of Grundy county in 1893 was 10,333 short tons in excess of 1892, with an increase in value of $21,183. The average price per ton has remained unchanged for five years. With the exception of 403 tons, all of the product in 1893 was consumed locally at the town of Trenton.

Coal product of Grundy county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	36,183	....	....	....	....
1888	(*a*)	....	....	....	....
1889	23,401	$47,972	$2.05	....	....
1890	24,000	49,200	2.05	200	50
1891	30,000	61,500	2.05	297	90
1892	27,300	55,965	2.05	275	140
1893	37,633	77,148	2.05	300	130

a Not reported.

Henry county.—The product in 1893 was 100,415 short tons, an increase from 1892 of 10,646 tons. The value increased $19,361, from $126,393 to $145,754.

Coal product of Henry county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	199,777	....	....	....	....
1888	(*a*)	....	....	....	....
1889	180,118	$278,986	$1.55	....	....
1890	109,768	161,995	1.48	207	311
1891	102,866	137,617	1.33	218	286
1892	89,769	126,393	1.41	219	246
1893	100,415	145,754	1.45	225	279

a Not reported.

Jasper county.—Jasper county is credited with 604 short tons in 1893, valued at $1,098. This is the first product reported from Jasper county since 1889, when 720 short tons were mined. The coal is all consumed by the local trade of Webb City.

Johnson county.—The product increased from 5,680 tons, valued at $8,912 to 11,009 short tons, valued at $15,872.

Lafayette county.—Coal produced in 1893, 339,668 short tons; value, $516,573. Lafayette county is the third in the State in importance of coal production. The product in 1893 was 14,820 tons more than that of 1892, while the value decreased $3,816. The shrinkage in value is attributed to overproduction, hard times, and excessive competition.

Coal product of Lafayette county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	352,087				
1888	(a)				
1889	348,670	$557,186	$1.60		1,116
1890	347,688	539,402	1.55	217	1,056
1891	277,393	430,581	1.55	206	850
1892	324,848	520,389	1.60	233	949
1893	339,668	516,573	1.52	226	1,148

a Not reported.

Linn county.—The product increased from 40,622 short tons, valued at $63,528 in 1892 to 93,207 short tons, valued at $151,442 in 1893. The large increase is due to the operations of the Marcelline Coal Company, at Marcelline, reported for the first time in 1893.

Coal product of Linn county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	728				
1888	(a)				
1889	6,992	$13,140	$1.88		
1890	1,300				
1891	26,994	32,018	1.19	240	90
1892	40,622	63,528	1.56	249	135
1893	93,207	151,442	1.62	233	290

a Not reported.

Macon county.—Macon county is the most important coal producer in the State, the output in 1893 being about 25 per cent. of the State's total. Production has been increased annually since 1889, the product in 1893 being 20,333 short tons more than 1892.

Coal product of Macon county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	637,092				
1888	(a)				
1889	446,396	$550,475	$1.23		
1890	540,061	600,373	1.11	259	1,027
1891	592,105	608,974	1.02	228	1,198
1892	668,146	694,381	1.04	252	1,489
1893	688,479	728,900	1.06	232	1,833

a Not reported.

Moniteau county.—A product of 520 short tons, valued at $1,000, is reported from Moniteau county in 1893. This is the first product reported. The coal is of the cannel variety, and consumed principally by the local trade at Versailles.

Montgomery county.—A product of 12,000 tons, valued at $16,200, in 1893 was obtained from one mine, against 16,689 short tons, valued at $22,750. The coal is used for railroad locomotives.

Coal product of Montgomery county, Missouri, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	12,300	$17,449	$1.42	....	....
1890	13,584	18,393	1.35	200	33
1891	16,129	21,842	1.35	260	37
1892	16,689	22,750	1.36	195	40
1893	12,000	16,200	1.35	200	48

Morgan county.—No coal was produced in Morgan county, in 1893 except from country banks. The product in 1889 was 2,000 short tons. It decreased to 650 tons in 1890, to 220 tons in 1891, again to 48 tons in 1892, and ceased altogether in 1892.

Putnam county.—Coal produced in 1893, 139,582 short tons; value, $189,273.

Compared with 1892, the product increased 2,524 short tons, while the value increased $2,089. The product has increased annually since 1889.

Coal product of Putnam county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	117,600	....	....	....	....
1888	(*a*)	....	....	....	....
1889	83,774	$112,089	$1.34	....	....
1890	108,514	140,014	1.31	234	355
1891	122,666	160,508	1.31	196	430
1892	137,058	187,184	1.37	242	393
1893	139,582	189,273	1.36	236	460

a Not reported.

Randolph county.—The product increased from 149,608 short tons, valued at $160,748, in 1892 to 214,490 short tons, valued at $236,571, in 1893, a gain of 64,882 short tons and $73,823.

Coal product of Randolph county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	279,416	....	....	....	....
1888	(*a*)	....	....	....	....
1889	221,463	$285,019	$1.29	....	....
1890	269,372	306,736	1.14	229	635
1891	274,520	291,955	1.06	249	535
1892	149,608	160,748	1.07	227	371
1893	214,490	236,571	1.10	191	523

a Not reported.

Ray county.—Coal produced in 1893, 220,418 short tons; valued at $333,563.

The product in 1893 was 14,880 tons less than in 1892, the value declining $29,740. The price fell off from $1.54 per ton to $1.51 per ton.

Coal product of Ray county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	202,586				
1888	(a)				
1889	220,530	$351,153	$1.57		819
1890	278,118	422,074	1.52	241	687
1891	213,539	346,236	1.62	178	753
1892	235,298	363,303	1.54	206	694
1893	220,418	333,563	1.51	196	636

a Not reported.

Saint Clair county.—The product of Saint Clair county in 1893 was only 336 short tons, valued at $525, against 6,500 tons, worth $9,750, in 1892.

Vernon county.—The coal product in 1893 was nearly 100 per cent. more than in 1892, and makes Vernon county the fourth in the State. The increase in 1892 was more than 100,000 tons larger than in 1891. The following table shows the annual output since 1887:

Coal product of Vernon county, Missouri, since 1887.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1887	22,344				
1888	(a)				
1889	39,420	$46,506	$1.18		
1890	13,385	16,183	1.20	118	44
1891	48,017	50,004	1.04	131	139
1892	155,070	158,600	1.02	166	186
1893	309,649	310,928	1.01	126	537

a Not reported.

MONTANA.

Total product in 1893, 892,309 short tons; spot value, $1,772,116.

Montana's coal product in 1893 exceeded by more than 50 per cent. the output of any previous year. This was due chiefly to extensive improvements being made in the Sand Coulee mines in Cascade county, the introduction of mining machines, and otherwise increasing their capacity. The result was that the product of the county more than doubled that of 1892. Increased activity was also manifested at the mines of Park county, which increased their output about 20 per cent. These two counties produced nearly 825,000 tons of the total product of 892,309 tons.

The increased production was obtained at a lower cost of mining, and the average price per ton obtained declined accordingly from $2.36 in

1892 to $1.99 in 1893, so that, although the amount of coal produced increased 327,661 tons, or about 58 per cent., the value increased only 33 per cent.

In the following tables are shown the statistics of production in the State, by counties, for 1892 and 1893:

Coal product of Montana in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons	Short tons	Short tons	Short tons	Short tons				
Cascade	241,596	524	....	....	242,120	$484,320	$2.00	275	426
Choteau	200	1,366	8	....	1,574	6,338	4.03	118	12
Dawson	....	335	....	....	335	1,000	3.03	100	2
Fergus	....	350	50	....	400	2,100	5.25	50	6
Gallatin	59,146	461	1,591	....	61,198	152,496	2.50	298	146
Meagher	....	30	....	....	30	120	4.00	60	1
Park	220,579	1,800	200	36,412	258,991	684,473	2.64	224	565
Total	521,521	4,866	1,849	36,412	564,648	1,330,847	2.36	258	1,158

Coal product of Montana in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	Short tons.	Short tons.	Short tons.	Short tons.				
Cascade	493,355	15,105	8,000	....	516,460	$906,640	$1.76	247	634
Choteau	1,596	3,529	170	....	5,295	20,953	3.96	93	36
Dawson	....	440	....	....	440	1,320	3.00	96	5
Deerlodge	....	....	....	....	....	....	......	......	......
Fergus	....	200	....	....	200	1,200	6.00	50	3
Gallatin	61,209	564	1,390	....	63,163	348,021	2.34	278	151
Lewis and Clarke	....	125	....	....	125	666	5.33	150	2
Meagher	....	100	....	....	100	500	5.00	140	2
Park	233,356	7,000	8,400	57,770	306,526	691,816	2.31	240	568
Yellowstone	....	....	....	....	....	....	......	......	......
Total	789,516	27,063	17,960	57,770	892,309	1,772,116	1.99	242	1,401

The following table shows the total output of coal in Montana since 1883, and the value of the product in the past four years.

Product of coal in Montana since 1883.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1883	19,795	....	1889	363,301	....
1884	80,376	....	1890	517,477	$1,252,492
1885	86,440	....	1891	541,861	1,228,630
1886	49,846	....	1892	564,648	1,330,847
1887	10,202	....	1893	892,309	1,772,116
1888	41,467	....			

Cascade county.—Coal produced in 1893, 516,460 short tons; spot value, $906,640.

The product of Cascade county in 1893 exceeded that of 1892 by 274,340 short tons or 113 per cent. The large increase is due to the more extended development of the Sand Coulee mines operated by the Great Northern Railroad Company. The mines have been equipped with Harrison mining machines, and have at present a daily capacity of over 2,000 tons. By reason of the increased capacity of these mines the cost of mining was reduced and in consequence the price to the consumer was also reduced, the average for the year being 1.76 cents against $2 in 1892. The total product of Cascade in 1893 was within 10 per cent. of the total output of the State in 1892.

Coal product of Cascade county, Montana, since 1889.

Years.	Short tons.	Value.	Average price per ton	Number of days active.	Number of men employed.
1889	166,480	$339,226	$2.04		
1890	200,435	406,748	2.03		379
1891	198,107	296,219	2.00		401
1892	242,120	484,320	2.00	275	426
1893	516,460	906,640	1.76	247	634

Choteau county.—Coal produced in 1893, 5,295 short tons; spot value, $20,953.

The product in 1893 was 3,721 tons more than in 1892. Most of the coal is lignite, and is consumed principally for domestic purposes by the local trade at Havre.

Coal product of Choteau county, Montana, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	820	$2,160	$2.64		
1890	800	2,000	2.50		6
1891	478	1,723	3.60		10
1892	1,574	6,338	4.03	118	12
1893	5,295	20,953	3.96	93	36

Dawson county.—Dawson county produces a limited amount of lignite annually for local use at Glendive and to supply the demand of farmers and ranchmen in the neighborhood.

Coal product of Dawson county, Montana, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	733	$1,900	$2.59		
1890	1,250	5,740	4.56		8
1891	250	625	2.50		1
1892	335	1,000	3.00	100	2
1893	440	1,320	3.00	96	5

Fergus county.—The product of Fergus county is lignite and is used by the citizens of Lewiston for domestic purposes. The output is small, being 200 tons in 1893, against 400 tons in 1892 and 250 tons in 1891.

Gallatin county.—Coal produced in 1893, 63,163 short tons; spot value, $148,021.

The principal producing mines in Gallatin county are the Timberline mines, operated by C. W. Hoffman, under lease from the Northern Pacific Coal Company. The product of the county has increased annually since 1889, though the value of the product in 1893 was less than that of the preceding year.

Coal product of Gallatin county, Montana, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	43, 838	$104, 377	$2. 38	....	....
1890	51, 452	119, 084	2. 31	....	120
1891	56, 981	135, 893	2. 38	....	139
1892	60, 998	152, 496	2. 50	298	146
1893	63, 163	148, 021	2. 34	278	151

In addition to the Timberline mines there is one of considerable local importance operated by Johnson & McCarthy, at Bozeman, and the Mountain Side mines, at Mountain Side, 17 miles from Bozeman, are of a promising nature, but for lack of railroad transportation are restricted to a local market.

Lewis and Clarke county.—A product of 125 tons was reported from this county in 1893. It was used entirely for the local trade of Augusta.

Park county.—Coal produced in 1893, 306,526 short tons; spot value, $691,816.

Until the past year Park county has been the chief coal-producing county in the State, but the greatly increased operations at the Sand Coulee mines in 1893 in Cascade county put that county in the lead. The mines of Park county, however, are increasing their output, as the following table shows:

Coal product of Park county, Montana, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	147, 300	$421, 950	$2. 86	....	....
1890	252, 737	690, 870	2. 73	....	705
1891	285, 745	692, 570	2. 43	....	562
1892	258, 991	684, 473	2. 64	241	565
1893	306, 526	691, 816	2. 31	240	568

The principal mines in the county are the Rocky Fork, operated by the Rocky Fork Coal Company, at Red Lodge; the Horr, worked by the Park Coal and Coke Company, at Horr, and the Cokedale mines, operated by the Livingston Coal and Coke Company, at Cokedale. A fire occurred in the Cokedale mines in October, but it was promptly drowned out, the water again pumped out and within two weeks after the fire started work was resumed. Park county is the only coke producing county in the State, 57,770 tons of coal being made into coke in 1893.

Meagher county.—Meagher county produced 100 tons in 1893, against 30 tons in 1892. The market for the coal is limited to the local trade of Castle.

NEBRASKA.

No product was reported from Nebraska in 1893. A discovery of a vein of coal was reported in the neighborhood of Dering, and a force of men was put to work sinking a shaft to the vein, said to be 30 inches thick. Another find of a vein 4 feet in thickness was reported near Plattsmouth. The State has offered a bounty to the discoverer of a vein of coal of good quality and workable thickness.

NEW MEXICO.

Total production in 1893, 665,094 short tons; spot value, $979,044.

The difference between the amount of coal produced in New Mexico in 1892 and 1893 was less than 1 per cent., that of 1893 being the larger by 4,764 tons. The value, however, showed a decrease of nearly $100,000, the average price per ton declining from $1.62 to $1.47.

There were no strikes reported and the condition of the industry, notwithstanding the decline in value, was of a satisfactory nature. The principal feature of the year's business was the extensive development of the mines of Santa Fe county, whose product more than trebled, and the cessation of operations in Socorro county.

The following tables exhibit the statistics of production in 1892 and 1893, by counties:

Coal products of New Mexico in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Bernalillo	245,738	1,425	1,748	248,911	$361,651	$1.45	179	449
Colfax	294,565	1,565	1,781	297,911	393,426	1.33	261	370
Lincoln	....	3,045	100	3,145	12,990	4.15	110	17
Rio Arriba	20,000	....	600	20,600	30,900	1.50	270	35
San Juan	....	200	....	200	200	1.00	50	2
Santa Fe	33,360	2,340	1,080	36,780	96,700	2.63	267	30
Socorro	51,894	201	1,688	53,783	178,734	3.43	253	180
Total	645,557	8,776	6,997	661,330	1,074,601	1.62	223	1,083

Coal product of New Mexico in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bernalillo	275,993	808	1,890	....	278,691	$396,106	$1.42	196	370
Colfax	246,936	1,339	1,508	....	249,783	301,503	1.31	248	272
Lincoln	....	1,962	....	....	1,962	7,698	3.92	78	12
Rio Arriba	15,000	100	400	....	15,500	20,150	1.30	250	25
San Juan	....	210	....	....	210	245	1.17	60	3
Santa Fe	98,073	1,143	4,978	14,698	118,892	253,242	2.13	257	328
Socorro									
Union	....	56	....	....	56	100	1.79	50	1
Total	636,002	5,618	8,776	14,698	665,094	979,044	1.47	229	1,011

The following table shows the annual output of the Territory since 1882, with the value of the product since 1885. It is probable, however, that the values given for years prior to 1889 are too high. They were estimated on a basis of $3 per ton, which was evidently excessive.

Coal product of New Mexico since 1882.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1882	157,092	....	1888	626,665	1,879,995
1883	211,347	....	1889	486,943	872,628
1884	220,557	....	1890	375,777	504,390
1885	306,202	$918,606	1891	462,328	779,018
1886	271,285	813,855	1892	661,230	1,074,251
1887	508,034	1,524,102	1893	665,094	979,044

Bernalillo county.—Coal produced in 1893, 278,691 short tons; spot value, $396,106.

Bernalillo county took first place in the Territory as a coal-producer in 1893, superseding Colfax county. The product was 29,780 short tons more than in 1892, with an increase in value of $34,455.

Coal product of Bernalillo county, New Mexico, since 1882.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1882	33,373	....	....	....	....
1883	42,000	....	....	....	....
1884	62,802	....	....	....	....
1885	97,755	....	....	....	....
1886	106,530	....	....	....	....
1887	275,952	....	....	....	....
1888	300,000	....	....	....	....
1889	233,059	$395,892	$1.70	....	....
1890	181,647	207,948	1.14	....	375
1891	76,515	113,175	1.47	....	187
1892	248,911	361,651	1.45	179	449
1893	278,691	396,106	1.42	196	370

Colfax county.—Coal produced in 1893, 249,783 short tons; total value, $301,503.

There was a general decrease in the coal-mining industry of Colfax county. The product decreased 48,128 short tons; the value fell off $91,923; the price declined from $1.33 to $1.21; the number of employés decreased from 370 to 272, and the average working time from 261 to 248.

Coal product of Colfax county, New Mexico, since 1882.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1882	91,798				
1883	112,089				
1884	102,513				
1885	135,833				
1886	87,708				
1887	154,875				
1888	227,427				
1889	151,464	$201,027	$1.33		
1890	151,400	198,500	1.31		360
1891	295,089	399,432	1.35		384
1892	297,911	393,426	1.33	261	370
1893	249,783	301,503	1.21	248	272

Lincoln county.—The limited product of Lincoln county is mined to supply a local demand and for operating the Homestake gold mine at White Oaks.

Coal product of Lincoln county, New Mexico, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	1,255	$3,138	$2.50		
1890	1,175	5,415	4.60		11
1891	1,000	5,000	5.00		2
1892	3,045	12,640	4.15	180	10
1893	1,962	7,698	3.92	78	12

Rio Arriba county.—Coal product in 1893, 15,500 short tons; spot value, $20,150.

The output in 1893 was 5,100 tons less than in 1892, while the value decreased $10,750, the price declining from $1.50 to $1.30. The coal is consumed principally by locomotives of the Denver and Rio Grande railroad.

Coal product of Rio Arriba county, New Mexico, since 1882.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1882	12,000				
1883	17,240				
1884	11,203				
1885	14,958				
1886	7,000				
1887	11,000				
1888	12,000				
1889	13,650	$24,843	$1.82		
1890	12,175	21,000	1.72		20
1891	7,350	14,350	1.95		20
1892	20,600	30,900	1.50	270	35
1893	15,500	20,150	1.30	250	25

San Juan county.—A small amount of coal is mined for local use. The product in 1892 was 200 tons and in 1893, 210 tons.

Santa Fe county.—Coal produced in 1893, 118,892 short tons; spot value, $253,242.

The product in 1893 was more than three times the amount reported in 1892, due to the Cerrillos Coal Railroad Company securing control of a number of mines at Madrid and operating them on a extensive scale.

Coal product of Santa Fe county, New Mexico, since 1882.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1882	3,600				
1883	3,000				
1884	3,000				
1885	1,000				
1886	1,000				
1887	7,500				
1888	25,200				
1889	34,870	$74,666	$2.14		
1890	22,770	52,190	2.29		55
1891	16,500	35,100	2.13		36
1892	36,780	96,700	2.63	267	30
1893	118,892	253,242	2.13	257	328

Santa Fe county is the only county where anthracite coal is produced west of the Mississippi river, except Gunnison county, Colorado, and a little semi-anthracite in Arkansas. The product of anthracite in 1893 was 9,982 tons against 3,100 tons in 1892. In addition to this, 73,217 tons of semi-anthracite was produced, the remainder of the product being bituminous.

Union county.—A product of 56 tons was mined in Union county in 1893, the first reported from this county.

Socorro county.—No product was reported from Socorro county in 1893. The output in previous years was as follows:

Coal product of Socorro county, New Mexico, since 1882.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1882	16,321				
1883	37,018				
1884	41,039				
1885	56,656				
1886	69,047				
1887	58,707				
1888	62,038				
1889	52,205	$171,807	$3.29		
1890	(a)50,000	162,500	3.25		
1891	65,574	211,361	3.22		175
1892	53,783	178,734	3.43	253	180

a Estimated.

NORTH CAROLINA.

Total product in 1893, 17,000 short tons; spot value, $25,500. During 1892 a fire occurred in the coal mines at Egypt Depot, and the output of that year was consequently greatly reduced. In 1893 the mines were operated only for a brief period (about three months), as the facilities for mining and handling the coal were found inadequate, and operations were temporarily suspended for the purpose of introducing new machinery and making alterations in the openings at the bottom of the shaft, which prevented advantageous mining. It is expected that with the completion of the improvement the capacity of the mine will reach 500 tons per day.

The statistics of production for the past three years and the total product since 1889 are shown in the following tables:

Coal product of North Carolina in 1891, 1892, and 1893.

Distribution.	1891.	1892.	1893.
	Short tons.	*Short tons.*	*Short tons.*
Loaded at mines for shipment	18,780	6,679	15,000
Sold to local trade and used by employés	600		
Used at mines for steam and heat	975		2,000
Total product	20,355	6,679	17,000
Total value	$39,635	$9,599	$25,500
Total number of men employed	80	90	70

Coal product of North Carolina since 1889.

Years.	Short tons.	Value.
1889	192	$451
1890	10,262	17,864
1891	20,355	39,635
1892	6,679	9,599
1893	17,000	25,500

NORTH DAKOTA.

Total product in 1893, 49,630 short tons; spot value, $56,250.

The total amount of coal produced in North Dakota and 1892 was 40,725 short tons, valued at $39,250, showing an increase in the output of 1893 of 8,905 short tons and $17,000. Indications are that the product in 1894 will be considerably more. In Stark county the owners of the principal mine have put in extensive improvements and have been given rates for transportation which will enable the operators to lay down their product in Fargo at remunerative prices. In Ward county also additional facilities have been obtained for transporting the product, and improvements are being made which, it is reported, will increase the capacity from 50 to 200 tons per day.

All of the coal produced in the State is lignite, which burns readily, with about two-thirds the steam-raising power as the average bituminous coal.

The following tables show the statistics of production in 1892 and 1893 by counties, and the total production of the State since 1884:

Coal product of North Dakota in 1892.

Distribution.	Short tons.
Loaded at mines for shipment	38,000
Sold to local trade and used by employés	2,725
Total product	40,725
Total value	$39,250
Number of men employed	54
Number of days active	216

Coal product of North Dakota in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Morton	19,000			19,000	20,900	$1.10	169	35
Stark	23,968	1,112		25,080	24,250	.97	227	41
Ward	5,000	500	50	5,550	11,100	2.00	150	12
Total	47,968	1,612	50	49,630	56,250	1.13	193	88

Coal product of North Dakota since 1884.

Years.	Short tons.	Years.	Short tons.
1884	35,000	1889	28,907
1885	25,000	1890	30,000
1886	25,955	1891	30,000
1887	21,470	1892	40,725
1888	34,000	1893	49,630

OHIO.

Total product in 1893, 13,253,646 short tons; spot value, $12,351,139.

The production of coal in Ohio in 1892 amounted to 13,562,927 short tons, valued at $12,722,745. This indicates a decrease in 1893 of 309,281 short tons in product and of $371,606 in value. The average price per ton declined from 94 cents to 92 cents. The statistics of labor show that there were 23,931 men employed in the mines in 1893, against 22,576, but the average working time decreased from two hundred and twelve to one hundred and eighty-eight days. In 1892 there were 27 counties producing coal from commercial mines. In 1893 the number was reduced to 26, Noble county not having any output reported. In 1892 there were 16 counties whose output increased over 1891 and 11 counties in which the amount was less, the aggregate increases amounting to 1,423,388 tons, and the total decreases to 729,144 tons, making a net increase of 694,244 tons. In 1893 there were only 7 counties whose product exceeded that of 1892, the total increases amounting to 520,764 short tons, while 20 counties (including Noble county, which did not produce any) had a lessened output, the total decreases aggregating 830,045 tons, and making the net decrease in the State 309,281 tons.

The more important increases were in Athens county, 196,820 tons; Jefferson county, 145,302 tons; Medina county, 51,660 tons; and Stark county, 69,593 tons. The counties in which the decreases exceeded 50,000 tons were Belmont, 63,657 tons; Carroll, 105,728 tons; Columbiana, 53,441 tons; Hocking, 149,751 tons; Summit, 118,858 tons; and Tuscarawas, 78,688 tons.

There were 3 counties whose output in 1893 exceeded 1,500,000 tons, Athens, Hocking, and Jackson, their combined output aggregating over 5,000,000 tons. Two others, Jefferson and Perry, produced over 1,000,000 tons each. Belmont and Stark counties each produced more than 900,000 tons. Only one other (Tuscarawas) exceeded 500,000 tons, and two (Columbiana and Guernsey) exceeded 400,000 tons. Four counties, Carroll, Coshocton, Meigs, and Muskingum, each produced over 200,000 tons, and two others, Mahoning and Medina, produced more than 100,000 tons.

The production of the State, by counties, in 1892 and 1893 is shown in the following tables:

Coal product of Ohio in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Athens	1,351,794	29,978	7,100	11,993	1,400,865	$1,196,225	$0.85	193	2,536
Belmont	837,926	189,031	3,783	6,960	1,037,700	870,393	.84	224	1,713
Carroll	365,819	700	536	....	367,055	303,752	.83	214	595
Columbiana	484,089	14,307	5,311	17,048	520,755	469,198	.90	223	932
Coshocton	215,877	12,450	400	....	228,727	232,024	1.01	229	386
Gallia	18,500	500	....	....	19,000	17,500	.92	220	38
Guernsey	441,297	7,600	7,100	....	455,997	330,742	.72	229	800
Harrison	....	3,220	....	....	3,220	4,820	1.50	179	9
Hocking	1,733,250	51,157	2,396	....	1,786,803	1,514,265	.85	216	2,099
Jackson	1,730,135	89,578	14,197	....	1,833,910	1,831,443	.99	214	3,347
Jefferson	828,677	97,213	4,045	2,542	932,477	761,273	.92	208	1,544
Lawrence	60,936	10,440	....	....	71,376	75,571	1.06	263	247
Mahoning	190,873	10,630	3,602	....	205,105	291,089	1.41	206	484
Medina	101,240	....	200	....	101,440	124,613	1.23	255	175
Meigs	121,790	141,659	2,597	....	266,044	299,626	1.13	190	636
Morgan	12,000	....	....	....	12,000	9,000	.75	160	20
Muskingum	166,603	10,835	....	....	177,488	161,038	.91	192	356
Noble	200	100	....	....	300	300	1.00	40	5
Perry	1,401,799	31,206	19,974	....	1,452,979	1,239,268	.85	187	2,380
Portage	69,832	3,766	2,800	....	76,398	116,243	1.52	207	204
Stark	811,808	15,709	29,090	....	856,607	1,044,674	1.22	199	1,776
Summit	138,213	9,215	419	....	147,847	211,839	1.43	221	406
Trumbull	27,537	1,650	1,000	....	30,187	46,577	1.54	205	86
Tuscarawas	701,316	65,769	10,130	....	777,215	660,987	.85	224	1,300
Vinton	70,307	12,206	600	....	83,113	84,756	1.02	198	197
Washington	42,120	2,584	16	....	44,720	32,443	.73	189	109
Wayne	71,318	91	2,190	....	73,599	93,086	1.30	166	196
Small mines	....	600,000	....	....	600,000	700,000	1.17	....	....
Total	11,995,256	1,411,642	117,486	38,543	13,562,927	12,722,745	.94	212	22,576

Coal product of Ohio in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Athens	1,528,894	18.563	26,811	23,417	1,597,685	$1,321,841	$0.83	162	3,203
Belmont	825,834	145,331	2,878		974,043	787,419	.81	199	1,684
Carroll	261,169		158		261,327	227,337	.87	166	652
Columbiana	460,075	4,459	2,780		467,314	412,599	.88	210	964
Coshocton	236,069	6,136	2,400		244,605	243,920	1.00	233	398
Gallia	11,109	284			11,393	10,399	.91	176	36
Guernsey	365,641	39,986	6,768		412,395	294,738	.71	176	993
Harrison		2,640			2,640	2,840	1.08	124	10
Hocking	1,601,109	18,940	17,003		1,637,052	1,343,231	.82	193	2,072
Jackson	1,704,601	96,546	25,425		1,826,572	1,933,116	1.06	201	3,188
Jefferson	955,914	116,810	3,891	1,164	1,077,779	848,449	.79	194	2,033
Lawrence	23,238	13,274			36,512	34,290	.94	143	142
Mahoning	157,503	14,603	1,598		173,704	249,903	1.44	196	419
Medina	146,700	5,200	1,200		153,100	191,725	1.25	228	349
Meigs	127,999	93,478	7,057		228,534	250,919	1.10	142	601
Morgan		10,000			10,000	7,500	.75	204	30
Muskingum	174,772	31,194			205,966	171,082	.83	214	388
Perry	1,389,250	27,591	21,282		1,438,123	1,218,789	.85	178	2,585
Stark	861,708	24,107	40,385		926,200	1,149,243	1.24	161	2,105
Summit	21,403	7,580	6		28,989	50,244	1.73	256	90
Trumbull	15,116	565			15,681	24,153	1.54	128	53
Portage	84,269	3,202	1,960		89,431	138,561	1.55	217	252
Tuscarawas	639,209	56,604	2,510	204	698,527	588,458	.84	234	1,329
Vinton	61,374	10,902	700		72,976	70,562	.97	200	179
Washington		646			646	571	.88	61	8
Wayne	60,160	102	2,190		62,452	79,251	1.27	167	168
Small mines		600,000			600,000	700,000	1.17		
Total	11,713,116	1,348,743	167,002	24,785	13,253,646	12,351,139	.92	188	23,931

The following table shows the annual output of the State since 1884 by counties:

Coal product of Ohio since 1884, by counties.

Counties.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	627,944	823,139	899,046	1,083,543	1,336,698
Belmont	643,129	744,446	573,779	721,767	1,108,106
Columbiana	469,708	462,733	336,063	516,057	466,191
Coshocton	56,562	99,609	52,934	124,791	167,903
Carroll	102,531	150,695	216,630	293,328	355,097
Guernsey	375,427	297,267	433,800	553,613	383,728
Gallia	20,372	16,383	17,424	15,365	16,722
Holmes	12,052	11,459	12,670	10,526	8,121
Hocking	372,694	656,441	741,571	853,063	1,086,538
Harrison			5,509	4,032	2,865
Jackson	831,720	791,608	856,740	1,134,705	1,088,761
Jefferson	316,777	271,329	275,666	293,875	243,178
Lawrence	176,412	145,916	166,933	143,559	137,806
Medina	77,160	152,721	252,411	225,487	198,452
Meigs	248,436	234,756	192,263	185,205	242,483
Muskingum	84,398	86,846	96,601	171,928	211,861
Mahoning	241,599	275,944	313,040	272,349	231,035
Morgan	7,636	5,536	4,370	4,100	
Noble			3,342	6,320	6,200
Perry	1,379,100	1,259,592	1,607,666	1,870,840	1,736,805
Portage	65,647	77,071	70,339	65,163	70,923
Sciota	3,650	2,440			
Stark	513,225	391,418	593,422	784,164	793,227
Summit	253,148	145,134	82,225	95,815	112,024
Tuscarawas	317,141	285,545	267,666	506,466	546,117
Trumbull	257,683	264,517	188,531	167,989	157,826
Vinton	69,740	77,127	60,013	89,727	108,695
Wayne	120,571	81,507	109,057	105,150	91,157
Washington	5,600	5,000	5,500	1,880	2,432
Total	7,640,062	7,816,179	8,435,211	10,300,807	10,910,951

Coal product of Ohio since 1884, by counties—Continued.

Counties.	1889.	1890.	1891.	1892.	1893.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	1,224,186	1,205,455	1,482,294	1,400,865	1,597,685
Belmont	641,862	774,110	819,236	1,037,700	974,043
Carroll	351,782	328,967	313,543	367,055	261,327
Columbiana	596,824	567,595	621,726	520,755	467,314
Coshocton	166,599	177,700	189,469	228,727	244,605
Gallia	23,208	16,512	17,493	19,000	11,393
Guernsey	362,168	413,739	390,418	455,997	412,395
Harrison	33,724	8,600	3,960	3,220	2,640
Hocking	845,049	1,319,427	1,515,719	1,786,803	1,637,052
Holmes	9,423				
Jackson	926,874	970,878	1,475,939	1,833,910	1,826,572
Jefferson	271,830	491,172	697,193	932,477	1,077,779
Lawrence	102,656	77,004	76,235	71,376	36,512
Mahoning	240,563	256,319	200,734	205,105	173,704
Medina	136,061	139,742	160,184	101,440	153,100
Meigs	220,277	255,365	282,094	266,044	228,534
Monroe	20,725	1,000			
Morgan	8,060			12,000	10,000
Muskingum	214,005	229,719	160,154	177,488	205,966
Noble	38,400	6,850	3,800	300	
Perry	1,565,786	1,921,417	1,785,626	1,452,979	1,438,123
Portage	78,117	70,666	69,058	76,398	89,431
Stark	851,994	836,449	917,995	856,607	926,200
Summit	50,726	112,997	140,079	147,847	28,989
Trumbull	108,120	47,714	83,950	30,187	15,681
Tuscarawas	683,505	589,875	736,297	777,215	698,527
Vinton	102,040	80,716	98,166	83,113	72,976
Washington	18,045	5,990	5,950	44,720	646
Wayne	84,178	38,528	21,371	73,599	62,452
Small mines		550,000	600,000	600,000	600,000
Total	9,976,787	11,494,506	12,868,683	13,562,927	13,253,646

From the above table the following statement showing the annual increases and decreases in the coal product of each county is deduced:

Comparative statistics of coal production in Ohio, by counties, from 1886 to 1893.

[Short tons.]

Counties.	1887 compared with 1886.		1888 compared with 1887.		1889 compared with 1888. (*a*)	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
Athens	184,497		253,155			112,512
Belmont	147,988		386,339			466,244
Carroll	76,698		61,784			3,315
Columbiana	179,994			49,866	130,633	
Coshocton	71,857		43,112			1,304
Gallia		2,059	1,357		6,486	
Guernsey	119,813			169,885		21,560
Harrison		1,477		1,167	30,859	
Hocking	111,492		233,475			241,489
Holmes		2,144		2,405	1,302	
Jackson	278,865			45,944		161,887
Jefferson	18,209			50,697	28,652	
Lawrencé		23,374		5,753		35,150
Mahoning		40,691		41,314	9,528	
Medina		26,924		27,035		62,391
Meigs		7,058	57,278			22,206
Monroe					(*d*)20,725	
Morgan		270		4,100	(*d*)8,060	
Muskingum	75,327		39,933		2,144	
Noble	2,978			120	32,200	
Perry	263,175			134,035		171,019
Portage		5,176	5,760		7,194	
Stark	190,742		9,063		58,767	
Summit	13,590		16,209			61,298
Trumbull		20,542		10,163		49,706
Tuscarawas	238,800		39,651		137,388	
Vinton	29,714		18,968			6,655
Washington		3,620	552		15,613	
Wayne		3,907		13,933		6,979
Total	2,003,739	137,242	1,166,636	556,477	489,551	1,423,715
Net increase or decreaso	1,866,497		610,159			934,164

Comparative statistics of coal production in Ohio, etc.—Continued.

[Short tons.]

Counties.	1890 compared with 1889. (*b*)		1891 compared with 1890.		1892 compared with 1891.		1893 compared with 1892.	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
Athens	....	18,731	276,839	....	....	81,429	196,820	....
Belmont	132,248	....	45,126	....	218,464	....	....	63,657
Carroll	....	22,815	....	15,424	53,512	....	....	105,728
Columbiana	....	29,229	54,131	....	....	100,971	....	53,441
Coshocton	11,101	....	11,769	....	39,258	....	15,878	....
Gallia	....	6,696	981	....	1,507	....	....	7,607
Guernsey	51,571	....	....	23,321	65,579	....	....	43,602
Harrison	....	25,124	....	4,640	....	740	....	580
Hocking	474,378	....	196,292	....	271,084	....	....	149,751
Holmes	....	(*c*) 9,423	....	....	....	....	....	....
Jackson	44,004	....	505,061	....	357,971	....	....	7,338
Jefferson	219,342	....	206,021	....	235,284	....	145,302	....
Lawrence	....	25,652	....	769	....	4,859	....	34,864
Mahoning	15,756	....	....	55,585	4,371	....	....	31,401
Medina	3,681	....	20,442	....	....	58,744	51,660	....
Meigs	35,088	....	26,729	....	....	16,050	....	37,510
Monroe	....	19,725	....	1,000	....	....	....	....
Morgan	....	(*c*) 8,060	....	....	12,000	....	....	2,000
Muskingum	15,714	....	....	69,565	17,334	....	28,478	....
Noble	....	31,550	....	3,050	....	3,500	....	300
Perry	355,631	....	....	135,791	....	332,647	....	14,856
Portage	....	7,451	....	1,608	7,340	....	13,033	....
Stark	....	15,545	81,546	....	....	61,388	69,593	....
Summit	62,271	....	27,082	....	7,768	....	....	118,858
Trumbull	....	60,406	36,236	....	....	55,763	....	14,506
Tuscarawas	....	173,630	146,422	....	40,918	....	....	78,688
Vinton	....	21,324	17,450	....	....	15,053	....	10,137
Washington	....	12,055	....	40	38,770	....	....	44,074
Wayne	....	45,650	....	17,157	52,228	....	....	11,147
Total	1,420,785	533,066	1,652,127	327,950	1,423,388	729,144	520,764	830,045
Net increase or decrease	887,719	....	1,324,177	....	694,244	....	....	309,281

a Includes product of small banks in 1889 and not in 1888.
b Includes product of small banks in 1889 and not in 1890.
c Product of small banks in 1889 not enumerated in 1890.
d Entire product of 1889; no product reported in 1888.

Records of the total production of coal in Ohio extend only as far back as 1872, since which time the annual output has been as follows:

Annual coal product of Ohio since 1872.

Years.	Short tons.	Years.	Short tons.
1872	5,315,294	1883	8,229,429
1873	4,550,028	1884	7,640,062
1874	3,267,585	1885	7,816,179
1875	4,864,259	1886	8,435,211
1876	3,500,000	1887	10,300,708
1877	5,250,000	1888	10,910,951
1878	5,500,000	1889	9,976,787
1879	6,000,000	1890	11,494,506
1880	7,000,000	1891	12,868,683
1881	8,225,000	1892	13,562,927
1882	9,450,000	1893	13,253,646

Athens county.—Coal produced in 1893; 1,597,685 short tons; value $1,321,841.

The product of coal in Athens county during 1892, was 1,400,865 short tons valued at $1,196,225, showing an increase in the product of 1893 of 196,820 short tons and $125,616. The county advanced from fourth to third place in coal production, displacing Perry county. The mines gave employment to 3,203 men in 1893, the average working time being 162 days, an increase from 2,536 men and a decrease from 193 days in 1892.

Coal product of Athens county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	627, 944				
1885	823, 139				
1886	899, 046				
1887	1, 083, 543				
1888	1, 336, 698				
1889	1, 224, 186	$994, 344	$0. 81		
1890	1, 205, 455	999, 003	. 83	198	2, 122
1891	1, 482, 294	1, 257, 081	. 85	193	2, 702
1892	1, 400, 865	1, 196, 225	. 85	193	2, 536
1893	1, 597, 685	1, 321, 841	. 83	162	3, 203

Belmont county.—The product of Belmont county decreased from 1,037,700 short tons in 1892 to 974,043 tons in 1893, a loss of 63,657 tons or a little more than 6 per cent. The value declined from $870,393 to $787,419, a decrease of $82,974, or between 9 and 10 per cent., the price declining from 84 cents to 81 cents. The coal of Belmont county is used extensively by iron and nail works in Bridgeport and Bellaire, and the closing down of some of these establishments, and decreased operations at the others during the latter part of the year together with importations of cheap coal from West Virginia, satisfactorily account for the decreased output of coal in the county. The total number of employés reported in 1893 was 1,684 against 1,713 the preceding year. The average working time decreased from 224 to 199 days.

Coal product of Belmont county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	643, 129				
1885	744, 446				
1886	573, 779				
1887	721, 767				
1888	1, 108, 106				
1889	641, 862	$558, 333	$0. 87		
1890	774, 110	605, 604	. 78	201	1, 401
1891	819, 236	990, 726	. 84	238½	1, 276
1892	1, 037, 700	870, 393	. 84	224	1, 713
1893	974, 043	787, 419	. 81	199	1, 684

Carroll county.—Carroll county's product decreased from 367,055 short tons in 1892, to 261,327 tons in 1893, a loss of 105,728 tons, or nearly 30 per cent. The value decreased from $303,752 to $227,337. The product in 1892 was the largest ever obtained, and that of 1893 the smallest since 1886.

Coal product of Carroll county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	102, 531				
1885	150, 695				
1886	216, 630				
1887	293, 328				
1888	355, 097				
1889	351, 782	$261, 813	$0. 74		565
1890	328, 967	278, 704	. 85	188	642
1891	313, 543	254, 613	. 81	200	589
1892	367, 055	303, 752	. 83	214	595
1893	261, 327	227, 337	. 87	166	652

Columbiana county.—The coal product of Columbiana county in 1893 amounted to 467,314 short tons, against 520,755 tons in 1892, a decrease of 53,441 tons, or a little more than 10 per cent. The average price per ton declined from 90 cents to 88 cents, making a total decrease in the value of the product of $56,599, or about 12 per cent.

Coal product of Columbiana county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	469, 798				
1885	462, 733				
1886	336, 063				
1887	516, 057				
1888	466, 191				
1889	596. 824	$471, 945	$0. 79		955
1890	567, 595	518, 186	. 91	219	987
1891	621, 726	595, 390	. 96	251	1, 031
1892	520, 755	469, 198	. 90	223	932
1893	467, 314	412, 599	. 88	210	964

Two mines were added to the list in Columbiana county in 1893, making a total of 15.

Coshocton county.—Coshocton county's product increased 15,878 tons, from 228,727 short tons in 1892 to 244,605 short tons in 1893. The value increased $11,896, from $232,024 to $243,920. There are six mines of commercial importance in the county.

Coal product of Coshocton county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	56, 562				
1885	99, 609				
1886	52, 934				
1887	124, 791				
1888	167, 903				
1889	166, 599	$163, 659	$0. 98		290
1890	177, 700	159, 150	. 90	237	327
1891	189, 469	189, 111	1. 00	265	284
1892	228, 727	232, 024	1. 01	229	386
1893	244, 605	243, 920	1. 00	233	398

Gallia county.—The product of Gallia county is from one mine, and amounted to 11,393 short tons, valued at $10,399, against 19,000 short tons, worth $17,500, in 1892.

Guernsey county.—The output of Guernsey county in 1893 was 412,395 short tons, against 455,997 short tons in 1892, a decrease of 43,602 tons. The decrease is due principally to disagreements between miners and owners regarding wages, and the striking of the men.

Coal product of Guernsey county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	375,427				
1885	297,267				
1886	433,800				
1887	553,613				
1888	383,728				
1889	362,168	$313,480	$0.87		668
1890	413,739	282,355	.68	225	788
1891	390,418	306,299	.79	188	810
1892	455,997	330,742	.72	229	800
1893	412,395	294,738	.71	176	993

Harrison county.—The production of coal in Harrison county is of small importance. Nearly the entire output is from small banks not considered separately in this report. The census of 1889 reported a product from this county of 33,724 short tons. In only one year since then has it been more than 4,000 tons annually, except in 1890, when 8,600 tons were reported. The product in 1893 was 2,640 tons, valued at $2,840.

Coal product of Harrison county, Ohio, since 1886.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1886	5,509				
1887	4,032				
1888	2,865				
1889	33,724	$41,028	$1.21		8
1890	8,600	12,900	1.50	268	14
1891	3,960	5,860	1.48	236	9
1892	3,220	4,820	1.50	179	9
1893	2,640	2,840	1.08	124	10

Hocking county.—There are only ten mines in Hocking county, but they are all important producers, the county being the second in the State in the amount of coal produced. In 1893 the product was 1,637,052 short tons, valued at $1,343,231, against 1,786,803 tons, valued at $1,514,265, in 1892. The mines employed 2,072 men for an average of 193 days in 1893, and 2,099 men for 216 days in 1892.

Coal product of Hocking county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	372,694				
1885	656,441				
1886	741,571				
1887	853,063				
1888	1,086,538				
1889	845,049	$683,551	$0.80		1,187
1890	1,319,427	1,084,557	.81	240	1,625
1891	1,515,719	1,235,017	.81	241	1,674
1892	1,786,803	1,514,265	.85	216	2,099
1893	1,637,052	1,343,231	.82	193	2,072

Jackson county.—This is the largest coal-producing county in the State. It embraces what is known as the celebrated Wellston coal district, which occupies the northeastern portion of the county. The principal producing mines are in and around Wellston, Coalton, Glen Roy, and Jackson. The product in 1893 was 1,826,572 short tons, valued at $1,933,116, a decrease in amount from 1892 of 7,338 short tons, but an increase in value of $101,673, the average price advancing from 99 cents to $1.06. The product also would have shown an increase but for a strike which lasted from September 12 to October 9. The strike was due to a proposition made by the operators, asking for a longer time in which to pay for work done. This was made necessary because of the financial crisis, which rendered the collection of money very difficult. The miners rejected the proposition by a practically unanimous vote. A compromise was finally effected by the acceptance of a proposition to pay once a month for the remainder of the year, and then to resume semi-monthly payments. Work was resumed October 9.

The following table shows the annual output of Jackson county since 1884:

Coal product of Jackson county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	831,720				
1885	791,608				
1886	856,740				
1887	1,134,705				
1888	1,088,761				
1889	926,874	$953,696	$1.03		2,251
1890	970,878	974,892	1.00	180	2,654
1891	1,475,939	1,559,547	1.06	189	3.097
1892	1,833,910	1,831,443	.99	214	3,347
1893	1,826,572	1,933,116	1.06	201	3,188

Jefferson county.—The product of Jefferson county has increased annually since 1888, and in 1893 exceeded 1,000,000 tons. The increase in coal production is due to the failure of the supply of natural gas. Attracted by this cheap and sometimes free fuel, a number of manufacturing establishments were started in this county. The failure of the gas caused the return to coal, and many of the ironworks now obtain coal from their own mines. There are also a number of brick-yards the owners of which mine their own coal. In such cases the value of the coal is taken at the ruling price reported for other mines in the vicinity.

Coal product of Jefferson county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	316,777				
1885	271,329				
1886	275,666				
1887	293,875				
1888	243,178				
1889	271,830	$273,075	$1.00		511
1890	491,172	409,654	.83	203	944
1891	697,193	589,667	.85	235	1,237
1892	932,477	761,273	.92	208	1,544
1893	1,077,779	848,449	.79	194	2,033

Lawrence county.—The amount of coal produced in Lawrence county has decreased each year since 1886, the product in 1893 being little more than half of that of 1892, while the value decreased more than half.

Coal product of Lawrence county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	176,412				
1885	145,916				
1886	166,933				
1887	143,559				
1888	137,806				
1889	102,656	$106,269	$1.04		232
1890	77,004	83,265	1.08	198	242
1891	76,235	79,143	1.04	223	232
1892	71,376	75,571	1.06	263	247
1893	36,512	34,290	.94	143	142

Mahoning county.—Compared with 1892 the product of Mahoning county in 1893 shows a decrease of 31,401 short tons, or 15 per cent. The value decreased $41,186, or about 14 per cent.

Coal product of Mahoning county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	241,599				
1885	275,944				
1886	313,040				
1887	272,349				
1888	231,035				
1889	240,563	$280,406	$1.12		636
1890	256,319	306,633	1.20	220	537
1891	200,734	270,744	1.25	233½	525
1892	205,105	291,089	1.41	206	484
1893	173,704	249,903	1.44	196	419

Medina county.—Coal produced in 1893, 153,100 short tons; value, $191,725. Increase from 1892, 51,660 short tons and $67,112. The average price per ton was $1.25, the highest ever reported.

Coal product of Medina county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	77,160				
1885	152,721				
1886	252,411				
1887	225,487				
1888	198,452				
1889	136,061	$158,003	$1.16		379
1890	139,742	167,538	1.20	219	310
1891	160,184	185,462	1.16	221	314
1892	101,440	124,613	1.23	255	175
1893	153,100	191,725	1.25	228	349

Meigs county.—A large part of the coal product in Meigs county is consumed by industrial establishments in Pomeroy, Middleport, and Syracuse, and sympathizing with the unfavorable conditions which affected such enterprises in the latter part of the year the coal production decreased 37,510 tons, with a larger decline in value of $48,707. Low water in the Ohio river and a strike at the mines of the Syracuse Coal and Salt Company also contributed to a decreased output.

Product of Meigs county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	248,436				
1885	234,756				
1886	192,263				
1887	185,205				
1888	242,483				
1889	220,277	$223,614	$1.02		567
1890	255,365	316,247	1.24	202	616
1891	282,094	271,143	.96	190	623
1892	266,044	299,626	1.13	190	636
1893	228,534	250,919	1.10	142	601

Morgan county.—The production decreased from 12,000 short tons, valued at $9,000, in 1892, to 10,000 short tons, valued at $7,500. The product in 1892 was the first reported from commercial mines.

Muskingum county.—The product increased from 177,488 short tons in 1892 to 205,966 short tons in 1893, a gain of 28,478 short tons. The value increased only $10,044, due to a decline in price from 91 cents to 83 cents per ton.

Coal product of Muskingum county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	84,398				
1885	86,846				
1886	96,601				
1887	171,928				
1888	211,861				
1889	214,005	$212,873	$0.99		304
1890	229,719	197,640	.86	250	366
1891	160,154	130,674	.82	213	338
1892	177,488	161,038	.91	192	356
1893	205,966	171,082	.83	214	388

Noble county.—No product was reported from Noble county in 1893. In 1889, according to the Eleventh Census, the product, including the output of local banks, was 38,400 short tons. In 1890 the product was 6,850 tons, decreasing to 3,800 tons in 1891, again to 300 tons in 1892, and ceasing altogether in 1893.

Perry county.—Perry county ranks fourth among the coal producing counties of the State, having fallen from third place in 1892. The production has decreased annually since 1890, the output in 1893 being 14,856 tons less than in 1892, with a decrease in value of $20,479.

Coal product of Perry county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	1,379,100				
1885	1,259,952				
1886	1,607,666				
1887	1,870,840				
1888	1,736,805				
1889	1,565,786	$1,317,963	$0.84		3,056
1890	1,921,417	1,642,967	.85	188	2,977
1891	1,785,626	1,483,542	.84	170	3,284
1892	1,452,979	1,239,268	.85	187	2,380
1893	1,438,123	1,218,789	.85	178	2,585

Portage county.—The coal product of Portage county increased from 76,398 short tons, valued at $116,243 in 1892 to 89,431 tons, valued at $138,561 in 1893, a gain of 13,033 in quantity, and $22,318 in value.

Coal product of Portage county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	65,647				
1885	77,071				
1886	70,339				
1887	65,163				
1888	70,923				
1889	78,117	$99,213	$1.27		179
1890	70,666	112,475	1.59	236	155
1891	69,058	104,906	1.52	225	149
1892	76,398	116,243	1.52	207	204
1893	89,431	138,561	1.55	217	252

Stark county.—The product of Stark county in 1893 was the largest in its history, being 69,593 short tons more than in 1892, and reaching a total of 926,200 tons. The value increased $104,569, from $1,044,674 to $1,149,243. During 1893 the mines gave employment to 2,105 men for an average of 161 days, against 1,776 men for 199 days in 1892.

Coal product of Stark county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	513, 225				
1885	391, 418				
1886	593, 422				
1887	784, 164				
1888	793, 227				
1889	851, 994	$1, 073, 703	$1. 26		1, 975
1890	836, 449	1, 088, 978	1. 30	182	1, 930
1891	917, 995	1, 148, 222	1. 25	190	1, 952
1892	856, 607	1, 044, 674	1. 22	199	1, 776
1893	926, 200	1, 149. 243	1. 24	161	2, 105

Summit county.—The product of Summit county decreased from 147,847 tons, valued at $211,839, in 1892, to 28,989 tons, valued at $50,244.

Coal product of Summit county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	253, 148				
1885	145, 134				
1886	82, 225				
1887	95, 815				
1888	112, 024				
1889	50, 726	$92, 723	$1. 83		170
1890	112, 997	169, 171	1. 50	173	389
1891	140, 079	193, 380	1. 38	194	376
1892	147, 847	211, 839	1. 43	221	406
1893	28, 989	50, 244	1. 73	256	90

Trumbull county.—Trumbull county produced 15,681 short tons in 1893, valued at $24,153, a decrease from 1892 in both quantity and value of nearly 50 per cent.

Coal product of Trumbull county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	257, 683				
1885	264, 517				
1886	188, 531				
1887	167, 989				
1888	157, 826				
1889	108, 120	$176, 934	$1. 64		388
1890	47, 714	57, 713	1. 20	243	102
1891	83, 950	118, 286	1. 41	226	176
1892	30, 187	46, 577	1. 54	265	86
1893	15, 681	24, 153	1. 54	128	53

Tuscarawas county.—The amount of coal produced in Tuscarawas county in 1893 was 698,527 short tons, valued at $588,458, a decrease from 1892 of 78,688 short tons and $72,529.

Coal product of Tuscarawas county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	317,141				
1885	285,545				
1886	267,666				
1887	506,466				
1888	547,117				
1889	683,505	$544,524	$0.80		1,061
1890	589,875	499,685	.85	196	1,082
1891	736,297	583,206	.79	232	1,161
1892	777,215	660,987	.85	224	1,300
1893	698,527	588,458	.84	234	1,329

Vinton county.—A decrease of 10,137 short tons and of $14,194 is noted in the production of Vinton county in 1893 as compared with 1892.

Coal product of Vinton county, Ohio, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	69,740				
1885	77,127				
1886	60,013				
1887	89,727				
1888	108,695				
1889	102,040	$104,972	$1.03		256
1890	80,716	86,611	1.07	241	186
1891	98,166	103,148	1.05	206	197
1892	83,113	84,756	1.02	198	197
1893	72,976	70,562	.97	200	179

Washington county.—The production in 1893 was only 646 tons, valued at $571, against 44,720 tons, valued at $32,434, in 1892.

Wayne county.—Wayne county produced 62,452 short tons in 1893, valued at $79,251, against 73,599 short tons, valued at $93,086, in 1892.

OREGON.

Total product in 1893, 41,683 short tons; spot value, $164,500.

In 1892 the output of coal in Oregon was 34,661 short tons, valued at $148,546, showing an increase in the product of 1893 of 7,022 tons, and an increase in value of $15,954. The price per ton declined from $4.29 to $3.57.

The Newport mine, in Coos county, continues the only producer. The product is lignite of good quality, and the mine being situated on the shore of Coos bay, the output is shipped by ocean routes, chiefly to San Francisco.

The following tables show the statistics of production for the past two years, and the total output since 1885:

Coal product in Oregon in 1892 and 1893.

Distribution.	1892.	1893.
Loaded at the mines for shipment........................short tons..	31,760	37,835
Sold to local trade and used by employés ....do....	2,353	3,594
Used at mines for steam and heat.........................do....	548	254
Total product..do....	34,661	41,683
Total value..	$148,546	$164,500
Total number of employés....................................	90	110
Average number of days worked..............................	120	192

Coal product of Oregon from 1885 to 1893.

Years.	Short tons.	Years.	Short tons.
1885	50,000	1890	61,514
1886	45,000	1891	51,826
1887	31,696	1892	34,661
1888	75,000	1893	41,683
1889	64,359		

The Coos county mines changed hands in the early part of 1893, Messrs. Goodall, Perkins & Co., of San Francisco, becoming the purchasers. The new owners will, it is reported, open up some new veins and extend the operations.

PENNSYLVANIA.

Total product in 1893, 87,534,167 long tons, or 98,038,267 short tons; spot value, $120,947,752. This product includes all grades of both anthracite and bituminous coal taken from the mines, except the culm or slack thrown on the dump and not sold or used.

Anthracite.—Total product in 1893, 48,185,306 long tons, or 53,967,543 short tons; spot value, $85,687,078. The increase over 1892, when the product amounted to 46,850,450 long tons, or 52,472,504 short tons, valued at $82,442,000, was 1,334,856 long tons, or 1,495,039 short tons, and represented an increase in value of $3,245,078. The average price per ton advanced from $1.92 to $1.94. In arriving at the value of anthracite, the item of colliery consumption is excluded. The coal used at the mines is largely an estimate, and is composed of culm and unsalable sizes. The average price per ton is the figure obtained by dividing the total value by the product sold.

Bituminous.—Total product in 1892, 44,070,724 short tons; spot value, $35,260,674. The production of bituminous coal in Pennsylvania in 1892 was 46,694,576 short tons, valued at $39,017,164, showing decrease in product for 1893 of 2,623,852 short tons, and a loss in value of $3,756,490. The average price per ton declined from 84 cents in 1892 to 80 cents in 1893.

The details of production of anthracite and bituminous coal are discussed separately in the following pages. The statistics of anthracite production have been compiled by Mr. William W. Ruley, Chief of the Bureau of Anthracite Coal Statistics, of Philadelphia, under the supervision of Mr. John H. Jones. The statistics of bituminous production have been compiled in the office of the Geological Survey.

PENNSYLVANIA ANTHRACITE.

[By John H. Jones.]

Nothwithstanding the business depression in the latter half of the year, with its consequent effects upon all industries, and which was very markedly felt in the soft coal trade, the year 1893 closed with the largest production of anthracite coal in the history of the industry amounting to 48,185,306 tons, an increase of 1,334,856 tons over the large production in 1892.

This increase, however, was all in the first part of the year, as will be seen in the statement of shipments by months, given in another part of this report, there being really a considerable decrease in the last six months, as compared with the corresponding period in 1892.

The large increase in the early part of the year was due to the very severe weather in the latter part of 1892 and beginning of 1893; stocks of coal at different points were almost completely exhausted, and at the end of 1892 considerable difficulty was experienced in forwarding coal to market, particularly to western points, this naturally resulting in a rush to fill orders and renew stocks which held out for the first six months of 1893; about this time, however, the bad trade conditions began to have their effects, and during the remainder of the year the tonnage fell off in harmony with a depressed and restricted market.

The fields from which the supply of anthracite is drawn cover an area of about 480 square miles, are situated in the eastern part of the State, and extend about equal distances north and south of a line drawn through the middle of the State from east to west, in the counties of Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, and Susquehanna, and known under 3 general divisions, viz: Wyoming, Lehigh, and Schuylkill regions. Geologically they are divided into 5 well-defined fields or basins, which are again subdivided, for convenience of identification, into districts, as follows:

Geological fields or basins.	*Local districts.*	*Trade regions.*
Northern	Carbondale	Wyoming.
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Eastern Middle	Green Mountain	Lehigh.
	Black Creek	
	Hazleton	
	Beaver Meadow	
Southern	Panther Creek	
	East Schuylkill	Schuylkill.
	West Schuylkill	
	Lorberry	
	Lykens Valley	
Western Middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The above territory is reached by 12 so-called initial railroads, as follows:

Philadelphia and Reading Railroad Company
Lehigh Valley Railroad Company.
Central Railroad Company, of New Jersey.
Delaware, Lackawanna and Western Railroad Company.
Delaware and Hudson Canal Company's Railroad.
Pennsylvania Railroad Company.
Erie and Wyoming Valley Railroad Company.
New York, Lake Erie and Western Railroad Company.
New York, Ontario and Western Railroad Company.
Delaware, Susquehanna and Schuylkill Railroad Company.
New York, Susquehanna and Western Railroad Company.
Wilkesbarre and Eastern Railroad Company.

The last road above-mentioned was not completed and opened for business until December of 1893.

Of the total product of 48,185,306 tons, the above roads carried to market 43,094,798 tons, the remainder being sold to local trade and used for steam and heating purposes at the mines.

This local business amounted during the year to 1,073,799 tons, while the mine consumption was 4,016,709 tons. This latter item is partly approximated, as much of it is culm and dirt and for this reason the operators in some cases keep no accurate account of the amount, and are therefore compelled to estimate it in their reports. For the above reasons, also, this coal is not considered in the valuation of the product.

The value of the product at the mines for 1893 was $85,687,078, or $1.94 per long ton.

The average number of days worked during the year was 197, and the average number of persons employed, including superintendents, engineers, clerical force at mines, offices, etc., was 132,944.

Following are given in tabular form the details above noted in comparison with 1892:

Total anthracite coal produced in the years 1892 and 1893.

Years.	Total product.	Value at mines.	Average per ton.	Number of persons employed.	Number of days worked.
1892	46, 850, 450	$82, 442, 000	$1. 92	129, 050	198
1893	48, 185, 306	85, 687, 078	1. 94	132, 944	197

In the following tables is given for comparison the production, by counties, for years 1892 and 1893, showing not only the total product of each county for the last two years, but also the amounts shipped to market, sold to local trade, and used at mines in each.

Distribution of the anthracite product of Pennsylvania in 1892.

Counties.	Total product of coal of all grades for year 1892.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for steam and heat at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna	404, 300	350, 000	20, 000	34, 300
Lackawanna	11, 309, 635	10, 292, 972	353, 864	662, 799
Luzerne	18, 755, 704	16, 731, 470	446, 021	1, 576, 213
Carbon	1, 154, 188	1, 034, 276	5, 370	114, 542
Schuylkill	9, 913, 463	8, 693, 550	130, 615	1, 089, 298
Columbia	896, 536	797, 425	13, 521	85, 590
Northumberland	3, 718, 612	3, 385, 340	47, 441	285, 831
Dauphin	700, 012	613, 597	26, 282	60, 133
Total	46, 850, 450	41, 898, 630	1, 043, 114	3, 908, 706

Distribution of the anthracite product of Pennsylvania in 1893.

Counties.	Total product of coal of all grades for year 1893.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for steam and heat at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna	435, 000	375, 000	25, 000	35, 000
Lackawanna	11, 550, 005	10, 548, 629	318, 545	682, 831
Luzerne	19, 108, 135	17, 049, 072	466, 503	1, 592, 560
Carbon	1, 365, 663	1, 207, 204	18, 421	140, 038
Schuylkill	10, 533, 245	9, 256, 310	132, 777	1, 144, 158
Columbia	687, 334	591, 421	13, 842	82, 071
Northumberland	3, 827, 651	3, 462, 889	72, 711	292, 051
Dauphin	678, 273	604, 273	26, 000	48, 000
Total	48, 185, 306	43, 094, 798	1, 073, 799	4, 016, 709

In addition to the above, the shipments for 1892 and 1893, as prepared by the Bureau of Anthracite Coal Statistics, are shown by months in the following table, from which will be seen the condition of the trade, as stated in the beginning of this article.

Monthly shipments of anthracite in 1893 and 1892.

Months.	1893.	1892.	Difference.
January	3,069,579	2,851,487	Inc. 218,092
February	3,084,156	3,172,022	Dec. 87,866
March	3,761,744	3,070,527	Inc. 691,217
April	3,284,659	2,939,157	Inc. 345,502
May	3,707,082	3,524,728	Inc. 182,354
June	4,115,632	3,821,807	Inc. 293,825
July	3,275,863	3,648,583	Dec. 372,720
August	3,308,768	3,691,839	Dec. 383,071
September	3,614,496	3,754,482	Dec. 139,986
October	4,525,663	4,052,897	Inc. 472,766
November	3,905,487	3,769,711	Inc. 135,776
December	3,436,406	3,596,082	Dec. 159,676
Total	43,089,535	41,893,322	Inc. 1,196,213

Below is also given a table showing the shipments of anthracite by years since the commencement of the industry, shipments being divided according to the three trade regions, Wyoming, Lehigh, and Schuylkill. It must be borne in mind, however, that these figures show only shipments, and a proper allowance must be made for local trade and mine requirements.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions from 1820 to 1893.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*
1820			365				365
1821			1,073				1,073
1822	1,480	39.79	2,240	60.21			3,720
1823	1,128	16.23	5,823	83.77			6,951
1824	1,567	14.10	9,541	85.90			11,108
1825	6,500	18.60	28,393	81.40			34,893
1826	16,767	34.90	31,280	65.10			48,047
1827	31,360	49.44	32,074	50.56			63,434
1828	47,284	61.00	30,232	39.00			77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65,07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions from 1820 to 1893—Continued.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471
1853	2,665,110	51.30	1,054,309	20.29	1,475,732	28.41	5,195,151
1854	3,191,670	53.14	1,207,186	20.13	1,603,478	26.73	6,002,334
1855	3,552,943	53.77	1,284,113	19.43	1,771,511	26.80	6,608,567
1856	3,603,029	52.91	1,351,970	19.52	1,972,581	28.47	6,927,580
1857	3,373,797	50.77	1,318,541	19.84	1,952,603	29.39	6,644,941
1858	3,273,245	47.86	1,380,030	20.18	2,186,094	31.96	6,839,369
1859	3,448,708	44.16	1,628,311	20.86	2,731,236	34.98	7,808,255
1860	3,749,632	44.04	1,821,674	21.40	2,941,817	34.56	8,513,123
1861	3,160,747	39.74	1,738,377	21.85	3,055,140	38.41	7,954,264
1862	3,372,583	42.86	1,351,054	17.17	3,145,770	39.97	7,869,407
1863	3,911,683	40.90	1,894,713	19.80	3,759,610	39.30	9,566,006
1864	4,161,970	40.89	2,054,669	20.19	3,960,836	38.92	10,177,475
1865	4,356,959	45.14	2,040,913	21.14	3,254,519	33.72	9,652,391
1866	5,787,902	45.56	2,179,364	17.15	4,736,616	37.29	12,703,882
1867	5,161,671	39.74	2,502,054	19.27	5,325,000	40.99	12,988,725
1868	5,330,737	38.62	2,502,582	18.13	5,968,146	43.25	13,801,465
1869	5,775,138	41.66	1,949,673	14.06	6,141,369	44.28	13,866,180
1870	4,968,157	30.70	3,239,374	20.02	7,974,660	49.28	16,182,191
1871	6,552,772	41.74	2,235,707	14.24	6,911,242	44.02	15,669,721
1872	6,694,890	34.03	3,873,339	19.70	9,101,549	46.27	19,669,778
1873	7,212,601	33.97	3,705,596	17.46	10,309,755	48.57	21,227,952
1874	6,866,877	34.09	3,773,836	18.73	9,504,408	47.18	20,145,121
1875	6,281,712	31.87	2,834,605	14.38	10,596,155	53.75	19,712,472
1876	6,221,934	33.63	3,854,919	20.84	8,424,158	45.53	18,501,011
1877	8,195,042	39.35	4,332,760	20.80	8,300,377	39.85	20,828,179
1878	6,882,226	35.68	3,237,449	18.40	8,085,587	45.92	17,605,262
1879	8,960,829	34.28	4,595,567	17.58	12,586,293	48.14	26,142,689
1880	7,554,742	32.23	4,463,221	19.05	11,419,279	48.72	23,437,242
1881	9,253,958	32.46	5,294,676	18.58	13,951,383	48.96	28,500,017
1882	9,459,288	32.48	5,689,437	19.54	13,971,371	47.98	29,120,096
1883	10,074,726	31.69	6,113,809	19.23	15,604,492	49.08	31,793,027
1884	9,478,314	30.85	5,562,226	18.11	*a* 15,677,753	51.04	30,718,293
1885	9,488,426	30.00	5,898,634	18.65	*a* 16,236,470	51.35	31,623,530
1886	9,381,407	29.19	5,723,129	17.81	*a* 17,031,826	53.00	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	*a* 19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	*a* 21,852,365	57.29	38,145,717
1889	10,474,364	29.58	6,285,421	17.75	*a* 18,647,925	52.67	35,407,710
1890	10,867,821	30.31	6,329,658	17.65	*a* 18,657,694	52.04	35,855,173
1891	12,741,258	31.50	6,381,838	15.78	*a* 21,325,239	52.72	40,448,335
1892	12,626,784	30.14	6,451,076	15.40	*a* 22,815,480	54.46	41,893,340
1893	12,357,444	28.68	6,892,352	15.99	23,839,741	55.33	43,089,537

Directory of anthracite coal mines in Pennsylvania.

NORTHERN COAL FIELD.

Map Nos.	Names of mines.	Location. Local districts.	Inspectors' districts.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Operators. Names.	Post-office addresses.
15	Erie	Carbondale	1	Carbondale twp	Lackawanna	D. & H. C. Co. R. R	Glenwood	Hillside Coal and Iron Co	Scranton.
16	Glenwood	do	1	do	do	do	do	do	Do.
17	Keystone	do	1	do	do	do	Archbald	do	Do.
21	Eaton	do	1	Blakely twp	do	do	do	Jones, Simpson & Co	Archbald.
23	Pierce	do	1	do	do	D., L. & W. R. R	Winton	Pierce Coal Co., limited	Winton.
18	Edgerton	do	1	do	do	D. & H. C. Co. R. R	Jermyn	Edgerton Coal Co., limited.	Jermyn.
6	Elk Creek	do	1	Fell twp	do	N. Y., L. E. & W. R. R.	Carbondale	The Frisbie Coal Co	Elmira, N. Y.
25	Sterrick Creek	do	1	Blakely twp	do	D. & H. C. Co. R. R	Winton	Sterrick Creek Coal Co	Peckville.
36	Jermyn, No. 3	do	1	do	do	N. Y., S. & W. R. R., and N. Y., O. & W. R. R.	Dickson	John Jermyn	Scranton.
35	Jermyn, No. 4	do	1	do	do	do	do	do	Do.
28	Marshwood	do	1	do	do	D. & H. C. Co. R. R	Peckville	Moosic Mountain Coal Co	Marshwood
43	Murray	do	1	Dunmore twp	do	D., L. & W. R. R	Scranton	Murray, Carney & Brown.	Dunmore.
5	Simpson	do	1	Fell twp	do	N. Y., L. E. & W. R. R.	Carbondale	Simpson & Watkins	Scranton.
27	White	do	1	Blakely twp	do	N. Y., S. & W. R. R	Winton	Winton Coal Co., limited	Do.
24	Mount Jessup	do	1	do	do	D., L. & W. R. R. and N. Y., O. & W. R. R.	do	Mount Jessup Coal Co., limited.	Peckville.
7	Ben Carbon	do	1	Fell twp	do	N. Y., L. E. & W. R. R.	Carbondale	Chas. Hutchinson	Kingston.
8	Watkins	do	1	do	do	D. & H. C. Co. R. R	do	Boyer Coal Co	Scranton.
33	Olyphant, No. 2	do	1	Blakely twp	do	do	Olyphant	Delaware & Hudson Canal Co.	Providence.
34	Eddy Creek	do	1	do	do	do	do	do	Do.
29	Grassy Island	do	1	do	do	do	do	do	Do.
20	White Oak	do	1	do	do	do	Archbald	do	Do.
19	Jermyn Shaft	do	1	Carbondale twp	do	do	Jermyn	do	Do.
11	Coal Brook	do	1	do	do	do	Carbondale	do	Do.
12	No. 1 Shaft	do	1	do	do	do	do	do	Do.
13	No. 3 Shaft	do	1	do	do	do	do	do	Do.
10	Racket Brook	do	1	do	do	do	do	do	Do.
14	Powderly	do	1	do	do	do	do	do	Do.
3	Clinton Tunnel	do	1	Fell twp	do	N. Y., L. E. & W. R. R.	Forest City	do	Do.
9	Fall Brook	do	1	do	do	D. & H. C. Co., R. R	Carbondale	John Murrin	Carbondale.
26	Dolph	do	1	Blakely twp	do	N. Y., S. & W. R. R	Jessup	Dolph Coal Co. Limited	Scranton.
32	Lackawanna	do	1	do	do	do	Olyphant	Lackawanna Coal Co., Limited.	Do.

Directory of anthracite coal mines in Pennsylvania—Continued.

NORTHERN COAL FIELD—Continued.

Map Nos.	Names of mines.	Location. Local districts.	Inspectors' districts.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Operators. Names.	Post-office addresses.
31	Ontario, No. 1, & Stg's	Carbondale	1	Blakely twp	Lackawanna	N. Y., O. & W. R. R.	Peckville	New York & Scranton Coal Co.	Peckville.
2	Forest City	do	1	Forest City	Susquehanna	N. Y., L. E. & W. R. R.	Forest City	Hillside Coal & Iron Co.	Scranton.
1	Clifford	do	1	do	do	do	do	do	Do.
	Riverside	do	1	Archbald	Lackawanna	N. Y., O. & W. R. R.	Winton	Riverside Coal Co.	Do.
69	Archbald	Scranton	2	Lackawanna twp	do	D., L. & W. R. R.	Scranton	Delaware, Lackawanna & Western Railroad Co.	Do.
63	Bellevue	do	2	do	do	do	Bellevue	do	Do.
60	Brisbin	do	2	3d ward, Scranton	do	do	Scranton	do	Do.
59	Cayuga	do	2	do	do	do	do	do	Do.
66	Central	do	2	15th ward, Scranton	do	do	do	do	Do.
68	Continental	do	2	Lackawanna twp	do	do	do	do	Do.
64	Dodge	do	2	do	do	do	Bellevue	do	Do.
67	Hampton	do	2	do	do	do	Scranton	do	Do.
71	Holden	do	2	do	do	do	Taylorville	do	Do.
65	Hyde Park	do	2	5th ward, Scranton	do	do	Scranton	do	Do.
62	Oxford	do	2	do	do	do	do	do	Do.
73	Pyne	do	2	Lackawanna twp	do	do	Taylorville	do	Do.
70	Sloan	do	2	do	do	do	Scranton	do	Do.
44	Storrs	do	2	Blakely twp	do	do	Priceville	do	Do.
72	Taylor	do	2	Lackawanna twp	do	do	Taylorville	do	Do.
61	{Diamond No. 1	do	2	21st ward, Scranton	do	do	Scranton	do	Do.
	{Diamond No. 2	do	2	do	do	do	do	do	Do.
	{Tripp Shaft	do	2	do	do	do	do	do	Do.
38	Dunmore, No. 1	do	1	Dunmore twp	do	E. & W. V. R. R.	Dunmore	Pennsylvania Coal Co.	Dunmore.
41	Dunmore, No. 5	do	2	do	do	do	do	do	Do.
	Bunker Hill	do	2	do	do	do	do	do	Do.
30	Rushbrook	do	1	do	do	N. Y., O. & W. R. R.	Peckville	Blue Ridge Coal Co	Peckville.
	Austin	do	2	Old Forge twp	do	L. V. R. R.	Lackawanna	Austin Coal Co.	Scranton.
40	{Gypsy Grove, No. 3	do	1	Dunmore twp	do	E. & W. V. R. R.	Dunmore	Pennsylvania Coal Co.	Dunmore.
	{Gypsy Grove, No. 4	do	1	do	do	do	do	do	Do.
52	Pine Brook	do	2	7th ward, Scranton	do	D. L. & W. R. R.	Scranton	Lackawanna Iron & Coal Co	Scranton.
53	Capouse	do	2	21st ward, Scranton	do	do	do	do	Do.
54	Clark Tunnel	do	2	3d ward, Scranton	do	do	do	James Flynn	Do.
76	Greenwood, No. 1	do	2	Lackawanna twp	do	do	Peckville	Greenwood Coal Co., limited	Do.
77	Greenwood, No. 2	do	2	do	do	do	Minooka	do	Do.

80	Jermyn, Nos. 1, 2	do	2	Old Forge twp	do	do	Taylorville	Jermyn & Co	Do.
37	Pancoast	do	1	Blakely twp	do	do	Dickson City	Pancoast Coal Co	Do.
56	Providence	do	2	2d ward, Scranton	do	do	Green Ridge	Providence Coal Co., limited	Do.
79	Sibley	do	2	Old Forge, twp	do	do	Lackawanna	Elliott, McClure & Co	Do.
42	Spencer	do	2	Dunmore twp	do	do	Dunmore	A. D. & F. M. Spencer	Dunmore.
	Tripp	do	2	21st ward, Scranton	do	do	Providence	Tripp & Co	Scranton.
74	Meadow Brook	do	2	20th ward, Scranton	do	do	Taylorville	William Connell & Co	Do.
75	National	do	2	do	do	do	do	do	Do.
	Stafford	do	2	Lackawanna twp	do	do	do	do	Do.
49	Manville (a)	do	2	13th ward, Scranton	do	D. & H. C. Co. R. R	Green Ridge	Del. & Hudson Canal Co	Providence.
46	Legitt's Creek	do	2	1st ward, Scranton	do	do	Providence	do	Do.
45	Marvine	do	2	do	do	do	do	do	Do.
48	Von Storch	do	2	2d ward, Scranton	do	do	do	do	Do.
47	Dickson	do	2	do	do	do	Green Ridge	do	Do.
50	Green Ridge	do	2	Dunmore twp	do	do	do	O. S. Johnson	Scranton.
	Richmond	do	2	Scranton twp	do	do	Providence	Elk Hill Coal & Iron Co	Do.
57	Mount Pleasant	do	2	14th ward, Scranton	do	D., L. & W. R. R	Scranton	William T. Smith	Do.
81	William A	Pittston	2	Old Forge twp	do	L. V. R. R	Lackawanna	Connell Coal Co	Do.
88	Katy-Did	do	3	do	do	E. & W. V. R. R	Moosic	Robertson & Law	Moosic.
87	Central, No. 13	do	3	do	do	do	Pleasant Valley	Pennsylvania Coal Co	Dunmore.
	Law Shaft	do	3	Pittston twp	do	do	do	do	Do.
86	Old Forge	do	2	Old Forge twp	do	do	Lackawanna	do	Do.
109	Ewen Breaker	do	3	Jenkins twp	Luzerne	do	Pittston	do	Do.
	Shaft, No. 4	do	3	do	do	do	do	do	Do.
110	Breaker, No. 6	do	3	do	do	do	Port Blanchard	do	Do.
	Breaker, No. 8	do	3	Hughestown boro	do	do	Pittston	do	Do.
99	Breaker, No. 10	do	3	do	do	do	do	do	Do.
111	Breaker, No. 14	do	3	Jenkins twp	do	do	Port Blanchard	do	Do.
100	Barnum	do	3	Marcy twp	do	do	Pittston Junction	do	Do.
112	Annora	do	3	Jenkins twp	do	C. R. R. of New Jersey	Laflin	Annora Coal Co	Wilkesbarre.
91	Avoca	do	3	Pittston twp	do	L. V. R. R	Avoca	Avoca Coal Co., Limited	Avoca.
30	Langcliffe	do	3	Pittston	do	do	do	Langcliffe Coal Co	Do.
101	Twin	do	3	do	do	do	Pittston	Newton Coal Mining Co	Pittston.
	Ravine	do	3	do	do	do	do	do	Do.
102	Seneca	do	3	do	do	do	do	do	Do.
98	Mosier	do	3	Marcy twp	do	do	do	do	Do.
108	Hunt	do	3	Kingston twp	do	D., L. & W. R. R	Wyoming	Delaware, Lackawanna & Western R. R. Co.	Scranton.
83	Hallstead	do	3	Marcy twp	do	do	Duryea	do	Do.
95	Butler	do	3	Pittston twp	do	L. V. R. R	Pittston	Butler Mine Co., Limited	Pittston.
97	Fernwood	do	3	Jenkins twp	do	do	Yatesville	do	Do.
106	Schooley	do	3	Exeter twp	do	do	West Pittston	do	Do.
84	Columbia	do	3	Marcy twp	do	D., L. & W. and L. V. R. R.	Duryea	Old Forge Coal Mining Co.	Do.
85	Phœnix	do	3	do	do	do	do	do	Do.
82	Babylon	do	3	do	do	L. V. R. R	Coxton	Babylon Coal Co	Scranton.
89	Consolidated	do	3	Pittston twp	do	E. & W. V. R. R	Moosic	Hillside Coal and Iron Co	Do.
103	Clear Spring	do	3	West Pittston	do	D., L. & W. R. R	West Pittston	Clear Spring Coal Co	Pittston.
94	Elmwood	do	3	Pittston twp	do	L. V. R. R	Avoca	Florence Coal Co., Limited.	Dupont.
96	Fairmount	do	3	do	do	D. & H. C. Co. R. R	Pittston	W. M. Mallory, est	Pittston.

a Operated jointly with Delaware, Lackawanna & Western R. R. Co.

Directory of anthracite coal mines in Pennsylvania—Continued.

NORTHERN COAL FIELD—Continued.

Map Nos.	Names of mines.	Location.						Operators.	
		Local districts.	Inspectors' districts.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Names.	Post-office addresses.
113	Keystone	Pittston	3	Plains twp	Luzerne	D. & H. C. Co. R. R.	Mill Creek	Keystone Coal Co	Wilkesbarre.
104	Stevens	do	3	Exeter twp	do	L. V. R. R.	Exeter	Stevens Coal Co	Scranton.
107	Mount Lookout	do	3	do	do	D., L. & W. and L. V. R. R.	do	Mount Lookout Coal Co	Do.
	Morning Star	do	3	do	do	L. V. R. R.	Wyoming	J. A. Hutchins	Wyoming.
105	Exeter	do	3	do	do	do	West Pittston	Lehigh Valley Coal Co	Wilkesbarre.
92	Heidelberg, No. 1	do	3	Pittston twp	do	do	do	do	Do.
93	Heidelberg, No. 2	do	3	do	do	do	do	do	Do.
	Spring Brook	do	3	Old Forge twp	do	D. & H. C. Co. R. R.	Moosic	Whitney & Kemmerer	Philadelphia.
133	Diamond, No. 1	Wilkesbarre	4	Wilkesbarre	do	C. R. R. of New Jersey.	Ashley	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
132	Hollenback, No. 2	do	4	do	do	do	Wilkesbarre	do	Do.
134	Empire, No. 4	do	4	do	do	do	Ashley	do	Do.
137	S. Wilkesbarre, No, 5	do	4	do	do	do	S. Wilkesbarre	do	Do.
135	Stanton, No. 7	do	4	do	do	do	Ashley	do	Do.
138	Jersey, No. 8	do	4	Hanover twp	do	do	do	do	Do.
139	Sugar Notch, No. 9	do	4	Hanover twp	do	C. R. R. of New Jersey.	Sugar Notch	do	Do.
143	Wanamie, No. 18	do	4	Newport twp	do	do	Wanamie	do	Do.
142	Alden	do	4	do	do	do	Alden	Alden Coal Co	Alden.
148	Newport, No. 1	do	4	do	do	do	Lee	Newport Coal Co	Wilkesbarre.
130	Red Ash, No. 1	do	4	Wilkesbarre twp	do	do	Ashley	Red Ash Coal Co	Do.
131	Red Ash, No. 2	do	4	do	do	do	do	do	Do.
144	Colliery, No. 1	do	4	Hanover twp	do	P. R. R.	Nanticoke	Susquehanna Coal Co	Do.
145	Colliery, No. 2	do	4	do	do	do	do	do	Do.
146	Colliery, No. 5	do	4	do	do	do	do	do	Do.
147	Colliery, No. 6	do	4	Newport twp	do	do	Glen Lyon	do	Do.
117	Bennett	do	3	Plains twp	do	C. R. R. of New Jersey.	Mill Creek	Thomas Waddell & Co	Pittston.
141	Warrior Run	do	4	Hanover twp	do	L. V. R. R.	Warrior Run	A. J. Davis	Wilkesbarre.
149	West End, No. 1	do	4	Conyngham twp	do	P. R. R.	Mocanaqua	West End Coal Co	Shickshinny.
140	Maffett	do	4	Hanover twp	do	C. R. R. of New Jersey.	Sugar Notch	Hanover Coal Co	Wilkesbarre.
118	Abbott	do	3	Plains twp	do	L. V. R. R.	Miners Mills	P. J. Mallory	Do.
129	Hillman Vein	do	3	Wilkesbarre twp	do	do	Wilkesbarre	Hillman Vein Coal Co	Do.
136	Franklin	do	4	do	do	do	Ashley	Lehigh Valley Coal Co	Do.
119	Enterprise	do	3	Plains twp	do	do	Port Bowkley	do	Do.
120	Henry	do	3	do	do	do	do	do	Do.
	Midvale	do	3	do	do	do	do	do	Do.

124	Mineral Spring	....do	3	....do	....do	......do	Wilkesbarre	......do	Do.
122	Prospect	....do	3	....do	....do	......do	....do	......do	Do.
123	Dorrance	....do	3	Wilkesbarre twp	....do	......do	....do	......do	Do.
121	Wyoming	....do	3	Plains twp	....do	......do	Port Bowkley	......do	Do.
115	Mill Creek	....do	3	....do	....do	D. & H. C. Co. R. R.	Mill Creek	Delaware & Hudson Canal Co.	Providence.
116	Pine Ridge	....do	3	....do	....do	......do	Miners Mills	......do	Do.
125	Laurel Run	....do	3	....do	....do	......do	Parsons	......do	Do.
126	Baltimore Slope	....do	3	Wilkesbarre twp	....do	......do	....do	......do	Do.
	Bal. Red Ash, No. 2	....do	3	....do	....do	......do	....do	......do	Do.
127	Baltimore Tunnel	....do	3	....do	....do	......do	Wilkesbarre	......do	Do.
128	Conyngham	....do	3	Wilkesbarre	....do	......do	....do	......do	Do.
114	Delaware	....do	3	Plains twp	....do	......do	Mill Creek	......do	Do.
168	Lance, No. 11	Plymouth	4	Plymouth	....do	D., L. &W. R. R.	Plymouth	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
169	Nottingham, No. 15	....do	4	....do	....do	......do	....do	......do	Do.
170	Reynolds, No. 16	....do	4	....do	....do	......do	....do	......do	Do.
172	Avondale	....do	4	Plymouth twp	....do	......do	Avondale	Delaware, Lackawanna and Western R. R. Co.	Scranton.
160	Woodward	....do	4	....do	....do	......do	Kingston	......do	Do.
166	Dodson	....do	4	....do	....do	......do	Plymouth	John C. Haddock	Wilkesbarre.
155	East Boston	....do	3	Kingston	....do	......do	Kingston	W. G. Payne & Co	Kingston.
171	Parrish	....do	4	Plymouth	....do	......do	Plymouth	Parrish Coal Co	Plymouth.
173	Colliery, No. 3	....do	4	West Nanticoke	....do	......do	West Nanticoke	Susquehanna Coal Co	Wilkesbarre.
	Salem	....do	4	Shickshinny	....do	......do	Shickshinny	E. S. Stackhouse	Shickshinny.
161	Boston	....do	4	Plymouth twp	....do	D. & H. C. Co. R. R	Plymouth	Delaware and Hudson Canal Co.	Providence.
162	Plymouth, No. 2	....do	4	....do	....do	......do	....do	......do	Do.
163	Plymouth, No. 3	....do	4	....do	....do	......do	....do	......do	Do.
164	Plymouth, No. 4	....do	4	....do	....do	......do	....do	......do	Do.
165	Plymouth, No. 5	....do	4	....do	....do	......do	....do	......do	Do.
159	Pettebone	Kingston	3	Kingston	....do	D., L. & W. R. R	Bennett	Delaware, Lackawanna and Western R. R. Co.	Do.
156	Kingston, No. 1	....do	3	Kingston twp	....do	......do	Kingston	Kingston Coal Co	Kingston.
158	Kingston, No. 2	....do	3	Plymouth	....do	......do	....do	......do	Do.
	Kingston, No. 3	....do	3	....do	....do	......do	....do	......do	Do.
157	Kingston, No. 4	....do	3	Kingston twp	....do	......do	....do	......do	Do.
167	Gaylord	....do	4	Plymouth twp	....do	......do	Plymouth	......do	Do.
152	Harry E	....do	3	Kingston twp	....do	......do	Bennett	Wyoming Valley Coal Co	Wilkesbarre.
151	Harry E, No. 2	....do	3	....do	....do	D., L.&W. and L.V.R.R	Maltby	......do	Do.
154	Black Diamond	....do	3	....do	....do	......do	Kingston	John C. Haddock	Do.
153	Mill Hollow	....do	3	....do	....do	......do	Bennett	Thomas Waddell	Pittston.
150	Maltby	....do	3	....do	....do	......do	Maltby	Lehigh Valley Coal Co	Wilkesbarre.

Directory of anthracite coal mines in Pennsylvania—Continued.

EASTERN MIDDLE COAL FIELD.

Map Nos.	Names of mines.	Location.						Operators.	
		Local districts.	Inspectors' districts.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Names.	Post-office addresses.
175	Upper Lehigh, No. 2.	Green Mountain	5	Butler twp	Luzerne	C. R. R. of New Jersey.	Upper Lehigh	Upper Lehigh Coal Co	Upper Lehigh.
176	Upper Lehigh, No. 4.	do	5	do	do	do	do	do	Do.
191	Milnesville	Black Creek	5	Hazle twp	do	L. V. R. R.	Hazleton	A. S. Van Wickle & Co	Milnesville.
188 189 190	Lattimer, No. 1 Lattimer, No. 2 Lattimer, No. 3	do	5	do	do	do	do	Pardee Bros. & Co	Hazleton.
192	Hollywood	do	5	do	do	do	do	Calvin Pardee & Co	Do.
177	Sandy Run	do	5	Foster twp	do	C. R. R. of New Jersey.	Sandy Run	M. S. Kemmerer & Co	Sandy Run.
178	Highland, No. 1	do	5	do	do	L. V. R. R.	Highland	G. B. Markle & Co	Jeddo.
179	Highland, No. 2	do	5	do	do	do	do	do	Do.
	Highland, No. 5	do	5	do	do	do	do	do	Do.
184	Jeddo, No. 3	do	5	Hazle twp	do	do	Jeddo	do	Do.
185	Jeddo, No. 4	do	5	do	do	do	do	do	Do.
195	Derringer	do	5	Black Creek twp	do	D., S. & S. R. R	Derringer	Coxe Bros. & Co	Drifton.
180	Drifton, No. 1	do	5	Foster twp	do	do	Drifton	do	Do.
181	Drifton, No. 2	do	5	do	do	do	do	do	Do.
	Drifton, No. 3	do	5	Hazle twp	do	do	do	do	Do.
183	Eckley, No. 5	do	5	Foster twp	do	do	Eckley	do	Do.
182	Eckley, No. 10	do	5	do	do	do	do	do	Do.
196	Gowen	do	5	Black Creek twp	do	do	Gowen	do	Do.
194	Tomhicken	do	5	Sugar Loaf twp	do	do	Tomhicken	do	Do.
	Oneida, Nos. 1, 2, and 3	do	6	North Union	Schuylkill	do	Oneida	do	Do.
197	Hazlebrook	Hazleton	5	Foster twp	Luzerne	L. V. R. R.	Hazlebrook	J. S. Wentz & Co	Mauch Chunk
209	Humboldt	do	5	Hazle twp	do	do	Hazleton	Linderman, Skeer & Co	South Bethlehem.
201	East Sugar Loaf, No. 1.	do	5	do	do	do	Stockton	do	Do.
200	East Sugar Loaf, No. 2.	do	5	do	do	do	do	do	Do.
199	East Sugar Loaf, No. 5.	do	5	do	do	do	do	do	Do.
208	Harwood	do	5	do	do	D., S. & S. R. R.	Hazleton	Pardee Sons & Co	Harwood Mines.
198	Stockton	do	5	do	do	do	Stockton	Coxe Bros. & Co	Drifton.
207	Cranberry	do	5	do	do	L. V. R. R.	Hazleton	A. Pardee & Co	Hazleton.

205	Hazleton, No. 1	....do	5	Hazleton	....do	......do	....do	......do	Do.
204	Hazleton, No. 3	....do	5	....do	....do	......do	....do	......do	Do.
206	Hazleton, No. 6	....do	5	....do	....do	......do	....do	......do	Do.
203	Laurel Hill	....do	5	....do	....do	......do	....do	......do	Do.
202	South Sugar Loaf	....do	5	Hazle twp	....do	......do	....do	......do	Do.
217	Beaver Brook	Beaver Meadow	5	....do	....do	L. V. R. R. and C. R. R. of New Jersey.	Audenried	C. M. Dodson & Co	Audenried.
211	Beaver Meadow	....do	5	Banks twp	Carbon	D. S. & S. R. R. and L. V. R. R.	Beaver Meadow	Coxe Bros. & Co	Drifton.
218	Honeybrook, No. 2	....do	5	....do	....do	C. R. R. of New Jersey	Treskow	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
219	Honeybrook, No. 4	....do	6	Klein twp	Schuylkill	......do	Audenried	......do	Do.
220	Honeybrook, No. 5	....do	6	....do	....do	......do	....do	......do	Do.
	Washery, No. 1	....do	6	....do	....do	......do	....do	......do	Do.
	Washery, No. 2	....do	5	Banks twp	Carbon	......do	Treskow	......do	Do.
221	Silver Brook, No. 1	....do	6	Klein twp	Schuylkill	L. V. R. R	Silver Brook	Silver Brook Coal Co	Mauch Chunk
	Silver Brook, No. 2	....do	6	....do	....do	......do	....do	......do	Do.
212	Coleraine	....do	5	Banks twp	Carbon	......do	Beaver Meadow	A. S. Van Wickle & Co	Philadelphia.
210	Evans	....do	5	....do	....do	......do	....do	Evans Mining Co	Beaver Meadow.
216	Spring Brook	....do	5	....do	....do	......do	Audenried	L. V. Coal Co	Wilkesbarre.
213	Spring Mount, No. 1	....do	5	Jeanesville	....do	......do	Jeansville	J. C. Haydon & Co	Jeansville.
214	Spring Mount, No. 4	....do	5	....do	Luzerne	......do	....do	......do	Do.

WESTERN MIDDLE COAL FIELD.

235	Ellangowan	East Mahanoy	6	Mahanoy twp	Schuylkill	P. & R. R. R	St. Nicholas	Philadelphia and Reading Coal and Iron Co.	Pottsville.
230	Elmwood	....do	6	....do	....do	......do	Mahanoy City	......do	Do.
236	Knickerbocker	....do	6	....do	....do	......do	Yatesville	......do	Do.
229	Mahanoy City	....do	6	Mahanoy City	....do	......do	Mahanoy City	......do	Do.
228	North Mahanoy	....do	6	Mahanoy twp	....do	......do	....do	......do	Do.
227	Schuylkill	....do	6	....do	....do	......do	....do	......do	Do.
233	Suffolk	....do	6	....do	....do	......do	St. Nicholas	......do	Do.
232	St. Nicholas	....do	6	....do	....do	......do	....do	......do	Do.
231	Tunnel Ridge	....do	6	....do	....do	......do	Mahanoy City	......do	Do.
225	Glendon	....do	6	....do	....do	L. V. R. R	....do	Delano Land Co	Wilkesbarre.
230	Middle Lehigh	....do	7	....do	....do	......do	New Boston	Mill Creek Coal Co	New Boston.
223	Buck Mountain	....do	6	....do	....do	......do	Buck Mountain	......do	Do.
331	Morea	....do	8	....do	....do	P. R. R. and L. V. R. R	Morea	Dodson Coal Co.	Morea Colliery.
222	Park, No. 2	....do	6	....do	....do	L. V. R. R	Park Place	Lentz, Lilly & Co	Park Place.
226	Springdale	....do	6	....do	....do	......do	....do	......do	Do.
224	Primrose	....do	6	....do	....do	......do	Mahanoy City	Primrose Coal Co	New York city.
234	Maple Hill	....do	6	....do	....do	P. & R. R. R	St. Nicholas	Philadelphia and Reading Coal and Iron Co.	Pottsville.
284	Alaska	West Mahanoy	7	Mount Carmel twp	Northumberland.	......do	Alaska	......do	Do.

Directory of anthracite coal mines in Pennsylvania—Continued.

WESTERN MIDDLE COAL FIELD—Continued.

Map Nos.	Names of mines.	Location.						Operators.	
		Local districts.	Inspectors' districts.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Names.	Post office addresses.
283	Locust Gap	West Mahanoy	7	Mount Carmel twp	Northumberland	P. & R. R. R	Locust Gap	Philadelphia and Reading Coal and Iron Co.	Pottsville.
282	Locust Spring	do	7	do	do	do	do	do	Do.
279	Merriam	do	7	do	do	do	Locust Summit	do	Do.
280	Monitor	do	7	do	do	do	Locust Gap	do	Do.
281	Reliance	do	7	do	do	do	Mount Carmel	do	Do.
285	Black Diamond	do	7	do	do	L. V. and N. C. Ry	do	Ferndale Coal Co	Mt. Carmel.
276	Mount Carmel	do	7	do	do	P. & R., N. C., and L. V. R. R.	do	Thomas M. Righter & Co	Do.
274	Columbus	do	7	N. Conyngham twp	Columbia	L. V. R. R	do	W. H. Sheafer	Do.
271	Centralia	do	7	do	do	do	Centralia	Lewis A. Riley & Co	Centralia.
272	Logan	do	7	do	do	do	do	do	Do.
273	Morris Ridge	do	7	do	do	do	Mount Carmel	May, Troutman & Co	Shamokin.
268	North Ashland	do	7	do	do	P. & R. R. R	Continental	Philadelphia and Reading Coal and Iron Co.	Pottsville.
278	Potts	do	7	do	do	do	Locust Dale	do	Do.
270	Continental	do	7	do	do	L. V. R. R	Centralia	Lehigh Valley Coal Co	Wilkesbarre.
	Locust Run	do	7	do	Schuylkill	P. & R. R. R	Ashland	Philadelphia and Reading Coal and Iron Co.	Pottsville.
267	Bast	do	7	Butler twp	do	do	do	do	Do.
247	Bear Ridge	do	6	West Mahanoy twp	do	do	Mahanoy Plane	do	Do.
238	Boston Run	do	6	Mahanoy twp	do	do	St. Nicholas	do	Do.
237	Bear Run	do	6	do	do	do	do	do	Do.
241	Gilberton	do	6	West Mahanoy twp	do	do	Gilberton	do	Do.
	Sidney	do	6	do	do	do	Maizeville	Sidney Coal Co	Mahanoy Plane.
260	Girard Mammoth	do	6	do	do	do	Raven Run	Philadelphia and Reading Coal and Iron Co.	Pottsville.
263	Girard	do	6	Butler twp	do	do	Girardville	do	Do.
252	Hammond	do	6	do	do	do	Conner	do	Do.
248	Indian Ridge	do	6	West Mahanoy twp	do	do	Shenandoah	do	Do.
252	Kohinoor	do	6	do	do	do	do	do	Do.
277	Keystone	do	7	Butler twp	do	do	Locust Dale	do	Do.
249	Shenandoah City	do	6	West Mahanoy twp	do	do	Shenandoah	do	Do.
266	Tunnel	do	7	Butler twp	do	do	Ashland	do	Do.
250	Turkey Run	do	6	West Mahanoy twp	do	do	Shenandoah	do	Do.
251	West Shenandoah	do	6	do	do	do	do	do	Do.

264	Preston, No. 2	do	7	Butler twp	do	do	Girardville	do	Do.
265	Preston, No. 3	do	7	do	do	do	do	do	Do.
269	Big Mine Run	do	7	do	do	do	Ashland	A. Taylor	Ashland.
253	Cambridge	do	6	West Mahanoy twp	do	do	Shenandoah	Cambridge Coal Co	Shenandoah.
242	Draper	do	6	do	do	do	Gilberton	Philadelphia and Reading Coal and Iron Co.	Pottsville.
239	Furnace	do	6	do	do	do	do	Furnace Coal Co	Gilberton.
254	Kehley Run	do	6	do	do	do	Shenandoah	Thomas Coal Co	Philadelphia.
245	Lawrence	do	6	do	do	do	Mahanoy Plane	Simon Moore & Co	Mahanoy Plane.
255	William Penn	do	6	do	do	do	Shaft	William Penn Coal Co	Shaft.
258	Packer, No. 2	do	6	do	do	L. V. R. R	Lost Creek	Lehigh Valley Coal Co	Wilkesbarre.
256	Packer, No. 3	do	6	do	do	do	Shenandoah	do	Do.
257	Packer, No. 4	do	6	do	do	do	do	do	Do.
259	Packer, No. 5	do	6	Butler twp	do	do	Girardville	do	Do.
305	Bear Valley	Shamokin	7	Coal twp	Northumberland.	P. & R. R. R	Shamokin	Philadelphia and Reading Coal and Iron Co.	Pottsville.
293	Buck Ridge	do	7	do	do	do	Greenback	do	Do.
304	Burnside	do	7	do	do	do	Shamokin	do	Do.
299	Henry Clay	do	7	do	do	do	do	do	Do.
306	North Franklin	do	7	Zerbe twp	do	do	Treverton	do	Do.
297	Cameron	do	7	Coal twp	do	N. C. Ry	Shamokin	Mineral Railroad and Mining Co.	Wilkesbarre.
296	Luke Fidler	do	7	do	do	do	do	do	Do.
290	Hickory Ridge	do	7	do	do	do	Lancaster Switch	Union Coal Co	Shamokin.
291	Hickory Swamp	do	7	do	do	do	do	do	Do.
286	Pennsylvania	do	7	Mount Carmel twp	do	do	Mount Carmel	do	Do.
287	Enterprise	do	7	Coal twp	do	P. & R. R. R	Excelsior	Enterprise Coal Co	Scranton.
288	Excelsior	do	7	do	do	do	do	Excelsior Coal Co	Excelsior.
289	Corbin	do	7	do	do	do	do	do	Do.
292	Colbert	do	7	do	do	N. C. Ry	Lancaster Switch	Shipman Coal Co	Shamokin.
302	Neilson	do	7	do	do	P. & R. R. R	Shamokin	J. Langdon & Co	Elmira, N. Y.
	Natalie	do	7	do	do	do	do	Penn Anthracite Mining Co.	Mount Carmel.
275	Midvalley	do	7	Mount Carmel twp	do	L. V. R. R	Mount Carmel	Midvalley Coal Co	Wilburton.

SOUTHERN COAL FIELD.

307	Colliery, No. 1	Panther Creek	5	Packer twp	Carbon	C. R. R. of New Jersey	Nesquehoning	Lehigh Coal and Navigation Co.	Lansford.
308	Colliery, No. 4	do	5	do	do	do	Lansford	do	Do.
309	Colliery, No. 5	do	5	do	do	do	do	do	Do.
	Colliery, No. 6	do	5	do	do	do	do	do	Do.
311	Colliery, No. 8	do	8	Rahn twp	Schuylkill	do	Coaldale	do	Do.
310	Colliery, No. 9	do	5	Packer twp	Carbon	do	do	do	Do.
313	Colliery, No. 10	do	8	Rahn twp	Schuylkill	do	Tamaqua	do	Do.

a Idle in 1891.

Directory of anthracite coal mines in Pennsylvania—Continued.

SOUTHERN COAL FIELD—Continued.

Map Nos.	Names of mines.	Location. Local districts.	Inspector's district.	Townships, etc.	Counties.	Railroads.	Nearest shipping stations.	Operators. Names.	Post-office addresses.
314	Colliery, No. 11	Panther Creek	8	Rahn twp	Schuylkill	C. R. R. of New Jersey	Tamaqua	Lehigh Coal and Navigation Co.	Lansford.
312	Colliery, No. 12	do	8	do	do	do	Coaldale	do	Do.
315	Colliery, No. 13	do	8	do	do	do	Tamaqua	do	Do.
337	Beechwood	East Schuylkill	8	Newcastle twp	do	P. & R. R. R	Pottsville	Philadelphia and Reading Coal and Iron Co.	Pottsville.
327	Eagle	do	8	East Norwegian twp	do	do	St. Clair	do	Do.
324	Eagle Hill	do	8	Blythe twp	do	do	Cumbola	do	Do.
332	Chamberlain	do	8	East Norwegian twp	do	do	St. Clair	Thomson Hiatt & Co., Limited.	St. Clair.
316	East Lehigh	do	8	Tamaqua	do	do	Tamaqua	Mitchell & Sheep	Tamaqua.
336	Flowery Field	do	8	Newcastle twp	do	do	St. Clair	Geo. Y. Sturdevant	St. Clair.
321	Kaska William	do	8	Blythe twp	do	do	Middleport	Alliance Coal Mining Co.	Lansford.
329	Penna. Schuylkill Val., No. 1.	do	8	Newcastle twp	do	P. R. R. R	Newcastle	Richard White & Co	St. Clair.
335	Vulcan or Reserve	do	8	do	do	P. & R. R. R	St. Clair	do	Do.
334	Wadesville	do	8	do	do	do	Pottsville	Philadelphia and Reading Coal and Iron Co	Pottsville.
325	Pine Forest	do	8	East Norwegian twp	do	do	Mill Creek	do	Do.
322	Silver Creek	do	8	Blythe twp	do	do	Patterson	do	Do.
317	Tamaqua	do	8	Tamaqua	do	do	Tamaqua	Dunkelburger & Co	Tamaqua.
326	Hooker or Mt. Hope	do	8	East Norwegian twp	do	do	St. Clair	G. B. Linderman & Co	South Bethlehem.
338	York Farm	do	8	do	do	L. V. R. R	do	Lehigh Valley Coal Co	Wilkesbarre.
344	Glendower	West Schuylkill	8	Foster twp	do	P. & R. R. R	Glen Carbon	Philadelphia and Reading Coal and Iron Co	Pottsville.
350	Otto	do	8	Reilly twp	do	do	Branch Dale	do	Do.
342	Thomaston	do	8	Cass twp	do	do	Heckscherville	do	Do.
349	Phœnix Park	do	8	do	do	do	Llewellyn	do	Do.
343	Richardson	do	8	Foster twp	do	do	Glen Carbon	do	Do.
339	Ellsworth	do	8	Newcastle twp	do	do	Broad Mountain	John H. Davis	Broad Mountain.
	Jugular	do	8	do	do	do	do	Jacob S. Hepner	Do.
	Lyole	do	8	Cass twp	do	do	Minersville	Lyole Coal Co	Minersville.
345	Oak Hill	do	8	do	do	do	do	Leisenring & Co	Do.
	Mine Hill	do	8	do	do	do	do	P. J. Courtenay	Do.
352	Blackwood	do	8	do	do	L. V. R. R	Blackwood	Lehigh Valley Coal Co	Wilkesbarre.

351	Feger Ridge	do	8	do	do	P. & R. R. R.	Newtown	do	Do.
354	East Franklin	do	8	Tremont twp	do	do	Tremont	Philadelphia and Reading Coal and Iron Co.	Pottsville.
353	Middle Creek	Lykens Valley	8	Frailey twp	do	do	Swatara Switch	do	Do.
359	West Brookside	do	8	Porter twp	do	do	Brooksido	do	Do.
355	Lincoln	do	8	Tremont twp	do	do	Lorberry Junc	do	Do.
	North Brookside	do	8	Porter twp	do	do	Good Spring	do	Do.
358	Good Spring	do	8	do	do	do	do	do	Do.
	Pine Grove	do	8	Tremont twp	do	do	Tremont	John D. Felty	Pine Grove.
360	Williamstown	do	7	Wiconisco twp	Dauphin	N. C. Ry	Williamstown	Summit Branch R. R. Co	Wilkesbarre.
361	Short Mountain	do	7	do	do	do	Lykens	Lykens Valley Coal Co	Do.

GENERAL OFFICES OF CORPORATIONS NAMED IN FOREGOING DIRECTORY

Pennsylvania Coal Company, No. 1 Broadway, New York.

Lehigh and Wilkesbarre Coal Company, No. 143 Liberty street, New York.

Delaware, Lackawanna and Western Railroad Company, No. 26 Exchange Place, New York.

Delaware and Hudson Canal Company, No. 21 Cortlandt street, New York.

Coxe Bros. & Co., 143 Liberty street, New York.

Philadelphia and Reading Coal and Iron Company, No. 108 South Fourth street, Philadelphia.

Philadelphia and Reading Coal and Iron Company, No. 143 Liberty street, New York.

Lehigh Valley Coal Company, No. 108 South Fourth street, Philadelphia.

Lehigh Coal and Navigation Company, No. 226 South Third street, Philadelphia.

Hillside Coal and Iron Company, No. 21 Cortlandt street, New York.

New York, Susquehanna and Western Railroad Company, No. 15 Cortlandt street, New York.

Susquehanna Coal Company, No. 233 South Fourth street, Philadelphia.

Lykens Valley Coal Company, No. 233 South Fourth street, Philadelphia.

Mineral Railroad and Mineral Company, No. 233 South Fourth street, Philadelphia.

Summit Branch Railroad Company, No. 233 South Fourth street, Philadelphia.

Union Coal Company, Erie, Pa.

New York, Ontario and Western Railroad Company, 56 Beaver street, New York.

In the report for the year of 1892 an outline was given of the progress of the effort on the part of the management of the Philadelphia and Reading Railroad Company to consolidate the interests engaged in mining and transporting anthracite coal in Pennsylvania. It will be observed that at the close of the year the lease of the Central Railroad Company of New Jersey to the Port Reading Railroad Company had been abrogated and that the contracts for the purchases of coal from the Lehigh and Wilkesbarre Coal Company had been canceled, leaving the Philadelphia and Reading Railroad Company still in possession of the LehighValley system, together with the Lehigh Valley Coal Company, and the contracts with individual operators, which had not been affected by the withdrawal of the arrangement with the Central Railroad of New Jersey interests.

On February 20, 1893, the property of the Philadelphia and Reading, including the Lehigh Valley railroad, passed under the control of the U. S. circuit court, and Messrs. A. A. McLeod, Edward M. Paxson, and E. P. Wilbur were appointed receivers. On May 1, 1893, Mr. McLeod resigned, and Mr. Joseph S. Harris was appointed as receiver, and was also elected president. Mr. Wilbur resigned his position as receiver on August 8, 1893, and Mr. John Lowber Welsh was appointed to fill the vacancy.

The lease of the Lehigh Valley Railroad Company was abrogated and the contracts with affiliated interests were relinquished by the Philadelphia and Reading receivers as of August 1, 1893, thus severing the only remaining alliance which was comprised in the orginal consolidation of February 11, 1892.

An amicable arrangement was consummated between the Lehigh Valley Coal Company and the individual operators with whom contracts had been made for the sale of the product mined by the latter, which continued those contracts in substantially the same form as originally contemplated. Growing out of the changed relations of these individual operators to the trade by reason of the situation above referred to an association was formed, comprising a majority of the operators not interested in the transportation lines, which has for its object the general supervision of the interests of the individual operators engaged in producing anthracite coal and maintaining more harmonious relations with the larger mining companies and the general trade. This association has become an important factor in the anthracite situation and will no doubt be of great benefit to the trade.

The contract between the Philadelphia and Reading Railroad Company and Messrs. Coxe Brothers & Co., for the transportation of the coal mined by the latter at the collieries owned or controlled by them upon the line of the Delaware, Susquehanna and Schuylkill railroad, which was entered into May 14, 1891, was annulled August 15, 1893, and the tonnage of Messrs. Coxe Brothers & Co. was thereafter diverted to other lines.

On November 18, 1893, a formidable strike of the engineers, firemen, conductors, trainmen, and telegraph operators upon the Lehigh Valley railroad was inaugurated, which continued until December 6, 1893. The estimated loss to the company in consequence of this strike was $600,000, and resulted in materially diminishing the coal traffic of that line for the year.

The Wilkesbarre and Eastern railroad, extending from Wilkesbarre to a connection with the New York, Susquehanna and Western railroad, near Stroudsburg, Pa., a distance of 65 miles, was completed and opened for coal traffic December 11, 1893. This line is operated by the New York, Susquehanna and Western Railroad Company, and forms a direct line for the transportation of the coal controlled by that company to New York waters.

A noticeable feature of the anthracite trade is the constantly increasing demand for the smaller or refuse sizes. The utilization of this portion of the product for steam and heating purposes is markedly in the increase. Several extensive washeries have been erected during the year in the different districts for the purpose of reclaiming the immense culm banks which have accumulated during the earlier years of mining, and thus the proportion of these smaller sizes of the total output is becoming constantly greater. During the year 1893 the supply was considerably short of the demand.

At a meeting of the American Institute of Mining Engineers, at Chicago, in August, 1893, Mr. Eckley B. Coxe submitted a paper describing a furnace especially constructed for burning the small sizes of anthracite. From this paper the following has been abstracted:

"The furnace consists essentially of a traveling grate moving from the right toward the left. The coal which is brought to the hopper by a drag, spout, or any other convenient method, feeds down by gravity over the fire brick into the traveling grate. The coal is carried slowly at the rate of 3½ to 5 feet per hour toward the other end. In the beginning of the operation the coal on the right-hand side of the furnace is ignited, the other part being covered with ashes or partially consumed coal. After the furnace is heated, the firebrick wall, which we call the 'ignition brick,' becomes hot, and the coal passing down under the regulating gate becomes gradually heated, and by the time it reaches the foot of the ignition brick is incandescent. In some cases the coal becomes hot enough to ignite soon after it passes the regulating gate. Under the grate there are a number of chambers made of sheet iron, which are closed on all sides except the top. The blast from the fan which is used to furnish the air is blown into the large air chamber, which is the second one from the right. These air chambers are open on top, but the partitions are covered by plates. These plates are of such width that, no matter what may be the position of the grate bars, there is always one resting upon this plate, so that the air can not pass from one chamber to another except by leakage along the bar. The result of this arrangement is that if we are blowing into the large air chamber with a pressure, say, of 1 inch water gauge, the pressure in the next air chamber to the left would be about three-fourths inch, the next to that one-half inch, and the next to that one-fourth inch. Of course these figures are not strictly correct, and are used merely for the purpose of illustrating, only the general principles of the apparatus are now being described. The pressure in the air chamber to the right would be, say, three-fourths inch. The result of this state of affairs is that the coal when it arrives on the grate is subjected to a pressure of blast sufficient to ignite it, but not too strong to impede ignition.

"In order to regulate exactly the pressure of the air in each of the compartments the partitions are provided with registers, by the simple opening and closing of which the pressure in the air chambers can be varied to suit the conditions.

"As the thoroughly ignited coal passes slowly over the second compartment (where the air pressure is a maximum), it burns briskly and then slowly passes over the third compartment, where the air pressure is less and better suited to the combustion of the thinner layer of partly consumed coal; the bed continues to diminish in carbon, and to be subjected to less blast, until, finally, the hot ashes are cooled off (before being dumped) by a very gentle current of air, which is heated and mingles with the carbonic oxide produced in the zone of intense combustion and converts it into carbonic acid, the object being to subject the coal as soon as it arrives on the grate to a pressure of blast which is the proper one to ignite it; then it is burned with a blast as strong as will produce good combustion, and as the carbon is eliminated and the thickness of the bed becomes smaller to diminish the blast to correspond to these conditions. The mass of coal remains all the time in practically the same position and condition in which it was placed on the grate, except so far as altered by combustion. It is evident that there would be a tendency for the air to pass out between the brick rest and the top of the grate bars which have no coal on them, and if no provision was made to prevent it the air would pass under the air chamber along the line of travel of the grate and enter the furnace through the ash exit, thus forcing a large excess of air into the space under the boiler and causing a loss in two ways: First, in the power necessary to furnish the air, and, second, in the heat carried off by the surplus of air going out the stack. This is avoided by having the returning line of grate pass into a water pan. By means of the partition which passes down below the surface of the water, a water seal is obtained which absolutely cuts off all connection between the front and back ends of the lower portion of the furnace along the line of travel of the grate. The ash pit, which is practically the part to the left of the plate, is closed by a door out of which the ashes are taken and the front end of the boiler is closed by a sheet-iron casing, which passes down into the water in the water pan, thereby preventing the air from passing out between the brick rest and the grate bars into the free air. There is space enough between the extreme right-hand end of the water pan and the vertical wall of the casing to allow any ashes or dirt that may accumulate in the water pan to be taken out very easily."

PENNSYLVANIA BITUMINOUS COAL.

Total product in 1893, 44,070,724 short tons; spot value, $35,260,674.

In 1892 the total product of bituminous coal in Pennsylvania was 46,694,576 short tons, having a spot value at the mines of $39,017,164. There was a decrease accordingly in the output of 1893 of 2,623,852 short tons, and a decrease in value of $3,756,490. As was the case with anthracite production, the first half of 1893 was favorable in the bituminous regions of Pennsylvania and operations were active, but later, when the unfavorable conditions of trade manifested themselves, production fell off and prices declined so severely that all of the benefits of the earlier months were overcome, and the average price for the year was 4 cents lower than in 1892. Some operators endeavored to reduce the price of wages in accordance with the decline in price; and on account of poor collections and inability to realize on commercial paper, some others endeavored to make monthly payments for wages. Several strikes naturally resulted, which were settled without serious difficulty.

The statistics of labor employed show conditions to have been very similar to those in other States, a larger number employed but a lower average for the number of days worked. In 1892 the bituminous mines of Pennsylvania gave employment to 66,655 men for an average of 223 days. In 1893 the number of employés increased to 71,931 men, and the average working days decreased to 190.

The following tables show the statistics of the production of bituminous coal in Pennsylvania during 1892 and 1893.

Bituminous coal product of Pennsylvania in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Allegheny	6,052,630	331,098	15,471	....	6,399,199	$5,848,483	$0.91	225	11,223
Armstrong	565,399	18,080	40	....	583,519	443,160	.71	246	964
Beaver	120,244	20,096	80	415	140,835	142,174	1.01	210	323
Bedford	510,678	5,363	1,420	35,000	552,461	450,697	.82	265	975
Blair	115,875	2,868	2,894	137,587	259,224	219,272	.85	203	848
Bradford	(*a*)55,617	1,200	891	....	57,708	81,945	1.42	206	122
Butler	140,792	3,686	1,251	....	145,729	135,818	.93	169	358
Cambria	2,424,799	392,461	21,685	247,609	3,086,554	2,545,867	.82	228	4,913
Center	451,716	272	675	43,858	496,521	397,335	.79	181	767
Clarion	548,433	18,710	2,190	....	569,333	424,477	.75	235	985
Clearfield	6,582,271	36,061	45,438	213,015	6,876,785	5,538,591	.81	212	10,225
Clinton	98,242	....	....	....	98,242	99,208	1.01	175	175
Elk	685,234	4,012	4,102	38,227	731,535	611,112	.83	230	1,265
Fayette	1,051,414	155,630	70,675	5,982,325	7,260,044	5,620,159	.77	239	7,952
Huntingdon	239,282	8,355	6,559	79,659	333,855	249,715	.75	244	560
Indiana	418,348	1,095	250	94,770	514,463	393,388	.77	191	656
Jefferson	3,002,432	23,185	14,844	665,868	3,706,329	3,006,617	.81	232	4,567
Lawrence	215,466	865	230	....	216,561	221,329	1.02	250	368
Lycoming	16,600	3,865	50	....	20,515	23,036	1.13	252	60
McKean	12,610	8,672	....	....	21,282	23,410	1.10	304	28
Mercer	396,076	7,235	16,834	....	420,145	368,479	.88	181	876
Somerset	485,227	6,429	....	17,954	509,610	346,705	.66	238	577
Tioga	945,420	16,655	6,336	31,373	999,784	1,434,878	1.44	223	2,249
Washington	2,872,332	23,188	7,715	....	2,903,235	2,538,375	.87	202	4,895
Westmoreland	4,418,812	118,746	137,149	4,116,361	8,791,068	7,102,934	.81	234	10,724
Small mines	....	1,000,000	....	....	1,000,000	750,000	.75	....	....
Total	32,425,949	2,207,827	356,779	11,704,021	46,694,576	39,017,164	.84	223	66,655

a Includes 2,100 tons stocked at the mines, December 31, 1892.

Coal product of Pennsylvania in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Allegheny	6,445,548	156,987	45,560	15,000	6,663,095	$5,481,787	$0.82	161	14,328
Armstrong	534,029	14,352	1,730	10,928	561,039	426,886	.76	214	1,080
Beaver	135,140	14,230	725	....	150,095	146,390	.98	215	318
Bedford	392,443	46,068	1,630	61,366	501,507	371,499	.74	185	896
Blair	109,272	2,585	3,794	62,251	177,902	137,310	.77	166	632
Bradford	42,158	281	300	....	42,739	55,561	1.30	167	83
Butler	153,811	965	1,240	....	156,016	125,637	.81	208	276
Cambria	2,776,201	358,900	22,799	124,567	3,282,467	2,584,416	.79	199	6,073
Center	382,052	2,316	399	73,289	458,056	344,194	.75	193	743
Clarion	533,507	15,421	2,230	....	551,158	398,384	.72	231	1,224
Clearfield	5,982,263	21,294	21,366	123,835	6,148,758	4,905,089	.80	186	10,455
Clinton	94,582	....	....	....	94,582	70,792	.76	163	175
Elk	572,647	4,349	4,849	52,320	634,165	497,975	.79	195	1,244
Fayette	1,058,492	285,835	142,693	4,774,126	6,261,146	4,563,989	.73	195	6,780
Huntingdon	288,974	9,119	5,454	....	303,547	228,432	.75	182	487
Indiana	327,762	999	285	51,620	380,666	291,488	.77	186	606
Jefferson	3,329,782	20,876	19,752	514,786	3,885,196	2,863,049	.74	210	5,537
Lawrence	162,638	33,775	323	....	196,736	201,727	1.03	218	430
Lycoming	52,261	511	420	....	53,192	64,910	1.23	279	117
McKean	19,169	....	....	....	19,169	21,086	1.10	285	19
Mercer	469,921	17,027	12,703	....	499,651	444,855	.89	187	981
Tioga	913,707	16,950	9,454	22,137	962,248	1,166,769	1.21	214	2,425
Somerset	511,816	5,387	564	14,921	532,688	335,385	.63	214	695
Westmoreland	4,760,933	91,155	100,973	2,486,699	7,439,760	6,133,014	.82	205	10,270
Washington	3,273,220	15,047	26,879	....	3,315,146	2,600,050	.78	184	6,058
Small mines	....	800,000	....	....	800,000	800,000	....	....	....
Total	33,322,328	1,934,429	426,12[illegible]	8,387,845	44,070,724	35,260,674	.80	190	71,931

Notwithstanding a decrease in output from 1892 of over 1,300,000 tons, Westmoreland county continues the most important coal producer in the State both in amount and value of its output. Allegheny county advanced from fourth to second place in product, and continued in second place in the value of its output. Fayette county dropped from second to third place in product and from third to fourth in value. Clearfield county ranks fourth in product and third in value, holding directly opposite positions in 1892. All of these counties exceeded 6,000,000 tons, and Westmoreland exceeded 7,000,000. No other counties exceeded 4,000,000 tons. Three had outputs over 3,000,000 tons, Jefferson, Washington, and Cambria, in order. There was no other county which produced as much as 1,000,000 tons, though Tioga county was only 37,752 tons short of that amount.

There were three counties whose mines gave employment to more than 10,000 men both in 1892 and 1893. These were Allegheny, Clearfield, and Westmoreland. Three counties employed more than 6,000 men; Cambria, Fayette, and Washington, and one other county, Jefferson, employed more than 5,000 men.

The average working time in each county is obtained by multiplying the total number of men employed at each mine by the number of days the mine was operated, and the sum of these multiples divided by the total number of employés in the county. The sum of the multiples represents the total number of days made. In Allegheny county this amounted to 2,312,821; in Cambria county, 1,212,432; in Clearfield, 1,945,271; in Fayette, 1,320,432; in Jefferson, 1,165,329; in Washington, 1,114,658; and in Westmoreland, 2,108,569. The average tonnage per man per day is obtained by dividing the total product by these figures. From this it will be found that the average in Allegheny county was 2.88; in Cambria county, 2.71; in Clearfield county, 3.16; in Fayette, 4.74; in Jefferson, 3.33; in Washington, 2.97, and in Westmoreland, 3.53.

Comparing the production of 1893 with 1892, it is found that in only 9 counties out of 25 was the product increased. The more important increases were in Allegheny county, 263,896 tons; Cambria county, 195,913 tons; Jefferson county, 178,867 tons; Mercer county, 79,506 tons; and Washington county, 411,911 tons. Of the 16 counties in which production decreased the most important were Clearfield, 728,027 tons; Fayette, 998,898 tons; Elk, 97,410 tons; Indiana, 133,797 tons; and Westmoreland, 1,351,308 tons. It is observed that in the Pittsburg region, embracing Allegheny and Washington counties, the largest increases occurred, the total increases for the 2 counties being 675,807 tons, while in the Connellsville coking region, including Fayette and Westmoreland counties, the greatest loss occurred. The total decrease for these 2 counties was 2,350,206 tons. The increase in Cambria county was due to the opening up of a new and important field in the northern part of the county, and to the stimulus given to production by the severe weather in the early part of the year. The latter cause is also applied to the increased production in Allegheny and Washington counties. The production was also somewhat augmented by the increased locomotive and ocean steamer consumption, due to the extra traffic occasioned by the World's Columbian Exposition. None of these conditions benefited the production in the Connellsville field. In the earlier months of the year the trade was normal, and the bad conditions in the later months show their effects in the largely decreased output.

In the following table is shown the annual bituminous coal production by counties since 1886, with the increases and decreases in 1893 as compared with 1892:

Bituminous coal product of Pennsylvania since 1886, by counties.

Counties.	1886.	1887.	1888.	1889.	1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	4, 202, 086	4, 680, 924	5, 575, 505	4, 717, 431	4, 894, 372
Armstrong	210, 856	235, 221	226, 093	289, 218	380, 554
Beaver	208, 820	197, 863	63, 900	93, 461	139, 117
Bedford	173, 372	311, 452	248, 159	257, 455	445, 192
Blair	305, 695	287, 367	314, 013	215, 410	298, 196
Bradford	206, 998	167, 416	163, 851	129, 141	126, 687
Butler	162, 306	161, 764	194, 715	288, 591	167, 578
Cambria	1, 222, 028	1, 421, 980	1, 540, 460	1, 751, 664	2, 790, 954
Cameron	3, 200	3, 000	700	2, 300	....
Center	313, 383	508, 255	382, 770	395, 127	452, 114
Clarion	429, 544	593, 758	535, 192	596, 589	512, 387
Clearfield	3, 753, 986	5, 180, 311	5, 398, 981	5, 224, 506	6, 651, 587
Clinton	....	....	32, 000	106, 000	159, 000
Elk	526, 036	609, 757	555, 960	614, 113	1, 121, 534
Fayette	4, 494, 613	4, 540, 322	5, 208, 993	5, 897, 254	6, 413, 081
Greene	5, 600	3, 002	5, 323	53, 714	(a)
Huntingdon	313, 581	265, 479	281, 823	280, 133	322, 630
Indiana	103, 615	207, 597	157, 285	153, 698	357, 580
Jefferson	1, 023, 186	1, 693, 492	2, 275, 349	2, 896, 487	2, 850, 799
Lawrence	101, 154	125, 361	106, 921	143, 410	140, 528
McKean	617	9, 214	10, 443	11, 500	(a)
Mercer	537, 712	539, 721	487, 122	575, 751	524, 319
Somerset	349, 926	416, 240	370, 228	442, 027	522, 796
Tioga	1, 384, 800	1, 328, 963	1, 106, 146	1, 036, 175	903, 997
Venango	2, 500	2, 296	2, 000	6, 911	(a)
Washington	1, 612, 407	1, 751, 615	1, 793, 022	2, 364, 901	2, 836, 667
Westmoreland	5, 446, 480	6, 074, 486	6, 519, 773	7, 631, 124	8, 290, 504
Small mines	....	200, 000	240, 000	(b)	1, 000, 000
Total	27, 094, 501	31, 516, 856	33, 796, 727	36, 174, 089	42, 302, 173
Net increase	....	4, 422, 355	2, 279, 871	2, 377, 362	6, 128, 084

a Included in product of small mines.
b Included in county distribution.

Bituminous coal product of Pennsylvania since 1886, by counties—Continued.

Counties.	1891.	1892.	1893. Total product.	1893. Increase.	1893. Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	5,640,669	6,399,199	6,663,095	263,896	
Armstrong	484,000	583,519	561,039		22,480
Beaver	129,961	140,835	150,095	9,260	
Bedford	389,257	552,461	501,507		50,954
Blair	237,626	259,224	177,902		81,322
Bradford	68,697	57,708	42,739		14,969
Butler	211,647	145,729	156,016	10,287	
Cambria	2,932,973	3,086,554	3,282,467	195,913	
Cameron					
Center	526,753	496,521	458,056		38,465
Clarion	479,887	569,333	551,158		18,175
Clearfield	7,143,382	6,876,785	6,148,758		728,027
Clinton	130,802	98,242	94,582		3,660
Elk	973,600	731,575	634,165		97,410
Fayette	5,782,573	7,260,044	6,261,146		998,898
Greene					
Huntingdon	269,021	333,855	303,547		30,308
Indiana	456,077	514,463	380,666		133,797
Jefferson	3,160,614	3,706,329	3,885,196	178,867	
Lawrence	164,669	216,561	196,736		19,825
Lycoming		20,515	53,192	32,677	
McKean	15,345	21,282	19,169		2,113
Mercer	526,220	420,145	499,651	79,506	
Somerset	480,194	509,610	532,688	23,078	
Tioga	1,010,872	999,784	962,248		37,536
Venango					
Washington	2,606,158	2,903,235	3,315,146	411,911	
Westmoreland	7,967,493	8,791,068	7,439,760		1,351,308
Small mines	1,000,000	1,000,000	800,000		200,000
Total	42,788,490	46,694,576	44,070,724	1,205,395	3,829,247
Net increase	486,317	3,906,086			2,623,852

Allegheny county.—Coal produced in 1893, 6,663,095 short tons; spot value, $5,481,787.

Allegheny county advanced from fourth to second place in the quantity of coal produced, having an increase in product over 1892 of 263,896 short tons, and in spite of a decrease of $366,296 in the value, retains also second place in that regard.

Coal product of Allegheny county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	2,863,631				
1885	3,588,244				
1886	4,202,086				
1887	4,680,924				
1888	5,575,505				
1889	4,717,431	$4,000,104	$0.85		9,386
1890	4,894,372	4,534,708	.93	198	9,036
1891	5,640,669	5,790,967	1.03	199	11,194
1892	6,399,199	5,848,083	.91	225	11,223
1893	6,663,095	5,481,787	.82	161	14,328

The increased production during the first few months of the year was due principally to the exhaustion of stocks at retailers' yards by the severe winter of 1892–'93. This gave a stimulus to production, and later when the demand fell off, and low water prevented river shipments, stocks accumulated at the mines and prices sharply declined, making the average for the year 9 cents lower than in 1892. Many mines closed down, and while a larger number of men were on the rolls, the average time made was considerably less than in the preceding year.

Armstrong county.—Coal produced in 1893, 561,039 short tons; spot value, $426,886.

The product of Armstrong county in 1893 was 22,480 tons less than in 1892, the value decreasing $16,274. The average price per ton has remained the same for three years. As was usually the case, the number of employés was more and the average working time less, than in 1892.

Coal product of Armstrong county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	170,826				
1885	139,327				
1886	210,856				
1887	235,221				
1888	226,093				
1889	289,218	$210,067	$0.73		459
1890	380,554	275,011	.72	251	661
1891	484,000	367,906	.76	230	805
1892	583,519	443,160	.76	246	964
1893	561,039	426,886	.76	214	1,080

Beaver county.—Coal produced in 1893, 150,095 short tons; spot value, $146,390.

Beaver county was one of the nine counties whose output in 1893 was more than in 1892, the increase being 9,260 short tons. The increase in value was less in proportion, due to a decline in the average price per ton from $1.01 to 98 cents.

Coal product of Beaver county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	156,695				
1885	184,631				
1886	208,820				
1887	197,863				
1888	63,900				
1889	93,461	$110,604	$1.18		162
1890	139,117	145,946	1.05	251	205
1891	129,961	130,051	1.00	201½	228
1892	140,835	142,174	1.01	210	323
1893	150,095	146,390	.98	215	318

Bedford county.—Coal produced in 1893, 501,507 short tons; spot value, $371,499.

Bedford county's product decreased in 1893 50,954 short tons, with a decrease in value of $79,198, and a decline in price from 82 to 74 cents. The decrease is attributed to the financial disturbance.

Coal product of Bedford county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	69,770				
1885	107,694				
1886	173,372				
1887	311,452				
1888	248,159				
1889	257,453	$205,672	$0.80		560
1890	445,192	356,005	.80	288	662
1891	389,257	324,402	.86	230	605
1892	552,461	450,697	.82	265	975
1893	501,507	371,499	.74	185	896

Blair county.—Coal produced in 1893, 177,902 short tons; spot value, $137,310.

The unfavorable commercial conditions in 1893 were manifested in Blair county by a decrease in its coal production of 81,322 tons, and a decline in price from 85 to 77 cents. The mines supply coal and coke to local rolling mills, and seriously felt the financial strain. The amount of coal made into coke decreased from 137,587 tons in 1892 to 61,366 tons in 1893.

Coal product of Blair county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	208,541				
1885	205,075				
1886	305,695				
1887	287,307				
1888	314,013				
1889	215,410	$210,465	$0.98		466
1890	298,196	241,678	.81	284	595
1891	237,626	205,989	.87	249	503
1892	259,224	219,272	.85	203	848
1893	177,902	137,310	.77	166	632

Bradford county.—The production of Bradford county has decreased annually since 1884, the product in 1893 being 14,969 short tons less than in 1892, with a decrease in value of $26,384.

Coal product of Bradford county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	313,575				
1885	249,920				
1886	206,998				
1887	167,416				
1888	163,851				
1889	129,141	$171,387	$1.33		321
1890	126,687	161,751	1.28	196	292
1891	68,697	92,054	1.34	228	169
1892	57,708	81,945	1.42	206	122
1893	42,739	55,561	1.30	167	83

Butler county.—Coal produced in 1893, 156,016 short tons; spot value, $125,637.

The product of Butler county was 10,287 short tons more than in 1892, though the value decreased $10,181.

Coal product of Butler county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	151,355				
1885	85,429				
1886	162,306				
1887	161,764				
1888	194,715				
1889	288,591	$270,394	$0.97		451
1890	167,578	146,162	.87	237	314
1891	211,647	187,481	.89	240	342
1892	145,729	135,818	.93	169	358
1893	156,016	125,637	.81	208	276

Cambria county.—Coal produced in 1893, 3,282,467 short tons; spot value, $2,584,416.

Cambria county's product increased 195,913 short tons over 1892, though the increase in value was only $38,549. The increase in product was largely due to the opening up of a new and important field in the northern part of the county, the new town of Patton being the center of operations. A number of local mines were also opened up at Johnstown by miners thrown out of employment in the latter half of the year. A considerable portion of the product is mined and made into coke by owners of iron-rolling mills. The coal so used without coking is included in the amount sold to local trade. This item amounted to 358,900 tons in 1893 against 392,461 tons in 1892. The amount made into coke decreased from 247,609 tons in 1892 to 124,567 tons in 1893. These decreases show the effect of the industrial depression, though the total output of the county increased.

Coal product of Cambria county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	659,843				
1885	1,037,000				
1886	1,222,028				
1887	1,421,980				
1888	1,540,460				
1889	1,751,664	$1,348,484	$0.77		2,791
1890	2,790,954	2,332,997	.83	361	4,140
1891	2,932,973	2,354,831	.80	258	4,284
1892	3,086,554	2,545,867	.82	228	4,913
1893	3,282,467	2,584,416	.79	199	6,073

Center county.—Coal produced in 1893, 458,056 short tons; spot value, $344,194.

The product of Center county in 1892 was 496,521 short tons, valued at $397,335, showing a decrease of 38,465 tons, and $53,141 in value. The average price declined from 79 to 75 cents per ton.

Coal product of Center county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	216,422				
1885	373,504				
1886	313,383				
1887	508,255				
1888	382,770				
1889	395,127	$311,544	$0.79		750
1890	452,114	356,121	.79	230	623
1891	526,753	397,451	.75	200	823
1892	496,521	397,335	.79	181	767
1893	458,056	344,194	.75	193	743

Clarion county.—Coal produced in 1893, 551,158 short tons; spot value, $398,384. The product of Clarion county was 18,175 less than in 1892, the value decreasing $26,093.

Coal product of Clarion county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	329,973				
1885	299,216				
1886	429,544				
1887	593,758				
1888	535,192				
1889	596,589	$430,850	$0.72		940
1890	512,387	386,617	.75	237	938
1891	479,887	361,741	.75	221	895
1892	569,333	424,477	.75	235	985
1893	551,158	398,384	.72	231	1,224

Clearfield county.—Coal produced in 1893, 6,148,758; spot value, $4,905,089.

The effects of the general trade disturbances were shown in Clearfield county by a decreased output in 1893, as compared with 1892, of 728,027 short tons, with a decrease in value of $633,502.

Coal product of Clearfield county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	2,177,543				
1885	3,368,671				
1886	3,753,986				
1887	5,180,311				
1888	5,398,981				
1889	5,224,506	$4,403,551	$0.84		7,703
1890	6,651,587	5,642,098	.85	236	9,324
1891	7,143,382	5,968,763	.84	227	10,067
1892	6,876,785	5,538,591	.81	212	10,225
1893	6,148,758	4,905,089	.80	186	10,455

Clinton county.—Coal produced in 1893, 94,582 short tons; spot value $70,792.

The output of Clinton county is from one mine. In 1893 the product was 3,660 short tons. The price declined from $1.01 to 76 cents, the total decrease in value being $28,416.

Coal product of Clinton county, Pennsylvania, since 1888.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1888	32,000				
1889	106,000				
1890	159,000	$123,326	$0.78	265	200
1891	130,802	149,830	1.15	291	181
1892	98,242	99,208	1.01	175	175
1893	94,582	70,792	.76	163	175

Elk county.—Coal produced in 1893, 634,165 short tons; spot value, $497,975.

The product of Elk county in 1893 was 97,410 short tons less than in 1892, the value showing a decrease of $113,137. The price declined from 83 cents to 79 cents.

Coal product of Elk county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	413,243				
1885	537,826				
1886	526,036				
1887	609,757				
1888	555,960				
1889	614,113	$498,728	$0.81		1,185
1890	1,121,534	942,081	.84	255	1,181
1891	973,600	804,635	.83	229	1,622
1892	731,575	611,112	.83	230	1,265
1893	634,165	497,975	.79	195	1,244

Fayette county.—Coal produced in 1893, 6,261,146 short tons; spot value, $4,563,989.

The total decrease in Fayette county's product was 998,898 short tons. The effects of the industrial crisis in 1893 are shown in the decreased output of coal made into coke in Fayette county. In 1892 the amount was 5,982,325 tons, declining to 4,774,126 tons in 1893.

Coal product of Fayette county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	4,041,643				
1885	3,192,172				
1886	4,194,613				
1887	4,540,322				
1888	5,208,993				
1889	5,897,254	$3,702,548	$0.63		6,567
1890	6,413,081	4,931,015	.77	247	6,503
1891	5,782,573	4,755,444	.82	216½	7,545
1892	7,260,044	5,620,159	.77	239	7,952
1893	6,261,146	4,563,989	.73	195	6,780

Fayette county in connection with Westmoreland county form what is known as the Connellsville coke region. The decrease in the amount of coal made into coke in this field during 1893 as compared with 1892 was nearly 3,000,000 tons.

Huntingdon county.—Coal produced in 1893, 303,547 short tons; spot value, $228,432. The county's output decreased 30,308, or about 9 per cent., from 1892. The average price did not change.

Coal product of Huntingdon county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	212, 587				
1885	247, 424				
1886	313, 581				
1887	265, 479				
1888	281, 823				
1889	280. 133	$211, 597	$0. 75		538
1890	322, 630	247. 364	. 77	237	611
1891	269, 021	210, 918	. 78	246	595
1892	333, 855	249, 715	. 75	244	560
1893	303, 547	228, 432	. 75	182	487

The coal fields of this county are contained exclusively in the Broad Top semi-bituminous field. The mines are opened on both sides of what is known as the Broad Top mountain field, on both sides of the mountain, being known, respectively, as the east and west fields.

On account of the superior character of the coal it is much sought for by the trade to supply special consumers. Although a very small area of the southwestern corner of the county is underlaid by coal beds, yet the amount of available coal is very considerable, and there are no facts to warrant the popular impression that the coal beds will be early exhausted.

Indiana county.—Coal produced in 1893, 380,666 short tons; spot value, $291,488. The product of Indiana county was 133,797 short tons less than in 1892. The value decreased in proportion, there being no change in the price.

Coal product of Indiana county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	30, 758				
1885	82. 750				
1886	103, 615				
1887	207, 597				
1888	157, 285				
1889	153, 698	$124, 088	$0. 71		139
1890	357, 580	294, 389	. 82	245	668
1891	456, 077	345, 623	. 76	227	561
1892	514, 463	393, 388	. 77	191	656
1893	380, 666	291, 488	. 77	186	605

Press reports state that near Glen Campbell, in this county, parties have been quietly at work looking for coal where it was predicted there was none. However, the prospectors went ahead, and, it is claimed they have been rewarded by the discovery of a 5-foot seam of coal of good quality, and that arrangements for mining the same have been made.

Jefferson county.—Coal produced in 1893, 3,885,196 short tons; spot value, $2,863,049.

Jefferson county is fifth in the State in its production of coal. In 1893 the product was 178,867 short tons more than in 1892, though due to the bad trade conditions the value decreased $143,568. The price declined from 81 to 74 cents.

Coal product of Jefferson county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	450, 079				
1885	479, 675				
1886	1, 023, 186				
1887	1, 693, 492				
1888	2, 275, 349				
1889	2, 896, 487	$2, 117, 531	$0. 73		3, 738
1890	2, 850, 799	2, 421, 960	. 85	245	3, 971
1891	3, 160, 614	2, 774, 610	. 88	237	4, 172
1892	3, 706, 329	3, 006, 617	. 81	232	4, 567
1893	3, 885, 196	2, 863, 049	. 74	210	5, 537

The production of coke in the county decreased, the amount of coal so consumed in 1893 being 514,786 tons against 665,868 short tons in 1892.

Lawrence county.—Coal produced in 1893, 196,736 short tons; spot value, $201,727.

The product of Lawrence county decreased from 216,561 short tons in 1892, a loss of 19,825. The value decreased $19,602, an increase of 1 cent being shown in the average price received.

Coal product of Lawrence county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	42, 818				
1885	42, 137				
1886	101, 154				
1887	125, 361				
1888	106, 921				
1889	143, 410	$150, 537	$1. 05		267
1890	140, 528	142, 682	1. 02	232	307
1891	164, 669	168, 114	1. 02	226	327
1892	216, 561	221, 329	1. 02	250	368
1893	196, 736	201, 727	1. 03	218	430

Lycoming county.—The product increased from 20,515 short tons in 1892 to 53,192 tons in 1893, a gain of 32,677 short tons. The value increased from $23,036 to $64,910. The output in 1892 was the first reported from this county.

McKean county.—Coal produced in 1893, 19,169 short tons; spot value, $21,086.

The product is from one mine and is used principally by locomotives of the Western New York and Pennsylvania railroad.

Product of coal in McKean county, Pennsylvania, since 1875.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1875	33,501				
1876	81,830				
1877	73,222				
1878	72,098				
1879	85,745				
1880	100,046				
1881	110,099				
1882	73,834				
1883	84,899				
1884	78,870				
1885	44,312				
1886	617				
1887	8,761				
1888	10,443				
1889	11,500				
1890	(*a*)				
1891	15,345	$16,112	$1.65	230	42
1892	21,282	23,410	1.10	304	28
1893	19,169	21,086	1.10	285	19

a None.

Mercer county.—Coal produced in 1893, 499,651 short tons; spot value, $444,855.

Mercer county is one of nine counties having an increased production in 1893, the product exceeding that of 1892 by 79,506 tons, with an increase in value of $76,376.

Coal product of Mercer county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	276,350				
1885	378,508				
1886	537,712				
1887	539,721				
1888	487,122				
1889	575,751	$511,202	$0.89		1,094
1890	524,319	446,392	.85	231	1,023
1891	526,220	474,853	.90	241	972
1892	420,145	368,479	.88	181	876
1893	499,651	444,855	.89	187	981

Potter county.—The finding of a paying vein of good bituminous coal on the property of Mr. George D. Briggs, of Buffalo, in Potter county, is reported in that section, and the organization of a new railroad company for its transportation to market. The Portage Creek and Rich Valley is the title of the organization, and it has been formed with Mr. Briggs as president. The new line will open a fine coal territory to the Buffalo, New York, market.

Somerset county.—Coal produced in 1893, 532,688 short tons; spot value, $335,385.

The product of Somerset county in 1893 was the largest in its history, being 23,078 short tons more than in 1892. The value, however, decreased $11,320, and was less than in any year since 1889.

Coal product of Somerset county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	269,930				
1885	302,715				
1886	349,926				
1887	416,240				
1888	370,238				
1889	442,027	$308,400	$0.70		525
1890	522,796	341,518	.65	225	646
1891	480,194	338,533	.71	266	531
1892	509,610	346,705	.66	238	577
1893	532,688	335,385	.63	214	695

Tioga county.—Coal produced in 1893, 962,248 short tons; spot value, $1,166,769.

The product of Tioga county in 1893 was 37,536 tons less than in 1892, while the value decreased $268,109, due to a decline in price from $1.44 to $1.21.

Coal product of Tioga county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	931,922				
1885	1,067,081				
1886	1,384,800				
1887	1,328,963				
1888	1,106,146				
1889	1,036,175	$1,264,889	$1.22		2,400
1890	903,997	995,936	1.10	192	2,019
1891	1,010,872	1,156,959	1.14	241	1,980
1892	999,784	1,434,878	1.44	223	2,249
1893	962,248	1,166,769	1.21	214	2,425

Washington county.—Coal produced in 1893, 3,315,146 short tons; spot value, $2,600,050. The product of Washington county was 411,911 short tons more than in 1892, but owing to a decline of 9 cents in the price the value increased only $61,675. The remarks made upon the increased production in Allegheny county apply also to Washington county and need not be repeated.

Coal product of Washington county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	707, 262				
1885	836, 633				
1886	1, 612, 407				
1887	1, 751, 615				
1888	1, 793, 022				
1889	2, 364, 901	$1, 557, 486	$0. 66		4, 605
1890	2, 836, 667	2, 649, 627	. 93	227	4, 644
1891	2, 606. 158	2, 251, 788	. 87	222	4, 135
1892	2, 903, 235	2, 538, 375	. 87	202	4, 895
1893	3, 315, 146	2, 600, 050	. 78	184	6, 058

Westmoreland county.—Coal produced in 1893, 7,439,760 short tons; spot value, $6,133,014. The product in 1893 was 1,351,308 short tons less than 1882, due to the industrial depression which restricted the demand for and production of coke, the amount of coal made into coke in 1893 being more than 1,600,000 tons less than in 1892. This is discussed more fully under Fayette county.

Coal product of Westmoreland county, Pennsylvania, since 1884.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1884	3, 282, 733				
1885	3, 774, 072				
1886	5, 446, 480				
1887	6, 074, 486				
1888	6, 519, 773				
1889	7, 631, 124	$5, 674, 493	$0. 74		9, 109
1890	8, 290, 504	6, 691, 532	. 80	228	12, 080
1891	7. 967, 493	6, 891, 998	. 87	221	11, 083
1892	8, 791, 068	7, 102, 934	. 81	234	10, 724
1893	7, 439, 760	6, 133, 014	. 82	205	10, 270

Notwithstanding a decrease in production exceeding the total output of thirteen coal-producing States, Westmoreland county stands first in producing importance in Pennsylvania, and consequently the first in the United States.

TENNESSEE.

Total product in 1893, 1,902,258 short tons; spot value, $2,048,449.

The coal output of Tennessee in 1892 was 2,092,064 short tons, valued at $2,355,441, indicating a decrease in 1893 of 189,806 short tons in quantity and $306,992 in value. There was a decrease in the average price per ton from $1.13 to $1.08. The labor statistics show that the total number of employés increased from 4,926 to 4,976, but that the average working time decreased from 240 to 232 days.

In 1892 the coal-mining industry of Tennessee suffered severely because of strikes and riots brought on by the opposition of free labor to the convict-lease system. These demonstrations were less marked in 1893, but the industry felt the effects of the industrial and financial depression, and the decreased production is generally attributed to that.

The State has taken steps to discontinue the leasing of convicts after the present contracts expire, which will be in 1896. To this end the authorities have purchased several thousand acres of coal land in Morgan county, with the intention of employing the convicts in mines of its own. This will take the convicts away from direct association and competition with the free labor, but the product of their (the convicts') labor will still be put upon the market in competition with the product of the other mines of the State, and, while this arrangement may be some improvement over the lease system, it seems doubtful if it will prove entirely satisfactory. The State will be able to dispose of its coal at prices lower than that from other mines, and unless means are adopted to maintain a price in keeping with the market value there is likely to be trouble. The plan is worth trying, however, and the results will be looked for with interest.

The following tables show the statistics of coal production in Tennessee for 1892 and 1893, by counties:

Coal product of Tennessee in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Anderson	404,225	3,779	1,966	....	409,970	$454,592	$1.11	218	1,072
Campbell	280,577	4,658	2,370	2,000	289,605	346,980	1.19	213	732
Claiborne	107,836	....	....	29,383	137,219	142,754	1.04	207	276
Franklin	600	800	....	....	1,400	2,800	2.00	50	20
Grundy	137,575	658	2,607	217,183	358,023	397,406	1.11	309	800
Hamilton	87,546	539	820	16,378	105,283	116,652	1.11	192	365
Marion	129,214	11,448	684	100,628	241,974	262,167	1.08	286	375
Morgan	34,439	231	300	....	34,970	47,250	1.36	148	156
Rhea	....	13,143	3,360	116,921	133,424	133,424	1.00	307	175
Roane	25,194	2,495	1,053	73,846	102,588	107,238	1.05	282	207
Scott	152,978	13,201	2,077	14,974	183,230	227,105	1.24	243	448
White	88,078	500	1,800	....	90,378	112,973	1.25	232	300
Small mines	....	4,000	....	....	4,000	4,100	1.03	......	......
Total	1,448,262	55,452	17,037	571,313	2,092,064	2,355,441	1.13	240	4,926

Coal product of Tennessee in 1893 by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Anderson	306,177	1,750	3,850	....	311,777	$319,115	$1.02	247	665
Bledsoe	....	....	....	....	....	....	......	......	......
Campbell	251,796	7,231	1,476	2,000	262,503	328,897	1.25	175	936
Claiborne	154,754	500	800	25,476	181,530	163,447	.90	142	280
Franklin	600	600	....	....	1,200	2,400	2.00	100	6
Grundy	132,912	1,019	2,302	157,780	294,013	305,774	1.04	247	548
Hamilton	112,750	1,552	1,848	39,373	155,523	158,681	1.02	260	670
Marion	140,572	1,254	633	69,135	211,594	206,452	.98	262	480
Morgan	77,565	384	241	....	78,190	83,542	1.07	224	272
Rhea	1,790	9,353	1,344	84,044	96,531	86,151	.89	295	245
Roane	5,405	3,842	4,557	25,750	39,554	57,891	1.46	203	160
Scott	138,395	9,395	2,190	8,000	157,980	220,800	1.40	222	414
White	104,503	1,680	1,680	....	107,863	111,299	1.03	307	300
Small mines	....	4,000	....	....	4,000	4,000	......	......	......
Total	1,427,219	42,560	20,921	411,558	1,902,258	2,048,449	1.08	232	4,976

In the following table is shown the total production by counties, since 1889, with the increase and decrease in each county during 1893 as compared with the preceding year. It will be observed that in only four counties was there an increased output, while in eight the product decreased:

Coal product of Tennessee since 1889, by counties.

Counties.	1889.	1890.	1891.	1892.	1893. Product.	1893. Increase.	1893. Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Anderson	457, 069	582, 403	587, 558	409, 970	311, 777	....	98, 193
Campbell	123, 103	126, 367	159, 937	289, 605	262, 503	....	27, 102
Claiborne	(*a*)	(*a*)	73, 738	137, 219	181, 530	44, 311	....
Franklin	(*b*)	1, 500	1, 400	1, 400	1, 200	....	200
Grundy	400, 107	349, 467	398, 936	358, 023	294, 013	....	64, 010
Hamilton	241, 067	277, 896	243, 298	105, 283	155, 523	50, 240	....
Marion	203, 923	213, 202	271, 809	241, 974	211, 594	....	30, 380
Morgan	68, 229	143, 518	125, 287	34, 970	78, 190	43, 220	....
Rhea	149, 194	211, 465	213, 649	133, 424	96, 531	....	36, 893
Roane	(*c*)174, 551	70, 452	112, 308	102, 588	39, 554	....	63, 034
Scott	108, 027	136, 365	142, 943	183, 230	157, 980	....	25, 250
White	(*b*)	52, 650	78, 315	90, 378	107, 863	17, 485	....
Other counties and small mines	419	4, 300	4, 500	4, 000	4, 000	....	....
Total	1, 925, 689	2, 169, 585	2, 413, 678	2, 092, 064	1, 902, 258	155, 256	345, 062
Net increase	....	243, 896	244, 093	(*d*)321, 614	....	....	(*d*)189, 806

a Developing.
b Included in Roane county.
c Includes Franklin and White counties.
d Net decrease.

The annual output of the State since 1873 has been as follows:

Coal product of Tennessee from 1873 to 1893.

Years.	Short tons.	Years.	Short tons.
1873	350, 000	1884	1, 200, 000
1874	350, 000	1885	1, 440, 957
1875	360, 000	1886	1, 714, 290
1876	550, 000	1887	1, 900, 000
1877	450, 000	1888	1, 967, 297
1878	375, 000	1889	1, 925, 689
1879	450, 000	1890	2, 169, 585
1880	641, 042	1891	2, 413, 678
1881	750, 000	1892	2, 092, 064
1882	850, 000	1893	1, 902, 258
1883	1, 000, 000		

Anderson county.—Coal produced in 1893, 311,777 short tons; spot value, $319,115.

The product of Anderson county in 1893 was 98,193 short tons less than in 1892, due to strikes and riotous uprisings among the miners, the employment of convicts in the mines of one of the operating companies being the cause of the trouble. In addition to this there was a decline in price, owing to the businesss depression, from $1.11 to $1.02 per ton.

Coal product of Anderson county, Tennessee, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	457, 069	$531, 920	$1. 16	....	986
1890	582, 403	680, 249	1. 17	291	1, 325
1891	587, 558	671, 633	1. 15	242	1, 350
1892	409, 970	454, 592	1. 11	218	1, 072
1893	311, 777	319, 115	1. 02	247	665

Bledsoe county.—Coal mines are being developed in Bledsoe county, but had not reached the point of producing coal for market at the close of 1893.

Campbell county.—Coal produced in 1893, 262,503 short tons; spot value $328,897.

Campbell county, Tennessee, with Whitley county, Kentucky, form what is known as the Jellico coal field. The product is well and favorably known for its steam-raising qualities, and is popular as a domestic fuel. Large quantities are shipped to Brunswick and Savannah, Georgia, and other seaports, for steamer fuel.

Coal product of Campbell county, Tennessee, since 1889.

Years.	Short tons.	Value.	Average price per ton.	Number of days active.	Number of men employed.
1889	123,103	$146,610	$1.15	....	393
1890	126,367	153,790	1.22	212	251
1891	159,937	203,729	1.27	145	451
1892	289,605	346,980	1.19	213	732
1893	262,503	328,897	1.25	175	936

It is reported that a combination has been effected among the producers of the Jellico coal field, putting all the mines under one management. Arrangements have also, it is reported, been made with the Louisville and Nashville railroad for a reduction in freight rates on Jellico coal, which will enable the producers to ship it to Chicago and other Western points for special uses.

Claiborne county.—Coal produced in 1893, 181,530 short tons; spot value, $163,447. Claiborne county began producing coal in 1891, when 73,738 short tons, valued at $87,624, were mined. In 1892 the output increased to 137,219 short tons, valued at $142,754; and, as predicted in the last report, the product in 1893 shows a still further increase to 181,530 tons, a gain of 44,311 tons or about 32 per cent. Notwithstanding this evidence of prosperity the largest producing company has been placed in the hands of a receiver.

Franklin county.—The output is from one mine at Sewanee. The production varies very little from year to year. About half the product is consumed locally, supplying the University of the South at Sewanee and the residents in the vicinity.

Grundy county.—Coal produced in 1893, 294,013 short tons; spot value, $305,774.

The product of Claiborne coal was 64,010 short tons less than in 1892, with a decrease in value of $82,632. The entire product of the county is from the Sewanee mines of the Tennessee Coal, Iron, and Railroad Company.

Coal product of Grundy county, Tennessee, since 1889.

Years.	Total product.	Total value.	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	400,107	$395,767	$0.99	....	501
1890	349,467	326,827	.94	310	880
1891	398,936	353,313	.89	311	515
1892	358,023	397,406	1.11	309	800
1893	294,013	305,774	1.04	247	548

Hamilton county.—Coal produced in 1893, 155,523 short tons; spot value, $158,681.

The output of Hamilton county was nearly 50 per cent. larger than in 1892, though the price declined from $1.11 to $1.02. The mines of the Soddy Coal and Iron Company were sold, and a new company known as the New Soddy Coal Company was organized. The new company has put in a number of improvements, a large coal washer was constructed, and a number of coke ovens built. These improvements stimulated production, and the mines were quite active throughout the year, averaging 275 days, and employing about 600 men.

Coal product of Hamilton county, Tennessee, since 1889.

Years..	Total product.	Total value.	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	241,067	$313,991	$1.30	....	625
1890	277,896	318,898	1.15	285	500
1891	243,298	282,502	1.12	213	475
1892	105,283	116,652	1.11	192	365
1893	155,523	158,681	1.02	260	670

Marion county.—Coal produced in 1893, 211,594 short tons; spot value, $206,452.

Compared with 1892 the product of Marion county decreased 30,380 short tons, with a decrease in value of $55,715. The price declined 10 cents per ton.

According to the press reports there are to be some new coal mines developed in Marion county, near Chattanooga. The prospects are in Waldens ridge, the vein of coal ranging from 2 to 3½ feet in thickness.

Coal product of Marion county, Tennessee, since 1889.

Years.	Total product.	Total value	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	203,923	$230,116	$1.13	....	423
1890	213,202	225,403	1.06	226	523
1891	271,809	301,910	1.11	220	615
1892	241,974	262,167	1.08	286	375
1893	211,594	206,452	.98	262	480

Morgan county.—Coal produced in 1893, 78,190 short tons; spot value, $83,542.

In 1892 the product of Morgan county was greatly reduced by strikes, and the shutting down of iron mills restricted the product in 1893, which, however, was 43,220 tons more than in 1892.

During 1893 the State authorities purchased 9,000 acres of coal land in Morgan county, the object being to use the State convicts in mining the coal. The contracts now existing between the State and the coal companies leasing convicts expire in 1896. It is proposed upon the expiration of these leases that the State will employ all the convicts in its own mines and thus, it is hoped, prevent the recurrence of the riots which have from time to time brought the coal regions of Tennessee into unpleasant notoriety.

Coal product of Morgan county, Tennessee, since 1889.

Years.	Total product.	Total value.	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	68, 229	$91, 511	$1. 34	....	135
1890	143, 518	158, 243	1. 10	258	363
1891	125, 287	135, 202	1. 09	250	363
1892	34, 970	47, 250	1. 36	148	156
1893	78, 190	83, 542	1. 07	224	272

Rhea county.—Coal produced in 1893, 96,531 short tons; spot value, $86,151.

The product of Rhea county decreased 36,893 short tons, as compared with 1892, and the average price having declined from $1 to 89 cents the value decreased $47,273.

The Fox Coal and Coke Company, which has been in litigation and not producing for several years, resumed operations in March, but until August the work was confined to developing the property, and shipments were rather limited after that time, as the development work was not fully completed before the end of the year.

Coal product of Rhea county, Tennessee, since 1889.

Years.	Total product.	Total value.	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	149, 194	$164, 118	$1. 10	....	475
1890	211, 465	211, 465	1. 00	200	450
1891	213, 649	213, 649	1. 00	250	350
1892	133, 424	133, 424	1. 00	307	175
1893	96, 531	86, 151	. 89	295	245

Roane county.—The product of Roane county decreased from 102,588 tons in 1892 to 39,554 tons in 1893, a loss of over 60 per cent.

Scott county.—Coal produced in 1893, 157,980 short tons; spot value, $220,800.

The product of Scott county decreased from 189,230 tons in 1892 to 157,980 tons, a loss of 25,250 short tons. Operators generally report unsatisfactory business, but the returns show a higher comparative value in 1893 than in 1892.

Coal product of Scott county, Tennessee, since 1889.

Years.	Total product.	Total value.	Average price per ton.	Number of days active.	Total employés.
	Short tons.				
1889	108,027	$145,075	$1.34	....	180
1890	136,365	175,327	1.29	241	475
1891	142,943	179,165	1.25	182	347
1892	183,230	227,105	1.24	243	448
1893	157,980	220,800	1.40	222	414

White county.—The Bon Air mines, the only ones in the county, have shown an increased output each year since 1890 when the product was 52,650 tons. In 1891 the output increased to 78,315 tons; again in 1892 to 90,378 tons, and reaching a total of 107,863 tons in 1893.

TEXAS.

Total product in 1893, 302,206 short tons; spot value, $688,407.

The production of coal in 1893, both in quantity and value, exceeded any previous year, with indications that the output will continue to increase. In 1892 the product was 245,690 short tons, valued at $569,333, showing the increase in 1893 to have been 56,516 short tons, or about 23 per cent. in amount and $119,074, or a little more than 20 per cent. During 1893 996 men were employed, and the mines were worked an average of 251 days against 871 men for 218 days in 1892. Coal was produced in six counties in the State, but there is only one mine in each county. For this reason the statistics are not published in detail by counties, but the following tables, showing the product in each county in 1893 and the statistics of the total production in the State since 1889, will be found of interest:

Coal product of Texas in 1893, by counties.

Counties.	Short tons.	Value.
Bexar	18,501	$46,253
Coleman	70	140
Erath	243,773	548,001
Maverick	6,680	11,869
Parker	12,845	29,268
Webb	20,337	52,876
Total	302,206	688,407

Coal product of Texas since 1889.

Distribution.	1889.	1890.	1891.	1892.	1893.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Loaded at mines for shipment	120,602	180,800	169,300	241,005	300,064
Sold to local trade and used by employés	6,552	1,840	900	4,460	462
Used at mines for steam and heat	1,062	1,800	1,900	225	1,680
Total	128,216	184,440	172,100	245,690	302,206
Total value	$340,617	$465,900	$412,300	569,333	$688,407

THE SAN CARLOS COAL FIELDS.

The coal fields of Texas, so far as they were known and prospected, have been fully described in previous volumes of "Mineral Resources." Since these articles were published a valuable discovery of coal has been made in Presidio county, and during 1892 and 1893 active development work has been prosecuted. The San Carlos Coal Company, composed of Pittsburg, Pennsylvania, business men, was formed, with a capital stock of $500,000.

The property on which the company is now operating consists of (1) 2 sections, or 1,280 acres, of land situated in Presidio county, Texas, acquired by purchase in fee from the State of Texas, all of which is underlaid with coal; (2) 83 sections, or 53,120 acres of land are held by the company under a lease from private owners in fee for the term of thirty years from May 16, 1892. Some of this land is below the Coal Measures and contains no coal. From 10 to 20 sections of it are known to contain coal. The lease also contains an option to the company to purchase in fee, both coal and surface, at any time within ten years after date of lease, any of the 83 sections of land found to contain coal, at the rate of $15.62½ per acre. The rental to be paid until the option to purchase is exercised, is 15 cents per ton for all merchantable lump coal run over a 1½-inch screen, up to an output of 150,000 tons per annum, all coal mined in excess of that amount to be at the rate of 12½ cents per ton.

The coal lies in a horizontal stratum, cropping out on the mountain side about 100 feet above the level of a valley. It rises from the outcrop at an angle of 1 degree from the horizontal, making good drainage by natural flow from the mine. The coal consists of two veins separated by a strata of soft shale.

In reply to a request from the Survey for a report on the progress made during 1893, Mr. R. E. Russell, general manager of the company, responds as follows:

"Development work during the past twelve months has been confined mainly to driving tunnels and drifts, and sinking a large working or hoisting shaft. About 5,500 feet of tunnels and drifts have been driven, and the working shaft is at present (April, 1894) 250 feet deep, and will cut the seam of coal at 300 feet. "The workable coal lies in two benches, separated by a seam of slate from 6 to 18 inches thick. In all of the drifts and tunnels, the lower bench, which is the softer coal, will average from 30 to 40 inches thick, and the upper bench, which is the harder coal, will average about 32 inches. In places, this widens out to 6 feet or more. The seam is covered with an excellent hard roof of slate, and the parting is not so thick but that both benches can easily be mined together.

"Below is given the result of what is considered an average analysis of the two benches:

Analysis of coal from Presidio county, Texas.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Moisture	1	0.94
Volatile matter	39.05	34.48
Fixed carbon	49.05	58.96
Ash	10	5.62
Sulphur	Trace.	.64

"A trial of the coal for steaming purposes was made on the Southern Pacific railroad. The coal tested had been subjected to exposure for five or six months on the various dumps, and was practically crop coal, yet the average mileage per ton of coal was 52.21 on passenger trains of 5 or 6 coaches.

"Tests of the coking qualities of the coal were made at Connellsville, Pennsylvania, with good results. Forty-eight-hour coke, burned in the oven at the mine, quite recently gave the following result:

Analysis of coke made from Presidio county, Texas, coal.

	Per cent.
Combustible matter	93.7
Ash	6.3

"The property lies 26 miles south of the Southern Pacific railroad, but ground will soon be broken on the branch line which will connect the mines with the Southern Pacific railroad at Chispa station, and by the time this line is completed the company expects to have the property developed sufficiently to enable us to ship from 800 to 1,200 tons per day.

"The coal dips back into the main range. The mountains are perfectly regular in stratification and undisturbed by faulting, although a monoclinal fold is seen toward the southern end of the coal basin. The average dip is 5 degrees to the northeast."

With the bringing of this coal into the market the product of Texas will probably be doubled.

UTAH.

Total product in 1893, 413,205 short tons; spot value, $611,092.

Utah's output in 1893 was the largest ever obtained, being 52,192 short tons, or nearly 15 per cent. more than in 1892. The increased production brought increased competition, and the average price declined from $1.56 to $1.48 per ton, but this decline was offset by an increase in the average tonnage per day for each employé. The total number of employés decreased from 646 in 1892 to 576 in 1893, and the average working time, from 230 to 226 days.

Emery county is the principal producer, yielding in 1893 nearly 87 per cent. of the total output of the Territory. Summit county produced about 12½ per cent. and the other one-half of 1 per cent. was produced by Morgan and San Pete county for local trade.

The following tables show the statistics of production during 1892 and 1893, by counties:

Coal product of Utah in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Emery	283, 319	2, 481	1, 800	26, 298	313, 898	$490, 201	$1. 56	210	474
Morgan		100			100	250	2. 50	30	3
San Pete		2, 095			2, 095	4, 443	2. 12	143	14
Summit	38, 112	2, 099	4, 709		44, 920	67, 731	1. 50	305	155
Total	321, 431	6, 775	6, 509	26, 298	361, 013	562, 625	1. 56	230	646

Coal product of Utah in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Emery	304, 511	920	1, 874	50, 875	358, 180	523, 422	1. 46	238	416
Morgan		100			100	175	1. 75	50	2
San Pete		2, 671	12		2, 683	4, 752	1. 77	220	11
Summit	45, 912	3, 958	2, 372		52, 242	82, 743	1. 58	194	147
Total	350, 423	7, 649	4, 258	50, 875	413, 205	611, 092	1. 48	226	576

There are no records of the amount of coal produced in the Territory prior to 1885. Since that time the annual output has been as follows:

Coal product of Utah since 1885.

Years.	Short tons.	Years.	Short tons.
1885	213, 120	1890	318, 159
1886	200, 000	1891	371, 045
1887	180, 021	1892	361, 013
1888	258, 961	1893	413, 205
1889	236, 651		

VIRGINIA.

Total product in 1893, 820,339 short tons; spot value, $692,748.

The output of coal in Virginia in 1893 was the largest since 1889, when 865,786 short tons were produced. The increase over 1892 was 145,134 short tons, with an increase in value of $114,319. The increase was due almost entirely to the developments of the Wise county coal field on the Clinch Valley division of the Norfolk and Western railroad. The output in Wise county was 126,216 short tons, this being the first product reported from the county, although above 2,000 tons taken out in the course of developing the mines were shipped out of the county during December, 1892. This item was not included in the product of that year.

There was also a slight increase in the output of Tazewell county, from 614,333 tons in 1892 to 653,374 tons in 1893.

The following tables show the statistics of production during 1892 and 1893 by counties.

Coal product of Virginia in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Chesterfield..	....	....	....	....	....	....	....	....	....
Henrico	22,400	11,200	....	56	33,656	$42,070	$1.22	200	65
Montgomery .	2,677	868	18	....	3,563	8,674	2.43	110	42
Pulaski	16,032	7,621	....	....	23,653	24,932	1.09	237	29
Tazewell.....	486,195	1,032	6,593	120,513	614,333	502,753	.82	200	700
Total.....	527,304	20,721	6,611	120,569	675,205	578,429	.86	192	836

Coal product of Virginia in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Tazewell....	565,245	3,805	3,360	80,964	653,374	$520,565	$0.80	310	600
Wise........	124,088	896	1,232	....	126,216	113,436	.90	149	260
Other counties (*a*)....	18,084	15,877	17	....	33,978	50,622	1.49	185	101
Total...	714,188	20,578	4,609	80,964	820,339	692,748	.84	253	961

a Includes Chesterfield, Henrico, Montgomery, and Pulaski counties.

The total production of coal in Virginia since 1880 has been as follows:

Coal product of Virginia since 1880.

Years.	Short tons.	Years.	Short tons.
1880	112,000	1887	825,263
1881	112,000	1888	1,073,000
1882	112,000	1889	865,786
1883	252,000	1890	784,011
1884	336,000	1891	736,399
1885	567,000	1892	675,205
1886	684,951	1893	820,339

WASHINGTON.

Total product in 1893, 1,264,877 short tons; spot value, $2,920,876.

By an increase over the output in 1890 of a little more than 1,000 tons, Washington attained its largest production of coal in 1893. The increase over 1892 was 51,450 short tons. The average price per ton was advanced from $2.28 to $2.31, increasing the total value $157,329. The increased production was due to the extended developments in some of the old mines in King and Pierce counties, and the opening of some new ones, mention of which was made in the report for 1892. The output in Kittitas county decreased, and no product was reported in Thurston county.

The mines of the State gave employment to 2,757 men during 1893, against 2,564 in 1892, and were operated an average of 241 days, as compared with 247 days in 1892.

The following tables exhibit the statistics of production during 1892 and 1893, by counties:

Coal product of Washington in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
King	479,458	4,021	24,988		508,467	$1,228,262	$2.42	265	1,296
Kittitas	275,471	2,552	7,065		285,088	572,615	2.11	178	500
Pierce	344,260	2,745	5,534	11,755	364,294	824,606	2.26	269	626
Skagit	3,783			920	4,703	15,249	3.24	100	30
Thurston	20,817	484	818		22,119	45,790	2.01	223	42
Whatcom	27,076		1,680		28,756	77,025	2.68	305	70
Total	1,150,865	9,802	40,085	12,675	1,213,427	2,763,547	2.28	247	2,564

Coal product of Washington in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
King	544, 848	4, 360	28, 523	....	577, 731	$1,284,684	$2. 22	272	1, 256
Kittitas	239, 888	3, 048	10, 531	....	253, 467	653,922	2. 71	162	672
Pierce	389, 196	764	7, 140	10, 974	408, 074	917,122	2. 25	260	756
Skagit	1, 985	100	420	400	2, 905	10,698	3. 68	94	17
Thurston	....	....	....	....	....	....	....	....	....
Whatcom	10, 192	10, 616	1, 892	....	22, 700	54,450	2. 40	291	56
Total	1, 186, 109	18, 888	48, 506	11, 374	1, 264, 877	2,920,876	2. 31	241	2, 757

The total output of the State since 1887, by counties, is shown in the following table:

Product of coal in Washington since 1887, by counties.

[Short tons.]

Counties.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
King	339, 961	546, 535	415, 779	517, 492	429, 778	598, 467	577, 731
Kittitas	104, 782	220, 000	294, 701	445, 311	348, 018	285, 088	253. 467
Pierce	229, 785	276, 956	273, 618	285, 886	271, 053	364, 294	408. 074
Skagit	....	....	....	....	1, 400	4, 703	2, 905
Thurston	15, 295	42, 000	46, 480	15, 000	....	22, 119	....
Whatcom	....	....	....	....	6, 000	28, 756	22, 700
Not specified	82, 778	130, 259	....	....	....	....	....
Total	772, 601	1, 215, 750	1, 030, 578	1, 263, 689	1, 056, 249	1, 213, 427	1, 264, 877

The first discovery of coal in what is now the most important producing region of the Pacific States was made in 1852. The first mine was opened on Bellingham Bay in 1854. The coal from this mine was shipped to San Francisco, and was the only coal shipped out of the Territory (now State) of Washington until 1870, when exportation commenced at Seattle from the Seattle, Renton, and Talbot mines in the vicinity. In 1874 the product from the Seattle mines was 50,000 tons; from July 1, 1878, to July 1, 1879, the product was 155,900 tons. In the year ended December 31, 1879, the product was 137,207 short tons. The Renton mine, opened in 1874, produced in 1875 and 1876 50,000 short tons. The Talbot mine, opened in 1875, produced, in 1879 18,000 short tons of coal. Records of the operations of Washington coal mines are incomplete, and entirely wanting from 1879 to 1884. The mining during this time was confined to King and Pierce counties. During the fiscal year ended June 30, 1885, the total product of the Territory is given at 380,250 short tons, of which King county is credited with 204,480 short tons and Pierce county with 175,770 short tons.

The annual product since that time has been as follows:

Product of coal in Washington since 1885.

Years.	Total product.	Total value.	Average price per ton.	Total employés.	Average number of days worked.
	Short tons.				
1885	380,250				
1886	423,525	$952,931	$2.25		
1887	772,601	1,699,746	2.19	1,571	
1888	1,215,750	3,647,250	3.00		
1889	1,030,578	2,393,238	2.32	2,657	
1890	1,263,689	3,426,590	2.71	2,206	270
1891	1,056,249	2,437,270	2.31	2,447	211
1892	1,213,427	2,763,547	2.28	2,564	247
1893	1,264,877	2,920,876	2.31	2,757	241

King county.—Coal produced in 1893, 577,731 short tons; spot value, $1,284,684.

Compared with 1892, the product of King county shows an increase of 69,264 short tons in quantity and $56,422 in value. The average price declined from $2.42 to $2.22. The increased product is due largely to extensive improvements in the mines of the Oregon Improvement Company at Franklin and Newcastle, and would have been somewhat larger still but for a fire in the airway of the Franklin mine, causing a suspension of operations for about forty days. The new mines were opened at Palmer on what is claimed to be an excellent grade of cannel coal, but had produced only about 150 tons of coal at the close of 1893. The veins promise well, however, and it is expected that the product in 1894 will be of considerable importance.

Coal product of King county, Washington, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	339,961			
1888	546,535			
1889	415,779	$954,295	$2.55	1,220
1890	517,492	1,352,920	2.61	1,098
1891	429,778	1,009,278	2.35	1,285
1892	508,467	1,228,262	2.42	1,296
1893	577,731	1,284,684	2.22	1,256

Kittitas county.—Coal produced in 1893, 253,467 short tons; spot value, $653,922.

The product of Kittitas county is from the Roslyn mines, operated by the Northern Pacific Coal Company. The output in 1893 was 31,621 short tons less than in 1892, while the value showed an increase of $81,307.

Coal product of Kittitas county, Washington, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	104,782	....	....	....
1888	220,000	....	....	....
1889	294,701	$777,450	$2.64	....
1890	445,311	1,229,330	2.76	489
1891	348,018	772,421	2.22	501
1892	285,088	572,615	2.11	500
1893	253,467	653,922	2.71	672

Pierce county.—Coal produced in 1893, 408,074 short tons; spot value, $917,122.

The product of Pierce county increased 43,780 short tons in 1893, the value increasing $92,516. The average price per ton was not materially changed, and the business was generally satisfactory.

Coal product of Pierce county, Washington, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	229,785	....	....	....
1888	276,956	....	....	....
1889	273,618	$578,493	$2.11½	759
1890	285,886	814,340	2.85½	589
1891	271,053	632,671	2.33½	601
1892	364,294	824,606	2.26	626
1893	408,074	917,122	2.25	756

Skagit county.—The product of Skagit county in 1893 was 2,905 short tons, valued at $10,698, against 4,703 tons, valued at $15,249, in 1892.

Thurston county.—No product was reported from Thurston county in 1893.

Whatcom county.—Whatcom county produced 22,700 short tons in 1893, against 22,119 tons in 1892. About half the output was consumed by the local trade of New Whatcom.

WEST VIRGINIA.

Total product in 1893, 10,708,578 short tons; spot value, $8,251,170.

West Virginia ranks fourth in the coal-producing States of the country, Pennsylvania being first, Illinois second, and Ohio third. The product has increased annually since 1879, and at the present rate of increase the State will probably take third place in about four years. The completion of the Norfolk and Western Railroad to the Ohio river has opened up new fields in Logan county, while along the Chesapeake and Ohio route branch lines have been constructed, bringing in new fields on Loup creek and Nuttallburg branch, and an extension of the road is in contemplation, which will open up some valuable coal lands in Raleigh county.

Whether, in the face of the present condition of the coal trade, i. e., a general overproduction and demoralized prices, with consequent low wages and strikes, the development of new coal fields is a wise thing to do may be questioned. Our mines as now developed are well able to supply all the demand that may be put upon them, and in order to maintain prices that will allow a fair remuneration to the miners it would appear wiser to keep the production within the limit of the market rather than to add to the supply.

West Virginia's product in 1893 passed the 10,000,000-ton mark, and amounted to nearly 9 per cent. of the total output of the bituminous coal mines in the United States. But in order to reach this large figure the coal had to be taken to markets previously supplied by other regions. These markets lie in the West, and in order to find sale reductions in prices were made. The two great regions in the southern part of the State, the Pocahontas and the New river and Kanawha river fields, were in active competition with each other, in addition to the rivalry of other sections. In order to augment the western shipments over its line the Chesapeake and Ohio railroad reduced the freight rates over its line from the Kanawha field to Cincinnati 15 cents a ton. All of these conditions helped to increase the production, but the activity was not a healthy one. The output of each county in both fields, except Raleigh, on the Chesapeake and Ohio, and Mercer, on the Norfolk and Western, increased, but with what result? The price declined from 84 cents to 80 cents in Fayette county, from 92 cents to 86 cents in Kanawha county, from 74 cents to 70 cents in McDowell county, from 76 cents to 69 cents in Mercer county, and from $1.11 to $1.01 in Putnam county. The latter part of the year found the market glutted with coal. A proposition was made by the operators to their miners to accept a reduction of 10 cents per ton for mining or to close down the mines. This offer was accepted. Other mining regions were similarly affected, a general reduction in wages being made. The arrangement worked satisfactorily for awhile, but at the opening of 1894 some of the miners demanded a return to their old wages, a demand to which, on account of the state of the market, the operators were unwilling, if not unable, to accede. Several local strikes occurred along the Kanawha, and riots were frequent. These strikes were settled, but in April of 1894 the United Mine Workers' Association at Columbus, Ohio, ordered a general strike for a return to the old rate. This strike, however, affected other regions more seriously than the West Virginia fields, as a number of the mines are operated by unorganized labor, the Pocahontas region not being included in the strike at all. The New river and Kanawha men were also rather lukewarm at first, having seen by their own troubles that a recovery of old rates at that time was not practicable. Most of these were, however, finally persuaded or intimidated into joining the strikers, and for some time only a few river mines, and those on Loup creek, have been in operation. At the time of writing this report the miners who did go out are reported to be returning to work, or are willing to do so if protected from bodily harm from their more beligerent fellows. The conflict at present has settled down to a question of principle, neither side seeming inclined to yield.

Considering the production in West Virginia by counties during 1892 and 1893, it will be seen that (not including Grant, Barbour, Logan, and Randolph counties, reported in 1893 for the first time) the product in nine counties increased, while in eight it decreased. The average price per ton, however, shows a decrease in thirteen counties, an increase in three, and in one it remained the same.

The following tables show the statistics of production in 1892 and 1893, by counties:

Coal product of West Virginia in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Brooke	12,681	13,790	50	....	26,521	$25,029	$0.94	226	51
Fayette	1,864,754	27,960	10,995	551,691	2,455,400	2,073,277	.84	252	4,102
Harrison	194,731	12,302	274	14,419	221,726	170,871	.77	148	473
Kanawha	1,287,720	27,411	2,490	....	1,317,621	1,213,541	.92	217	2,677
McDowell	1,229,864	28,832	4,928	433,351	1,696,975	1,222,019	.73	195	2,061
Marion	537,152	10,272	13,986	358,294	919,704	682,111	.74	275	1,114
Marshall	103,414	15,000	560	....	118,974	93,573	.79	199	210
Mason	77,432	80,538	1,674	....	159,644	153,237	.96	215	338
Mercer	1,020,496	6,158	4,779	160,519	1,191,952	917,550	.76	211	1,621
Mineral	568,974	11,466	1,962	....	582,402	451,150	.77	244	500
Monongalia	35,000	250	100	13,550	48,900	35,208	.72	308	72
Ohio	41,414	77,588	1,321	....	120,323	119,660	.99	243	222
Preston	66,676	1,228	1,903	28,199	98,006	66,072	.67	209	170
Putnam	84,638	4,024	1,224	....	89,886	99,715	1.11	180	483
Raleigh	94,704	1,120	....	....	95,824	85,557	.89	167	120
Taylor	96,626	2,418	112	15,989	115,145	70,049	.61	282	128
Tucker	244,514	802	3,205	111,231	359,752	253,495	.70	306	525
Small mines	....	120,000	....	....	120,000	120,000	1.00	....	....
Total	7,560,790	441,159	49,563	1,687,243	9,738,755	7,852,114	.80	228	14,867

Coal product of West Virginia in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Brooke	25,700	6,650	550	....	32,900	$29,015	$0.88	260	79
Fayette	2,116,656	34,323	12,657	489,224	2,652,860	2,120,758	.80	224	4,487
Harrison	168.686	3,151	228	21,567	193,632	128,828	.67	211	298
Grant	5,600	1,120	11	....	6,731	5,109	.76	150	15
Barbour	4,088	1,196	....	....	5,284	4,718	.89	217	8
Kanawha	1,415,745	22,485	5,106	2,916	1,446,252	1,236,861	.86	276	2,306
Logan	....	425	....	....	425	425	1.00	50	4
Marion	783,024	10,708	13,490	255,112	1,062,334	742,616	.70	203	1,536
Marshall	152,697	5,200	1,100	....	158,997	124,407	.78	194	245
Mason	112,408	39,815	1,410	....	153,633	143,130	.93	194	376
McDowell	1,620,409	29,173	6,549	510,347	2,166,478	1,526,598	.70	185	3,375
Mercer	776,217	5,134	2,366	211,711	995,428	690,490	.69	209	1,281
Mineral	643,329	9,346	350	....	653,025	537,366	.82	229	666
Monongalia	27,500	200	350	10,550	38,600	27,975	.72	225	60
Ohio	....	80,565	45	....	80,610	66,269	.82	221	135
Preston	52,211	1,579	989	27,893	82,672	57,131	.69	140	200
Putnam	208,231	1,450	200	....	209,881	211,556	1.01	204	520
Raleigh	91,730	600	....	....	92,330	92,330	1.00	165	145
Taylor	63,661	1,820	91	13,068	78,640	45,968	.58	260	105
Tucker	322,576	15,749	1,406	136,641	476,372	338,126	.71	267	675
Randolph	1,494	....	....	....	1.494	1,494	1.00	100	8
Small mines	....	120,000	....	....	120,000	120,000	......	......	......
Total	8,591,962	390,689	46,898	1,679,029	10,708,578	8,251,170	.77	219	16,524

In the following table will be found the total product of the State, by counties, since 1886, with the increases and decreases in 1893 as compared with 1892. The important increases were in Fayette, Kanawha, McDowell, Marion, Putnam, and Tucker counties, while the greater part of the decrease was borne by Mercer county.

Coal product of West Virginia from 1886 to 1893, by counties.

[Short tons.]

Counties.	1886.	1887.	1888.	1889.	1890.
Brooke	22,880	40,366	11,568	31,119	36,794
Fayette	1,413,778	1,252,427	1,977,030	1,450,780	1,591,298
Harrison	234,597	154,220	109,515	174,115	144,403
Kanawha	876,785	1,126,839	863,600	1,218,236	1,421,116
McDowell	....	....	....	586,529	956,222
Marion	172,379	365,844	363,974	282,467	455,728
Marshall	251,333	92,368	47,702	47,706	123,669
Mason	150,878	140,968	72,410	185,030	145,314
Mercer	328,733	575,885	969,395	921,741	1,005,870
Mineral	361,312	478,636	456,361	493,464	573,684
Monongalia	....	....	....	74,031	31,360
Ohio	(*a*)	131,936	140,019	143,170	103,586
Preston	170,721	276,224	231,540	129,932	178,439
Putnam	(*b*)	53,200	145,440	218,752	205,178
Raleigh	....	....	....	....	....
Taylor	(*c*)	168.000	55,729	83,012	76,618
Tucker	22,400	24,707	62,517	173,492	245,378
Other counties and small mines	....	....	....	18,304	100,000
Total	4,005,796	4,881,620	5,498,800	6,231,880	7,394,654

a Included in product of Marshall county.
b Included in product of Mason county.
c Included in product of Harrison county.

Coal product of West Virginia from 1886 to 1893, by counties—Continued.

[Short tons.]

Counties.	1891.	1892.	1893.	Increase in 1893.	Decrease in 1893.
Brooke	33,950	26,521	32,900	6,379	
Fayette	2,307,421	2,455,400	2,652,860	197,460	
Harrison	150,522	221,726	193,632		28,094
Kanawha	1,324,788	1,317,621	1,446,252	128,631	
McDowell	1,267,136	1,696,975	2,166,478	469,503	
Marion	1,000,047	919,704	1,062,334	142,630	
Marshall	193,703	118,974	158,997	40,023	
Mason	159,990	159,644	153,633		6,011
Mercer	1,172,910	1,191,952	995,428		196,524
Mineral	693,574	582,402	653,025	70,623	
Monongalia	31,000	48,900	38,600		10,300
Ohio	90,600	120,323	80,610		39,713
Preston	140,399	98,006	82,672		15,334
Putnam	94,230	89,886	209,881	119,995	
Raleigh		95,824	92,330		3,494
Taylor	101,661	115,145	78,640		36,505
Tucker	358,734	359,752	476,372	116,620	
Other counties and small mines	100,000	120,000	133,934	13,934	
Total	9,220,665	9,738,755	10,708,578	969,823	

The total product of the State since 1873 has been as follows:

Coal product of West Virginia since 1873.

Years.	Short tons.	Years.	Short tons.
1873	672,000	1884	3,360,000
1874	1,120,000	1885	3,369,062
1875	1,120,000	1886	4,005,796
1876	896,000	1887	4,881,620
1877	1,120,000	1888	5,498,800
1878	1,120,000	1889	6,231,880
1879	1,400,000	1890	7,394,654
1880	1,568,000	1891	9,220,665
1881	1,680,000	1892	9,738,755
1882	2,240,000	1893	10,708,578
1883	2,335,833		

The following table will be found of interest as showing the annual increase in the coal output of West Virginia since 1880, and the average annual increase in the thirteen years:

Annual increase in the coal product of West Virginia since 1880.

Years.	Short tons.
1881 over 1880	112,000
1882 over 1881	560,000
1883 over 1882	95,833
1884 over 1883	1,024,167
1885 over 1884	9,062
1886 over 1885	636,734
1887 over 1886	875,824
1888 over 1887	617,180
1889 over 1888	733,080
1890 over 1889	1,162,774
1891 over 1890	1,826,011
1892 over 1891	518,090
1893 over 1892	969,823
Total increase in thirteen years	9,140,578
Average annual increase	761,715

Barbour county.—Barbour county produced 5,284 short tons in 1893, valued at $4,718. About 80 per cent. of the product was used by railroad locomotives, the other 20 per cent. being sold to local trade. This was the first coal product reported from Barbour county.

Brooke county.—Coal produced in 1893, 32,900 short tons; spot value, $29,015.

Production in Brooke county during 1892 was somewhat restricted on account of a strike in the mines of Forbes, Carmichael & Company at Short Creek. The product in 1893 resumed the usual amount.

Coal product of Brooke county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	22,880			
1887	40,366	$37,394	$0.94	50
1888	11,568			
1889	31,119	22,828	.73	50
1890	36,794	28,520	.77½	50
1891	33,950	28,000	.82½	59
1892	26,521	25,029	.94	51
1893	32,900	29,015	.88	79

Fayette county.—Coal produced in 1893, 2,652,860 short tons; spot value, $2,120,758.

Fayette county is the largest coal-producing county in the State, having in 1893 an output nearly 500,000 tons greater than McDowell county, which comes second. The output of Fayette county in 1893 shows an increase of 197,460 short tons over 1892, though the increase in value was only $57,481. This decrease in value was due to a cut in prices in order to meet the competition at the seaboard of Pocahontas coal.

The principal feature of the coal industry of Fayette county was the development of the Loup Creek coal field, which, though having a small output in 1893, will prove an important factor in the future. A brief description of this field will be found on page 403.

Coal product of Fayette county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	1,413,778			
1887	1,252,427	$1,127,184	$0.90	3,030
1888	1,977,030			
1889	1,450,780	1,302,438	.90	2,644
1890	1,591,298	1,438,612	.90	2,824
1891	2,307,421	1,958,016	.85	3,823
1892	2,455,400	2,073,277	.84	4,102
1893	2,652,860	2,120,758	.80	4,487

Harrison county.—Coal produced in 1893, 193,632 short tons; spot value $128,828.

The industrial depression in 1893 was the cause of a decreased coal product in Harrison county of 28,094 short tons, a decline in price from 77 to 67 cents per ton and a total decrease in value of $42,043.

Coal product of Harrison county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*)234, 597			
1887	154, 220	$100, 243	$0. 65	263
1888	109, 515			
1889	174, 115	114, 427	. 66	233
1890	144, 403	100, 818	. 70	305
1891	150, 522	108, 911	. 72	285
1892	221, 726	170, 871	. 77	473
1893	193, 632	128, 828	. 67	298

a Including Taylor county.

Grant county.—Grant county became a coal producer in 1893 with an output of 6,731 short tons, valued at $5,109.

Kanawha county.—Coal produced in 1893, 1,446,252 short tons; spot value $1,236,861.

The product of Kanawha county increased 128,631 short tons over 1892, and was the largest output in the history of the county. Owing to lower prices, due to active competition, the value increased only $23,320. In order to meet in part this competition, which was due to the completion of the Norfolk and Western railroad to the Ohio river, the Chesapeake and Ohio railroad reduced the rates on Kanawha coal to Cincinnati, 15 cents per ton.

Coal product of Kanawha county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	876, 785			
1887	1, 126, 839	$1, 408, 559	$1. 25	2, 496
1888	863, 600			
1889	1, 218, 236	1, 166, 038	. 96	2, 484
1890	1, 421, 116	1, 365, 585	. 96	2, 756
1891	1, 324, 788	1, 285, 164	. 97	2, 802
1892	1, 317, 621	1, 213, 541	. 92	2, 677
1893	1, 446, 252	1, 236, 861	. 86	2, 306

Logan county.—The completion of the Norfolk and Western railroad to the Ohio river has offered inducements to the opening up of the coal fields of Logan county. In an article contributed to the *American Manufacturer and Iron World*, Maj. Jed Hotchkiss, of Staunton, Virginia, says of this new field:

"The Guyandot Coal Land Association, the shareholders of which are mainly representative men of England, Scotland, New York, Pennsylvania, and Virginia, is the owner of a large portion of this Logan coal field. It has already made quite a number of leases in the vicinity of Dingess, a station about 70 miles up from the Ohio river, at Kenova, to men who have heretofore been coal operators in Pennsyvania and other States. One of these lessees, "The Pearl Mining Company," the principal men of which are Messrs. McCafferty & Morrison, of East Brady, Pennsylvania, will be the first to ship coal from this field. Their mine is now open and their tipple ready for use. They are only awaiting the completion of a short spur from the Norfolk and Western to begin the shipment of coal. In a letter to the writer, under date of June 20, 1893, these gentlemen say: 'We are opening our mines on the double entry system, with a view, in the future, of putting in rope haulage. Our mine going under the right-hand mountain is now about in 600 feet, and the one under the left-hand mountain, about 200 feet. This second entry will parallel the main entry driven on the face of the coal under the right-hand mountain, and this, when driven up will complete the double-entry system in that mine. We are anxiously awaiting the completion of the switch. As soon as it is completed we will be ready to ship coal, and will push our work so as to increase our output very rapidly. We expect to be shipping 10 cars per day in three months from the time the switch is completed, and 30 cars per day in one year from that time.'

"There are several coal beds above water level at Dingess, but the one in which mining operations will begin is that known in the Kanawha region of West Virginia and in the Cincinnati markets as the Campbell Creek coal; standing in those markets on an even footing and selling interchangeably with the Youghiogheny (or Pittsburg) coals of Pennsylvania. This coal is found near the center of the Middle Coal Measures, and is known in Pennsylvania as the Lower Kittanning. It is known in the Kanawha valley, at different mines, under the names of Campbell Creek, Peerless, Coal Valley, Hawk's Nest, etc.

"As mined at Dingess this coal bed appears in 3 benches with 2 thin slate partings, and having a thickness of 56 inches. An analysis of samples of this coal, by its benches, was recently made by Dr. Henry Froehling, the well-known analyst of Richmond, Virginia, with the following results:

Analysis of Logan county, West Virginia, coals.

	Moisture at 212°.	Vol. comb. matter.	Fixed carbon.	Ash.	Sulphur.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Upper bench	1.30	41.47	54.78	2.45	0.805
Middle bench	1.15	43.15	53.31	2.39	0.605
Lower bench	1.22	39.88	55.65	3.25	0.688
Average	1.22	41.50	54.58	2.60	0.699

"Messrs. McCafferty & Morrison write: 'We are highly pleased with the result of these analyses. They fully confirm the opinion we have steadily held to as to the quality of this coal. It is second to none for all purposes except coke, and in that the deficiency is not in quality but rather in quantity. The high percentage in volatile matter cuts down the percentage of coke. For steam, gas, and domestic purposes, it has few equals and no superiors. The low percentage in ash is remarkable.

"This is a superior block or splint coal, one having a very bright and shining fracture, and solid structure, and that will bear shipment for almost any distance without breaking up. It is affected but little by the weather, so it is well suited for stocking. In Cincinnati and other Western markets it is the coal that is most in demand for gas making, steam producing, and domestic purposes. The writer is confident that the amount of coal sent from the Logan field before the expiration of another year will be quite an important item in the transportation of the Norfolk and Western, and in the coal trade of the country."

McDowell county.—Coal produced in 1893, 2,166,478 short tons; spot value, $1,526,598.

The product in 1893 was 469,503 short tons, or over 25 per cent., more than in 1892, due to the bringing in of the output of a number of new mines opened in 1892, and of which mention was made in the preceding report. Two more mines were opened in 1893, and a continued increase in product may be expected. At the time of writing this report the mines in the Pocahontas field, embracing McDowell and Mercer counties, West Virginia, and Tazewell county, Virginia, have not participated in the general strike, and are running to their utmost capacity to supply the demand for coal. The product for 1894, therefore, will probably be of unusually large proportions.

Coal product of McDowell county, West Virginia, since 1889.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	586,529	$390,232	$0.67½	764
1890	956,222	678,305	.71	1,315
1891	1,267,136	856,292	.67½	1,536
1892	1,696,975	1,222,019	.73	2,061
1893	2,166,478	1,526,598	.70	3,375

Marion county.—Coal produced in 1893, 1,062,334 short tons; spot value, $742,616.

In 1892 the production of coal in Marion county was somewhat reduced by labor troubles. In 1893 the product was larger than ever before, being 142,630 tons more than in 1892. This increase was effected in spite of a fire in February, at the works of the Montana Coal and Coke Company, which destroyed the buildings and machinery. An entire new plant was constructed, being completed about May 1. The new plant is a great improvement over the one destroyed, the machinery being said to be the strongest in the Upper Monongahela valley.

Coal product of Marion county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	172, 379	....	....	....
1887	365, 844	$312, 675	$0. 80	590
1888	363, 974	....	....	....
1889	282, 467	199, 692	.71	333
1890	455, 728	313, 505	.69	865
1891	1, 000, 047	705, 853	.70	1, 408
1892	919, 704	682, 111	.74	1, 114
1893	1, 062, 334	742, 616	.70	1, 536

Marshall county.—Coal produced in 1893, 158,997 short tons; spot value, $124,407.

The product of Marshall county in 1893 was 40,023 short tons more than in 1892, but did not reach as high a figure as 1891. The small product in 1892 was due to labor troubles.

Coal product of Marshall county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*)251, 333	....	....	....
1887	92, 368	$70, 200	$0. 76	125
1888	47, 702	....	....	....
1889	47, 706	35, 956	.75	72
1890	123, 669	100, 846	.81½	175
1891	193, 703	154, 402	.80	190
1892	118, 974	93, 573	.79	210
1893	158, 997	124, 407	.78	245

a Including Ohio county.

Mason county.—Coal produced in 1893, 153,633 short tons; spot value, $143,130.

The output of Mason county was 6,011 tons less than in 1892. The product is used to a considerable extent in the manufacture of salt at Clifton and Hartford City, several salt companies mining coal exclusively for that purpose.

Coal product of Mason county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*)150, 878	....	....	....
1887	140, 968	$140, 968	$1. 00	368
1888	72, 410	....	....	....
1889	185, 030	167, 783	.91	363
1890	145, 314	134, 643	.93	320
1891	159, 990	144, 052	.90	311
1892	159, 644	153, 237	.96	338
1893	153, 633	143, 130	.93	376

a Including Putnam county.

Mercer county.—Coal produced in 1893, 995,428 short tons; spot value, $690,490.

Mercer county forms a part of the celebrated Pocahontas field. Its output in 1893 was less than 1892 by 195,524 short tons. The value fell off over $225,000, due to a reduced price in a competitive market.

Coal product of Mercer county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	328, 733	....	....	....
1887	575, 885	$437, 673	$0. 76	965
1888	969, 395	....	....	....
1889	921, 741	594, 885	. 64½	1, 121
1890	1, 005, 870	755, 014	. 75	1, 465
1891	1, 172, 910	861, 709	. 74	1, 510
1892	1, 191, 952	917, 550	. 76	1, 621
1893	995, 428	690, 490	. 69	1, 281

Mineral county.—Coal produced in 1893, 653,025 short tons; spot value, $537,366.

This county produced 70,623 short tons more in 1893 than 1892, the value increasing $85,816. During 1893 the mines of the Davis and Elkins Coal Company, in this county, and of the Davis Coal and Coke Company, and the H. G. Davis Coal Company in Tucker county were consolidated under one corporation, the Davis Coal and Coke Company. Several cargoes of coke have lately been shipped from these works to Mexico, where it is said to have been received with great favor in competition with foreign cokes.

Coal product of Mineral county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	361, 312	....	....	....
1887	478, 636	$382, 909	$0. 80	475
1888	456, 361	....	....	....
1889	493, 464	394, 827	. 80	608
1890	573, 681	501, 391	. 87½	620
1891	693, 574	581, 814	. 84	624
1892	582, 402	451, 150	. 77	500
1893	653, 025	537, 366	. 82	666

Monongalia county.—The product of Monongalia county is from two mines operated by one company and amounted in 1893 to 38,600 short tons, valued at $27,975, against 48,900 tons, valued at $35,208 in 1892.

Ohio county.—Coal produced in 1893, 80,610 short tons; spot value $66,269.

The product of Ohio county is consumed by rolling mills and the local trade of Wheeling. The decrease in product in 1893 was due to the industrial depression and mild winter weather.

Coal product of Ohio county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	131,936	$145,130	$1.10	211
1888	140,019			
1889	143,170	126,909	.88½	204
1890	103,586	100,017	.97	153
1891	90,600	70,553	.78	131
1892	120,323	119,660	.99	222
1893	80,610	66,269	.82	135

Preston county.—Coal produced in 1893, 82,672 short tons; spot value, $57,131.

The production of coal in Preston county has shown a decreasing tendency for several years. The decrease is attributed to the construction of new lines of railroad which brought coke from other sections in the territory formerly supplied entirely by this county.

Coal product of Preston county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	170,721			
1887	276,224			348
1888	231,540			
1889	129,832	$86,024	$0.66	239
1890	178,439	127,803	.72	337
1891	140,399	89,829	.64	304
1892	98,006	66,072	.67	170
1893	82,672	57,131	.69	200

Putnam county.—Coal produced in 1893, 209,881 short tons; spot value, $211,556.

Low water in the Kanawha river in 1892, and a long strike in 1891, reduced the product of Putnam county in both those years. In 1893 the product regained its normal amount, and with favorable trade conditions is likely to increase.

Coal product of Putnam county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	53,200			200
1888	145,440			
1889	218,752	$244,203	$1.12	451
1890	205,178	198,269	.97	375
1891	94,230	112,282	1.19	526
1892	89,886	99,715	1.11	483
1893	209,881	211,556	1.01	520

Raleigh county.—One mine opened in 1892 produced 92,330 short tons in 1893; 3,494 tons less than in 1892. The Chesapeake and Ohio railroad is contemplating building a branch line to open up other valuable coal fields in the county.

Randolph county.—Two mines were opened in Randolph county, only one of which produced any coal in 1893. The output was 1,494 short tons.

Taylor county.—The product of Taylor county decreased from 115,145 short tons, valued at $70,049, in 1892 to 78,460 short tons, valued at $45,968, in 1893.

Coal product of Taylor county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	168,000	....	....	225
1888	55,729	....	....	....
1889	83,012	$52,725	$0.63½	96
1890	76,618	58,159	.76	108
1891	101,661	61,488	.60½	118
1892	115,145	70,049	.61	128
1893	78,640	45,968	.58	105

Tucker county.—Coal produced in 1893, 476,372 short tons; spot value, $338,126.

The product in 1893 exceeded that of 1892 by 116,620 short tons, with an increase in value of $84,631.

Coal product of Tucker county, West Virginia, since 1886.

Years.	Total product.	Total Value.	Average price per ton.	Total employés.
	Short tons.			
1886	22,400	....	....	....
1887	24,407	$19,526	$0.80	100
1888	62,517	....	....	....
1889	173,492	120,574	.69½	229
1890	245,378	186,641	.76	353
1891	358,734	231,301	.64½	550
1892	359,752	253,495	.70	525
1893	476,372	338,126	.71	675

THE LOUP CREEK, WEST VIRGINIA, COAL FIELD.(a)

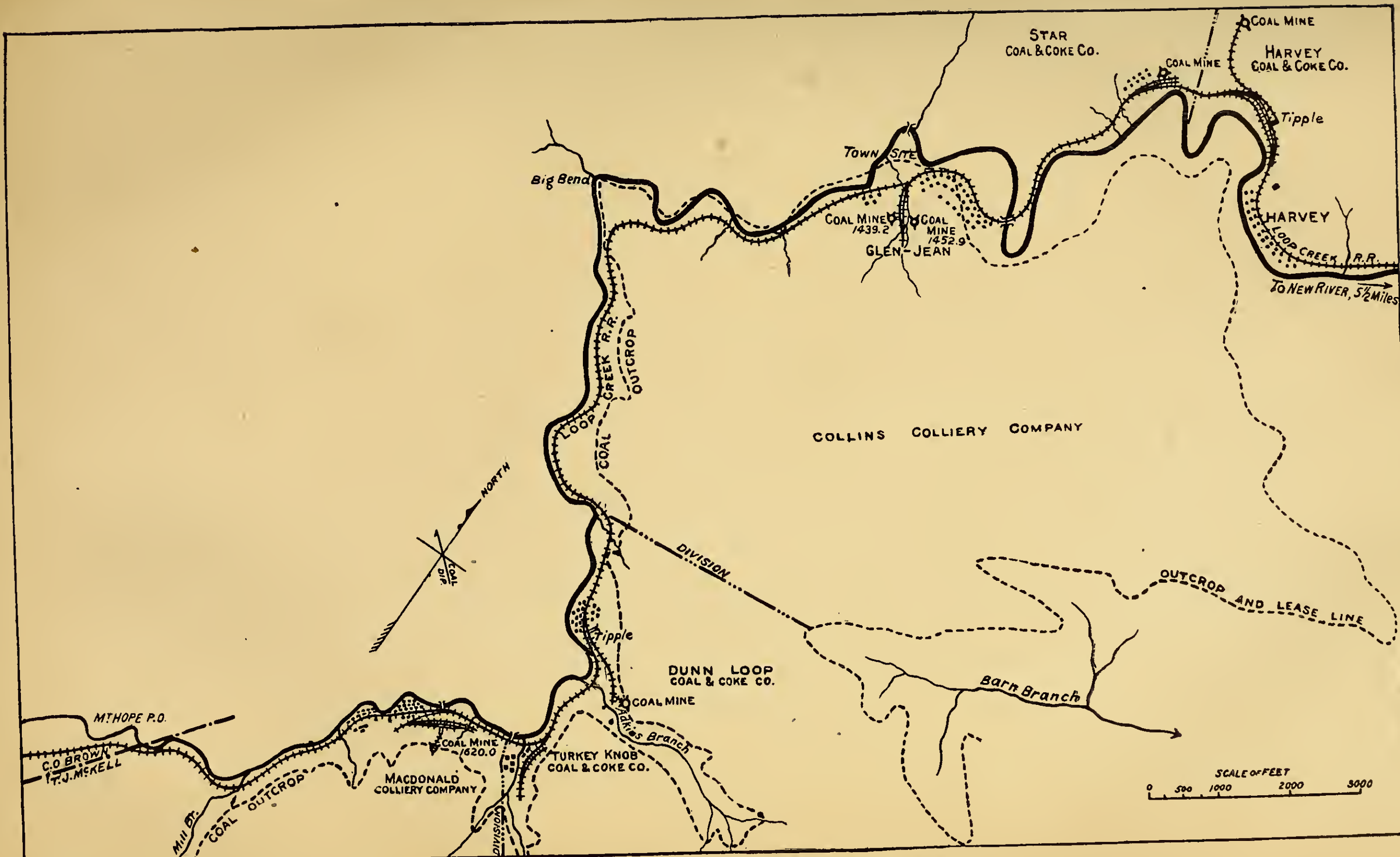
The Loup Creek coal field is so called from the creek of that name which runs through it and empties into the New river opposite the station of Thurmond. This new coal-producing territory lies entirely within Fayette county. The seam, which is an extension of the Sewell seam, outcrops on the north side about 6 miles from the mouth of the creek, and at an elevation above sea level of about 1,400 feet. A remarkable feature of this portion of the New river coal field is the

a For much of the information contained in this brief notice the writer is indebted to Mr. Louis W. Atkinson, of Thurmond, West Virginia, who, as mining engineer for most of the companies in the field, was able to give accurate data concerning its development, etc. The map and section accompanying the report were prepared by Mr. Atkinson.

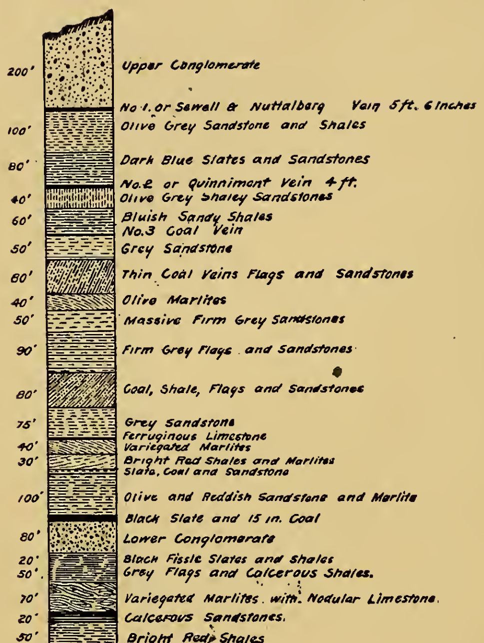
regularity of the stratification, which is notably free from faults and distortions. The coal seam has a gradual dip to the southeast of 3 feet in 100, and this inclination is very regular throughout the field. The thickness of the seam averages about 5½ feet, widening in places to 6 feet 3 inches, and only in occasional places where rolls are encountered does it become less than 5 feet in thickness. From the regularity of the coal and the nature of the strata contiguous to it, this seam is believed by some to be the same as that of the Pocohontas Flat Top field. In some places there appears a band of coal rather higher in sulphur, extending from 8 to 18 inches from the top of the coal. This is termed, when encountered, the "sulphur band." In mining, the miner digs into the seam, just below this band, the charge of power is put in near the bottom of the seam, and the coal "shot" up. The sulphur band is then pulled down. It is not mixed with the other coal, but is kept apart and shipped in separate cars. Some of it is sold to farmers in the vicinity for domestic purposes. The conditions for mining are generally favorable. The miner is able to do most of his work in an upright position, and the regularity of the thickness and of the dip of the seam enables the mines to be run on systematic principles with reference to "centers" and drainage. The field is reached by a branch of the Chesapeake and Ohio railroad following the course of the creek, the New river being crossed by a substantial iron bridge of three spans.

There are at present (June 1, 1894) five companies operating in the field, whose development work was carried on throughout 1893, but very little coal was shipped out prior to January 1, 1894. Another company is engaged in opening a drift, and several other leases are in contemplation. With one exception, that of the Star Coal and Coke Company, all of the coal lands are leased on a royalty of 10 cents per ton of coal mined. Miners are paid at the rate of 55 cents per miner's car, with "yardage" of $1 per yard in addition for entry work. The methods of working each mine, together with other data of interest connected with each, will be considered separately.

Harvey Coal and Coke Company.—Upon leaving Thurmond and following the line of the railroad along Loup creek (called also Dunn Loop or Dun Loup creek) the first mine reached is that of the Harvey Coal and Coke Company, 5 miles from the river. The general course of Loup creek at this point is toward the east, the mine being opened on the north side of the water course. In order to make an effective opening it was found advisable to construct a tramway about 4,000 feet around the base of a hill, thus necessitating about three-fourths of a mile haul from entry to tipple. At present this hauling is done by mules, but by July 1 the company expects to have a locomotive for this work, which will enter the mine to the first parting (about 350 feet) to collect cars. The general dip of 3 feet in 100 is remarkably regular at this opening. The main entry is made on the rise of the seam so



THE LOUP CREEK COAL FIELD AS AT PRESENT DEVELOPED.



IDEAL SECTION IN THE LOUP CREEK COAL FIELD.

that the drainage is natural, and what little water collects in the mine is bailed out by boys into cars constructed for the purpose. The main entry is now driven in about 1,000 feet with four cross entries on the right. Pillars of 50 feet are left in the cross entries between the entrances to rooms, which are worked from one entry until met by the room from the next. At the entrance to the drift the seam is about 6 feet 3 inches, including 8 inches of "sulphur band." At the heading the sulphur band has disappeared, leaving about 6 inches of draw slate and 6 feet of clean coal. This company's lease covers about 1,500 acres of coal land. The coal is clean and especially adapted to making steam. Coke ovens are to be erected. The present output of the mine (on the 1st of June) is about eight cars, averaging 25 tons of 2,240 pounds, or 200 tons. This can easily be pushed to twelve cars, or about 300 tons, which may be stated as the capacity of the mine at present. As development work progresses, however, the capacity will be largely increased.

Star Coal and Coke Company.—This mine is about one-half mile farther up the creek, and on the same side as the Harvey. The company operates on its own land, and owns about 1,100 acres. The opening at this mine is about 300 feet from the tipple. At the opening to the main entry the coal seam is 5½ feet, pinching down to 4 feet at the heading, 1,450 feet from the opening. The thinness of the seam here is due to the fact that the company is operating on a narrow point to get to the bulk of their coal, which becomes thicker farther on. This company is mining down the dip with the intention of installing a rope-haulage plant. When this is completed, the drainage of the mine will be accomplished either by shaft or by breaking through to daylight at the other side. As the present operations are on a narrow point, the cross entries are necessarily short, and may be classed as rooms. These conditions also make the present capacity and output rather limited, the latter being about 100 tons per day, and the former about 150 tons. When the bulk of the coal is reached and the improvements contemplated installed, both of these will increase largely. In fact, the present capacity of all the mines in the field must not be taken as a measure of what they will be able to do by the end of the year. The capacity of each mine may be said to increase each month as new entries are driven and development work progresses.

The Collins Colliery Company, at Glen Jean.—This company has two openings, known as Nos. 1 and 2, one on each side of a small branch entering Loup creek. They are on the opposite side of the creek from Harvey and Star, about a mile farther up the creek from the former, or 6½ miles from New river. The company's lease covers about 900 acres. At No. 1, which is on the left-hand side of the branch on the ascent, the coal is about 65 inches in thickness, including 12 inches of sulphur band, which, while not mixed with the other coal, is marketable. It sometimes changes from sulphur to clean coal. The coal is mined on the rise of the dip. The mine is in first-class condition. It is ventilated by a 15-foot Brazil fan, and has excellent drainage. The roof is partly sandstone and partly slate. The main entry is now in about 900 feet, with four cross entries on the right. The pillars are 40 feet. No cross entries have been driven on the left side of the main entry, as by doing so the town would be undermined.

At No. 2 there are 65 inches of clean coal with a middle stratum noticeably harder than the rest of the seam. This is not separated though its steam-raising quality is even better than the other. In this mine the main entry is in 1,100 feet, with six cross entries on the right and two on the left. It is worked on the rise of the dip and is ventilated by an 18-foot Brazil fan.

The present output of No. 1 is about 8 cars of 25 tons per day, which can be pushed to 11 cars. No. 2 is producing 14 cars daily, with a capacity of 19 cars. The company contemplates erecting a large tipple connecting with both mines by rope haulage. At present there is a tipple for each mine. Coke ovens will be erected when justified by the amount of output.

Dunn Loop Coal and Coke Company.—This company's property is on the same side of the creek as the Collins, 8 miles from the river. There are 5 feet of clean coal and 8 inches of marketable sulphur band. The entry runs east 1,025 feet, slightly on the rise. The mouth of the mine is 700 feet from the tipple, connected by tramway. This was necessary for advantageous working. When the work of this mine was first laid out a discouraging fault was struck, but they are now out of it and the coal is showing up better than was anticipated. The roof is of sandstone, with 5 inches of draw slate. There are three cross entries running from the right of the main entries to the crop line and five on the left, one of which is short, striking the crop. The company is operating on a lease of 917 acres. The present output is about 11 cars of 25 tons daily; capacity, about 15 tons.

Turkey Knob Coal and Coke Company.—This company is not yet a producer, but expects to be about July 15. It is 9 miles from the river on the east side of the creek. The entry is only in a short distance. An extensive plant, including coke ovens, is being erected, and the company anticipates doing a large private shipping business, in contradistinction to the usual custom in this field and along New river, where the coal is purchased by the Chesapeake and Ohio railroad, which transports it to the seaboard or other market, making its freight out of the difference between what it pays and what it gets for the coal.

Macdonald Coal and Coke Company.—This company's property is at the end of the branch railroad, 10 miles from the river. It is on the east side of the creek and embraces 900 acres of coal land. The mine is operated on the extreme rise, following the dip of the coal. The main entry is now in 1,600 feet. There are three cross entries to the left of the main entry. Daylight is tapped at four places, including the opening.

The main entry is being double tracked, and active preparations are making to greatly increase the capacity of the mine. There is ample storage room for cars, the company having 6,800 feet of side track. The present daily capacity is computed at 16 cars, with about 12 cars actual output. There are 60 inches of clean coal and 12 inches of sulphur band, which is shipped separately. The company is prepared to screen its coal and can ship three grades—lump, nut, and slack. Work is now being prosecuted on a narrow point in the seam and the company is just preparing to enter the main body of coal, which makes a favorable showing. The roof of this mine is of sandstone with slight draw slate.

WYOMING.

Total product in 1893, 2,439,311 short tons; spot value, $3,290,904.

The output in 1893 was 64,528 short tons less than in 1892. This decrease was due to a restricted product in Carbon county. The production of Carbon county in 1892 was larger than ever before, but prices were demoralized. In 1893 the output was decreased over 100,000 tons and prices improved so that the value in Carbon county was larger than in 1892, and affected the State's total similarly.

The following tables show the statistics of production during 1892 and 1893, by counties:

Coal product of Wyoming in 1892, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total product.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	479,693	1,456	18,638		499,787	$553,555	$1.11	241	505
Converse	42,918	1,089	1,900		45,907	74,655	1.63	210	105
Fremont		8,000			8,000	20,000	2.50	200	3
Johnson		10,290	10		10,300	27,606	2.68	236	15
Sweetwater	1,218,480	1,381	45,580		1,265,441	1,462,571	1.16	198	1,643
Uinta	326,266	3,838			330,104	513,939	1.56	243	462
Weston	311,300	1,000	30,000	2,000	344,300	516,450	1.50	297	400
Total	2,378,657	27,054	96,128	2,000	2,503,839	3,168,776	1.27	225	3,133

Coal product of Wyoming in 1893, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Total number of employés.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Carbon	379,763	2,316	12,980		395,059	$606,325	$1.53	164	622
Converse	52,320	1,300	2,700		56,320	88,916	1.58	201	110
Crook		500			500	1,900	3.80	47	9
Fremont		900			900	2,250	2.50	180	2
Johnson		10,100	26		10,126	27,900	2.76	198	19
Sheridan		35,720	200		35,920	60,070	1.67	241	48
Sweetwater	1,280,675	8,391	48,140		1,337,206	1,528,699	1.14	179	1,729
Uinta	281,844	3,570	6,960		292,374	508,485	1.74	201	439
Weston	286,083	1,391	16,080	7,352	310,906	466,359	1.50	250	400
Total	2,280,685	64,188	87,086	7,352	2,439,311	3,290,904	1.35	189	3,378

In the following table is shown the total production of coal in Wyoming since 1868:

Coal product of Wyoming since 1868.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1868	6,925		1881	628.181	
1869	49,382		1882	707,764	
1870	105,295		1883	779,689	
1871	147,328		1884	902,620	
1872	221,745		1885	807,328	$2,421,984
1873	259,700		1886	829,355	2,488,065
1874	219,061		1887	1,170,318	3,510,954
1875	300,808		1888	1,481,540	4,444,620
1876	334,550		1889	1,388,276	1,748,617
1877	342,853		1890	1,870,366	3,183,669
1878	333,200		1891	2,327,841	3,555,275
1879	400,991		1892	2,503,839	3,168,776
1880	527,811		1893	2,439,311	3,290,904

Carbon county.—Coal produced in 1893, 395,059 short tons; spot value, $606,325.

The output of Carbon county was 104,728 short tons less than in 1892, but with an increase in value of $52,770. Prices in 1892 were greatly demoralized and recovered their normal condition in 1893.

Coal product of Carbon county, Wyoming, since 1868.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1881	156,820
1869	30,482	1882	200,123
1870	54,915	1883	248,380
1871	31,748	1884	319,883
1872	59,237	1885	226,863
1873	61,164	1886	214,233
1874	55,880	1887	288,358
1875	61,750	1888	338,947
1876	69,060	1889	199,276
1877	74,343	1890	305,969
1878	62,418	1891	432,180
1879	75,424	1892	499,787
1880	100,433	1893	395,059

The product of Carbon county is lignite. The principal producing mines are the Hanna Nos. 1 and 2 and Carbon No. 1, of the Union Pacific Coal Company.

A discovery of anthracite coal near Rawlins, in this county, has been reported.

Converse county.—Coal produced in 1892, 56,320 short tons; spot value, $88,916.

The product of Converse county in 1893 was 10,413 short tons more than in 1892, the value increasing $14,261. The coal is lignite and is used at Fort Fetterman, Douglass, and other points along the line of the Fremont, Elkhorn, and Missouri Valley railroad.

Coal product of Converse county, Wyoming, since 1888.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1888	29, 933	....	1891	27, 897	$49, 258
1889	17, 393	$30, 955	1892	45, 907	74, 655
1890	25, 748	44, 696	1893	56, 320	88, 916

Crook county.—This county began producing coal in 1893, with a total output of 500 short tons, valued at $1,900.

Fremont county.—A total product of 900 short tons, valued at $2,250, was obtained in 1893, which was used entirely for local trade.

Johnson county.—The product in 1893 was 10,126 tons, valued at $27,900, against 10,300 tons, valued at $27,606 in 1892. There are no railroad facilities and the product is consumed locally at Buffalo and for supplying Fort McKinney, 3 miles distant.

Sweetwater county.—Sweetwater county yields more than 50 per cent. of the total output of Wyoming. The principal mines are the Rock Springs collieries Nos. 1, 3, 4, 7, and 8 operated by the Union Pacific Coal Company. The output from the Rock Springs mines since 1868 has been as follows:

Product of the Rock Springs mines, Wyoming, since 1868.

Years.	Short tons.	Years.	Short tons.
1868	365	1881	270, 425
1869	16, 933	1882	287, 510
1870	20, 945	1883	304, 495
1871	40, 566	1884	318, 197
1872	24, 677	1885	328, 601
1873	44, 700	1886	359, 234
1874	58, 476	1887	465, 444
1875	104, 664	1888	662, 277
1876	134, 952	1889	777, 213
1877	146, 494	1890	652, 408
1878	154, 282	1891	993, 478
1879	193, 253	1892	1, 084, 572
1880	244, 460	1893	1, 074, 693

At the Rock Springs mines an electric locomotive has been introduced. to haul a number of trucks a distance of 6,000 feet. The current is supplied by a dynamo located a mile distant from the mouth of the mine, the generating pressure being 550 volts. The loss in transmission from the power house to the mine is about 10 per cent., so that the current received at the mine has an electro-motive force of about 495 volts. The locomotive, which is of 60-horse power, is of 30-inch gauge, and it collects the current from an overhead wire, the rails forming the return. It hauls 30 trucks, which when filled weigh 40 tons.

The other producers are the Rock Springs Coal Company, the Sweetwater Coal and Mining Company, the Van Dyke Coal and Mining Company, the Black Butte Mining Company, and the Peacock Coal Company.

Prior to 1888 the total output of the county was from the Rock Springs mines of the Union Pacific Coal Company. The total output since 1888 has been as follows:

Coal product of Sweetwater county, Wyoming, since 1888.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1888	732, 327	....	1891	1, 202, 017	1, 773, 414
1889	857, 213	$1, 025, 067	1892	1, 265, 441	1, 462, 571
1890	978, 827	1, 666, 068	1893	1, 337, 206	1, 528, 699

Sheridan county.—This county produced 35,920 short tons in 1893, valued at $60,070, all of which was consumed locally. No product was reported in 1892.

Uinta county.—Coal produced in 1893, 292,374 short tons; spot value, $508,485.

There are but two companies operating in the county, the Union Pacific Coal Company at Almy and the Rocky Mountain Coal and Iron Company at Red Canyon. The following tables show the total annual output from each:

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1, 967	1882	117, 211
1870	12, 454	1883	111, 713
1871	21, 171	1884	150, 880
1872	22, 713	1885	164, 441
1873	22, 847	1886	155, 547
1874	23, 006	1887	196, 913
1875	41. 805	1888	160, 035
1876	60, 756	1889	118, 629
1877	54, 643	1890	176, 131
1878	59, 096	1891	143, 932
1879	71, 576	1892	157, 897
1880	100, 234	1893	148, 521
1881	110, 157		

Product of the Rocky Mountain Coal and Iron Company's mines at Red Canyon, Wyoming.

Years.	Short tons.	Years.	Short tons.
1870	16, 961	1882	94, 065
1871	53, 843	1883	78, 450
1872	105, 118	1884	68, 471
1873	130, 989	1885	70, 216
1874	181, 699	1886	100, 341
1875	92, 589	1887	164, 510
1876	69, 782	1888	209, 298
1877	67, 373	1889	190, 589
1878	57, 404	1890	174, 147
1879	60, 739	1891	188, 395
1880	82, 684	1892	172, 207
1881	90, 779	1893	143, 853

Weston county.—Coal produced in 1893, 310,906 short tons; spot value, $466,359.

The only mines operating in Weston county on the Antelope and Jumbo collieries of the Cambria Mining Company. These mines are on a broad plateau on the southwestern border of the Black Hills, and about 5,500 feet above sea level. They are drift mines, being entered from the side of the hill. The coal from both mines is delivered at a common tipple in the middle of the cañon. The coal is brought out by the tail-rope system of haulage. The chute, where the railway cars are loaded, contains the finest of machinery for crushing, screening, elevating and conveying the different grades of coal to any desired point of delivery, the customer being thus enabled to procure, at pleasure, any size or grade of coal desired. The method is thus described by a correspondent of the Coal Trade Journal:

"The mining is done exclusively by machinery, the power used being compressed air, which is conveyed into the workings by means of pipes and air-receivers supplied from the power-house located on the outside. The Jeffrey mining machines are used in connection with the Jeffrey giant air-power coal drill. There are three compressors, kept running night and day, year in and year out, which were built by the Norwalk Iron Works Company. An electric plant furnishes light for the mines, as well as for the buildings connected with the mines. Eleven steam boilers, with a capacity of 800-horse power, and which will shortly be increased to 1,200, drive the machinery. A finely equipped blacksmith and machine shop keeps up all needed repairs.

Although these mines have been opened only about three years, they already have a capacity of from 1,600 to 1,800 tons daily, which capacity will surely be doubled before the end of 1893. The mines are distant several hundred miles from any other coal fields, and the Cambria proprietors are practically without competition. Had it not been for the existence of this coal, the railroad before named would not have been built, owing to the want of proper fuel with which to operate it.

"As the principal part of the mining is done by machinery, unskilled workmen have here a rare opportunity for remunerative employment. More than this, there naturally cannot be, under a system of mining like this, that great variance in the wages of the different employés which is naturally so productive of discontent and consequent strikes. The company has a plant of coke ovens, by which a good article of coke is made from the fine slack, taken from the coal by the screens. The slack which enters into this coke requires no treatment other than screening to fit it for use, though experts say that the product could be improved by a system of washing."

The following table shows in brief the annual product of each county since 1868 and the total output of the State for each year:

Total product of coal in Wyoming, by counties.

Years.	Carbon county.	Sweetwater county.	Uinta county.	Weston county.	Converse county.	Other counties.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1868	6,560	365					6,925
1869	30,482	16,933	1,967				49,382
1870	54,915	20,945	29,435				105,295
1871	31,748	40,566	75,014				147,328
1872	59,237	34,677	127,831				221,745
1873	61,164	44,700	153,836				259,700
1874	55,880	58,476	104,705				219,061
1875	61,750	104,664	134,394				300,808
1876	69,060	134,952	130,538				334,550
1877	74,343	146,494	122,016				342,853
1878	62,418	154,282	116,500				333,200
1879	75,424	193,252	132,315				400,991
1880	100,433	244,460	182,918				527,811
1881	156,820	270,425	200,936				628,181
1882	200,123	287,510	211,276			8,855	707,764
1883	248,380	304,495	190,163			36,651	779,689
1884	319,883	318,197	219,351			45,189	902,620
1885	226,863	328,601	234,657			17,207	807,328
1886	214,233	359,234	255,888				829,355
1887	288,358	465,444	361,423			55,093	1,170,318
1888	338,947	732,327	369,333		29,933	11,000	1,481,540
1889	199,276	857,213	309,218		17,393	5,847	1,388,276
1890	305,969	978,827	350,278	200,024	25,748	9,520	1,870,366
1891	432,180	1,202,017	332,327	326,155	27,897	7,265	2,327,841
1892	499,787	1,265,441	330,104	344,300	45,907	18,300	2,503,839
1893	395,059	1,337,206	292,374	310,906	56,320	47,446	2,439,311

THE COAL FIELDS OF WYOMING.

By G. C. Hewitt.

The greater number of the valuable coal seams of Wyoming, as of the entire West, are contained in the Laramie Measures. A notable exception is that at Newcastle, in the Black Hills, shown by Prof. H. M. Chance to be of Dakota age, which also contains valuable seams in parts of Colorado.

The Green River shales also contain large patches, at variable horizons, of rich oil shales that have been used for fuel where other was inaccessible. They are known at so many points in the State, and in Colorado and Utah, that if a market existed a little search would probably find large areas. These oil shales may be the source of the asphaltum lodes of Utah and Colorado. Wyoming has as large an area as Colorado of Laramie rocks, but having as yet but one transcontinental railway, and the metallurgical development being north and south of it, the coal fields of Colorado and Montana have been further exploited.

There are valuable coal fields on the Big Horn, Powder, and Bellefourche rivers, and at high altitude on the upper Green and Snake rivers there are anthracite, coking, and dry coals.

Platte field.—This lies west of the Laramie Mountain Archæan in distorted synclinals, much broken by faulting, cut off on the north by the Sweetwater and Seminole mountains, and extending up the Laramie and Snake rivers to the State line, on the south and west to the continental divide.

This area is reduced by the mountains on both sides of the Platte valley and by the Rawlings laccolite or uplift.

There are at least three, and probably more, horizons in these measures, in different parts of the field, that have seams of workable character and size, but the lack of a persistent datum has delayed identification.

The seams are accessible at many points, owing to the faulting, but their correlation is the more difficult.

As is usual, approaching the shore line of original deposition, the eastern outcrops of these seams are thin, and as they have not there been subjected to great weight or ponderous movement, the coals have more combined water. The best coals so far found are near the center of the field, and in the immediate neighborhood of faults. The physical character of these coals has been much affected by their history. This is true, quite locally, even in the same mine and in layers of the same bed. Where the coal has not been consolidated the volatile part burns off quickly, and the charred remainder, with the ash adhering, burns more and more slowly, so that small pieces retain fire a long time; a pile of them for days. This quality, with that of decrepitation in burning, has been the cause of costly failures, whose lessons should be heeded in new development.

There is much good coal in this field, and as it lies nearest the plains and Colorado markets, its production should naturally increase; but each failure, to read past experience, makes the next enterprise more difficult.

Rock Spring field.—Going west from the continental divide, the Laramie falling faster than the surface, sinks below later rocks. The upper portion, with two beds of coal at Black Buttes and Hallville, is brought up by the rock anticline and subsequent erosion. These coals, though relatively good, have not been able to compete with the better coals of Rock Spring. Westward, to within 3 miles of Rock Spring, the Laramie and core of the anticline are covered by later Measures and a recent lake bed, above the shore of which are exposed about 600 feet of the Montana, containing at 150 to 200 feet from the top a siliceous limestone or flint, a convenient datum, which, though not persistent, is shown at many exposures in this State, and Colorado and Utah.

The available Rock Spring field is the west side of this anticline, dipping 5 to 15 degrees, and containing five or six seams of workable size in about 1,900 feet of shales and sandstones, with an outcrop 20 miles in length. These seams, brought up from great depth in the center of a wide field of deposition, are of good size, excellent chemical and physical character, and of great persistence. As might be expected, the lower coals are in general better than the upper.

The three beds operated are 3 feet 9 inches to 11 feet thick and well marked and persistent; one of them has a slope 5,000 feet long on the dip of the seam and levels 6,000 feet long. A large area in advance of operations was recently proved by a diamond drill hole 1,260 feet in depth.

Ham's Fork field.—Fifty miles west the southward sinking anticline of Absaroka ridge brings up the Laramie with thick seams on the Black's and Ham's forks of Green river.

The exploitation of these seams has been most on the upper ones and has been unfortunate for several reasons, aside from the economic position and value of the coals.

The accessible area is large and some of the seams will be valuable eventually.

Bear River field.—On the west side of the next synclinal the Laramie outcrops for many miles in the Bear River valley, buried occasionally under later Measures or thrown back by faulting or erosion.

The seams are still very large, one 24 feet thick, but in some qualities the coal is inferior and the seam worked is an expensive one. The southern end has been the source of supply for the Central Pacific railway for years as far west as Sacramento, California.

MANUFACTURE OF COKE.

BY JOSEPH D. WEEKS.

[The ton used in this report is uniformly the short ton of 2,000 pounds.]

The coal used in coking in the United States is mined from all five of its great coal fields: (1) The Appalachian; (2) the Central; (3) the Western; (4) the Rocky Mountain; and (5) the Pacific Coast. With the exception of that made in the Appalachian field, however, the tonnage of coke produced is quite small.

The Appalachian coking field.—Beginning with a few isolated patches of coal near the northern boundary of Pennsylvania, the great Appalachian coal field stretches for a distance of over 750 miles in a southwesterly direction to Tuscaloosa, Alabama, where it loses itself. This is at present, and promises to be in the future, the most important coal field in America. It has an average breadth of from 80 to 90 miles and an area of fully 65,000 square miles. The eastern escarpment of the Allegheny mountains formed and still forms the eastern border of this basin, while the Cincinnati anticlinal hems it in on the west and separates it from the measures of the Illinois basin. The eastern line of this field is comparatively regular, following the trend of the mountains, but the western line is very irregular, being quite broad in its northern area, contracting through Tennessee and northern Alabama and expanding considerably at its termination in Alabama, though it is here by no means so broad as in Pennsylvania, Ohio, and West Virginia.

Along nearly the entire length of this great coal field from Blossburg, Pennsylvania, to Birmingham, Alabama, on the south, the coke industry has been established. The ovens following the zone of best coking coal are generally found near the eastern limits of the field; that is, hugging the mountains, the coal in the middle or western part of the basin being, as a rule, not so well adapted to coking as that of the eastern.

In this field are found the Connellsville, Pennsylvania; the New River, Virginia; the Pocahontas Flat Top, Virginia and West Virginia; the Sewanee, Tennessee; and the Birmingham, Alabama, coal fields, together with other though less important fields.

Central coking field.—The Central field includes the coals in Indiana, Illinois, and the western part of Kentucky, the field reaching from the Cincinnati anticlinal on the east to the Mississippi river on the west.

While it is estimated to cover an area of 47,250 square miles of coal fields, it is at present of but little importance as a producer of coke, the total output in 1893 being not over 12,000 tons. Most persistent efforts have been made to produce a coke from the coals of this field that would answer as a metallurgical fuel. The iron and steel works of Chicago are in this district and St. Louis is just at its western border. It is readily seen what an advantage it would be to these works could they draw their supply of coke from the coal fields which are just at their doors, instead of sending to Connellsville and the Virginias, from 500 to 650 miles distant, for their fuel. But all attempts to make such a fuel have been abandoned, and what little coke is made in these States, with the exception of that made in western Kentucky, is from slack coal, chiefly for use in the manufacture of water gas and for domestic use as crushed coke.

The Western coking field.—The Western field, which includes the States of Missouri and Kansas and Indian Territory, is of but little more importance than the Central field as a producer of coke. The coke made in this field is chiefly in the new Pittsburg district of Kansas and in the lead district of Missouri for use by the lead and zinc smelters in the neighborhood. A small amount is also made at McAlester, Indian Territory.

Rocky Mountain coking field.—Located, as the Rocky Mountain field is, in close proximity to the mines of the precious metals, as well as near good iron ore, it is the most important coking field in the United States next to the Appalachian and has more promise than any of the others. It includes the coal fields of Dakota, Montana, Idaho, Wyoming, Utah, Colorado, and New Mexico.

Geological horizon of the coals.—By far the largest part of the coal used for coking in the United States comes from three seams, the Pittsburg seam of the Upper Coal Measures (No. XV of Rogers), the great Conglomerate (the lower formation of the Carboniferous) and the Pratt seam of Alabama. The coal used in Connellsville is from the Pittsburg seam, known locally as the Connellsville seam; that used in the New River and Flat Top districts of Virginia and West Virginia is from the Conglomerate, known as the Pottsville Conglomerate in Pennsylvania and as No. XII of the Rogers' Virginia survey. The identification of the Pratt seam with the northern coals is not definite. It is from this seam that most of the coke produced in Alabama is made.

Coals and ovens used.—In many parts of the United States in which coking is carried on coke is made chiefly for the purpose of utilizing the slack or fine coal which results from the mining and preparation of coal for steam, household, and the other purposes of the general market. All of the coals used in Georgia, Illinois, Indiana, Indian Territory, Kansas, Missouri, and Washington are of this character, while a large proportion of that from Colorado, Kentucky, Montana, Ohio, Tennessee, Virginia, and West Virginia is also slack coal. Even in Pennsylvania some 10 per cent. of the total amount of coal used is slack.

It still holds true that the solid wall oven, usually of the beehive form, is practically the only one used in the country. Some flue ovens are reported as in existence in Pennsylvania, and a few retorts were used in Colorado and West Virginia. It should be said, however, that a block of flue ovens on the Semet-Solvay principle has been erected at Syracuse, New York, near the works for making soda ash, the design of these ovens being chiefly to collect the ammonia for use in the Solvay or ammonia process of soda-making. Similar ovens or retorts have been erected at Winifrede, West Virginia, on the Hüessener principle. These ovens are erected chiefly for the recovery of the by-products, the coke made being used for domestic purposes. Accompanying these ovens is a Slocum benzol plant. We are also informed that probably during 1894 similar ovens will be erected on the Otto-Hoffmann system. This is a flue oven with regenerators, something on the principle of the Siemens regenerators, attached, and are largely used in Germany.

PRODUCTION OF COKE IN THE UNITED STATES.

In the following table will be found a statement of the production of coke in the United States in 1893, by States, together with similar tables for 1891 and 1892 for comparison. From these tables it appears that the total production of coke in the United States in 1893 was 9,477,580 tons, as compared with 12,010,829 tons in 1892, a reduction of 2,533,249 or 21.1 per cent. This great falling off in production is due to the depression in the blast-furnace industry. Coke-made pig iron in the United States in 1893 was 5,390,184 tons, as compared with 6,822,266 tons in 1892; and of anthracite and mixed anthracite and coke pig iron, 1,347,529 tons in 1893, as compared with 1,797,113 tons in 1892. This is a reduction of nearly 2,000,000 tons, and would probably account for the decrease in production of coke to an equal amount, say, 2,000,000 tons. The remainder of the decrease in production is due to the falling off in demand at foundries and at other works where coke is used.

It will be noted that Pennsylvania still maintains its supremacy as the chief coke-producing State, its production being 6,229,051 tons out of a total of 9,477,580 tons, or 65.7 per cent. In 1892 its proportion was 69 per cent. Alabama stands second, producing 1,168,085 tons, or 12.3 per cent. West Virginia is third, producing 1,062,076 tons, or 11.2 per cent. These were the only States that produced 1,000,000 tons or over. Colorado was the fourth State in point of production, its output being 346,981 tons, or 3.66 per cent. Tennessee, whose production was very close to that of Colorado in 1892, in 1893 produced 90,000 tons less than that State, its production being but 265,777 tons. Virginia's production was 125,092 tons. These six States are the only ones that produced over 100,000 tons.

Making a comparison by States between 1892 and 1893, it will be seen that of the chief producing States, Georgia, Kentucky, and West Virginia, show an increase. Georgia increased its production 9,000 tons, Kentucky some 12,000 tons, and West Virginia 27,326 tons. The notable reductions in production were in Alabama, where it fell off some 330,000 tons; in Colorado, which fell off over 26,000 tons; in Pennsylvania, which fell off over 2,000,000 tons; in Tennessee, which fell off nearly 90,000 tons; in Virginia, which fell off some 22,000 tons, and Wisconsin, which fell off nearly 19,000 tons.

Manufacture of coke in the United States, by States and Territories, in 1893.

States and Territories.	Establishments.	Ovens.		Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				Short tons.	Per ct.	Short tons.		
Alabama	23	5,548	60	2,015,398	58	1,168,085	$2,648,632	$2.27
Colorado (a)	8	b1,154	200	628,935	57.7	362,986	1,137,488	3.13
Georgia	1	338	0	171,645	52.8	90,726	136,089	1.50
Illinois	1	24	0	3,300	66.7	2,200	4,400	2.00
Indiana	2	94	0	11,549	49.6	5,724	9,048	1.58
Indian Territory	1	80	0	15,118	47	7,135	25,072	3.51
Kansas	6	75	0	13,645	62.8	8,565	18,640	2.18
Kentucky	4	283	100	97,212	50	48,619	97,350	2.00
Missouri	3	10	0	8,875	66.5	5,905	9,735	1.65
Montana	2	153	0	61,770	48.5	29,945	239,560	8.00
New Mexico	1	50	0	14,698	39.5	5,803	18,476	3.18
New York	1	12	0	15,150	84.8	12,850	35,925	2.80
Ohio	9	435	0	42,963	52	22,436	43,671	1.95
Pennsylvania	102	25,744	19	9,386,702	66	6,229,051	9,468,036	1.52
Tennessee	11	1,942	0	449,511	59	265,777	491,523	1.85
Utah	1	83	0	....	....	c16,005	....	....
Virginia	2	594	206	194,059	64.5	125,092	282,898	2.26
Washington	3	84	0	11,374	59	6,731	34,207	5.08
West Virginia	75	7,354	132	1,745,757	60.8	1,062,076	1,716,907	1.62
Wisconsin	1	120	0	24,085	62	14,958	95,851	6.41
Wyoming	1	24	0	5,400	54	2,916	10,206	3.50
Total	258	44,201	717	14,917,146	63.5	9,477,580	16,523,714	1.74

a Includes Utah's production of coal and coke and value of same.
b Includes 36 gas retorts.
c Included with Colorado's coke production.

Manufacture of coke in the United States, by States and Territories, in 1892.

States and Territories.	Establishments.	Ovens.		Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				Short tons.	Per ct.	Short tons.		
Alabama	20	5,320	90	2,585,966	58	1,501,571	$3,464,623	$2.31
Colorado (a)	9	b1,128	220	599,200	62.3	373,229	1,234,320	3.31
Georgia	1	300	0	158,978	51.5	81,807	163,614	2.00
Illinois	1	24	0	4,800	66	3,170	7,133	2.25
Indiana	2	84	0	6,456	49.7	3,207	6,472	2.02
Indian Territory	1	80	0	7,138	50	3,569	12,402	3.47
Kansas	6	75	0	15,437	59.2	9,132	19,906	2.18
Kentucky	5	287	100	70,783	51	36,123	72,563	2.01
Missouri	3	10	0	11,088	65.8	7,299	10,949	1.50
Montana	2	153	0	64,412	53.6	34,557	311,013	9.00
New Mexico	1	50	0	0	0	0	0	0
Ohio	10	436	0	95,236	54.4	51,818	112,907	2.18
Pennsylvania	109	25,366	260	12,591,345	66.1	8,327,612	15,015,336	1.80
Tennessee	11	1,941	0	600,126	59	354,096	724,106	2.05
Utah	1	83	0	....	....	c7,309	....	....
Virginia	2	594	206	226,517	65.3	147,912	322,486	2.18
Washington	3	84	30	12,372	58	7,177	50,446	7.03
West Virginia	72	5,843	978	1,709,183	60.5	1,034,750	1,821,965	1.76
Wisconsin	1	120	0	54,300	62.2	33,800	185,900	5.50
Wyoming	1	24	0	0	0	0	0	0
Total	261	42,002	1,893	18,813,337	64	12,010,829	23,536,141	1.96

a Includes Utah's production of coal and coke and value of same.
b Includes 36 gas retorts.
c Included with Colorado's coke production.

Manufacture of coke in the United States, by States and Territories, in 1891.

States and Territories.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
				Short tons.	Per ct.	Short tons.		
Alabama	21	5,068	50	2,144,277	60	1,282,496	$2,986,242	$2.33
Colorado	7	948	21	452,749	61	277,074	896,984	3.24
Georgia	1	300	0	164,875	62.5	103,057	231,878	2.25
Illinois	1	25	0	10,000	52	5,200	11,700	2.25
Indiana	2	84	0	8,688	44	3,798	7,596	2.00
Indian Territory	1	80	0	20,551	46	9,464	30,483	3.22
Kansas	6	72	0	27,181	52	14,174	33,296	2.35
Kentucky	7	115	24	64,390	52	33,777	68,281	2.02
Missouri	3	10	0	10,377	66	6,872	10,000	1.46
Montana	2	140	0	61,667	47	29,009	258,523	8.91
New Mexico	1	Pit ...	0	4,000	57.5	2,300	10,925	4.75
Ohio	9	421	0	69,320	56	38,718	76,901	1.99
Pennsylvania	109	25,324	11	10,588,544	66	6,954,846	12,679,826	1.82
Tennessee	11	1,995	0	623,177	58	364,318	701,803	1.93
Utah Territory	1	80	0	25,281	31	7,949	35,778	4.50
Virginia	2	550	250	285,113	58.8	167,516	265,107	1.58
Washington	2	80	0	10,000	60	6,000	42,000	7.00
West Virginia	55	4,621	555	1,716,976	58.8	1,009,051	1,845,043	1.83
Wisconsin	1	120	0	52,904	65	34,387	192,804	5.61
Wyoming	1	24	0	4,470	60	2,682	8,046	3.00
Total	243	40,057	911	16,344,540	63	10,352,688	20,393,216	1.97

In the following table are shown the statistics of the manufacture of coke in the United States from 1880 to 1893, inclusive.

Statistics of the manufacture of coke in the United States, 1880 to 1893, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	186	12,372	1,159	5,237,741	3,338,300	$6,631,267	$1.99	63
1881	197	14,119	1,005	6,546,662	4,113,760	7,725,175	1.88	63
1882	215	16,356	712	7,577,648	4,793,321	8,462,167	1.77	63
1883	231	18,304	407	8,516,670	5,464,721	8,121,607	1.49	64
1884	250	19,557	812	7,951,974	4,873,805	7,242,878	1.49	61
1885	233	20,116	432	8,071,126	5,106,696	7,629,118	1.49	63
1886	222	22,597	4,154	10,688,972	6,845,369	11,153,366	1.63	64
1887	270	26,001	3,584	11,859,752	7,611,705	15,321,116	2.01	64
1888	261	30,059	2,587	12,945,350	8,540,030	12,445,963	1.46	66
1889	252	34,165	2,115	15,960,973	10,258,022	16,630,301	1.62	64
1890	253	37,158	1,547	18,005,209	11,508,021	23,215,302	2.02	64
1891	243	40,245	911	16,344,540	10,352,688	20,393,216	1.97	63
1892	261	42,002	1,893	18,813,337	12,010,829	23,536,141	1.96	64
1893	258	44,201	717	14,917,146	9,477,580	16,523,714	1.74	63.5

Total number of coke works in the United States.—The following table gives the number of establishments manufacturing coke in the United States at the close of each year from 1880 to 1893, by States:

Number of establishments in the United States manufacturing coke on December 31 of each year, from 1880 to 1893.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	4	4	5	6	8	11	14	15	18	19	20	21	20	23
Colorado	1	2	5	7	8	7	7	7	7	9	8	7	9	8
Georgia	1	1	1	1	1	2	2	2	1	1	1	1	1	1
Illinois	6	6	7	7	9	9	9	8	8	4	4	1	1	1
Indiana	2	2	2	2	2	2	4	4	3	4	4	2	2	2
Indian Territory	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kansas	2	3	3	4	4	4	4	4	6	6	7	6	6	6
Kentucky	5	5	5	5	5	5	6	6	10	9	9	7	5	4
Missouri	0	0	0	0	0	0	0	1	1	3	3	3	3	3
Montana	0	0	0	1	3	2	4	2	1	2	2	2	2	2
New Mexico	0	0	2	2	2	2	2	1	1	2	2	1	1	1
New York	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Ohio	15	15	16	18	19	13	15	15	15	13	13	9	10	9
Pennsylvania	124	132	137	140	145	133	108	151	120	109	106	109	109	102
Tennessee	6	6	8	11	13	12	12	11	11	12	11	11	11	11
Texas	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Utah	1	1	1	1	1	1	1	0	0	1	1	1	1	1
Virginia	0	0	0	1	1	1	2	2	2	2	2	2	2	2
Washington	0	0	0	0	1	1	1	1	3	1	2	2	3	3
West Virginia	18	19	22	24	27	27	29	39	52	53	55	55	72	75
Wisconsin	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Wyoming	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Total	186	197	215	231	250	233	222	270	261	252	253	243	261	258

The word "establishment" is rather an indefinite one. In some cases proprietors of coke works owning several different banks or blocks of ovens will report them all as one establishment, they being under one general management. In other cases they will be reported separately. The number differs so much from year to year as to make this table of but little value for comparison.

The number of establishments in the country for each year since 1850 for which there are any returns is as follows:

Number of coke establishments in the United States since 1850.

Years.	Number.	Years.	Number.
1850 (census year)	4	1885, December 31	233
1860 (census year)	21	1886, December 31	222
1870 (census year)	25	1887, December 31	270
1880 (census year)	149	1888, December 31	261
1880, December 31	186	1889, December 31	252
1881, December 31	197	1890, December 31	253
1882, December 31	215	1891, December 31	243
1883, December 31	231	1892, December 31	261
1884, December 31	250	1893, December 31	258

Number of coke ovens in the United States.—The following table shows the number of coke ovens in each State and Territory on December 31 of each year from 1880 to 1893, together with the total number of ovens in the United States at the close of each of these years. In the earlier years covered by this table some coke was made in pits and on the ground, and in testing the adaptability of certain coals to the manufacture of coke this is still customary, though in the later years but little of the coke reported as produced in the United States was made in anything but ovens.

Number of coke ovens in the United States on December 31 of each of the years from 1880 to 1893.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Alabama	316	416	536	767	976	1,075	1,301
Colorado	200	267	344	352	409	434	483
Georgia	140	180	220	264	300	300	300
Illinois	176	176	304	316	325	320	335
Indiana	45	45	37	37	37	37	100
Indian Territory	20	20	20	20	20	40	40
Kansas	6	15	20	23	23	23	36
Kentucky	45	45	45	45	45	33	76
Missouri	0	0	0	0	0	0	0
Montana	0	0	0	2	5	2	16
New Mexico	0	0	0	12	70	70	70
New York	......	......	......	......	......	......	......
Ohio	616	641	647	682	732	642	560
Pennsylvania	9,501	10,881	12,424	13,610	14,285	14,553	16,314
Tennessee	656	724	861	692	1,105	1,387	1,485
Utah	20	20	20	20	20	20	20
Virginia	0	0	0	200	200	200	350
Washington	0	0	0	0	0	2	11
West Virginia	631	689	878	962	1,005	978	1,100
Wisconsin	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0
Total	12,372	14,119	16,356	18,304	19,557	20,116	22,597

States and Territories.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	1,555	2,475	3,944	4,805	5,068	5,320	5,548
Colorado	532	602	834	916	948	a1,128	a1,154
Georgia	300	290	300	300	300	300	338
Illinois	278	221	149	148	25	24	24
Indiana	119	103	111	101	84	84	94
Indian Territory	80	80	78	78	80	80	80
Kansas	39	58	68	68	72	75	75
Kentucky	98	132	166	175	115	287	283
Missouri	4	4	9	10	10	10	10
Montana	27	40	90	140	140	153	153
New Mexico	70	70	70	70	b0	50	50
New York	......	......	......	......	......	......	c12
Ohio	585	547	462	443	421	436	435
Pennsylvania	18,294	20,381	22,143	23,430	25,324	25,366	25,744
Tennessee	1,560	1,634	1,639	1,664	1,995	1,941	1,942
Utah	0	0	34	80	80	83	83
Virginia	350	550	550	550	550	594	594
Washington	30	30	30	30	80	84	84
West Virginia	2,080	2,792	3,438	4,060	4,621	5,843	7,354
Wisconsin	0	50	50	70	120	120	120
Wyoming	0	0	0	20	24	24	24
Total	26,001	30,059	34,165	37,158	40,057	42,002	44,201

a Includes 36 gas retorts. *b* Coke was made in pits. *c* Semit-Solvay ovens.

As compared with 1892 the above table shows an increase in the number of ovens in the United States of 2,199. The great increase in the number of coke ovens was in West Virginia in which the number increased from 5,843 ovens in 1892 to 7,354 ovens in 1893, an increase of 1,511. The number in Pennsylvania increased from 25,366 ovens in 1892 to 25,744 in 1893, an increase of 378. The number of ovens in Alabama increased from 5,320 in 1892 to 5,548, or 228. These were the only States that showed any important increase in the number of ovens. As we have noted in previous volumes of this series, a calculation based upon this table and the one showing production indicates that the ovens in certain States were in much more active operation during the year than those in other States. For example, though Alabama had but 5,548 ovens as compared with 7,354 in West Virginia, it made nearly 110,000 tons more of coke, showing that the product of coke per oven during the year in Alabama was greater than that in West Virginia. The product per oven in West Virginia in 1893 was 144 tons; in Alabama 211 tons; and in Pennsylvania 242 tons.

As is elsewhere stated, most of the ovens in operation in the United States are of the solid wall type, in which the coal is coked by heat generated in the oven itself, a certain amount of the heat generated at a burning being stored in the walls of the oven. Most of the ovens are of the regular beehive shape; a few are somewhat modified in form, the oven being long and shaped like a muffle. The principle of coking, however, is the same in these long ovens (which are sometimes called Welsh ovens or drag ovens, certain shapes used in this country being also known as the Thomas oven, from its inventor) as in the beehive; that is, the coking of the coal is by the heat generated by the combustion of the coal in the oven itself with such slight heat as may be stored in the walls of the oven from a previous burning.

As we have stated elsewhere, some flue ovens were in operation in the United States in 1893, and a bank of Otto-Hoffmann ovens was contemplated. In the term flue ovens are included all ovens in which the coking operation is performed in whole or in part by heat applied externally to the inner wall of the oven by means of the waste gases which are burned usually in flues contained in the walls of the ovens. There is a great demand in this country for tar and ammonia water which the illuminating gas works are not able to supply, especially in view of the fact that the amount of these by-products has been considerably lessened by the use of enriched water gas. It is believed that there are certain coals in the United States which are largely used in coke-making at the present time the coke from which could be very much improved and the cost of production very much reduced by the use of some form of flue oven with the saving of by-products.

Number of ovens building in the United States.—The following table gives the number of ovens actually in course of construction at the close of each year from 1890 to 1893. It should be understood that this table does not include the increase in the number of ovens during the year. It only gives the number of ovens actually in course of construction at the close of each year. It will be noted that the number in course of erection at the close of 1893 was 717, which is the smallest of any year since 1885.

Number of coke ovens building in the United States at the close of each of the years from 1880 to 1893.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	100	120	0	122	242	16	1,012	1,362	406	427	371	50	90	60
Colorado	50	0	0	0	24	0	0	0	100	50	30	21	220	200
Georgia	40	40	44	36	0	0	0	0	0	0	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indiana	0	0	0	0	0	0	18	0	0	0	0	0	0	0
Indian Territory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kansas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky	0	0	0	0	0	0	2	0	2	100	303	24	100	100
Missouri	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montana	0	0	0	0	12	0	0	0	0	50	0	0	0	0
New Mexico	0	0	12	28	0	0	0	0	0	0	0	0	0	0
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	25	0	0	0	0	0	0	223	12	0	1	0	0	0
Pennsylvania	836	761	642	211	232	317	2,558	802	1,565	567	74	11	269	19
Tennessee	68	84	14	10	175	36	126	165	84	40	292	0	0	0
Virginia	0	0	0	0	0	0	100	300	0	250	250	250	206	206
Washington	0	0	0	0	0	0	21	0	100	0	80	0	30	0
West Virginia	40	0	0	0	127	63	317	742	318	631	334	555	978	132
Wisconsin	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,159	1,005	712	407	812	432	4,154	3,594	2,587	2,115	1,735	911	1,893	717

Production of coke in the several States from 1880 to 1893.—The production of coke in the several States and Territories from 1880 to 1893 is shown in the following table:

Amount of coke produced, in short tons, in the United States, 1880 to 1893, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Alabama	60,781	109,033	152,940	217,531	244,009	301,180	375,054
Colorado	25,568	48,587	102,105	133,997	115,719	131,960	142,797
Georgia	38,041	41,376	46,602	67,012	79,268	70,669	82,680
Illinois	12,700	14,800	11,400	13,400	13,095	10,350	8,103
Indiana	0	0	0	0	0	0	6,124
Indian Territory	1,546	1,768	2,025	2,573	1,912	3,584	6,351
Kansas	3,070	5,670	6,080	8,430	7,190	8,050	12,493
Kentucky	4,250	4,370	4,070	5,025	2,223	2,704	4,528
Missouri	0	0	0	0	0	0	0
Montana	0	0	0	0	75	175	0
New Mexico	0	0	1,000	3,905	18,282	17,940	10,236
New York	....	....	....	....	....	....	....
Ohio	100,596	119,469	103,722	87,834	62,709	39,416	34,932
Pennsylvania	2,821,384	3,437,708	3,945,034	4,438,464	3,822,128	3,991,805	5,406,597
Tennessee	130,609	143,853	187,695	203,691	219,723	218,842	368,139
Utah	1,000	0	250	0	0	0	0
Virginia	0	0	0	25,340	63,600	49,139	122,352
Washington	0	0	0	....	400	311	825
West Virginia	138,755	187,126	230,398	257,519	223,472	260,571	264,158
Wisconsin	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0
Total	3,338,300	4,113,760	4,793,321	5,464,721	4,873,805	5,106,696	6,845,369

Amount of coke produced, in short tons, in the United States, etc.—Continued.

States and Territories.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	325,020	508,511	1,030,510	1,072,942	1,282,496	1,501,571	1,168,085
Colorado	170,698	179,682	187,638	245,756	277,074	365,920	346,981
Georgia	79,241	83,721	94,727	102,233	103,057	81,807	90,726
Illinois	9,198	7,410	11,583	5,000	5,200	3,170	2,200
Indiana	17,658	11,956	8,301	6,013	3,798	3,207	5,724
Indian Territory	10,060	7,502	6,639	6,639	9,464	3,569	7,135
Kansas	14,950	14,831	13,910	12,311	14,174	9,132	8,565
Kentucky	14,565	23,150	13,021	12,343	33,777	36,123	48,619
Missouri	2,970	2,600	5,275	6,136	6,872	7,299	5,905
Montana	7,200	12,000	14,043	14,427	29,009	34,557	29,945
New Mexico	13,710	8,540	3,460	2,050	2,300	0	5,803
New York	0	0	0	0	0	0	12,850
Ohio	93,004	67,194	75,124	74,633	38,718	51,818	22,436
Pennsylvania	5,832,849	6,545,779	7,659,055	8,560,245	6,954,846	8,327,612	6,229,051
Tennessee	396,979	385,693	359,710	348,728	364,318	354,096	265,777
Utah	0	0	761	8,528	7,949	7,309	16,005
Virginia	166,947	149,199	146,528	165,847	167,516	147,912	125,092
Washington	14,625	0	3,841	5,837	6,000	7,177	6,731
West Virginia	442,031	531,762	607,880	833,377	1,009,051	1,034,750	1,062,076
Wisconsin	0	500	16,016	24,976	34,387	33,800	14,958
Wyoming	0	0	0	0	2,682	0	2,916
Total	7,611,705	8,540,030	10,258,022	11,508,021	10,352,688	12,010,829	9,477,580

The following table gives the relative rank of the States and Territories in the production of coke in the years 1880 to 1893, both inclusive:

Rank of the States and Territories in production of coke in 1880 to 1893.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Pennsylvania	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Alabama	5	5	4	3	2	2	2	4	3	2	2	2	2	2
West Virginia	2	2	2	2	3	3	4	2	2	3	3	3	3	3
Colorado	7	6	6	5	5	5	5	5	5	5	5	5	4	4
Tennessee	3	3	3	4	4	4	3	3	4	4	4	4	5	5
Virginia	.....	.....	.....	8	7	7	6	6	6	6	6	6	6	6
Georgia	6	7	7	7	6	6	7	8	7	7	7	7	7	7
Kentucky	9	10	10	11	12	13	14	12	9	12	11	10	9	8
Montana	.....	.....	.....	.....	15	15	.....	16	12	10	10	11	10	9
Ohio	4	4	5	6	8	8	8	7	8	8	8	8	8	10
Utah	12	.....	13	.....	.....	.....	.....	.....	.....	19	13	14	13	11
Wisconsin	.....	.....	.....	.....	.....	.....	.....	.....	18	9	9	9	11	12
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
Kansas	10	9	9	10	11	11	9	10	11	11	12	12	12	14
Indian Territory	11	11	11	13	13	12	12	14	15	15	14	13	16	15
Washington	.....	.....	.....	.....	14	14	15	11	10	17	17	16	15	16
Missouri	.....	.....	.....	.....	.....	.....	.....	17	17	16	15	15	14	17
New Mexico	.....	.....	12	12	9	9	10	13	14	18	19	20	.....	18
Indiana	.....	.....	.....	.....	.....	.....	13	9	13	14	16	18	17	19
Wyoming	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19	.....	20
Illinois	8	8	8	9	10	10	11	15	16	13	18	17	18	21

An inspection of the above table indicates that the relative rank of quite a number of the States changed in 1893. Ohio, which held eighth place for a number of years, has fallen to the tenth. New Mexico, which has been nineteenth or twentieth, has risen to the eighteenth place, while Illinois, which has been the seventeenth and eighteenth, has dropped to the twenty-first place. Kansas has dropped from twelfth to the fourteenth place; Indiana from the seventeenth to the nineteenth place. Kentucky has risen from ninth to the eighth; Indian Territory from the sixteenth to the fifteenth place, and Montana from the tenth to the ninth place; Missouri has dropped from the fourteenth to the seventeenth place; Wisconsin from the eleventh to the twelfth place, and Wyoming from the nineteenth to the twentieth.

Value and average selling price of coke.—In the following table is given the total value of coke produced in the United States in each year from 1880 to 1893, inclusive.

Total value at the ovens of the coke made in the United States in the years from 1880 to 1893, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Alabama	$183,063	$326,819	$425,940	$598,473	$609,185	$755,645	$993,302
Colorado	145,226	267,156	476,665	584,578	409,930	512,162	569,120
Georgia	81,789	88,753	100,194	147,166	169,192	144,198	179,031
Illinois	41,950	45,850	29,050	28,200	25,639	27,798	21,487
Indiana	0	0	0	0	0	0	17,953
Indian Territory	4,638	5,304	6,075	7,719	5,736	12,902	22,229
Kansas	6,000	10,200	11,460	16,560	14,580	13,255	19,204
Kentucky	12,250	12,630	11,530	14,425	8,760	8,499	10,082
Missouri	0	0	0	0	0	0	0
Montana	0	0	0	0	900	2,063	0
New Mexico	0	0	6,000	21,478	91,410	89,700	51,180
New York	....	....	....	....	....	....	....
Ohio	255,905	297,728	266,113	225,660	156,294	109,723	94,042
Pennsylvania	5,255,040	5,898,579	6,133,698	5,410,387	4,783,230	4,981,656	7,664,023
Tennessee	316,607	342,585	472,505	459,126	428,870	398,459	687,865
Utah	10,000	0	2,500	0	0	0	0
Virginia	0	0	0	44,345	111,300	85,993	305,880
Washington	0	0	0	0	1,900	1,477	4,125
West Virginia	318,797	429,571	520,437	563,490	425,952	485,588	513,843
Wisconsin	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0
Total	6,631,265	7,725,175	8,462,167	8,121,607	7,242,878	7,629,118	11,153,366

States and Territories.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	$775,090	$1,189,679	$2,372,417	$2,589,447	$2,986,242	$3,464,623	$2,648,632
Colorado	682,778	716,305	643,479	959,246	896,984	*a*1,234,320	*a*1,137,488
Georgia	174,410	177,907	149,059	150,995	231,878	163,614	136,089
Illinois	19,594	21,038	29,764	11,250	11,700	7,133	4,400
Indiana	51,141	31,993	25,922	19,706	7,596	6,472	9,048
Indian Territory	33,435	21,755	17,957	21,577	30,483	12,402	25,072
Kansas	28,575	29,073	26,593	29,116	33,296	19,906	18,640
Kentucky	31,730	47,244	29,769	22,191	68,281	72,563	97,350
Missouri	10,395	9,100	5,800	9,240	10,000	10,949	9,735
Montana	72,000	96,000	122,023	125,655	258,523	311,013	239,560
New Mexico	82,260	51,240	18,408	10,025	10,925	0	18,476
New York	....	....	....	....	....	....	35,925
Ohio	245,981	166,330	188,222	218,090	76,901	112,907	43,671
Pennsylvania	10,746,352	8,230,759	10,743,492	16,333,674	12,679,826	15,015,336	9,468,036
Tennessee	870,900	490,491	731,496	684,116	701.803	724,106	491,523
Utah	0	0	3,042	37,196	35,778	....	....
Virginia	417,368	260,000	325,861	278,724	265,107	322,486	282,898
Washington	102,375	0	30,728	46,696	42,000	50,446	34,207
West Virginia	976,732	905,549	1,074,177	1,524,746	1,845,043	1,821,965	1,716,907
Wisconsin	0	1,500	92,092	143,612	192,804	185,900	95,851
Wyoming	0	0	0	0	8,046	0	10,206
Total	15,321,116	12,445,963	16,630,301	23,215,302	20,393,216	23,536,141	16,523,714

a Includes Utah's production.

While this table gives the totals of the values as returned in the schedules, the figures do not always represent the same thing. A statement as to the actual selling price of the coke was asked for, and in most cases, including possibly 80 per cent. of all the coke produced, the figures are the actual selling price. In some cases, however, the value is an estimate. Considerable of the coke made in the United States is produced by proprietors of blast furnaces for consumption in their own furnaces, none being sold. The value, therefore, given for this coke would be an estimate based, in some instances where there are coke works in the neighborhood selling coke for the general market, upon the price obtained for this coke; in other cases the cost is estimated at the cost of the coke at the furnace, plus a small percentage for profit on the coking operation, while in still other cases the value given is only the actual cost of the coke at the ovens.

An inspection of this table shows the value of coke in 1893 to range from $1.50 a ton in Georgia to $8 a ton in Montana. These high prices are not always arbitrary, the character of the coal in Montana and Washington, where the highest price rules, the higher price of labor and the other elements of cost rendering the manufacture of coke in these districts not as remunerative as the price given would indicate.

This table shows that the average value of coke in 1893 was $1.74, as compared with $1.96 in 1892.

Average value per short ton at the ovens of the coke made in the United States in the years from 1880 to 1893, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	$3.01	$3.00	$2.79	$2.75	$2.50	$2.50	$2.65	$2.39	$2.34	$2.30	$2.41	$2.33	$2.31	$2.27
Colorado	5.68	5.29	4.67	4.36	3.45	3.88	3.99	4.00	4.00	3.43	3.90	3.24	3.31	*a*3.13
Georgia	2.15	2.15	2.15	2.20	2.13	2.04	2.17	2.20	2.12	1.57	1.48	2.25	2.00	1.50
Illinois	3.30	3.10	2.55	2.10	1.96	2.68	2.65	2.13	2.84	2.57	2.25	2.25	2.25	2.00
Indiana	.....	.....	.....	.....	.....	.....	2.93	2.81	2.68	3.12	3.28	2.00	2.02	1.58
Indian Territory	3.00	3.00	3.00	3.00	3.00	3.60	3.50	3.33	2.90	2.70	3.25	3.22	3.47	3.51
Kansas	1.95	1.80	1.70	1.96	2.02	1.65	1.54	1.91	1.96	1.91	2.37	2.35	2.18	2.18
Kentucky	2.88	2.89	2.83	2.87	3.94	3.14	2.23	2.18	2.04	2.28	1.80	2.02	2.01	2.00
Missouri	.....	.....	.....	.....	.....	.....	.....	3.50	3.50	1.10	1.51	1.46	1.50	1.65
Montana	.....	.....	.....	.....	12.00	11.72	.....	10.00	8.00	8.69	8.71	8.91	9.00	8.00
New Mexico	.....	.....	6.00	5.50	5.00	5.00	5.00	6.00	6.00	5.32	4.89	4.75	0	3.18
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.80
Ohio	2.54	2.49	2.57	2.57	2.49	2.78	2.69	2.65	2.48	2.50	2.92	1.99	2.18	1.95
Pennsylvania	1.86	1.70	1.55	1.22	1.25	1.25	1.42	1.84	1.26	1.40	1.91	1.82	1.80	1.52
Tennessee	2.42	2.33	2.52	2.25	1.95	1.31	1.87	2.19	1.27	2.03	1.96	1.93	2.05	1.85
Utah	10.00	.....	10.00	.....	.....	.....	.....	.....	.....	4.00	4.36	4.50	0	.....
Virginia	.....	.....	.....	1.75	1.75	1.75	2.50	2.50	1.74	2.22	1.68	1.58	2.18	2.26
Washington	.....	.....	.....	.....	4.75	4.75	5.00	7.00	0	8.00	8.00	7.00	7.03	5.08
West Virginia	2.30	2.30	2.26	2.19	1.19	1.86	1.94	2.22	1.70	1.76	1.83	1.83	1.76	1.62
Wisconsin	.....	.....	.....	.....	.....	.....	.....	.....	3.00	5.75	5.75	5.61	5.50	6.41
Wyoming	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.00	0	3.50
Average	1.99	1.88	1.77	1.49	1.49	1.49	1.63	2.01	1.46	1.62	2.02	1.97	19.6	1.74

a Utah included.

Coal consumed in the manufacture of coke.—In the following table is given the total number of tons of coal used in the manufacture of coke in the United States for the years 1880 to 1893:

Amount of coal used (short tons) in the manufacture of coke in the United States from 1880 to 1893, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Alabama	106, 283	184, 881	261, 839	359, 699	413, 184	507, 934	635, 120
Colorado	51, 891	97, 508	180, 549	224, 089	181, 968	208, 069	228, 060
Georgia	63, 402	68, 960	77, 670	111, 687	132, 113	117, 781	136, 133
Illinois	31, 240	35, 240	25, 270	31, 370	30, 168	21, 487	17, 806
Indiana							13, 020
Indian Territory	2, 494	2, 852	3, 266	4, 150	3, 084	5, 781	10, 242
Kansas	4, 800	8, 800	9, 200	13, 400	11, 500	15, 000	23, 062
Kentucky	7, 206	7, 406	6, 906	8, 437	3, 451	5, 075	9, 055
Missouri							
Montana					165	300	
New Mexico			1, 500	6, 941	29, 990	31, 889	18, 194
New York							
Ohio	172, 453	201, 145	181, 577	152, 502	108, 164	68, 796	59, 332
Pennsylvania	4, 347, 558	5, 393, 503	6, 149, 179	6, 823, 275	6, 204, 604	6, 178, 500	8, 290, 849
Tennessee	217, 656	241, 644	313, 537	330, 961	348, 295	412, 538	621, 669
Utah	2, 000		500				
Virginia				39, 000	99, 000	81, 899	200, 018
Washington					700	544	1, 400
West Virginia	230, 758	304, 823	366, 653	411, 159	385, 588	415, 533	425, 002
Wisconsin							
Wyoming							
Total	5, 237, 741	6, 546, 762	7, 577, 646	8, 516, 670	7, 951, 974	8, 071, 126	10, 688, 972

States and Territories.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	550, 047	848, 608	1, 746, 277	1, 809, 964	2, 144, 277	2, 585, 966	2, 015, 398
Colorado	267, 487	274, 212	299, 731	407, 023	452, 749	*a* 599, 200	*a* 628, 935
Georgia	158, 482	140, 000	157, 878	170, 388	164, 875	158, 978	171, 645
Illinois	16, 596	13, 020	19, 250	9, 000	10, 000	4, 800	3, 300
Indiana	35, 600	26, 547	16, 428	11, 753	8, 688	6, 456	11, 549
Indian Territory	20, 121	13, 126	13, 277	13, 278	20, 551	7, 138	15, 118
Kansas	27, 604	24, 934	21, 600	21, 809	27, 181	15, 437	13, 645
Kentucky	29, 129	42, 642	25, 192	24, 372	64, 390	70, 783	97, 212
Missouri	5, 400	5, 000	8, 485	9, 491	10, 377	11, 088	8, 875
Montana	10, 800	20, 000	30, 576	32, 148	61, 667	64, 412	61, 770
New Mexico	22, 549	14, 628	7, 162	3, 980	4, 000	0	14, 698
New York							15, 150
Ohio	164, 974	124, 201	132, 828	126, 921	69, 320	95, 236	42, 963
Pennsylvania	8, 938, 438	9, 673, 097	11, 581, 292	13, 046, 143	10, 588, 544	12, 591, 345	9, 386, 702
Tennessee	655, 857	630, 099	626, 016	600, 387	623, 177	600, 126	449, 511
Utah			2, 217	24, 058	25, 281		
Virginia	235, 841	230, 529	238, 793	251, 683	285, 113	226, 517	194, 059
Washington	22, 500		6, 983	9, 120	10, 000	12, 372	11, 374
West Virginia	698, 327	863, 707	1, 001, 372	1, 395, 266	1, 716, 976	1, 709, 183	1, 745, 757
Wisconsin		1, 000	25, 616	38, 425	52, 304	54, 300	24, 085
Wyoming					4, 470	0	5, 400
Total	11, 859, 752	12, 945, 350	15, 960, 973	18, 005, 209	16, 344, 540	18, 813, 337	14, 917, 146

a Includes Utah's production.

In regard to this table it is to be noted that in many cases the statement as to the amount of coal used in the production of coke is an estimate. At but few works is the coal weighed before being charged into the ovens. A great deal of the coke made in the United States is from run-of-mine, that is, all of the product of mining, lump, nut, and slack, as it comes to the mouth of the pit in the mine car is charged into the ovens, and if no coal is sold as coal it is comparatively easy to ascertain from the amounts paid for mining what is the amount of coal charged into the ovens. But even in such cases considerable difficulty arises from the fact that mining is paid for by the measured bushel or ton of so many cubic feet, while our statistics are by weight, and the measured bushel or ton is often not the equivalent of the weighed bushel or ton. It is also true that in certain districts where the men are paid by the car the car contains even of measured tons more than the men are paid for. Under such circumstances it is not to the interest of the operator to weigh the coal as it is charged into the oven.

Further, in many districts coke-making is simply for the purpose of utilizing the slack coal produced in mining or that which falls through the screen at the tipple when lump coal is sold. In such cases the slack is rarely, if ever, weighed as it is charged into the ovens, so that any statement as to the amount of coal used at such works will be an estimate. At some works the coal is often weighed for a brief period, and the coke being weighed as it is sold a percentage of yield is ascertained which is used in statements as to the amount of coal used and the yield of this coal in coke.

Great care has been exercised, in view of these facts, to reach a satisfactory estimate as to the amount of coal used in the production of coke, as given in the table immediately preceding, and the percentage yield of coal in coke as shown in the table next subsequent. Analyses of coals from most of the districts in the United States have been secured. These analyses, checked by personal knowledge as to the wastefulness of the methods of coking in each district, have enabled the writer to reach a conclusion as to whether the returns made were approximately correct or not. Where it has been judged that they were incorrect, correspondence has usually led to a revision of the same. It is sometimes the custom of coke manufacturers who do not weigh the coal charged into the ovens to estimate that the yield of coke is equal to the percentage of the fixed carbon and ash in the coal. A report from a certain coke works showed a yield of 77 per cent. This was equal to the average amount of fixed carbon and ash in the coal. Further inquiry developed the fact that at other mines in this district, using the same character of coal, the yield as reported varied from 50 to 66 per cent. Upon the attention of the party making the return showing 77 per cent. being called to these facts, the yield was reduced to 63 per cent. As coke is sold by weight, it has always been assumed that the production of coke was accurate, and where the coal was not weighed, yield of coal in coke being ascertained, a calculation could be made which would show approximately the amount of coal used.

But even under these conditions it is believed that more coal was actually used in the production of coke in each of the years covered by the above table than is shown.

The amount of coal necessary to produce a ton of coke, assuming that the above tables are approximately correct, was as follows:

Coal required to produce a ton of coke in tons or pounds.

Years.	Tons.	Pounds.	Years.	Tons.	Pounds.
1880	1.57	3,140	1887	1.56	3,120
1881	1.59	3,180	1888	1.51	3,020
1882	1.58	3,160	1889	1.55	3,100
1883	1.56	3,120	1890	1.56	3,120
1884	1.63	3,260	1891	1.58	3,160
1885	1.58	3,160	1892	1.57	3,140
1886	1.56	3,120	1893	1.57	3,140

It is believed that the amount of coal used is greater than that reported. This would increase the amount of coal given above as necessary to produce a ton of coke.

In the following table is shown the percentage of yield of coal in the manufacture of coke for the years 1880 to 1893. The statements made above must be kept in mind in examining this table. By the "yield' is of course meant the percentage of the constituents of the coal that remained as coke, and in the coke after the process of coking.

While these tables show an average of something like 63 per cent. for most of the years, it is believed that even this is a little too high. Probably the actual yield of coal in coke throughout the United States, if the actual weight of coal charged into the ovens and the actual weight of the coke drawn had been taken, would not have exceeded 60 or 61 per cent

Percentage yield of coal in the manufacture of coke in the United States in the years 1880 to 1893, inclusive, by States and Territories.

[Per cent.]

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
Alabama	57	59	58	60	60	59	59	59	60	59	59	60	58	58
Colorado	49	50	57	60	64	63	62.6	64	65.6	63	60	61	63.9	a57.7
Georgia	60	60	60	60	60	60	60	50	60	60	60	62.5	51.5	52.8
Illinois	41	42	45	43	43	48	46	55½	56.9	60	55	52	66	66.7
Indiana	0	0	0	0	0	0	47	50	45	51	51	44	49.7	49.6
Indian Territory	62	62	62	62	62	62	62	50	57	50	50	46	50	47
Kansas	64	64.4	65	62.9	62¼	53⅔	54.2	54	59	64	56	52	59.2	62.8
Kentucky	60	60	59	60	64	53	50	50	54	52	51	52	51	50
Missouri	0	0	0	0	0	0	0	55	52	62	65	66	65.8	66.5
Montana	0	0	0	0	46	58½	0	66⅔	60	46	45	47	53.6	48.5
New Mexico	0	0	66⅔	57¼	57½	56¼	56	61	58	48	51.5	57.5	0	39.5
New York	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	84.8
Ohio	58	59	57	58	58	57	59	56	54	56	59	56	54.4	52
Pennsylvania	65	64	64	65	62	64.6	65.2	65¼	68	66	65	66	66.1	66
Tennessee	60	60	60	62	63	53	59	61	61	57	58	58	59	59
Texas	0	0	0	0	0	0	50	0	0	0	0	0	0	0
Utah	50	0	50	0	0	0	0	0	0	34	35	31	.....	.....
Virginia	0	0	0	64½	64¼	60	61.1	70.8	64.7	61	66	58.8	65.3	64.5
Washington	0	0	0	0	57.5	57	58.9	65	0	55	64	60	58	59
West Virginia	60	61	63	63	62	63	62	63.3	61.6	61	59	58.8	60.5	60.8
Wisconsin	0	0	0	0	0	0	0	0	50	62.5	65	65	62.2	62
Wyoming	0	0	0	0	0	0	0	0	0	0	0	60	0	54
Total average	63	63	63	64	61	63	64	64.2	66	64	64	63	64	63.5

a Average, including Utah.

In connection with these tables of yields it should be said that there is no doubt that the yield of coal in coke is increasing throughout the United States. Better forms of oven are being used; slight modifications in construction are being made, which increases the yield; the coal is being crushed and disintegrated, which not only improves the quality but increases the yield as well, and better methods of burning are being employed, all of which tend not only to make a better coke but to get more coke out of a given weight of coal.

The value of coal used per ton of coke.—In the following tables will be found a statement of the amount and value of coal used in the manufacture of coke in the United States in the years 1893, 1892, and 1891. The chief point in these tables is to show the average value of coal used per ton, and the amount of coal necessary to make a ton of coke, and the value of the same. The average value of coal per ton in 1891 was 76½ cents; in 1892 it was 75 cents; and in 1893 it was 70 cents. The amount of coal necessary to make a ton of coke in 1891 was 1.58 tons; in 1892, 1.57 tons; and in 1893 the same, 1.57 tons. The value of the coal necessary to make a ton of coke in 1891 was $1.21; in 1892, $1.18; and in 1893, $1.10.

Amount and value of coal used in the manufacture of coke in the United States in 1893 and amount and value of same per ton of coke.

States and Territories.	Coal used.	Total value of coal.	Value of coal per ton.	Amount of coal used per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	2, 015, 398	$1, 894, 666	$0. 94	1. 725	$1. 62
Colorado (*a*)	628, 935	599, 773	. 95	1. 73	1. 65
Georgia	171, 645	171, 645	1. 00	1. 89	1. 89
Illinois	3, 300	660	. 20	1. 50	. 30
Indiana	11, 549	4, 043	. 35	2. 02	. 71
Indian Territory	15, 118	3, 779	. 25	2. 12	. 53
Kansas	13, 645	7, 117	. 52	1. 59	. 82
Kentucky	97, 212	34, 804	. 36	2. 00	. 72
Missouri	8, 875	3, 168	. 36	1. 50	. 54
Montana	61, 770	185, 310	3. 00	2. 06	6. 18
New Mexico	14, 698	21, 069	1. 43	2. 53	3. 63
New York	15, 150	39, 550	2. 61	1. 18	3. 08
Ohio	42, 963	24, 700	. 58	1. 91	1. 10
Pennsylvania	9, 386, 702	5, 738, 798	. 61	1. 51	. 92
Tennessee	449, 511	363, 260	. 808	1. 69	1. 37
Utah (*c*)	......	......	......	......	......
Virginia	194, 059	212, 467	1. 09	1. 55	1. 70
Washington	11, 374	25, 163	2. 21	1. 69	3. 74
West Virginia	1, 745, 757	1, 044, 219	. 60	1. 64	. 98
Wisconsin	24, 085	*b* 72, 255	3. 00	1. 61	4. 83
Wyoming	5, 400	3, 240	. 60	1. 85	1. 11
Total and averages	14, 917, 146	10, 449, 686	. 70	1. 57	1. 10

a Figures given for Colorado include the statistics of Utah.
b Value estimated.
c Included with Colorado figures.

Amount and value of coal used in the manufacture of coke in the United States in 1892 and amount and value of same per ton of coke.

States and Territories.	Coal used.	Total value of coal.	Value of coal per ton.	Amount of coal per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	2,585,966	$2,551,946	$0.99	1.72	$1.70
Colorado (*a*)	599,200	617,744	1.03	1.605	1.65
Georgia	158,978	*b* 143,080	.90	1.943	1.75
Illinois	4,800	1,200	.25	1.514	.38
Indiana	6,456	2,333	.36	2.013	.72
Indian Territory	7,138	1,785	.25	2.00	.50
Kansas	15,437	8,297	.54	1.69	.91
Kentucky	70,783	19,681	.28	1.96	.55
Missouri	11,088	4,165	.38	1.51	.57
Montana	64,412	193,236	3.00	1.864	5.59
New Mexico	0	0	0	0	0
Ohio	95,236	82,890	.87	1.84	1.60
Pennsylvania	12,591,345	8,372,171	.67	1.512	1.01
Tennessee	600,126	624,275	1.04	1.70	1.77
Utah (*c*)	....	....	....	....	....
Virginia	226.517	243,112	1.07	1.53	1.64
Washington	12,372	29,344	2.37	1.724	4.09
West Virginia	1,709,183	1,106,806	.65	1.65	1.07
Wisconsin	54,300	149,325	2.75	1.606	4.42
Wyoming	0	0	0	0	0
Total and averages	18,813,337	14,151,390	.75	1.57	1.18

a Figures given for Colorado include the statistics of Utah.
b Value estimated.
c Included with Colorado figures.

Amount and value of coal used in the manufacture of coke in the United States in 1891 and amount and value of same per ton of coke.

States and Territories.	Coal used.	Total value of coal.	Value of coal per ton.	Amount of coal per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	2,144,277	$2,186,707	$1.02	1.67	$1.67
Colorado	452,749	573,052	1.26	1.63	2.05
Georgia	164,875	148,388	.90	1.60	1.44
Illinois	10,000	1,500	.15	1.92	.29
Indiana	8,688	2,172	.25	2.28	.57
Indian Territory	20,551	5,138	.25	2.17	.54
Kansas	27,181	13,820	.51	1.91	.97
Kentucky	64,390	16,278	.25	1.91	.48
Missouri	10,377	4,143	.40	1.51	.60
Montana	61,667	128,864	2.09	2.12	4.43
New Mexico	4,000	6,600	1.65	1.72	2.84
Ohio	69,320	56,056	.81	1.79	1.43
Pennsylvania	10,588,544	7,318,697	.69	1.52	1.05
Tennessee	623,177	525,571	.84	1.71	1.45
Utah	25,281	19,198	.76	3.18	2.42
Virginia	285,113	227,995	.80	1.70	1.36
Washington	10,000	22.500	2.25	1.66	3.74
West Virginia	1,716,976	1,084,428	.63	1.74	1.10
Wisconsin	52,904	158,712	3.00	1.54	4.62
Wyoming	4,470	....	....	1.66	....
Total and averages	16,344,540	12,499,819	.77	1.58	1.21

Condition in which coal is charged into ovens.—In the following table will be found a statement of the condition of coal when charged into ovens; that is, whether it is run-of-mine, slack, washed or unwashed. The tables for 1893, 1892, and 1891 are given. The headings explain themselves. It is only necessary to state that run-of-mine, washed, includes that run-of-mine coal which is crushed before being washed;

Character of coal used in the manufacture of coke in 1893.

States and Territories.	Run-of-mine, unwashed.	Run-of-mine, washed.	Slack, unwashed.	Slack, washed.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	1, 246, 307	51, 163	292, 198	425, 730	2, 015, 398
Colorado (*a*)	109, 915	0	519, 020	0	628, 935
Georgia	0	0	0	171, 645	171, 645
Illinois	0	0	0	3, 300	3, 300
Indiana	0	0	930	10, 619	11. 549
Indian Territory	0	0	0	15, 118	15, 118
Kansas	0	0	12, 445	1, 200	13, 645
Kentucky	825	11, 973	26, 759	57, 655	97, 212
Missouri	0	0	8, 875	0	8. 875
Montana	0	44, 000	0	17, 770	61, 770
New Mexico	14, 698	0	0	0	14. 698
New York	....	....	15, 150	....	15, 150
Ohio	0	0	24, 859	18. 104	42, 963
Pennsylvania	8, 302, 307	216, 762	739, 128	128, 505	9, 386, 702
Tennessee	179, 126	0	137, 483	132, 902	449, 511
Virginia	107, 498	0	86, 561	0	194, 059
Washington	0	10, 974	0	405	11, 374
West Virginia	324, 932	15, 240	1. 176, 656	228, 929	1, 745, 757
Wisconsin	20, 474	0	3, 611	0	24, 085
Wyoming	0	0	5, 400	0	5, 400
Total	10. 306, 082	350, 112	3, 049, 075	1, 211, 877	14, 917, 146

a Utah included.

Character of coal used in the manufacture of coke in 1892.

States and Territories.	Run-of-mine, unwashed.	Run-of-mine, washed.	Slack, unwashed.	Slack, washed.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	2, 463, 366	0	11, 100	111, 500	2, 585, 966
Colorado (*a*)	82, 098	0	517, 102	0	599, 200
Georgia	0	0	0	158, 978	158, 978
Illinois	0	0	4, 800	0	4, 800
Indiana	0	0	0	6, 456	6, 456
Indian Territory	0	0	0	7, 138	7, 138
Kansas	0	0	15, 437	0	15, 437
Kentucky	0	5, 955	7, 883	56, 945	70, 783
Missouri	0	0	11, 088	0	11, 088
Montana	0	28, 000	0	36, 412	64, 412
New Mexico	0	0	0	0	0
Ohio	35, 334	0	32, 402	27, 500	95, 236
Pennsylvania	11, 237, 253	159, 698	1, 059, 994	134, 400	12, 591, 345
Tennessee	176, 453	15, 000	367, 827	40, 846	600, 126
Virginia	106, 010	0	120, 507	0	226, 517
Washington	0	0	0	12, 372	12, 372
West Virginia	298, 824	115, 397	1, 108, 353	186, 609	1, 709, 183
Wisconsin	54, 300	0	0	0	54, 300
Wyoming	0	0	0	0	0
Total	14, 453, 638	324, 050	3, 256, 493	779, 156	18, 813, 337

a Including Utah's production.

Character of coal used in the manufacture of coke in 1891.

States and Territories.	Run-of-mine, unwashed.	Run of-mine, washed.	Slack, unwashed.	Slack, washed.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	1,943,469	0	192,238	8,570	2,144,277
Colorado	90,000	0	362,749	0	452,749
Georgia	106,131	0	0	58,744	164,875
Illinois	0	0	10,000	0	10,000
Indiana	0	0	0	8,688	8,688
Indian Territory	0	0	9,500	11,051	20,551
Kansas	0	0	27,181	0	27,181
Kentucky	11,000	0	3,500	49,890	64,390
Missouri	0	0	10,377	0	10,377
Montana	0	34,000	0	27,667	61,667
New Mexico	4,000	0	0	0	4,000
Ohio	5,200	0	64,120	0	69,320
Pennsylvania	9,470,646	256,807	558,106	302,985	10,588,544
Tennessee	184,556	0	377,914	60,707	623,177
Utah	3,752	0	21,529	0	25,281
Virginia	107,498	0	177,615	0	285,113
Washington	0	0	10,000	0	10,000
West Virginia	276,259	0	1,116,060	324,657	1,716,976
Wisconsin	0	52,904	0	0	52,904
Wyoming	0	0	4,470	0	4,470
Total	12,202,511	343,711	2,945,359	852,959	16,344,540

From this table it appears that of the total amount of coal used in 1893, in the manufacture of coke, 10,306,082 tons, or 69.09 per cent. of the total of 14,917,146 tons, were run-of-mine, unwashed; 350,112 tons, or 2.35 per cent. run-of-mine, washed; 3,049,075 tons, or 20.44 per cent. were unwashed slack; while 1,211,877 tons, or 8.12 per cent. of the total was washed slack. In 1891, 77 per cent. was run-of-mine; in 1892, 78.5 per cent., and in 1893, 71.4 per cent. In 1891, 23 per cent. was slack; in 1892, 21.5 per cent., and in 1893, 28.6 per cent. But 7 per cent. of the total was washed in 1891, 6 per cent. in 1892, and 10.5 per cent. in 1893.

Imports of coke.—The following table gives the quantities and value of coke imported and entered for consumption into the United States from 1862 to 1893, inclusive. In the reports of the Treasury Department the quantities given are long tons. These have been reduced to short tons to make the table consistent with the other tables in this report:

Coke imported and entered for consumption in the United States, 1869 to 1893, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Short tons.			*Short tons.*	
June 30, 1869	....	$2,053	June 30, 1882	14,924	$53,244
1870	....	6,388	1883	20,634	113,114
1871	....	19,528	1884	14,483	36,278
1872	9,575	9,217	1885	20,876	64,814
1873	1,091	1,366	Dec. 31, 1886	28,124	84,801
1874	634	4,588	1887	35,320	100,312
1875	1,046	9,648	1888	35,201	107,914
1876	2,065	8,657	1889	28,608	88,008
1877	4,068	16,686	1890	20,808	101,767
1878	6,616	24,186	1891	50,753	223,184
1879	6,035	24,748	1892	27,420	86,350
1880	5,047	18,406	1893	37,183	99,683
1881	15,210	64,987			

ALABAMA.

Alabama still maintains its position as the second of the coke-producing States. The coal fields of Alabama, and consequently the coke fields, are divided into three districts, which take their names from the chief rivers draining them; that portion drained by the Warrior river and its tributaries and the Tennessee river, and its tributaries in Alabama, constitutes the Warrior field. The Coosa field is drained by the Coosa river and is situated in Saint Clair and Shelby counties. The Cahaba field along the Cahaba river, in the counties of Shelby, Jefferson, and Tuscaloosa.

The total production of coke in Alabama in 1893 was 1,168,085 tons, as compared with 1,501,571 tons in 1892. This decrease in production is without doubt due to the falling off in the production of pig iron, which consumes the larger part of the coke manufactured, not only in Alabama, but in the entire United States. Of the total production, 1,117,018 tons were from the Warrior district, 43,227 tons from the Cahaba district, and 7,840 tons from the Coosa field. The production of these three districts in 1892 was as follows: Warrior, 1,411,693 tons; Cahaba, 68,218 tons, and Coosa, 21,660 tons.

In the production of this coke 2,015,398 tons of coal were used. This is an average yield of coal in coke of 58 per cent. The yield of coal in coke in the Warrior district was 58 per cent.; in the Coosa district, 53.5 per cent., and in the Cahaba 49.2 per cent. The total value of this coal was $1,894,666, or 94 cents a ton. The total value of the coke—this value in some cases being the selling prices, and in other cases, where the coke was made by the furnace owners, an assumed value, usually what coke bought would have cost at the furnace—was $2,648,632, or $2.27 a ton. The total number of ovens in the State at the close of 1893 was 5,548, as compared with 5,320 at the close of 1892.

The following are the statistics of the manufacture of coke in Alabama, from 1880 to 1893, inclusive:

Statistics of the manufacture of coke in Alabama, 1880 to 1893, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	4	316	100	106,283	60,781	$183,063	$3.01	57
1881	4	416	120	184,881	109,033	326,819	3.00	59
1882	5	536	....	261,839	152,940	425,940	2.79	58
1883	6	767	122	359,699	217,531	598,473	2.75	60
1884	8	*a* 976	242	413,184	244,009	609,185	2.50	60
1885	11	1,075	16	507,934	301,180	755,645	2.50	59
1886	14	*a*1,301	1,012	635,120	375,054	993,302	2.65	59
1887	15	1,555	1,362	550,047	325,020	775,090	2.39	59
1888	18	2,475	406	848,608	508,511	1,189,579	2.34	60
1889	19	3,944	427	1,746,277	1,030,510	2,372,417	2.30	59
1890	20	4,805	371	1,809,964	1,072,942	2,589,447	2.41	59
1891	21	5,068	50	2,144,277	1,282,496	2,986,242	2.33	60
1892	20	5,320	90	2,585,966	1,501,571	3,464,623	2.31	58
1893	23	5,548	60	2,015,398	1,168,085	2,648,632	2.27	58

a One establishment made coke on the ground.

Considerable attention has been given in Alabama to coal washing or coal separation as well as to the preparation of the coal before coking. The result has been a very marked improvement in the character of the coke produced. The Standard Coal Company, of Brookwood, in Tuscaloosa county, washed all of the coal used in 1893. One hundred and sixty analyses were made of the coke, which showed but 8.51 per cent. of ash, and 5.83 per cent. of sulphur. A complete analysis of what is regarded as an average sample of the coke from this company is as follows:

Analysis of Standard Coal Company's coke, Alabama.

Constituents.	Per cent.
Moisture	0.85
Volatile matter	1.05
Sulphur	.56
Ash	8.50
Fixed carbon	89.04
Total	100.00

COLORADO.

Colorado still maintains its position as the most important coke-producing State outside of the Appalachian field. It ranks fourth in the list, being exceeded only by Pennsylvania, Alabama, and West Virginia, and is the only one of the States of the far West which is a large producer of coke.

The coke ovens of Colorado are quite widely scattered. The two important coking districts are, first, the El Moro, or Trinidad district, located in Las Animas county, near the southern boundary of the State, close to the line of New Mexico, in the neighborhood of the town of Trinidad. This district produced, in 1893, 223,416 tons of the total of 346,981 tons produced in Colorado. The other important district is the Crested Butte, which includes the coke produced in the coal fields near the place of that name in Gunnison county, and also the ovens at Cardiff in Garfield county, north of Crested Butte. From these two localities, which we have included in the Crested Butte district, 103,805 of the 346,981 tons produced in Colorado in 1893 were shipped.

Outside of these two districts some oven coke for smelting purposes was made in what we have heretofore called the Durango district, which is in La Plata county, in the extreme southwestern portion of the State. In these three districts oven coke is produced for smelting purposes. In addition to these, in Denver, some coke is made in retorts for domestic use only. The gas produced from the coal is used for its carbonization, the tar, ammonia, and other by-products being sold. This concern has 36 gas retorts. In addition to this, at Grand Junction, in Mesa county, in the extreme western middle portion of the State, there are three ovens in which nut coal is carbonized for domestic use in the place of anthracite coal.

The following are the statistics of the manufacture of coke in Colorado for the years 1880 to 1893, inclusive:

Statistics of the manufacture of coke in Colorado, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	1	200	50	51,891	25,568	$145,226	$5.68	49
1881	2	267	0	97,508	48,587	267,156	5.29	50
1882	5	344	0	180,549	102,105	476,665	4.67	57
1883	7	352	0	224,089	133,997	584,578	4.36	60
1884	8	409	24	181,968	115,719	409,930	3.45	64
1885	7	434	0	208,069	131,960	512,162	3.88	63
1886	7	483	0	228,060	142,797	569,120	3.99	62.6
1887	7	532	0	267,487	170,698	682,778	4.00	64
1888	7	602	100	274,212	179,682	716,305	4.00	65.6
1889	9	834	50	299,731	187,638	643,479	3.43	63
1890	8	916	30	407,023	245,756	959,246	3.90	60
1891	7	948	21	452,749	277,074	896,984	3.24	61
1892	9	*a*1,128	220	572,904	365,920	1,201,429	3.28	63.9
1893	8	*a*1,154	200	581,246	346,981	1,065,465	3.07	59.7

a Includes 36 gas retorts.

GEORGIA.

The extreme northwestern portion of this State is cut by the extreme border of the Appalachian coal field. In this small field coke has been produced for many years, the product in 1893 being 90,726 tons, as compared with 81,807 tons in 1892.

There seems to have been an increase in the number of ovens in 1893 as compared with 1892.

The statistics of the production of coke in Georgia, 1880 to 1893, are as follows:

Statistics of the manufacture of coke in Georgia, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	140	40	63,402	38,041	$81,789	$2.15	60
1881	1	180	40	68,960	41,376	88,753	2.15	60
1882	1	220	44	77,670	46,602	100,194	2.15	60
1883	1	264	36	111,687	67,012	147,166	2.20	60
1884	1	300	0	132,113	79,268	169,192	2.13	60
1885	2	300	0	117,781	70,669	144,198	2.04	60
1886	2	300	0	136,133	82,680	179,031	2.17	60
1887	2	300	0	158,482	79,241	174,410	2.20	50
1888	1	290	0	140,000	83,721	177,907	2.12	60
1889	1	300	0	157,878	94,727	149,059	1.57	60
1890	1	300	0	170,388	102,233	150,995	1.48	60
1891	1	300	0	164,875	103,057	231,878	2.25	62.5
1892	1	300	0	158,978	81,807	163,614	2.00	51.5
1893	1	338	0	171,645	90,726	136,089	1.50	52.8

ILLINOIS.

Coke was made at but one works in Illinois in 1893, the total product being 2,200 tons, as compared with 3,170 tons in 1892. This coke was used entirely for domestic purposes and the manufacture of water gas.

The following are the statistics of the manufacture of coke in Illinois for the years from 1880 to 1893:

Statistics of the manufacture of coke in Illinois, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	176	....	31,240	12,700	$41,950	$3.30	41
1881	6	176	....	35,240	14,800	45,850	3.10	42
1882	7	304	....	25,270	11,400	29,050	2.55	45
1883	7	316	....	31,170	13,400	28,200	2.10	43
1884	9	325	....	30,168	13,095	25,639	1.96	43
1885	9	320	....	21,487	10,350	27,798	2.68	48
1886	9	335	....	17,806	8,103	21,487	2.65	46
1887	8	278	....	16,596	9,198	19,594	2.13	55.5
1888	8	221	....	13,020	7,410	21,038	2.84	56.9
1889	4	149	....	19,250	11,583	29,764	2.57	60
1890	4	148	....	9,000	5,000	11,250	2.25	55
1891	1	25	....	10,000	5,200	11,700	2.25	52
1892	1	24	....	4,800	3,170	7,133	2.25	66
1893	1	24	0	3,300	2,200	4,400	2.00	66.7

INDIANA.

While there is an abundance of coal in Indiana that is good coking coal, its manufacture on a large scale has never been successful. There are still but two works in this State, one with 40 ovens, the other with 54. One of these works ran but a month and a half in 1893. Only slack is used, and this is washed.

It will be noticed, however, that the production of coke in Indiana in 1893 was in excess of its production in 1891 and 1892.

The statistics of the manufacture of coke from 1886 to 1893, both inclusive, are given in the following table. No coke was made in Indiana from 1879 to 1885, both inclusive.

Statistics of the manufacture of coke in Indiana, 1886 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1886	4	100	18	13,030	6,124	$17,953	$2.93	47
1887	4	119	....	35,600	17,658	51,141	2.81	50
1888	3	103	....	26,547	11,956	31,993	2.68	45
1889	4	111	....	16,428	8,301	25,922	3.12	51
1890	4	101	....	11,753	6,013	19,706	3.28	51
1891	2	84	....	8,688	3,798	7,596	2.00	44
1892	2	84	....	6,456	3,207	6,472	2.02	49.7
1893	2	94	0	11,549	5,724	9,048	1.58	49.6

INDIAN TERRITORY.

The Osage Coal and Mining Company, of McAlester, still remains the only producer of coke in the Indian Territory, the works being for the utilization of the slack coal produced in mining. The coke finds its chief market in Kansas and Missouri. We have described this field and the coke produced from it in previous issues of Mineral Resources.

In the following table it will be noticed that there has been a considerable increase in the production of coke in this Territory in 1893. The production, however, still remains quite small, being but 7,135 tons in 1893.

The statistics of the manufacture of coke in the Indian Territory from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	20	....	2,494	1,546	$4,638	$3.00	62
1881	1	20	....	2,852	1,768	5,304	3.00	62
1882	1	20	....	3,266	2,025	6,075	3.00	62
1883	1	20	....	4,150	2,573	7,719	3.00	62
1884	1	20	....	3,084	1,912	5,736	3.00	62
1885	1	40	....	5,781	3,584	12,902	3.60	62
1886	1	40	....	10,242	6,351	22,229	3.30	62
1887	1	80	....	20,121	10,060	33,435	3.33	50
1888	1	80	....	13,126	7,502	21,755	2.90	57
1889	1	78	....	13,277	6,639	17,957	2.70	50
1890	1	78	....	13,278	6,639	21,577	3.25	50
1891	1	80	....	20,551	9,464	30,483	3.22	46
1892	1	80	....	7,138	3,569	12,402	3.47	50
1893	1	80	0	15,118	7,135	25,072	3.51	47

KANSAS.

All of the coke made in Kansas is by the lead and zinc smelters for use in their furnaces and is made from slack. The coke industry of this State is, therefore, only of local importance.

The statistics of the manufacture of coke in Kansas from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in Kansas, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	2	6	....	4,800	3,070	$6,000	$1.95	64
1881	3	15	....	8,800	5,670	10,200	1.80	64.4
1882	3	20	....	9,200	6,080	11,460	1.70	65
1883	4	23	....	13,400	8,430	16,560	1.96	62.9
1884	4	23	....	11,500	7,190	14,580	2.02	62.5
1885	4	23	....	15,000	8,050	13,255	1.65	53⅔
1886	4	36	....	23,062	12,493	19,204	1.54	54.2
1887	4	39	....	27,604	14,950	28,575	1.91	54
1888	6	58	....	24,934	14,831	29,073	1.96	59
1889	6	68	....	21,600	13,910	26,593	1.91	64
1890	7	68	....	21,809	12,311	29,116	2.37	56
1891	6	72	....	27,181	14,174	33,296	2.35	52
1892	6	75	....	15,437	9,132	19,906	2.18	59.2
1893	6	75	0	13,645	8,565	18,640	2.18	62.8

KENTUCKY.

Owing to the depression in the iron business in the South during 1893, the production of coke in Kentucky does not show as great an increase as the conditions at the beginning of the year led us to expect, though there was considerable of an increase in the production of 1893 over that of 1892, the production in the latter year being 36,123 tons as compared with 48,619 tons in 1893, an increase of 34.5 per cent. Some 500 tons of this was produced from slack coal gathered in the coal yards of Louisville. Some 34,814 tons were made in the Western district. The remainder was made in the Pineville district.

The statistics of the manufacture of coke in Kentucky from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in Kentucky, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	45	....	7,206	4,250	$2.88	$12,250	60
1881	5	45	....	7,406	4,370	2.89	12,630	60
1882	5	45	....	6,906	4,070	2.83	11,530	59
1883	5	45	....	8,437	5,025	2.87	14,425	60
1884	5	45	....	3,451	2,223	3.94	8,760	64
1885	5	33	....	5,075	2,704	3.14	8,489	53
1886	6	78	2	9,055	4,528	2.23	10,082	50
1887	6	98	....	29,129	14,565	2.18	31,730	50
1888	10	132	2	42,642	23,150	2.04	47,244	54
1889	9	166	100	25,192	13,021	2.28	29,769	52
1890	9	175	303	24,372	12,343	1.80	22,191	51
1891	7	115	24	64,390	33,777	2.02	68,281	52
1892	5	287	100	70,783	36,123	2.01	72,563	51
1893	4	283	100	97,212	48,619	2.00	97,350	50

MISSOURI.

The statistics of the production of coke in Missouri from 1887, when coking began in this State, to 1893 are as follows:

Statistics of the manufacture of coke in Missouri, 1887 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	4	....	5,400	2,970	$3.50	$10,395	55
1888	1	4	....	5,000	2,600	3.50	9,100	52
1889	3	9	....	8,485	5,275	1.10	5,800	62
1890	3	10	....	9,491	6,136	1.51	9,240	65
1891	3	10	....	10,377	6,872	1.45	10,000	66
1882	3	10	....	11,088	7,299	1.50	10,949	65.8
1893	3	10	0	8,875	5,905	1.65	9,735	66.5

MONTANA.

Owing to the agitation regarding silver in 1893 the demand for coke from the Montana coking works was not as great as in 1892, and the low price of eastern cokes made it possible to send them into Montana in competition with that produced in the State. Coke is still produced from but two fields, near the entrance to the Yellowstone National Park, namely, the Gardner and the Bozeman. The production in 1893 was 29,945 tons, as compared with 34,557 tons in 1892.

The statistics of the manufacture of coke in Montana from 1883, when ovens were first reported, to 1893 are as follows:

Statistics of the manufacture of coke in Montana, 1883 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	2	0	0	0	0	0	0
1884	3	5	12	165	75	$12.00	$900	46
1885	2	2	0	300	175	11.72	2,063	58.5
1886	4	16	0	0	0	0	0	0
1887	2	27	0	10,800	7,200	10.00	72,000	66⅔
1888	1	40	0	20,000	12,000	8.00	96,000	60
1889	2	90	50	30,576	14,043	8.69	122,023	46
1890	2	140	0	32,148	14,427	8.71	125,655	45
1891	2	140	0	61,667	29,009	8.91	258,523	47
1892	2	153	0	64,412	34,557	9.00	311,013	53.6
1893	2	153	0	61,770	29,945	8.00	239,560	48.5

NEW MEXICO.

A small amount of coke is produced for use of the smelters of the Territory. The industry is of but little importance. In 1893 the total amount of coke made was 5,803 tons, as compared with no production in 1892.

The statistics of the production of coke in New Mexico from 1882, when coke ovens were first reported, until 1893 were as follows:

Statistics of the manufacture of coke in New Mexico, 1882 to 1893.

Years.	Establishments.	Ovens built. (*a*)	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1882	2	0	12	1,500	1,000	$6.00	$6,000	66⅔
1883	2	12	28	6,941	3,905	5.50	21,478	57¼
1884	2	70	0	29,990	18,282	5.00	91,410	57¼
1885	2	70	0	31,889	17,940	5.00	89,700	56¼
1886	2	70	0	18,194	10,236	5.00	51,180	56
1887	1	70	0	22,549	13,710	6.00	82,260	61
1888	1	70	0	14,628	8,540	6.00	51,240	58
1889	2	70	0	7,162	3,460	5.32	18,408	48
1890	2	70	0	3,980	2,050	4.89	10,025	51.5
1891	1	70	0	4,000	2,300	4.75	10,925	57.5
1892	1	50	0	0	0	0	0	0
1893	1	50	0	14,698	5,803	3.18	18,476	39.5

a At one works there are ten stone pits, with an average capacity of 10 tons each.

OHIO.

In reporting upon the manufacture of coke in Ohio we have separated the Cincinnati district, in which the coke is made from the dust and screenings of the coal yards at Cincinnati, from the coke produced in the remainder of the State, which is made direct from coal at or near the mines. The Cincinnati district in this report, therefore, includes the ovens near that city, and the Ohio district includes the ovens in the remainder of the State.

Cincinnati district.—All of the coke made in this district is from the dust and screenings of the coal yards at Cincinnati and of the coal boats and barges that bring coal from the upper Ohio, chiefly from Pittsburg and the Kanawha region of West Virginia.

The statistics of the manufacture of coke in the Cincinnati district from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Cincinnati district, Ohio, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	4	32	0	16,141	10,326	$4.09	$42,255	64
1881	4	32	0	20,607	13,237	4.11	54,439	64
1882	4	32	0	19,687	12,045	3.78	47,437	64
1883	5	57	0	33,978	20,106	3.28	65,990	59
1884	5	57	0	32,134	18,840	3.24	61,072	59
1885	5	82	0	17,480	10,962	3.27	35,873	63
1886	5	82	0	17,015	10,566	2.99	31,633	62.1
1887	5	150	20	56,723	32,894	2.91	95,754	56
1888	6	156	12	63,217	35,868	2.67	95,618	57
1889	5	146	0	75,892	45,108	2.68	120,899	59
1890	5	150	0	68,266	43,278	3.97	171.848	63
1891	3	130	0	13,403	9,080	3.47	31,529	67.6
1892	4	146	0	31,330	19,320	3.33	64,319	61.6
1893	3	142	0	13,700	9,000	3.00	27,000	65.7

Ohio district.—This district includes all of the ovens coking Ohio coal, and comprises the ovens near Leetonia, in the Hocking Valley and in the vicinity of Steubenville and Bridgeport. The important establishment in this district is the Cherry Valley, at Leetonia, which, however, produced no coke in 1893.

Of the six works in the Ohio district only three produced coke, the production of this district falling from 32,498 tons in 1892 to 13,436 in 1893. Unless Connellsville coke sells for above $1.50 it is not profitable to produce coke in Ohio. Most of the coke that was produced was, however, for domestic consumption, or for use in the mills of the companies producing the same.

The following table gives the statistics of the production of coke i the Ohio district for the years 1880 to 1893.

Statistics of the manufacture of coke in the Ohio district, Ohio, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	11	584	25	156,312	90,270	$213,650	$2.37	57
1881	11	609	0	180,438	106,232	243,289	2.39	59
1882	12	615	0	161,890	91,677	218,676	2.39	57
1883	13	625	0	118,524	67,728	159,670	2.36	57
1884	14	675	0	76,030	43,869	95,222	2.17	58
1885	8	560	0	51,316	28,454	73,850	2.60	55
1886	10	478	0	42,317	24,366	62,409	2.56	57¾
1887	10	435	203	108,251	60,110	150,227	2.50	55½
1888	9	391	0	60,984	31,326	70,712	2.25	51
1889	8	316	0	56,936	30,016	67,323	2.24	52.7
1890	8	293	1	58,655	31,335	46,242	1.47	53.4
1891	6	291	0	55,917	29,638	45,372	1.53	53
1892	6	290	0	63,905	32,498	48,588	1.50	50.9
1893	6	293	0	29,263	13,436	16,671	1.24	46

Total production of coke in Ohio.—In the following table the statistics of the production of coke in the several districts of Ohio for the years 1880 to 1893 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	15	616	25	172,453	100,596	$255,905	$2.54	58
1881	15	641	0	201,045	119,469	297,728	2.49	59
1882	16	647	0	181,577	103,722	266,113	2.57	57
1883	18	682	0	152,502	87,834	225,660	2.57	58
1884	19	732	0	108,164	62,709	156,294	2.49	58
1885	13	642	0	68,796	39,416	109,723	2.78	57
1886	15	560	0	59,332	34,932	94,042	2.69	59
1887	15	585	223	164,974	93,004	245,981	2.65	56
1888	15	547	12	124,201	67,194	166,330	2.48	54
1889	13	462	0	132,828	75,124	188,222	2.50	56
1890	13	443	1	126,921	74,633	218,090	2.92	59
1891	9	421	0	69,320	38,718	76,901	1.99	56
1892	10	436	0	95,236	51,818	112,907	2.18	54.4
1893	9	435	0	42,963	22,436	43,671	1.95	52

PENNSYLVANIA.

The coking districts of Pennsylvania are divided in this and previous volumes of Mineral Resources into the twelve districts named in the table given below. The division of these districts is chiefly geographical and for the most part explains itself.

The Allegheny Mountain district includes the ovens along the line of the Pennsylvania railroad from Gallitzin eastward over the crest of the Alleghenies to beyond Altoona. The Allegheny Valley district includes the coke works of Armstrong and Butler counties, and one of those in Clarion county, the other ovens in the latter county being included in the Reynoldsville-Walston district. The Beaver district includes the ovens in Beaver county; the Blossburg and Broad Top those in the Blossburg and Flat Top coal fields. The ovens of the Clearfield-Center district are chiefly in the two counties from which it derives its name. The Connellsville district is the well-known region in western Pennsylvania, in Westmoreland and Fayette counties, extending from just south of Latrobe to Fairchance. The Greensburg, Irwin, Pittsburg, and Reynoldsville-Walston districts include the ovens near the towns which have given the names to these districts. The Upper Connellsville, sometimes called the Latrobe, district is near the town of this name.

A notable feature of the coke industry in Pennsylvania in 1893 is the great falling off in production, the total having declined from 8,327,612 tons in 1892 to 6,229,051 tons in 1893, a decrease of over 25 per cent., and the smallest production in Pennsylvania since 1887, when 5,832,849 tons were produced. All of the twelve districts, with the exception of three, namely, the Allegheny Valley, the Greensburg, and the Pittsburg districts show a notable falling off in the production of coke during the year. The reduction of production in the Connellsville region is from 6,329,452 tons in 1892 to 4,805,623 tons in 1893. This great decrease in production is due to the depression in the blast-furnace industry.

The statistics of the production of coke in Pennsylvania by districts in 1891, 1892, and 1893 are given in the following tables:

Coke production in Pennsylvania in 1893, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per ct.*
Allegheny Mountain	15	1,260	0	275,865	173,131	$264,292	$1.53	62.8
Allegheny Valley	2	116	0	10,927	6,557	11,147	1.70	60
Beaver	2	10	0	2,998	1,644	4,446	2.70	54.8
Blossburg	2	407	0	22,176	11,463	31,427	2.74	51.7
Broad Top	5	456	14	136,069	86,752	150.196	1.73	63.8
Clearfield-Center	8	695	0	155,119	98,650	171,482	1.74	63.6
Connellsville	28	17,504	5	7,095,491	4,805,623	7,141,031	1.49	67.7
Greensburg	3	88	0	29,983	18,393	26,303	1.43	61
Irwin	5	725	0	238,832	150,463	195,609	1.30	63
Pittsburg	10	885	0	357,400	216,268	438,801	2.03	60.5
Reynoldsville-Walston	8	1,755	0	562,033	339,314	586,212	1.73	60.4
Upper Connellsville	14	1,843	0	499,809	320,793	447,090	1.39	64
Total	102	25,744	19	9,386,702	6,229,051	9,468,036	1.52	66

Coke production in Pennsylvania in 1892, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per ct.
Allegheny Mountain	16	1,260	0	724,903	448,522	$775,927	$1.73	61.9
Allegheny Valley	3	148	0	0	0	0	0.	0.
Beaver	2	10	0	3,925	2,154	6,270	2.91	54.9
Blossburg	2	404	0	30,746	16,675	45,855	2.75	54.2
Broad Top	5	488	8	185,600	117,554	216,090	1.84	63.3
Clearfield-Center	7	731	0	231,357	147,819	264,422	1.79	63.9
Connellsville	31	17,309	0	9,389,549	6,329,452	11,598,407	1.83	67.4
Greensburg	2	58	0	15,005	9,037	13,173	1.46	60.2
Irwin	4	696	0	328,193	202,809	284,029	1.40	61.8
Pittsburg	15	725	261	292,357	176,365	376,613	2.14	60.3
Reynoldsville-Walston	8	1,734	0	683,539	425,250	743,227	1.75	62.2
Upper Connellsville	14	1,843	0	706,171	451,975	691,323	1.53	64
Total	109	25,366	269	12,591,345	8,327,612	15,015,336	1.80	66.1

Coke production in Pennsylvania in 1891, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per ct.
Allegheny Mountain	16	1,201	0	708,523	448,067	$782,175	$1.75	63
Allegheny Valley	3	148	0	21,833	11,314	25,909	2.29	52
Beaver	3	88	0	4,224	2,332	6,663	2.86	55
Blossburg	2	407	0	46,084	24,351	66,195	2.72	53
Broad Top	5	448	0	146,008	90,728	197,048	2.17	62
Clearfield-Center	7	666	0	293,542	183,911	339,082	1.84	63
Connellsville	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67
Greensburg	2	58	0	38,188	22,441	36,627	1.63	50
Irwin	4	696	0	323,099	197,082	266,061	1.35	61
Pittsburg	13	590	11	154,054	94,160	201,458	2.14	61
Reynoldsville-Walston	7	1,747	0	769,100	470,479	744,098	1.58	61
Upper Connellsville	14	1,724	0	1,000,184	649,316	1,111,056	1.71	65
Total	109	25,324	11	10,588,544	6,954,846	12,679,826	1.82	66

It will be seen from the above table that out of a total production of coke in the United States in 1893 of 9,477,580 tons, Pennsylvania produced 6,229,051 tons, or 65.7 per cent. The Connellsville, Reynoldsville, Walston, and Upper Connellsville districts each produced more coke than any State except Pennsylvania, Alabama, and West Virginia, while there were but seven States in the Union that produced more coke than the Allegheny Mountain, Irwin, Broad Top, Clearfield-Center, or Pittsburg districts.

In the production of this 6,229,051 tons of coke 9,386,702 tons of coal, valued at $5,738,798, or 61 cents a ton, were used. The yield of coal in coke was 66 per cent.

Of the 9,386,702 tons of coal used, 8,302,307 tons were run-of-mine, unwashed, and 739,128 tons slack coal, unwashed, while 216,762 tons of run-of-mine and 128,505 tons of slack were used, washed. The average value of the coke produced in Pennsylvania was $1.52 a ton in 1893, as compared with $1.80 in 1892.

In the following table are given the statistics of the production of coke in Pennsylvania for the years 1880 to 1893:

Statistics of the manufacture of coke in Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	124	9,501	836	4,347,558	2,821,384	$5,255,040	$1.86	65
1881	132	10,881	761	5,393,503	3,437,708	5,898,579	1.70	64
1882	137	12,424	642	6,149,179	3,945,034	6,133,698	1.55	64
1883	140	13,610	211	6,823,275	4,438,464	5,410,387	1.22	65
1884	145	14,285	232	6,204,604	3,822,128	4,783,230	1.25	62
1885	133	14,553	317	6,178,500	3,991,805	4,981,656	1.25	64.6
1886	108	16,314	2,558	8,290,849	5,406,597	7,664,023	1.42	65.2
1887	151	18,294	802	8,938,438	5,832,849	10,746,352	1.84	65¼
1888	120	20,381	1,565	9,673,097	6,545,779	8,230,759	1.26	68
1889	109	22,143	567	11,581,292	7,659,055	10,743,492	1.40	66
1890	106	23,430	74	13,046,143	8,560,245	16,333,674	1.91	65.6
1891	109	25,324	11	10,588,544	6,954,846	12,679,826	1.82	66
1892	109	25,366	269	12,591,345	8,327,612	15,015,336	1.80	66.1
1893	102	25,744	19	9,386,702	6,229,051	9,468,036	1.52	66

Connellsville district.—The Connellsville district still remains the most important coke-producing center in the United States and one of the most important in the world. The Connellsville coal basin is in the southwestern part of Pennsylvania, some 50 or 60 miles from Pittsburg. According to a recent topographic survey, made by Mr. Kenneth Allen, civil engineer, for the H. C. Frick Coke Company, the basin has a length of 43.6 miles and an average width of 3.1 miles, or an area of 137 square miles. This entire territory is supposed to be underlaid with the Connellsville seam of coal, which is without a fault, the beds yielding from 8 to 10 feet of workable coal. On the basis of 137 square miles there would be 87,680 acres of coal. There is not this amount now, however, as considerable of it has been worked out. It is estimated that the amount of coal land still remaining is somewhere about 60,000 acres, which at the usual average of this coal per acre would leave about 450,000,000 tons of coal still available in the Connellsville vein. There are in this district several other veins of coal lying under the Connellsville seam that will be available to make a coke much above the average of cokes when the Connellsville vein is exhausted, and the trough in which the Connellsville region is found extends both to the north and south in which the same coal bed occurs, though the coal is not of the same high grade.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1893:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	$65\frac{1}{2}$
1881	70	8,208	654	4,018,782	2,639,002	4,301,573	1.63	$65\frac{2}{3}$
1882	72	9,283	592	4,628,736	3,043,394	4,473,789	1.47	$65\frac{3}{4}$
1883	74	10,176	101	5,355,380	3,552,402	4,049,738	1.14	$66\frac{1}{3}$
1884	76	10,543	200	4,829,054	3,192,105	3,607,078	1.13	$66\frac{1}{10}$
1885	68	10,471	48	4,683,831	3,096,012	3,776,388	1.22	$66\frac{1}{10}$
1886	36	11,324	1,895	6,305,460	4,180,521	5,701,086	1.36	$66\frac{3}{10}$
1887	73	11,923	98	6,182,846	4,146,989	7,437,669	1.79	67
1888	38	12,818	1,320	7,191,708	4,955,553	5,884,081	1.19	69
1889	29	14,458	430	8,832,371	5,930,428	7,974,633	1.34	67
1890	28	15,865	30	9,748,449	6,464,156	12,537,370	1.94	66
1891	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67
1892	31	17,309	0	9,389,549	6,329,452	11,598,407	1.83	67.4
1893	28	17,504	5	7,095,491	4,805,623	7,141,031	1.49	67.7

Prices of Connellsville coke.—During the past year the course of prices in the Connellsville coke trade has been astonishing. At the beginning of 1893 prices were considered low, but during the year they fell to an unprecedented figure. At the close of the year the quoted rates were the lowest ever known to the coke trade, and were as follows: Furnace coke, $1; foundry, $1.35; crushed, $1.65; all per ton of 2,000 pounds, free on board at the ovens.

In the following table is given the average monthly prices of Connellsville coke for each month of the year:

Average monthly prices of Connellsville coke in 1893.

Months.	Furnace.	Foundry.	Crushed.
January	$1.90	$2.30	$2.65
February	1.90	2.30	2.65
March	1.90	2.30	2.65
April	1.70	2.10	2.60
May	1.60	2.00	2.50
June	1.50	1.90	2.40
July	1.45	1.80	2.20
August	1.25	1.50	2.10
September	1.20	1.50	2.00
October	1.20	1.50	1.90
November	1.10	1.45	1.80
December	1.05	1.40	1.70

Some coke was sold lower than these prices. Indeed, it is asserted that just before the close of the year some blast-furnace coke was sold free on board at the ovens for 85 cents a ton, but if so it was in small quantities.

The following table gives the ruling prices of blast-furnace coke free on board at the ovens for the past thirteen years:

Monthly prices of Connellsville blast-furnace coke free on board at ovens.

Months.	1881.	1882.	1883.	1884.	1885.	1886.
January	\$1.50–\$1.75	\$1.70–\$1.80	\$1.15–\$1.20	\$1.00	\$1.10	\$1.20
February	1.50– 1.75	1.70– 1.80	1.20– 1.10	1.00	1.10	1.20
March	1.50– 1.75	1.70– 1.75	1.05	1.00	1.10	1.35
April	1.60– 1.75	1.70– 1.75	1.05	1.10	1.20	1.35
May	1.60– 1.65	1.65– 1.70	.95– 1.05	1.10	1.20	1.50
June	1.60– 1.65	1.50– 1.65	.90	1.10	1.20	1.50
July	1.50– 1.60	1.35– 1.50	.90	1.10	1.20	1.50
August	1.60	1.35	.90	1.10	1.20	1.50
September	1.60	1.25– 1.35	1.00	1.10	1.20	1.50
October	1.60– 1.65	1.25	1.00	1.10	1.20	1.50
November	1.60– 1.65	1.25– 1.35	1.00	1.10	1.20	1.50
December	1.60– 1.70	1.15– 1.35	1.00	1.10	1.20	1.50

Months.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
January	\$1.50	\$1.75	\$1.25	\$1.75	\$1.90	\$1.90	\$1.90
February	2.00	1.75	1.25	1.75	1.90	1.90	1.90
March	2.00	\$1.25– 1.50	1.25	2.15	1.90	1.90	1.90
April	2.00	1.00	1.15	2.15	1.90	1.90	1.70
May	2.00	1.00	1.10	2.15	1.90	1.80	1.60
June	2.00	1.00	1.10	2.15	1.90	1.80	1.50
July	2.00	1.00	\$1.00– 1.10	2.15	1.90	1.75	1.45
August	2.00	1.00	1.00	2.15	1.90	1.75	1.25
September	2.00	1.00	\$1.25– 1.50	2.15	1.85	1.75	1.20
October	2.00	1.00	1.50	2.15	1.85	1.75	1.20
November	2.00	1.25	1.75	2.15	1.80	1.75	1.10
December	2.00	1.25	1.75	2.15	1.80	1.75	1.05

The Upper Connellsville district.—This district, as stated in previous reports, includes that portion of the trough or basin in which the Connellsville coke is found that is located northerly from a point just below Latrobe. The coal differs somewhat from that found in the lower part of the basin, and, as stated previously, the district is known as the "washed-coal district." It is one of the most important coking districts in the amount of product in the country. Its product, among the districts of Pennsylvania, is surpassed only by the Connellsville.

The following are the statistics of the manufacture of coke in the Upper Connellsville region for the years 1880 to 1893:

Statistics of the manufacture of coke in the Upper Connellsville district, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	757	0	319,927	229,433	\$1.73	\$397,945	59
1881	10	986	0	588,924	343,728	1.60	548,362	58
1882	11	1,118	0	650,174	375,918	1.43	536,503	58
1883	11	1,118	0	668,882	389,053	1.08	422,174	58
1884	11	1,118	0	496,894	294,477	1.06	311,665	59
1885	11	1,168	40	555,735	319,297	1.08	346,168	57
1886	12	1,337	29	691,331	442,968	1.29	572,073	64.1
1887	16	1,442	87	717,274	470,233	1.79	840,144	65.6
1888	16	1,977	0	657,966	441,966	1.40	617,189	68
1889	13	1,568	80	635,220	417,263	1.46	609,828	65.6
1890	14	1,569	28	889,277	577,246	1.75	1,008,102	64.9
1891	14	1,724	0	1,000,184	649,316	1.71	1,111,056	65
1892	14	1,843	0	706,171	451,975	1.53	691,323	64
1893	14	1,843	0	499,809	320,793	1.39	447,090	64

Allegheny Mountain district.—This district was not as important a coke producer in 1893 as in 1892, its production fell from 448,522 tons in 1892 to 173,131 tons in 1893, its position among the districts being the sixth in 1893 and the third in 1892. This district includes not only the ovens along the Pennsylvania railroad from Gallitzin eastward in Cambria and Blair counties, but the ovens in Somerset county as well. Of the fifteen coke works in this district seven made no coke in 1893.

The statistics of the manufacture of coke in the Allegheny Mountain district from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	291	0	201,345	127,525	$2.27	$289,929	63
1881	9	371	0	225,563	144,430	2.28	329,198	64
1882	10	481	0	284,544	179,580	2.10	377,286	63
1883	10	532	0	200,343	135,342	1.78	240,641	68
1884	12	614	0	241,459	156,290	1.30	203,213	65
1885	11	523	82	327,666	212,242	1.30	286,539	65
1886	10	579	14	351,070	227,369	1.64	374,013	64.8
1887	10	694	150	461,922	297,724	2.25	671,437	64.4
1888	12	950	145	521,047	335,689	1.43	479,845	64.4
1889	16	1,069	20	564,112	354,288	1.69	601,964	63.5
1890	16	1,171	0	633,974	402,514	1.81	730,048	63.5
1891	16	1,201	0	708,523	448,067	1.75	782,175	63
1892	16	1,260	0	724,903	448,522	1.73	775,927	61.9
1893	15	1,260	0	275,865	173,131	1.53	264,292	62.8

Clearfield-Center district.—This district, formerly known as the Snow Shoe, is one of the important districts in Pennsylvania, though its production has declined during the last few years. About half the coal used in this district is run-of-mine, though many of the ovens were built originally to use slack, but the quality of the coke has proved so good that it has been found profitable to use a large proportion of run-of-mine.

The statistics of the manufacture of coke in the Clearfield-Center district for the years 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Clearfield-Center district, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	0	0	200	100	$2.00	$200	50
1881	2	50	0	20,025	13,350	1.70	22,695	67
1882	1	50	0	25,000	17,160	1.60	27,406	69
1883	1	60	0	26,500	18,696	1.50	28,844	71
1884	1	60	0	33,000	23,431	1.40	32,849	71
1885	2	245	0	69,720	48,103	1.46	70,331	69
1886	3	299	20	84,870	55,810	1.70	94,877	66
1887	6	523	10	154,566	97,852	2.02	198,095	63.3
1888	6	601	0	172,999	115,338	1.51	174,220	66.6
1889	6	671	0	195,473	120,734	1.78	215,112	61.7
1890	7	701	0	331,104	212,286	1.85	391,957	64
1891	7	666	0	293,542	183,911	1.84	339,082	63
1892	7	731	0	231,357	147,819	1.79	264,422	63.9
1893	8	695	0	155,119	98,650	1.74	171,482	63.6

The Broad Top district.—In this district are included all the ovens in what is known as the "Broad Top coal fields," the ovens being situated in Bedford and Huntingdon counties.

The statistics of the manufacture of coke in the Broad Top region, Pennsylvania, for the years of 1880 to 1893, are as follows:

Statistics of the manufacture of coke in the Broad Top region, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	188	105	92,894	51,130	$2.40	$123,748	55
1881	5	188	105	111,593	66,560	2.51	167,074	59
1882	5	293	50	170,637	105,111	2.05	215,079	62
1883	5	343	110	220,932	147,154	1.84	271,692	66
1884	5	453	0	227,954	151,959	1.74	264,569	66
1885	5	537	0	190,836	112,073	1.65	185,656	58
1886	5	562	100	171,137	108,294	1.73	187,321	63.3
1887	5	581	0	262,730	164,535	2.11	347,061	62.6
1888	5	591	0	196,015	119,469	2.40	286,655	61
1889	5	589	0	152,090	91,256	2.05	186,718	60
1890	5	482	16	247,823	157,208	2.00	314,416	63
1891	5	448	0	146,008	90,728	2.17	197,048	62
1892	5	448	8	185,600	117,554	1.84	216,090	63.3
1893	5	456	14	136,069	86,752	1.73	150,196	63.8

Pittsburg district.—Practically all the coal used in this district is slack, mostly from the several levels of the Monongahela river, which is brought to Pittsburg by barges. The Pittsburg seam of coal at Pittsburg does not make a good coke. It contains too much volatile matter and makes a spongy coke. The district includes the ovens at and near Pittsburg. The ovens in Washington county that use slack from the mines of that county are also included in the Pittsburg district. The statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, for the years 1880 to 1893, are as follows:

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	21	534	0	194,393	105,974	$2.40	$254,500	55
1881	21	538	0	178,509	96,310	2.15	206,965	54
1882	21	557	0	114,956	64,779	2.07	134,378	61
1883	20	542	0	119,310	66,820	1.89	126,020	56
1884	20	535	0	97,367	53,857	1.87	99,911	55
1885	17	416	4	91,101	46,930	1.55	72,509	51.5
1886	18	730	0	228,874	138,646	1.88	221,617	60.6
1887	20	880	235	366,184	177,097	1.78	315,546	48.4
1888	22	980	0	428,899	264,156	1.33	350,818	62
1889	17	600	21	233,571	141,324	2.00	283,402	60.5
1890	14	541	0	149,230	93,984	1.82	171,465	63
1891	13	590	11	154,054	94,160	2.14	201,458	61
1892	15	725	261	292,357	176,365	2.14	376,613	60.3
1893	10	885	0	357,400	216,268	2.03	438,801	60.5

Beaver district.—A small amount of coke is made in this district each year for use in local manufactories. The demand fluctuates greatly at times.

The following are the statistics of the manufacture of coke in the Beaver district, Pennsylvania, for the years 1880 to 1893:

Statistics of the manufacture of coke in the Beaver district, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	106	....	8,013	4,880	$10,150	$2.08	61
1881	5	106	....	6,887	4,333	9,013	2.08	63
1882	5	106	....	11,699	7,960	15,124	1.90	68
1883	5	107	....	19,510	12,395	21,062	1.70	64
1884	4	89	....	2,250	1,390	2,168	1.56	62
1885	4	89	....	686	438	696	1.59	63
1886	3	87	....	698	411	646	1.57	59
1887	3	65	....	25,207	13,818	24,137	1.75	55
1888	4	145	....	262	175	260	1.48	66.6
1889	3	90	....	3,100	1,853	3,848	2.07	60
1890	3	90	....	4,010	2,148	4,564	2.12	53.5
1891	3	88	....	4,224	2,332	6,663	2.86	55
1892	2	10	....	3,925	2,154	6,270	2.91	54.9
1893	2	10	....	2,998	1,644	4,446	2.70	54.8

Allegheny valley district.—This district includes the coke works of Armstrong and Butler counties, situated in the valley of the Allegheny river.

The statistics of the manufacture of coke in the Allegheny valley district for the years 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Allegheny valley district, Pennsylvania, 1880 to 1893, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	97	0	45,355	23,470	$49,068	$2.10	52
1881	5	109	0	55,676	29,650	64,664	2.18	53
1882	6	159	0	76,000	41,897	80,294	1.92	55
1883	6	159	0	64,810	34,868	62,982	1.81	54
1884	7	209	0	55,110	31,430	54,859	1.75	57
1885	5	208	0	28,630	15,326	30,151	1.97	53.5
1886	5	208	0	51,580	28,948	44,422	1.54	56
1887	5	288	88	77,666	44,621	84,913	1.90	57.1
1888	5	376	0	37,792	21,719	36,008	1.66	57.5
1889	4	198	0	13,105	6,569	10,538	1.62	50
1890	3	148	0	33,049	18,733	40,204	2.15	56.7
1891	3	148	0	21,833	11,314	25,909	2.29	52
1892	3	148	0	0	0	0	0	0
1893	2	116	0	10,927	6,557	11,147	1.70	60

Reynoldsville-Walston district.—This district continues to hold its position as one of the most important coke districts in the United States, though its production fell from 425,250 tons in 1892 to 339,314 tons in 1893. It was surpassed in Pennsylvania only by the Connellsville district and in the United States only by Pennsylvania, Alabama, West Virginia, and Colorado.

The district includes all of the ovens on the Rochester and Pittsburg Railroad as well as those on the low-grade division of the Allegheny Valley Railroad, and the mines on the New York, Lake Erie and Western Railroad.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1893:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	3	117	0	45,055	28,090	$46,359	$1.65	62
1881	4	125	2	99,489	44,260	80,785	1.85	44
1882	5	177	0	87,314	44,709	80,339	1.80	51
1883	6	229	0	76,580	37,044	65,584	1.77	48
1884	7	321	0	159,151	78,646	113,155	1.44	49
1885	8	600	143	183,806	114,409	153,795	1.35	62
1886	9	783	500	271,037	161,828	217,834	1.35	59.7
1887	11	1,492	134	507,320	316,107	592,728	1.88	62.3
1888	9	1,636	100	404,346	253,662	320,203	1.26	62.7
1889	8	1,747	0	514,461	313,011	436,857	1.40	60.8
1890	8	1,737	0	652,966	406,184	771,996	1.90	62
1891	7	1,747	0	769,100	470,479	744,098	1.58	61
1892	8	1,734	0	683,539	425,250	743,227	1.75	62.2
1893	8	1,755	0	562,033	339,314	586,212	1.73	60.4

Blossburg district.—In this district are included the two establishments making coke from the coal of the Blossburg coal field. All of the coal used is washed slack.

The following are the statistics of the manufacture of coke in the Blossburg, Pennsylvania, district from 1880 to 1893:

Statistics of the manufacture of coke in the Blossburg district, Pennsylvania, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	1	200	0	72,520	44,836	$134,500	$3.00	62
1881	1	200	0	88,055	56,085	168,250	3.00	64
1882	1	200	0	100,119	64,526	193,500	3.00	64
1883	2	344	0	71,028	44,690	122,450	2.74	63
1884	2	344	32	62,365	39,043	93,763	2.40	63
1885	2	296	0	46,489	26,975	59,423	2.17	58
1886	2	405	0	136,136	81,801	174,532	2.13	60
1887	2	406	0	182,623	103,873	234,622	2.26	56.9
1888	2	407	0	62,063	38,052	81,400	2.14	61
1889	2	407	0	31,806	18,422	47,765	2.59	58
1890	2	407	0	41,785	23,196	62,804	2.71	55.5
1891	2	407	0	46,084	24,351	66,195	2.72	53
1892	2	404	0	30,746	16,675	45,855	2.75	54.2
1893	2	407	0	22,176	11,463	31,427	2.74	50.7

The following are the statistics of the manufacture of coke in the Greensburg district from 1889 to 1893:

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1889	2	50	16	32,070	20,459	$21,523	$1.05	63.8
1890	2	58	0	44,000	30,261	44,290	1.46	68.7
1891	2	58	0	38,188	22,441	36,627	1.63	59
1892	2	58	0	15,005	9,037	13,173	1.46	60.2
1893	3	88	0	29,983	18,393	26,303	1.43	61

The following are the statistics of the manufacture of coke in the Irwin district for the years 1889 to 1893.

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1889	4	696	0	373,913	243,448	$1.44	$351,304	65
1890	4	661	0	270,476	172,329	1.49	256,458	63.7
1891	4	696	0	323,099	197,082	1.35	266,061	61
1892	4	696	0	328,193	202,809	1.40	284,029	61.8
1893	5	725	0	238,832	150,463	1.30	195,609	63

TENNESSEE.

The coal fields of Tennessee are a continuation of the great coal deposits of western Pennsylvania and West Virginia. The fields extend through the State from northeast to southwest and are coextensive with the Cumberland table lands. The most important, as well as the best known coke-producing seam of Tennessee, is that known as the Sewanee in the little Sequatchie coal field. This coal seam is in the Upper Measures and is supposed to correspond with bed B of the Geological Survey of Pennsylvania, and is to Tennessee what the Pittsburg seam is to Pennsylvania.

In Tennessee is also included the larger part of the production of coke in what is known as the Mingo Mountain or Middlesboro district, this district overlapping from Kentucky into the northeastern part of the State, the ovens being situated just over the border from Kentucky in Tennessee. Most of the coke is used in Tennessee.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1893:

Statistics of manufacture of coke in Tennessee, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	656	68	217,656	130,609	$316,607	$2.42	60
1881	6	724	84	241,644	143,853	342,585	2.38	60
1882	8	861	14	313,537	187,695	472,505	2.52	60
1883	11	992	10	330,961	203,691	459,126	2.25	62
1884	*a* 13	1,105	175	348,295	219,723	428,870	1.95	63
1885	12	1,387	36	412,538	218,842	398,459	1.82	53
1886	12	1,485	126	621,669	368,139	687,865	1.87	59
1887	11	1,560	165	655,857	396,979	870,900	2.19	61
1888	11	1,634	84	630,099	385,693	490,491	1.27	61
1889	12	1,639	40	626,016	359,710	731,496	2.03	57
1890	11	1,664	292	600,387	348,728	684,116	1.96	58
1891	11	1,995	0	623,177	364,318	701,803	1.93	58
1892	11	1,941	0	600,126	354,096	724,106	2.05	59
1893	11	1,942	0	449,511	265,777	491,523	1.85	59

a One establishment made coke in pits.

VIRGINIA.

But one of the two coke works in Virginia draws any portion of its supplies of coal from Virginia coal mines. The coke works at Pocahontas, in the Flat Top region, gets most of its coal from Virginia; the mines, however, are on the line between Virginia and West Virginia, and some of the coal used is mined in the latter State. The ovens at Lowmoor, in Alleghany county, which are on the Chesapeake & Ohio railroad, just east of the West Virginia line, draw their entire coal supplies from the New River coal fields of West Virginia. As the coke is made in Virginia, its production is credited to this State; but the several coal fields from which the coal is drawn will be described in connection with the report on West Virginia.

The following are the statistics of the manufacture of coke in Virginia from 1883 to 1893:

Statistics of the manufacture of coke in Virginia, 1883 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	200	0	39,000	25,340	$44,345	$1.75	65
1884	1	200	0	99,000	63,600	111,300	1.75	64.25
1885	1	200	0	81,899	40,139	85,993	1.75	60
1886	2	350	100	200,018	122,352	305,880	2.50	61.2
1887	2	350	300	235,841	166,947	417,368	2.50	70.8
1888	2	550	0	230,529	140,199	260,000	1.74	64.7
1889	2	550	250	238,793	146,528	325,861	2.22	61
1890	2	550	250	251,683	165,847	278,724	1.68	66
1891	2	550	250	285,113	167,516	265,107	1.58	58.8
1892	2	594	206	226,517	147,912	322,486	2.18	65.3
1893	2	594	206	194,059	125,092	282,898	2.26	64.5

WASHINGTON.

In addition to the coke that has heretofore been made in Washington from the coal of the Wilkerson field near Tacoma, some coke was made at Cokedale in Skagit county. An analysis of the coke from Cokedale, made by the Department of Mines and Mining at the World's Columbian Exposition, is as follows:

Analysis of coke from Cokedale, Washington.

	Per cent.
Moisture	0.3
Volatile matter	3.8
Fixed carbon	86.38
Sulphur	0.62
Phosphorus	0.3
Ash	8.6
Total	100

The following are the statistics of the manufacture of coke in Washington for the years 1884 to 1893, the only years in which coke has been made:

Statistics of the production of coke in Washington, 1884 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1884	1	0	0	700	400	$1,900	$4.75	57.5
1885	1	2	0	544	311	1,477	4.75	57
1886	1	11	21	1,400	825	4,125	5.00	58.9
1887	1	30	0	22,500	14,625	102,375	7.00	65
1888	3	30	100	0	0	0	0	0
1889	1	30	0	6,983	3,841	30,728	8.00	55
1890	2	30	80	9,120	5,837	46,696	8.00	64
1891	2	80	0	10,000	6,000	42,000	7.00	60
1892	3	84	30	12,372	7,177	50,446	7.03	58
1893	3	84	0	11,374	6,731	34,207	5.08	59

WEST VIRGINIA.

The division of West Virginia into districts is precisely the same as that followed in previous volumes of "Mineral Resources." These districts are known as the Kanawha, the New River, the Flat Top, the Northern, and the Upper Potomac. The first two are compact and continuous. They include the ovens along the line of the Chesapeake and Ohio railroad from Quinnimont to the Kanawha valley. The Flat Top region includes the ovens in the Pocahontas Flat Top district, which are located in West Virginia. The ovens in this district, which are located in Virginia, are reported under that State. This Flat Top district is in reality a part of the New River district. The fourth district, the Northern, which may also be called the Upper Monongahela district, is a scattered one, including the ovens in Preston, Taylor, Harrison, and Marion counties, and in previous volumes those in Wheeling, West Virginia. Most of the coke made in Wheeling in previous years has been used in glass manufacture. The advent of natural gas has entirely stopped the production of coke in Ohio county, in which Wheeling is situated. The fifth district, the Upper Potomac, includes the ovens along the line of the West Virginia Central and Pittsburg railway, in what may be called the Upper Potomac basin.

Pocahontas Flat Top district.—By reason of the completion of the Elkhorn extension of the Norfolk and Western railroad to the Ohio river the Pocahontas Flat Top district has acquired an additional importance. This district, known in its early history as the Pocahontas and later as the Flat Top, from the mountain, which is the most important and conspicuous feature of this region, is located in the counties of Tazewell, in southwestern Virginia, and Mercer and McDowell, in southeastern West Virginia.

This field can be divided roughly into (1) the Pocahontas district, including the workings at and near the town of Pocahontas, Virginia; (2) the Bluestone district, including the workings on the Bluestone, near Bramwell, in Mercer county, West Virginia, on the southeast slope of Flat Top mountain; (3) the Elkhorn district, including the workings in McDowell county, West Virginia, on the northeast slope of the Flat Top mountain, on the headwaters of the Elkhorn.

By reason of the extension of the Norfolk and Western railroad above referred to there was a considerable increase in the production of the Flat Top district in 1893, the total coke produced in that year being 451,503 tons, as compared with 353,696 tons in 1892. This is the one district in the United States that shows an important increase in production, and that notwithstanding the very great decrease in the demand from Virginia and southern furnaces due to the continued depression in iron. Large quantities of coke were shipped to Chicago and points on the Ohio river extension of the Norfolk and Western which more than made up the loss in demand from the markets previously occupied by this coke.

It will be noted that there has been a great increase in the number of ovens buildings, it rising from 2,848 at the close of 1892 to 4,349 at the close of 1893. Regarding this great increase in the number of ovens the board of managers of the Flat Top Coal Association say, in their seventh annual report, that "the number completed would have been far in excess of any previous year had not the railroad company, under date of August 1, refused to recognize in its car distribution more than a stipulated number of ovens until the growth of business would warrant their erection. Six hundred and eighty-three new ovens were completed (this is on the leases of the Flat Top Coal Land Association only), and the lessees are under agreement with the association and railroad company to erect several hundred more during the early part of the coming year. As the distribution of coal cars is based upon the number of coke ovens at each colliery, there has been a great incentive to build more ovens than were required by the coke trade, and the action of the railroad company last summer should prevent the useless waste of money by the operators in advance of the requirements of the business."

The report of the Flat Top Coal Land Association, to which we have referred, gives the following statement as to the results of mining from the beginning of operations in this district:

Total area of coal under lease December 31, 1893...acres..	26,016.2
Mined out during the year...do....	299.9
Yield in coal...tons..	2,311,592
Average yield per acre...do....	7,713
Total area mined out December 31, 1893...acres..	1,701.8
Total yield in coal...tons..	15,005,909
Average yield per acre...do....	8,818

Commenting on this table, the board of managers says: "There was a decided falling off in the yield per acre during 1893. This is due to two causes—the older collieries did a large amount of robbing, and the new collieries have a thinner seam, which does not contain as much coal per acre.

The statistics of the manufacture of coke in the Flat Top district for the years 1886 to 1893 are as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia from 1886 to 1893, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1886	2	10	38	1,075	658	$1,316	$2.00	61.2
1887	5	348	642	76,274	51,071	100,738	1.97	67
1888	13	882	200	164,818	103,947	183,938	1.77	63
1889	16	1,433	431	387,533	240,386	405,635	1.69	64
1890	17	1,584	252	566,118	325,576	571,239	1.75	57.5
1891	19	1,889	358	537,847	312,421	545,367	1.70	58
1892	30	2,848	933	595,734	353,696	596,911	1.69	59.3
1893	34	4,349	80	746,051	451,503	713,261	1.58	60.5

New River district.—The New River coking district includes the ovens along the line of the Chesapeake and Ohio railroad from Quinnimont to Nuttallburg. The coal is very much of the same character as that of the Flat Top region.

The statistics of the manufacture of coke in the New River district from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	468	40	159,032	98,427	$239,977	$2.44	62
1881	6	499	0	219,446	136,423	334,652	2.45	62
1882	6	518	0	233,361	148,373	352,415	2.38	64
1883	6	546	0	264,171	167,795	384,552	2.29	64
1884	8	547	12	219,839	135,335	274,988	2.03	62
1885	8	519	0	244,769	156,007	325,001	2.08	63⅔
1886	8	513	5	203,621	127,006	281,778	2.22	62
1887	11	518	50	253,373	159,836	401,164	2.51	63
1888	12	743	0	334,695	199,831	390,182	1.95	60
1889	12	773	0	268,185	157,186	351,132	2.23	58.6
1890	12	773	4	275,458	174,295	377,847	2.17	63
1891	13	787	102	309,073	193,711	426,630	2.20	63
1892	14	965	0	315,511	196,359	429,376	2.19	62
1893	13	947	10	281,600	178,049	355,965	2.00	63

Kanawha district.—In this district are included all the ovens from Ansted down the Kanawha river. It has been thoroughly described in previous volumes, particularly in "Mineral Resources of the United States, 1886."

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	18	0	6,789	4,300	$9,890	$2.30	63⅓
1881	4	18	0	11,516	6,900	16,905	2.45	60
1882	5	(a) 138	0	40,782	26,170	62,808	2.40	64
1883	5	(a) 147	0	58,735	37,970	88,090	2.32	64⅔
1884	6	(a) 177	15	60,281	39,000	76,070	1.95	64⅔
1885	7	(b) 181	63	65,348	37,551	63,082	1.68	57
1886	7	302	170	89,410	54,329	117,649	2.17	60.7
1887	7	548	0	153,784	96,721	201,418	2.08	63
1888	9	572	8	141,641	84,052	146,837	1.75	59
1889	6	474	0	109,466	63,678	117,340	1.84	58
1890	6	474	0	182,340	104,676	196,583	1.89	57
1891	6	474	0	241,427	134,715	276,420	2.05	56
1892	6	506	0	242,627	140,641	284,174	2.02	58
1893	6	506	0	215,108	122,241	237,308	1.94	56.8

a Eighty of these ovens are Coppée, the balance beehive.
b Sixty of these ovens are Coppée, the balance beehive.

Upper Monongahela district.—This is the district that has at times been named the Northern district, but in view of the fact that most of the coke is produced on the Upper Monongahela river, a better name would be the Upper Monongahela district, though it is frequently known as the Fairmont district. It includes the ovens on the Baltimore and Ohio railroad and its branches at or near Fairmont and Clarksburg, West Virginia.

The statistics of the production of coke in the Upper Monongahela district of West Virginia from 1880 to 1893 are as follows:

Statistics of the manufacture of coke in the Upper Monongahela district, West Virginia, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	145	0	64,937	36,028	$68,930	$1.91	55
1881	9	172	0	73,863	43,803	78,014	1.78	59
1882	11	222	0	92,510	55,855	105,214	1.88	60
1883	13	269	0	88,253	51,754	90,848	1.76	59
1884	13	281	100	78,468	49,139	74,894	1.52	63
1885	12	278	0	105,416	67,013	97,505	1.45	63.5
1886	12	275	104	131,896	82,165	113,100	1.38	62.3
1887	15	646	0	211,330	132,192	268,990	2.03	62.5
1888	17	567	110	213,377	138,097	175,840	1.27	64.7
1889	17	674	200	210,083	128,685	171,511	1.33	62.5
1890	18	1,051	50	276,367	167,459	260,574	1.56	60
1891	15	1,081	56	517,615	291,605	462,677	1.58	56
1892	19	1,129	45	441,266	265,363	390,296	1.47	60.1
1893	19	1,158	42	379,506	225,676	295,123	1.31	59

Upper Potomac district.—A large amount of coke is being produced in what has been termed the Upper Potomac district, which includes the ovens along the line of the West Virginia Central and Pittsburg railroad, running south from near Cumberland. This region is an extension southwardly of the well known Cumberland region, though in the Upper Potomac portion of the extension the Cumberland or Big vein is not found, the coal mined being Upper Freeport and Lower Kittanning coal, the former known locally as the Thomas and the latter as the Davis vein. The coke from the Davis vein, which is the lowest in sulphur of any coke made in the United States, is largely used for foundry purposes, and has acquired a most favorable reputation for its ability to melt a large amount of iron per pound of fuel. The district, from its nearness to tide water, being but 214 miles by rail from Baltimore, promises to be an important coke-producing center in the near future.

Statistics of the manufacture of coke in the Upper Potomac district of West Virginia, 1887 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1887	1	20	50	3,565	2,211	$4,422	$2.00	62
1888	1	28	0	9,176	5,835	8,752	1.50	64
1889	2	84	0	26,105	17,945	28,559	1.58	69
1890	2	178	28	94,983	61,971	118,503	1.91	65
1891	2	390	39	111,014	76,599	133,549	1.75	69
1892	3	395	0	114,045	78,691	121,208	1.54	69
1893	3	394	0	123,492	84,607	115,250	1.36	68.5

Production of West Virginia by districts.—In the following table will be found consolidated the statistics of the production of coke in West Virginia in the three years especially covered by this report, viz., 1891, 1892, and 1893, by districts:

Production of coke in West Virginia in 1891, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
Kanawha	6	474	0	241,427	134,715	$276,420	$2.05	56
New River	13	787	102	309,073	193,711	426,630	2.20	63
Flat Top	19	1,889	358	537,847	312,421	545,367	1.70	58
Northern	15	1,081	56	517,615	291,605	462,677	1.58	56
Upper Potomac	2	390	39	111,014	76,599	133,949	1.75	69
Total	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	58.7

Production of coke in West Virginia in 1892, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
Kanawha	6	506	0	242,627	140,641	$284,174	$2.02	58
New River	14	965	0	315,511	196,359	429,376	2.19	62
Flat Top	30	2,848	933	595,734	353,696	596,911	1.69	59.3
Northern	19	1,129	45	441,266	265,363	390,296	1.47	60.1
Upper Potomac	3	395	0	114,045	78,691	121,208	1.54	69
Total	72	5,843	978	1,709,183	1,034,750	1,821,965	1.76	60.5

Production of coke in West Virginia in 1893, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Kanawha	6	506	0	215,108	122,241	$237,308	$1.94	56.8
New River	13	947	10	281,600	178,049	355,965	2.00	63
Flat Top	34	4,349	80	746,051	451,503	713,261	1.58	60.5
Northern	19	1,158	42	379,506	225,676	295,123	1.31	59
Upper Potomac	3	394	0	123,492	84,607	115,250	1.36	68.5
Total	75	7,354	132	1,745,757	1,062,076	1,716,907	1.62	60.8

Statistics of the manufacture of coke in West Virginia, 1880 to 1893.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	18	631	40	230,758	138,755	$318,797	$2.30	60
1881	19	689	0	304,823	187,126	429,571	2.30	61
1882	22	878	0	366,653	230,398	520,437	2.26	63
1883	24	962	9	411,159	257,519	563,490	2.19	63
1884	27	1,005	127	385,588	223,472	425,952	1.91	62
1885	27	978	63	415,533	260,571	485,588	1.86	63
1886	29	1,100	317	425,002	264,158	513,843	1.94	62
1887	39	2,080	742	698,327	442,031	976,732	2.21	63.3
1888	51	2,764	318	854,531	525,927	896,797	1.71	61.5
1889	53	3,438	631	1,001,372	607,880	1,074,177	1.76	60
1890	55	4,060	334	1,395,266	833,377	1,524,746	1.83	60
1891	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	58.8
1892	72	5,843	978	1,709,183	1,034,750	1,821,965	1.76	60.5
1893	75	7,354	132	1,745,757	1,062,076	1,716,907	1.62	60.8

WISCONSIN.

All the coke made in Wisconsin is from Connellsville (Pennsylvania) coal, and the coke is standard Connellsville. Its production, therefore, is not of so much interest as the production of coke for developing certain regions. It is an interesting product, however, as showing that coal can be carried to a distance and successfully made into coke.

Statistics of the manufacture of coke in Wisconsin.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1888	1	50	....	1,000	500	$1,500	$3.00	50
1889	1	50	....	25,616	16,016	92,092	5.75	62.5
1890	1	70	....	38,425	24,976	143,612	5.75	65
1891	1	120	....	52,904	34,387	192,804	5.61	65
1892	1	120	....	54,300	33,800	185,900	5.50	62.2
1893	1	120	....	24,085	14,958	95,851	6.41	62

WYOMING.

The single coke-making establishment in Wyoming, that of the Cambria Iron Company, located at Cambria, Weston county, made coke in 1893, though none was made in 1892. Regarding the coal and coke made from it we are informed "that the coal occurs probably in the lowest portion of the Dakota measures of the Colorado Cretaceous, and almost upon the topmost rocks of the Jurassic."

The statistics of the production of coke in Wyoming for the years 1891, 1892, and 1893 are as follows:

Statistics of the production of coke in Wyoming for 1891, 1892, and 1893.

	1891.	1892.	1893.
Number of establishments	1	1	1
Number of ovens built	24	24	24
Number of ovens building	0	0	0
Amount of coal used.......short tons..	4, 470	0	5, 400
Coke produced............short tons..	2, 682	0	2, 916
Total value of coke at ovens	$8, 046	0	$10, 206
Value of coke per ton	$3. 00	0	$3. 50
Yield of coal in coke........per cent..	60	0	. 54

NEW YORK.

During the past year, 12 by-product ovens on the Semet-Solvay principle have been built at Syracuse, N. Y., and operated on Pennsylvania coal. These ovens are horizontal flue ovens, having movable flues, and are adapted for the saving of by-products. The operation of these ovens has been very successful. Coals that have not been regarded as very high-grade coking coals have been used with the most gratifying results. The yield of coal in coke, as is shown in the following table, was 84.8 per cent. This includes not only what might be termed commercial coke, that is, large coke, but the "breeze" as well. In the report for next year we will deal with this subject much more comprehensively than is possible in the present report.

The statistics of the production of coke in New York in 1893 are as follows:

Statistics of the production of coke in New York in the year 1893.

Number of establishments	1
Number of ovens built	12
Number of ovens building	0
Amount of coal used.......short tons..	15, 150
Total value of coal	$39,550
Amount of coke produced.......short tons..	12, 850
Total value of coke	$35, 925
Value of coal per ton	$2, 61
Value of coke per ton	$2. 80
Yield of coal in coke.......per cent..	84. 8

PETROLEUM.(a)

BY JOSEPH D. WEEKS.

[The barrel used in this report, unless otherwise specified, is of 42 Winchester gallons.]

IMPORTANT FEATURES OF THE YEAR.

The most notable features in connection with the production of petroleum in 1893 are: (1) The great decline in production of the older fields and the increase of the newer fields. (2) The decline in stocks held at the wells. (3) The increase in price as compared with 1892. (4) The increase in exports, and (5) The success attained in the refining of limestone oils.

Briefly summarized, the facts regarding these five features of the market of 1893 are as follows:

Decrease in old fields and increase in new.—As compared with 1892 the production of New York declined from 1,273,343 barrels in 1892 to 1,031,391 barrels in 1893. The production of Pennsylvania declined from 27,149,034 barrels in 1892 to 19,283,122 barrels in 1893, while the Lima, Ohio, production fell off from 15,169,507 barrels in 1892 to 13,646,804 barrels in 1893. On the other hand, the production of West Virginia increased from 3,810,086 barrels in 1892 to 8,445,412 barrels in 1893. The production in eastern Ohio increased from 1,190,302 barrels in 1892 to 2,601,394 barrels in 1893. Indiana increased from 698,068 barrels in 1892 to 2,335,293 barrels in 1893.

The total production for 1893 shows a decline as compared with 1892, the production of the latter year being 50,509,136 barrels, and of 1893 48,412,666 barrels. The year 1891 marked the highest output of petroleum, the production for that year being 54,291,980 barrels. This was the year of the remarkable production in the McDonald field, in Pennsylvania.

Decrease in stocks.—The stocks of crude petroleum in the Appalachian oil fields at the beginning of 1893 were 17,615,244 barrels as compared with 16,002,857 barrels at the beginning of 1892. At the close of 1893 the stocks had fallen to 11,900,711 barrels, a decline of 5,714,533 barrels, though production in the Appalachian region had fallen off but 2,076,022 barrels.

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a For much of the statistical information used in this report the writer is indebted to the previous publications of "Mineral Resources of the United States," to the reports of the Eleventh Census, the "Oil City Derrick," the "American Manufacturer and Iron World," and Stowell's "Petroleum Reporter," of Pittsburg. Other special acknowledgments will be given in the body of the report.

Increase in price.—The average value of certificate oil in the Appalachian fields in 1893 was 64 cents a barrel, as compared with $55\frac{5}{8}$ cents in 1892, an increase of $8\frac{3}{8}$ cents. In the Lima field the average price of oil advanced from $36\frac{5}{8}$ cents in 1892 to $47\frac{1}{4}$ cents in 1893—an increase of $10\frac{5}{8}$ cents.

Increase of exports.—The total exports of petroleum in the calendar year 1893, including in this crude, refined, and residuum, was 804,221,230 gallons, the largest exports recorded—an increase of nearly 60,000,000 gallons as compared with 1892. All forms of oil—crude, naphthas, benzine, illuminating, and residuum—except lubricating shared in this increased exportation.

Success attending the refining of limestone oils.—During the year 1893 most of the illuminating oil used in the United States was produced from the limestone oils of Lima and Indiana. Success had been attained in previous years in the use of these oils, but 1893 seems to have marked the era of complete success in refining these oils. It should be said, however, that all of the limestone oils do not give equally good results in refining.

LOCALITIES.

The important petroleum-producing localities of the United States remain as they were at the beginning of 1893. While petroleum has been found in nearly every State and Territory, the localities in which it has been produced in paying quantities are few. These are the well-known oil regions of Western Pennsylvania and New York; the Turkey Foot, Mount Morris, Mannington, Eureka, Macksburg, and Sistersville districts, some of which lie exclusively in West Virginia, others in Eastern Ohio, and others still in both States. These and adjacent districts the writer has designated as the Appalachian oil field. In addition to this Appalachian field the most important oil-producing district is the limestone oil field of Lima, Ohio, and the newly discovered districts in Indiana, which are a continuation of the Lima fields, the different sections, however, producing oils varying greatly in quality. In addition to these two fields, the Florence oil district of Colorado and the oil fields of Southern California are the only other important ones. Practically all the petroleum produced in the United States is from these four districts—the Appalachian, the limestone or Ohio-Indiana, the Florence of Colorado, and the Southern California fields. Outside of the districts named the total production of petroleum in the United States in 1893 was but a little over 7,000 barrels.

While it would be rash to say that the limits of the oil fields of the United States are well defined, the writer is of the opinion that the oil-producing localities of the future will be those at present recognized, or their extensions. Of course in this statement are included territories which have been only partially developed, such as the Wyoming districts and those named in our tables of production. There are possibilities that the oil-producing regions of West Virginia may be extended still farther southwardly, and the indications are that Wyoming may be a large producer in the future. Indiana may increase its product. At present the Kentucky and other southern oil fields, which it was thought at one time would be factors in oil production, give no such indications. From the Kansas and Texas fields we are only justified at present in predicting that a few thousand barrels of heavy-gravity lubricating oil may be produced each year. However, there have been so many surprises in petroleum that these statements must be regarded as only setting forth the indications as to producing localities at the present time.

TOTAL PRODUCTION AND VALUE OF CRUDE PETROLEUM IN THE UNITED STATES IN 1892 AND 1893.

In the following table is given a statement of the total amount and the total value of all crude petroleum produced in the United States in 1892 and 1893 by States and important districts:

Total amount and value of crude petroleum produced in the United States in 1892 and 1893.

States and districts.	1892.		1893.	
	Barrels.	Value.	Barrels.	Value.
New York	1, 273, 343	$708, 297	1, 031, 391	$660, 090
Pennsylvania:				
Pennsylvania	27, 061, 575	15, 053, 001	19, 196, 051	12, 285, 473
Franklin	58, 459	233, 836	66, 278	265, 112
Smiths Ferry	29, 000	16, 131	20, 793	13, 308
	27, 149, 034	15, 302, 968	19, 283, 122	12, 563, 893
West Virginia:				
West Virginia	3, 807, 086	2, 117, 692	8, 427, 448	5, 393, 567
Volcano			12, 000	27, 000
Burning Springs	3, 000	2, 209	5, 964	4, 955
	3, 810, 086	2, 119, 901	8, 445, 412	5, 425, 522
Ohio:				
Macksburg	197, 556	109, 891	2, 601, 394	1, 664, 892
Eastern	992, 746	552, 215		
Lima	15, 169, 507	5, 555, 832	13, 646, 804	6, 448, 115
Mecca-Belden	3, 112	21, 101	1, 571	11, 335
	16, 362, 921	6, 239, 039	16, 249, 769	8, 124, 342
Indiana	698, 068	260, 620	2, 335, 293	1, 050, 882
Kentucky	6, 500	16, 400	3, 000	1, 500
Missouri	10	40	50	154
Colorado	824, 000	692, 160	594, 390	497, 581
California	385, 049	561, 333	470, 179	608, 092
Texas	45	225	50	210
Indian Territory	80	480	10	60
Total	50, 509, 136	25, 901, 463	48, 412, 666	28, 932, 326

From the above table it will be seen that the total production of petroleum in the United States in 1893 was 48,412,666 barrels, as compared with a production of 50,509,136 barrels in 1892—a decrease of 2,096,470 barrels. The production in New York decreased from 1,273,343 barrels in 1892 to 1,031,391 in 1893. In Pennsylvania the

Franklin district shows a slight increase, while the production in Smith's Ferry declined. The production of certificate oil in Pennsylvania declined greatly, from 27,061,575 barrels in 1892 to 19,196,051 in 1893. The great surprise in production is the report from West Virginia. The production of certificate oil—that is, the common grade of oil, which is sold for the production of illuminating oil—increased from 3,807,086 barrels in 1892 to 8,427,448 barrels in 1893. The production of Macksburg and Eastern Ohio, which in 1892 was 1,190,302 barrels, increased to 2,601,394 barrels in 1893. On the other hand, Lima production shows a decrease from 15,169,507 barrels in 1892 to 13,646,804 barrels in 1893. Production in Indiana advanced from 698,068 barrels in 1892 to 2,335,293 barrels in 1893. Colorado shows a decline from 824,000 barrels in 1892 to 594,390 barrels in 1893, while California shows an increase from 385,049 barrels in 1892 to 470,179 barrels in 1893.

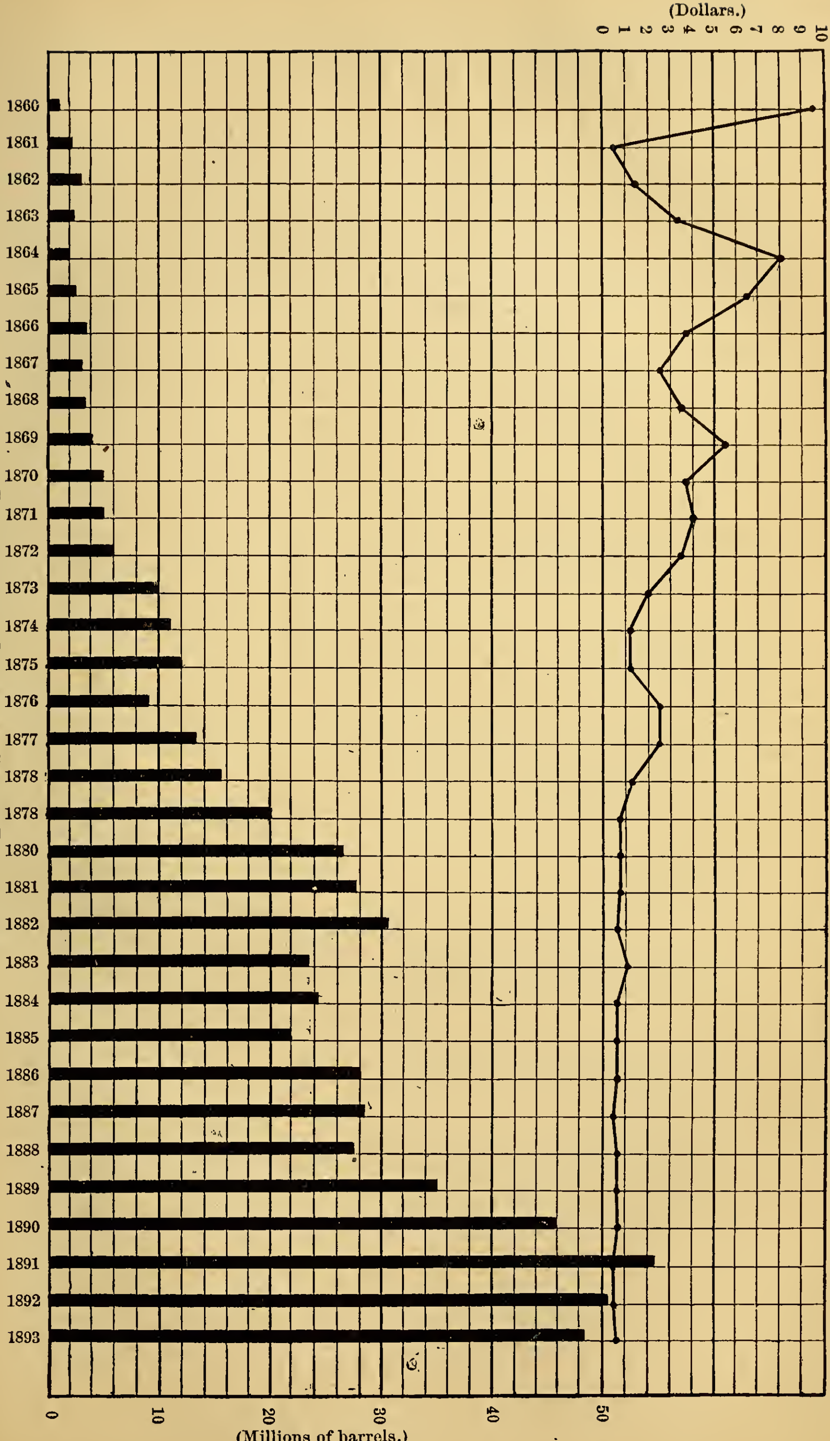
The oils produced in the Franklin (Pennsylvania), Burning Springs, and Volcano districts (West Virginia), Mecca-Belden district (Ohio), and in Missouri, Texas, and Indian Territory, are chiefly lubricating oils, being used either as lubricators in their natural state or for the production of a high grade of lubricating oils. All of the other oils are what are known as illuminating or fuel oils. The Indiana and Lima oils have in the past been regarded chiefly as fuel oils, and while they are still used to a large extent for fuel purposes, the illuminating oil produced from them, especially from the most eastward pool in Ohio, is of a very high character, the recent methods adopted for refining it being such as to remove thoroughly its offensive odor and to make from it all illuminating oils better in character than that produced from the Appalachian crude.

Value of petroleum produced.—The total value of the 48,412,666 barrels of crude petroleum produced in the United States in 1893 was $28,932,326, or more than $3,000,000 greater than the value of the total product of 1892, though the production of 1892 was over 2,000,000 barrels greater. The average value of certificate oil, or most of that produced in the Appalachian field—that is, in New York, Pennsylvania, West Virginia, and the Eastern district of Ohio—was 64 cents a barrel. The average value of Lima oil was 47¼ cents a barrel, and of that of Indiana 45 cents a barrel.

The average value of the Franklin lubricating was $4 a barrel; of the Volcano, West Virginia, $2.25 a barrel; of Burning Springs, 83 cents a barrel; of Colorado, 83¾ cents a barrel, and of California $1.29 a barrel.

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES, 1859 TO 1893.

In the following table will be found a statement of the production of crude petroleum in the United States from 1859 to 1893 by States:



PRODUCT AND PRICE OF CRUDE PETROLEUM.

Product of crude petroleum in the United States from 1859 to 1893.

[Barrels.]

Year.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.	Indian Territory.	Total United States.
1859	2,000												2,000
1860	500,000												500,000
1861	2,113,609												2,113,609
1862	3,056,690												a3,056,690
1863	2,611,309												2,611,309
1864	2,116,109												2,116,109
1865	2,497,700												2,497,700
1866	3,597,700												3,597,700
1867	3,347,300												3,347,300
1868	3,646,117												3,646,117
1869	4,215,000												4,215,000
1870	5,260,745												5,260,745
1871	5,205,234												5,205,234
1872	6,293,194												6,293,194
1873	9,893,786												9,893,786
1874	10,926,945												10,926,945
1875	8,787,514	b200,000	b3,000,000		b175,000								b12,162,514
1876	8,968,906	31,763	120,000		12,000								9,132,669
1877	13,135,475	29,888	172,000		13,000								13,350,363
1878	15,163,462	38,179	180,000		15,227								15,396,868
1879	19,685,176	29,112	180,000		19,858								19,914,146
1880	26,027,631	38,940	179,000		40,552								26,286,123
1881	27,376,509	33,867	151,000		99,862								27,661,238
1882	30,053,500	39,761	128,000		128,636		c160,933						30,510,830
1883	23,128,389	47,632	126,000		142,857		4,755						23,449,633
1884	23,772,209	90,081	90,000		262,000		4,148						24,218,438
1885	20,776,041	650,000	91,000		325,000		5,164						21,847,205
1886	25,798,000	1,782,970	102,000		377,145		4,726						28,064,841
1887	22,356,193	5,018,015	145,000	76,295	678,572		4,791						28,278,866
1888	16,488,668	10,010,868	119,448	297,612	690,333		5,096						27,612,025
1889	21,487,435	12,471,466	544,113	316,476	303,220	33,375	5,400	1,460	500	48	20		35,163,513
1890	28,458,208	16,124,656	492,578	368,842	307,360	63,496	6,000		1,200	54	278		45,822,672
1891	33,009,236	17,740,301	2,406,218	665,482	323,600	136,634	9,000		1,400	54	25	30	54,291,980
1892	28,422,377	16,362,921	3,810,086	824,000	385,049	698,068	6,500			45	10	80	50,509,136
1893	20,314,513	16,249,769	8,445,412	594,390	470,179	2,335,293	3,000			50	50	10	48,412,666
Total	478,492,880	96,990,189	20,481,855	3,143,097	4,769,450	3,266,866	219,513	1,460	3,100	251	383	120	607,369,164

a In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee.

b Including all production prior to 1876 in Ohio, West Virginia, and California.

c This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

From the above table it appears that the enormous total of 607,369,164 barrels of crude petroleum—nearly 100,000,000 tons—have been produced in the United States since the beginning of operations at Titusville, Pennsylvania, in 1859. By far the largest portion of this has been produced in what is known as the Pennsylvania and New York oil fields. These have produced 478,492,880 barrels, or nearly 80 per cent. of the total. Ohio has produced 96,990,189 barrels, or nearly 16 per cent.; West Virginia, 20,481,855 barrels, or a little over 3 per cent.; California gives 4,769,450 barrels, or about eight-tenths of 1 per cent., while the production of Indiana and Colorado are very nearly the same, Indiana's total production, two-thirds of which was in 1893, being 3,266,866 barrels and Colorado's production being 3,143,097 barrels. Kentucky and Tennessee have, together, produced but 219,513 barrels.

For convenience of reference a statement is given below of the production of petroleum in the United States from 1889 to 1893, by States.

Production of petroleum in the United States from 1889 to 1893.

[Barrels of 42 gallons.]

States.	1889.	1890.	1891.	1892.	1893.
Pennsylvania and New York	21, 487, 435	28, 458, 208	33, 009, 236	28, 422, 377	20, 314, 513
Ohio	12, 471, 466	16, 124, 656	17, 740, 301	16, 362, 921	16, 249, 769
West Virginia	544, 113	492, 578	2, 406, 218	3, 810, 086	8, 445, 412
Colorado	316, 476	368, 842	665, 482	824, 000	594, 390
California	303, 220	307, 360	323, 600	385, 049	470, 179
Indiana	33, 375	63, 496	136, 634	698, 068	2, 335, 293
Kentucky	5, 400	6, 000	9, 000	6, 500	3, 000
Illinois	1, 460	....	....	....	....
Kansas	500	1, 200	1, 400	....	....
Texas	48	64	54	45	50
Missouri	20	278	25	10	50
Indian Territory	....	....	30	80	10
Total	35, 163, 513	45, 822, 672	54, 291, 980	50, 509, 136	48, 412, 666

EXPORTS.

In the following table the exports are given of crude petroleum and its products from the United States from 1871 to 1893, together with a statement of the production of the United States in the years named. The figures of exports are from the Statistical Abstract of the United States, published by the Bureau of Statistics, Treasury Department. The figures of production are collected by the writer.

Quantity of crude petroleum produced in, and the quantities and values of petroleum products exported from, the United States during each of the calendar years from 1871 to 1893, inclusive.

Year ending Dec. 31—	Production.		Exports.											
					Mineral, refined or manufactured.									
	Barrels (of 42 gallons).	Gallons.	Mineral, crude (including all natural oils without regard to gravity).		Naphthas, benzine, gasoline, etc.		Illuminating.		Lubricating (heavy paraffine, etc.).		Residuum (tar, pitch, and all other from which the light bodies have been distilled).		Total.	
			Gallons.	*Dollars.*	*Gallons.*	*Dollars.*	*Gallons.*	*Dollars.*	*Gallons.*	*Dollars.*	*Gallons.*	*Dollars.*	*Gallons.*	*Dollars.*
1871....	5, 205, 234	218, 619, 828	11, 278, 589	2, 171, 706	8, 396, 905	895, 910	132, 178, 843	33, 493, 351	240, 228	92, 408	101, 052	10, 450	152, 195, 617	36, 663, 825
1872....	6, 293, 194	264, 314, 148	16, 363, 975	2, 761, 094	8, 688, 257	1, 307, 058	118, 259, 832	29, 456, 453	438, 425	180, 462	568, 218	56, 618	144, 318, 707	33, 761, 685
1873....	9, 893, 786	415, 539, 012	19, 643, 740	2, 665, 171	10, 250, 497	1, 266, 962	207, 595, 988	41, 357, 686	1, 502, 503	517, 466	1, 377, 180	117, 595	240, 369, 908	45, 924, 880
1874....	10, 926, 945	458, 931, 690	14, 430, 851	1, 428, 494	10, 616, 644	997, 355	206, 562, 977	30, 168, 747	993, 068	269, 886	2, 504, 628	177, 794	235, 108, 168	33, 042, 276
1875....	12, 162, 514	b510, 825, 588	16, 536, 800	1, 738, 589	14, 048, 726	1, 392, 192	203, 678, 748	28, 168, 572	938, 052	265, 837	2, 323, 986	169, 671	237, 526, 312	31, 734, 861
1876....	9, 132, 669	383, 572, 098	25, 343, 271	3, 343, 763	13, 252, 751	1, 502, 498	220, 831, 608	44, 089, 066	1, 157, 929	370, 431	2, 863, 896	239, 461	263, 449, 455	49, 545, 219
1877....	13, 350, 363	560, 715, 246	28, 773, 233	3, 267, 309	19, 565, 909	1, 938, 672	307, 373, 842	51, 366, 205	1, 914, 129	577, 610	4, 256, 112	390, 077	361, 883, 225	57, 539, 873
1878....	15, 396, 868	646, 668, 456	24, 049, 604	2, 169, 790	13, 431, 782	1, 077, 402	306, 212, 506	36, 855, 798	2, 525, 545	698, 182	3, 126, 816	220, 835	349, 346, 253	41, 022, 007
1879....	19, 914, 146	836, 394, 132	28, 601, 650	2, 069, 458	19, 524, 582	1, 367, 996	365, 597, 467	32, 811, 755	3, 168, 561	713, 208	4, 827, 522	273, 050	421, 719, 782	37, 235, 467
1880....	26, 286, 123	1, 104, 017, 166	36, 748, 116	2, 772, 400	15, 115, 131	1, 344, 529	286, 131, 557	29, 047, 908	5, 607, 009	1, 141, 825	3, 177, 630	198, 983	346, 779, 443	34, 505, 645
1881....	27, 661, 238	1, 161, 771, 996	40, 430, 108	3, 089, 297	20, 655, 116	1, 981, 197	444, 666, 615	42, 122, 683	5, 053, 862	1, 165, 605	3, 756, 018	197, 321	514, 561, 719	48, 556, 103
1882....	30, 510, 830	1, 281, 454, 860	45, 011, 154	3, 373, 302	16, 969, 839	1, 304, 041	428, 424, 581	37, 635, 981	8, 821, 536	2, 034, 487	4, 265, 352	275, 263	503, 492, 462	44, 623, 074
1883....	23, 449, 633	984, 884, 586	59, 018, 537	4, 439, 097	17, 365, 314	1, 195, 035	440, 150, 660	39, 470, 352	10, 108, 394	2, 193, 245	6, 502, 524	465, 350	533, 145, 429	47, 763, 079
1884....	24, 218, 438	1, 017, 174, 396	79, 679, 395	6, 102, 810	13, 676, 421	1, 132, 528	433, 851, 275	39, 450, 794	11, 985, 219	2, 443, 385	5, 303, 298	327, 599	544, 495, 608	49, 457, 116
1885....	21, 847, 205	917, 582, 610	81, 435, 609	6, 040, 685	14, 739, 469	1, 160, 999	445, 880, 518	39, 476, 082	12, 978, 955	2, 659, 210	5, 713, 908	334, 767	560, 784, 459	49, 671, 743
1886....	28, 064, 841	1, 178, 723, 322	76, 346, 480	5, 068, 409	14, 474, 951	1, 264, 736	485, 120, 680	39, 012, 922	13, 948, 367	2, 689, 464	1, 993, 824	109, 673	591, 884, 302	48, 145, 204
1887....	28, 278, 866	1, 187, 712, 372	80, 650, 286	5, 141, 833	12, 382, 213	1, 049, 043	485, 242, 107	37, 007, 336	20, 582, 613	3, 559, 280	2, 989, 098	141, 350	601, 846, 317	46, 898, 842
1888....	27, 612, 025	1, 159, 705, 050	77, 549, 452	5, 454, 705	13, 481, 706	1, 083, 429	455, 045, 784	37, 236, 111	24, 510, 437	4, 215, 449	1, 870, 596	116, 009	572, 457, 975	48, 105, 703
1889....	35, 163, 513	1, 476, 867, 546	85, 189, 658	6, 134, 002	13, 984, 407	1, 208, 116	551, 769, 666	41, 215, 192	27, 903, 267	4, 638, 724	1, 858, 458	97, 265	680, 705, 456	53, 293, 299
1890....	45, 822, 672	1, 924, 552, 224	96, 572, 625	6, 535, 499	12, 462, 636	1, 050, 613	550, 873, 438	39, 826, 086	32, 090, 537	4, 766, 850	1, 830, 612	91, 905	693, 829, 848	52, 270, 953
1891....	54, 291, 980	2, 280, 263, 160	96, 722, 807	5, 365, 579	11, 424, 993	868, 137	531, 445, 099	34, 879, 759	33, 310, 264	4, 999, 978	1, 002, 414	61, 382	673, 905, 577	46, 174, 835
1892....	50, 509, 136	2, 121, 383, 712	104, 397, 107	4, 696, 191	16, 393, 284	1, 037, 558	589, 418, 185	31, 826, 545	34, 026, 855	5, 130, 643	403, 032	38, 220	744, 638, 463	42, 729, 157
1893....	48, 412, 666	2, 033, 331, 972	111, 703, 508	4, 567, 391	17, 304, 005	1, 074, 710	642, 239, 816	31, 719, 404	32, 432, 857	4, 738, 892	541, 044	41, 661	804, 221, 230	42, 142, 058

PRODUCTION OF PETROLEUM BY FIELDS.

As is stated elsewhere the chief petroleum-producing fields of the United States are four, namely, the Appalachian, which includes all the oil-producing territory in New York, Pennsylvania, West Virginia, and the eastern part of Ohio; (2) the Limestone, or possibly better, the Lima–Indiana field, which includes the petroleum-producing districts beginning near Lima, Ohio, and extending in a southwesterly direction into Indiana, and from which comes all of the oil produced in Northeastern Ohio and in Indiana; (3) the Florence of Colorado, situated in and near the town of this name, which includes practically all the oil-producing territory in Colorado as at present developed; and (4) the Southern California, which includes the oil-producing territory in Santa Barbara, Ventura, Los Angeles, and Kern counties. These several fields will be described more in detail in connection with the statements of production. The other fields of the United States are of but little importance.

In the following table will be found a statement of the production of petroleum in the United States in 1893, by fields:

Production of petroleum in the United States in 1893, by fields.

[Barrels of 42 gallons.]

Fields.	Production.
	Barrels.
Appalachian	31,362,890
Lima-Indiana	15,982,097
Florence, Colorado	594,390
Southern California	466,179
Other	7,110
Total	48,412,666

THE APPALACHIAN OIL FIELD.

Broadly speaking, the Appalachian oil field should include all of the oil-producing territory within the limits of the well known and well-defined Appalachian region of the eastern part of the United States. In the production of this field, therefore, should be included all of the petroleum output of New York, Pennsylvania, West Virginia, eastern Ohio, eastern Kentucky, eastern Tennessee, Alabama, and Georgia. Commercially, however, at the present time the production of oil in this region is confined to the first four localities named.

For many years these four localities, with the exception of New York and Pennsylvania, were distinctly marked and widely separated, and it was possible to make reports that would show clearly all of the important facts regarding petroleum production in each one of these regions. Within the last five years, however, the opening of new oil pools has made a portion of the field practically one continuous oil belt stretching from Cattaraugus county, New York, to south of Macksburg, Ohio. These oil pools pay no attention to State lines. The Bradford is partly in New York and partly in Pennsylvania. Sistersville and

Eureka are in both West Virginia and Ohio. The pipe lines in receiving oil do not discriminate between the products of the States. Though the accounts kept with the producers by the pipe-line companies make it possible in most cases to ascertain very nearly the production of each State, the conditions are such that it is almost impossible to give accurately by States the other information that has usually been published in Mineral Resources. This will particularly apply to well records and the statements of shipments, deliveries, and stocks. Stocks and shipments can be given accurately for the entire Appalachian field, but when once the oil is in the pipe lines it is impossible to say whether the deliveries in the Bradford region are New York or Pennsylvania oil, and in the southwestern region whether they are West Virginia, Ohio, or Pennsylvania oil, and the same is true of the stocks. Well records might be so kept as to give the data for each State accurately, but the importance of a report of this character would not justify the labor involved.

The practice will therefore be changed from that which has obtained in previous reports on petroleum in these reports, and treat the Appalachian field as a whole, giving the well records, production, shipments, stocks, etc., for the entire field. In connection with each State, however, we shall give production as heretofore.

In the volume "Mineral Resources of the United States, 1892," and in the report on Mineral Industries at the Eleventh Census will be found quite complete statements regarding the geological occurrence of petroleum in New York and Pennsylvania, as well as statements regarding the character and composition of the petroleums from these States. The statements regarding the oil horizons of Pennsylvania will apply to the entire oil-producing territory of the western slopes of the Appalachian range. The great deposits are in the Devonian, though considerable oil is produced from the Carboniferous. The amount of oil found in the latter is, however, small compared with that found in the former. The petroleums from the Appalachian field, which are chiefly used in the production of illuminating oil—though some very high grade natural lubricants are found—are, as they come from the ground, clear, semi-transparent, generally of an amber color, but varying somewhat in this regard with their density. These oils, as a rule, produce from 10 to 11 per cent. of naphthas, from 75 to 78 per cent. of illuminating oils, from 2 to 6 per cent. of heavy oils, from 2¾ to 4 per cent. of residuum, and show from 5 to 8 per cent. of water and loss.

Production in the Appalachian field.—While petroleum has been produced for many years in the four States constituting the Appalachian field, it was not until 1890 that the production in eastern Ohio, and not until 1891 that that of West Virginia, showed the notable increase which marked these localities as important petroleum producers. In order to show the advances in these localities the following table gives statistics of the output of the Appalachian field from 1889.

Production of petroleum in the Appalachian oil field from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	Pennsylvania and New York.	West Virginia.	Eastern Ohio.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*
1889	21,487,435	544,113	318,277	32,349,825
1890	28,458,208	492,578	1,116,521	30,067,307
1891	33,009,236	2,406,218	424,323	35,839,777
1892	28,422,377	3,810,086	1,193,414	33,425,877
1893	20,314,513	8,445,412	2,602,965	31,362,890

From the above table it appears that in the five years covered the highest output of petroleum was reached in 1891, when the total production of the field was 35,839,777 barrels. This is also the highest production in any one year since the discovery of petroleum in Pennsylvania, the nearest approach to it prior to 1891 being in 1882, when 30,053,500 barrels were produced in Pennsylvania and New York. The year 1892 shows a reduction of production as compared with 1891, and 1893 a reduction as compared with 1892. In these three years the production of Pennsylvania and New York declined from 33,009,236 barrels to 20,314,513 barrels, a reduction of 12,694,723 barrels, or 38 per cent. A large part of this decrease in production in the Pennsylvania and New York portion of the Appalachian field has, however, been made up by the increased production in the other subfields. In these three years West Virginia has increased its production from 2,406,218 barrels to 8,445,412 barrels, an increase of more than 6,000,000 barrels, or very nearly 300 per cent. The production of eastern Ohio has increased from 424,323 barrels in 1891 to 2,602,965 barrels in 1893, or over 500 per cent. As a result of this increase in West Virginia and eastern Ohio, it happens that notwithstanding the reduction of over 12,000,000 barrels in the output of petroleum in Pennsylvania and New York, the entire decrease of production in the Appalachian field since 1891 has been only about 4,500,000 barrels.

Production in the Appalachian field by months.—In the following table is given the production of crude petroleum in the Appalachian oil field from 1890 to 1893 by months.

Production of crude petroleum in the Appalachian field from 1890 to 1893, by months.

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1890	2,170,937	2,102,264	2,384,864	2,381,786	2,451,461	2,450,622
1891	2,968,164	2,451,901	2,618,394	2,592,998	2,549,787	2,565,856
1892	3,016,062	2,923,272	2,885,531	2,802,221	2,741,848	2,757,436
1893	2,491,853	2,350,490	2,769,501	2,493,590	2,673,648	2,669,110

Years.	July.	August.	September.	October.	November.	December.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1890	2,603,281	2,598,332	2,666,877	2,858,500	2,676,825	2,721,558	30,067,307
1891	2,540,907	2,740,797	3,088,801	3,823,643	4,070,287	3,828,242	35,839,777
1892	2,759,309	2,851,348	2,698,196	2,729,444	2,606,646	2,654,564	33,425,877
1893	2,658,141	2,757,351	2,682,296	2,651,591	2,513,281	2,652,038	31,362,890

From this table it appears that the largest production in any one month in the four years covered was in November, 1891, when the output was 4,070,287 barrels. An examination of the table will show that a notable increase in production began in August, 1891, when the production was 2,740,797 barrels, which gradually increased to November, when it was 4,070,287 barrels. It then slowly decreased, with the exception of a slight increase in June, July, and August, until September, 1892, when the output was 2,698,196 barrels. From this date, September, 1892, to the close of 1893, the production by months was fairly uniform, varying but 100,000 or 200,000 barrels. The lowest monthly production since September, 1892, has been 2,350,490 barrels in February, 1893. The highest has been 2,769,501 barrels in March, 1893.

Average daily production of the Appalachian field.—The figures that are usually in the mind when production is spoken of is the average daily production. This is given in the following table for the years from 1890 to 1893. These averages are ascertained by dividing the production of each month by the number of days in the month and the average for the year is found by dividing the total production for the year by 365.

Average daily product of crude petroleum in the Appalachian field each month for the years 1890 to 1893, by months and years.

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1890	70,030	75,081	76,931	79,393	79,079	81,687
1891	95,747	87,568	84,464	86,433	82,251	85,529
1892	97,292	100,802	93,082	93,407	88,447	91,915
1893	80,382	83,946	89,339	83,120	86,247	88,970

Years.	July.	August.	September.	October.	November.	December.	Average.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1890	83,977	83,817	88,896	92,210	89,228	87,792	82,376
1891	81,965	88,412	102,960	123,343	135,676	123,492	98,191
1892	89,010	91,979	89,940	88,047	86,888	85,631	91,328
1893	85,746	88,947	89,410	85,535	83,776	85,550	85,926

As usually given, the tables of average daily production only include the average daily receipts published by the pipe lines; that is, the average of the runs, as they are usually termed. In the above table, however, by average daily production is meant the average total production, including some oil that is not reported in the daily returns of the pipe-line runs.

This table needs but little comment. Since March, 1893, there have been no important variations in the average daily production. The year 1893 began with an average daily production of 80,382 barrels; this increased to 89,339 barrels in March. Since then the production has fluctuated between 83,120 barrels, the average daily production of April, to 89,410 barrels, the average daily production of September.

The average daily production for the year 1893 was 85,926 barrels, as compared with 91,328 barrels in 1892, 98,191 barrels in 1891, and 82,376 barrels in 1890. The largest average daily production in any one month covered by the table was 135,676 barrels in November, 1891; the smallest in January, 1890, when it was but 70,030 barrels.

Pipe-line runs in the Appalachian field.—Usually the terms production and pipe-line runs are regarded as synonymous, but the production is usually somewhat in excess of the runs. By pipe-line runs are meant the amounts of oil which the several pipe lines receive from the wells. If all oil was sent from the wells by pipe lines, these runs would indicate the total production of petroleum in a given year, less the oil remaining in tanks at the wells. In other words, on the basis that all oil was shipped from the wells by pipe lines, the total production of a year would be the total runs plus the stock of oil on hand at the wells at the close of the year minus the well stocks at the beginning of the year.

In the following table will be found the pipe-line runs in the Appalachian oil field in 1893, by lines and by months.

Pipe-line runs in the Appalachian oil field in 1893, by lines and months.

[Barrels.]

Months.	National transit.	Tide water.	Octave.	Southwest.	Franklin.	Western and Atlantic.	Producers' and Refiners' Pipe Line Company, Limited.
January	685,990	120,977	2,061	495,732	3,716	84,772	13,178
February	632,929	125,087	1,852	497,523	3,814	83,931	56,811
March	748,801	147,625	2,293	553,152	7,056	91,804	78,631
April	658,026	138,117	1,584	485,694	5,567	79,908	87,758
May	703,666	140,519	2,113	509,821	5,555	61,500	99,295
June	700,272	138,164	1,928	491,581	6,356	83,666	113,636
July	653,906	130,468	2,327	474,151	5,737	107,082	117,421
August	665,237	130,831	1,678	459,186	4,932	107,579	108,061
September	635,982	128,903	1,735	437,567	5,866	84,211	104,981
October	665,702	124,629	1,648	433,944	6,800	101,501	104,598
November	630,455	124,715	2,125	408,977	4,800	93,405	100,800
December	656,371	129,551	2,004	493,528	6,079	40,490	89,074
Total	8,037,337	1,579,586	23,348	5,740,856	66,278	1,019,849	1,074,244

Months.	Chas. Miller.	Elk.	Producers' pipe line.	Emery.	Mellon.	Eureka.	Buckeye-Macksburg.	Total.
January	3,331	25,549	23,179	28,201	198,599	520,164	183,781	2,389,230
February	3,923	22,981	7,310	28,075	157,629	502,657	211,658	2,336,180
March	4,139	24,989		32,012	166,343	629,575	235,177	2,721,597
April	3,901	23,852		31,165	197,196	538,751	211,102	2,462,621
May	4,206	26,298		32,717	270,893	567,731	199,929	2,624,243
June	4,244	22,800	2,997	32,526	331,076	574,535	146,626	2,650,407
July	4,164	24,569	1,848	32,132	337,746	601,369	148,622	2,641,542
August	5,411	23,029	702	32,621	319,217	745,899	152,912	2,757,295
September	3,405	20,945	652	29,887	299,337	743,807	156,124	2,653,402
October		22,357	702	30,573	288,171	720,573	149,773	2,650,971
November		22,554	1,235	29,499	258,634	685,333	134,923	2,497,455
December		20,947	589	31,650	279,074	724,472	144,488	2,618,317
Total	36,724	280,870	39,214	371,058	3,103,915	7,554,866	2,075,115	31,003,260

The runs, or receipts as they are sometimes called, given in the above table are of Pennsylvania and New York oil, with the exception of the Eureka runs, which are of West Virginia oil, the Buckeye-Macksburg runs, which are of eastern Ohio oils, and a portion of the Mellon pipe-line runs, which is partly West Virginia and partly eastern Ohio oil. Of the 3,103,915 barrels received by the Mellon pipe line, 1,139,979 barrels were from the Sistersville field. This was received from both sides of the Ohio river, and the figures are not kept separately. To say that half of this was from Ohio and half from West Virginia would be probably as near correct as can be estimated.

It will be noted that the total of runs reported in the above table is 31,003,260 barrels, while the total production of the Appalachian oil field given above is 31,362,890 barrels. In the total production is included the production of Smiths Ferry in Pennsylvania and Volcano and Burning Springs in West Virginia, which are not included in the pipe-line runs. These amount to 38,757 barrels. The remainder of the difference should be charged to dump oil and to other production that is not included in pipe-line runs.

Shipments of Appalachian field oil.—In the following table the total deliveries are given of petroleum by the pipe lines in the Appalachian oil field from 1889 to 1893, by months.

These figures must not be taken as showing the actual consumption of oil. To them must be added, in order to ascertain what becomes of the oil produced in the oil regions, all of the sediment, the dump oil, or oil that does not pass through the pipe line, as well as the amount of oil destroyed by fire and disposed of in other ways than by refining or direct consumption. There is also a certain amount of loss by evaporation and otherwise. This is provided for by the pipe lines in receiving the oil from the producers, a certain number of gallons per barrel being allowed for such loss. Forty-four gallons are generally delivered by the producer to the pipe line as a barrel, but certificates are issued for barrels of 42 gallons only.

This table, therefore, only shows the deliveries by pipe lines to customers in the regular way of business. The total consumption of oil during the year can only be ascertained by adding to the production of the year the stocks at the beginning of the year and subtracting from this total the stocks at the close of the year. This will in no case equal the deliveries. For example, at the close of 1892 the stocks on hand in the pipe lines of the Appalachian oil field were 18,037,385 barrels. The production of this field for 1893 was 31,362,890 barrels. These two make a total of 49,400,275 barrels to draw upon in the year 1893. The total stocks of petroleum in tanks at the close of 1893 were 12,316,611 barrels, which, subtracted from the above total of available petroleum for 1893, namely, 49,400,275 barrels, shows a total consumption during the year of 37,083,664 barrels. Pipe-line deliveries, however, were but 36,295,381 barrels, which shows a consumption in the year of 788,283 barrels more than the pipe-line deliveries. This excess is made up of dump oil, direct deliveries, waste, and the amounts that from time to time are credited by the pipe-line companies for increase in "B. S."

Total deliveries of petroleum in the Appalachian oil field, 1889 to 1893, by months.

Months.	1889.	1890.	1891.	1892.	1893.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	2,400,456	2,681,646	2,475,783	2,420,825	2,957,358
February	2,288,229	2,185,007	2,170,172	2,443,546	2,584,742
March	2,286,948	2,184,018	2,430,705	2,586,075	2,843,938
April	2,244,615	2,348,385	2,157,605	2,338,421	2,666,199
May	2,265,150	2,488,036	2,073,199	2,278,027	3,033,700
June	2,277,214	2,509,056	2,163,811	2,108,386	3,074,443
July	2,964,866	2,687,061	2,260,996	2,314,405	3,319,658
August	2,640,433	2,645,399	2,498,573	2,626,043	3,248,873
September	2,590,127	2,711,887	2,704,645	2,770,472	3,000,740
October	2,797,732	2,783,121	2,802,254	2,824,508	3,316,914
November	2,441,055	2,717,439	2,604,135	2,916,265	3,096,578
December	2,718,608	2,743,225	2,783,766	2,978,921	3,152,238
Average	2,492,953	2,557,023	2,427,137	2,550,491	3,024,615
Totals	29,915,433	30,684,280	29,125,644	30,605,894	36,295,381

The notable feature of this table is the one to which we have already referred, namely, the great increase in consumption of petroleum in 1893 as compared with any previous year. Though, as stated above, this table does not show the actual total consumption of petroleum in the United States in the years covered, it indicates fairly accurately the relative consumption of the several years. The year 1893 marks the highest consumption of petroleum yet known, the deliveries of that year, which may be assumed roughly to be consumption, being 36,295,381 barrels, a monthly average of 3,024,615 barrels. The nearest approach to this in any previous year is also one of the years covered by this table, namely, 1890, when the total deliveries by the pipe lines in the Appalachian oil fields were 30,684,280 barrels, a monthly average of 2,557,023 barrels, or nearly 500,000 barrels a month less than in 1893.

Comparing this table with the table of production in the Appalachian oil field given on page 12, it will be seen that the pipe-line deliveries in 1893 were 4,932,491 barrels more than the total production. If to this excess of deliveries over production be added the 788,283 barrels excess of consumption over pipe-line deliveries, it will be noted that the total excess of consumption over production in the Appalachian oil field in 1893 was nearly five and three-fourths million barrels, or to be exact, 5,720,774 barrels.

Stocks of crude petroleum in the Appalachian oil field.—In the following table will be found a statement of the stocks of petroleum in the Appalachian oil field at the close of each month from 1889 to 1893:

Total stocks of petroleum in the Appalachian oil field at the close of each month, 1889 to 1893.

[Barrels of 42 gallons.]

	1889.	1890.	1891.	1892.	1893.
January	18, 529, 228	11, 356, 634	11, 068, 179	16, 973, 225	17, 305, 206
February	17, 597, 956	11, 282, 453	11, 340, 147	17, 416, 399	17, 042, 245
March	16, 994, 558	11, 472. 854	11, 419, 782	17, 587, 512	16, 834, 533
April	16, 441, 298	11, 503, 776	11, 793, 604	18, 028, 753	16, 641, 773
May	16, 044, 384	11, 445, 975	12, 138, 347	18, 464, 378	16, 285, 855
June	15, 656, 582	11, 318, 438	12, 455, 630	19, 056, 902	15, 845, 548
July	14, 928, 784	11, 170, 539	12, 640, 790	19, 446, 441	15, 182, 551
August	14, 248, 456	11, 057, 828	12, 791, 156	19, 563, 635	14, 730, 600
September	13, 581, 845	10, 942, 934	13, 039, 230	19, 394, 242	14, 261, 432
October	12, 823, 467	10, 923, 831	13, 936, 108	19, 039, 149	13, 559, 543
November	12, 353, 863	10, 783, 567	15, 413, 864	18, 529, 914	12, 904, 344
December	11, 873, 442	10, 691, 729	16, 457, 089	18, 037, 385	12, 316, 611
Average	15, 089, 489	11, 162, 547	12, 874, 494	18, 461, 495	15, 242, 520

This table needs but little explanation. The stocks do not represent total stocks in the region, but those held by the pipe lines. In some cases stocks at wells are included, but as a rule it is assumed that these are about the same from year to year.

The notable feature in the table is the gradual increase of stocks from the close of 1890 to August, 1892—that is, from December, when the stocks reached the lowest point in the years covered by the table, being but 10,691,729 barrels, and the gradual increase until August, 1892, when they had nearly doubled, being 19,563,635 barrels. From this time there has been a gradual decline, the close of each month showing a reduction in stocks until at the close of 1893 they had fallen to 12,316,611 barrels. This decline has continued in 1894, the stocks at the close of January being 11,755,219 barrels, and at the close of February 11,119,956 barrels.

Prices of crude petroleum in the Appalachian oil field.—The following table from *Stowell's Petroleum Reporter* gives the monthly and yearly average prices of pipe-line certificates, or the price of crude petroleum at the primary markets, from 1860 to 1893, in barrels of 42 gallons. These average prices cover in the latter years prices of all Appalachian pipe-line certificate oil. It does not include the price of special oils, such as that from Franklin in Pennsylvania or Burning Springs or Volcano oil in West Virginia, nor that from the Mecca-Belden district in Ohio, but only that grade of oil which is known as Pennsylvania oil and is used chiefly for the production of illuminating oil.

These averages, it should be understood, are not true averages—that is, the average which considers the price and the quantity sold at that price—but they are the averages of the prices obtained for certificates from day to day. It is probable that the true average prices are slightly under the averages usually obtained by averaging the prices. The figures given in the following table, however, under the circumstances are the only ones that can be ascertained and do not vary much from the true average.

Monthly and yearly average prices of pipe-line certificates of crude petroleum at wells from 1860 to 1893.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly.
1860	$19.25	$18.00	$12.62½	$11.00	$10.00	$9.50	$8.62½	$7.50	$6.62½	$5.50	$3.75	$2.75	$9.59
1861	1.00	1.00	1.00	0.62½	0.50	0.50	0.50	0.25	0.20	0.10	0.10	0.10	0.49
1862	0.10	0.15	0.22½	0.50	0.85	1.00	1.25	1.25	1.25	1.75	2.00	2.25	1.05
1863	2.25	2.50	2.62½	2.87½	2.87½	3.00	3.25	3.37½	3.50	3.75	3.85	3.95	3.15
1864	4.00	4.37½	5.50	6.56	6.87½	9.50	12.12½	10.12½	8.87½	7.75	10.00	11.00	8.06
1865	8.25	7.50	6.00	6.00	7.37½	5.62½	5.12½	4.62½	6.75	8.12½	7.25	6.50	6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	3.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82⅛	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	5.70	5.35	4.95	5.37½	5.57½	5.50	5.50	5.80	5.12½	5.63¾
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22½	3.40	3.86
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.80	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.64
1873	2.00	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.83
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	0.95	0.95	0.85	0.55	0.61½	1.17
1875	1.03	1.52½	1.75	1.36½	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.35
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.37½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅝	2.07½	2.51	2.38	2.56¾	1.91	1.80	2.42
1878	1.43	1.65¼	1.59	1.37½	1.35¼	1.14	0.98¾	1.01	0.86⅝	0.82½	0.89⅜	1.16	1.19
1879	1.03	0.98	0.86¼	0.78½	0.76	0.68⅜	0.69⅞	0.67⅛	0.69⅜	0.88⅛	1.05⅝	1.18⅓	0.85⅞
1880	1.10¼	1.03⅛	0.88¾	0.78	0.80	1.00	1.06¼	0.91	0.96	0.96⅞	0.91⅞	0.91⅝	0.94½
1881	0.95½	0.90⅜	0.83⅜	0.86¼	0.81⅞	0.81¼	0.76⅞	0.78⅛	0.97⅛	0.91¼	0.85¼	0.84⅜	0.85⅞
1882	0.83⅛	0.84½	0.81⅜	0.78⅜	0.71½	0.54⅜	0.57⅜	0.58⅝	0.72⅛	0.93¾	1.14	0.96	0.78⅛
1883	0.93¾	1.01	0.97⅝	0.94⅜	1.00⅛	1.10⅜	1.05⅞	1.08	1.12½	1.11⅛	1.14½	1.14¾	1.05¾
1884	1.11	1.04⅜	0.98⅛	0.94	0.85⅝	0.68⅝	0.63½	0.81⅞	0.78	0.71⅛	0.72½	0.74⅜	0.83½
1885	0.70⅞	0.72⅜	0.80⅜	0.78½	0.79	0.82	0.92½	1.00¼	1.00¾	1.05½	1.04⅜	0.89⅝	0.87⅞
1886	0.88⅜	0.79⅞	0.77¼	0.74⅛	0.70	0.66½	0.66	0.62⅛	0.63⅜	0.65⅛	0.71⅝	0.70⅝	0.71¼
1887	0.70	0.64⅝	0.63⅜	0.64⅞	0.64⅓	0.62⅝	0.59¼	0.60⅛	0.67	0.70⅞	0.73⅞	0.80¾	0.66¾
1888	0.91¼	0.91⅝	0.98⅝	0.82⅝	0.86¾	0.75⅞	0.80⅝	0.90⅛	0.93⅝	0.90⅝	0.85⅜	0.89¼	0.87⅝
1889	0.86⅝	0.89¼	0.90⅞	0.88	0.83⅛	0.83⅞	0.95⅛	0.99½	0.99⅛	1.01⅜	1.08½	1.04⅓	0.94⅛
1890	1.05¾	1.05⅛	0.90	0.82⅝	0.88⅞	0.89¼	0.89⅛	0.89¼	0.81⅞	0.80⅛	0.72⅜	0.67¼	0.86¾
1891	0.74¼	0.78⅜	0.74¼	0.71½	0.69¾	0.68⅛	0.66½	0.64	0.58½	0.60½	0.58¾	0.59⅝	0.67
1892	0.62⅜	0.60¼	0.57⅛	0.57⅞	0.57⅜	0.54⅛	0.52½	0.55	0.54⅜	0.51⅜	0.52	0.53¼	0.55⅝
1893	0.53½	0.57⅜	0.65¼	0.68¾	0.58¾	0.60¼	0.57⅝	0.58⅞	0.64⅝	0.70¾	0.73⅞	0.78¼	0.64

It will be noted from the above table that the average price of petroleum in 1893 was in excess of the average price of 1892, which, with the exception of 1861, was the lowest in the history of the trade. The nearest approaches, with the exception noted, to the price in 1892, were in 1891, when the average price was 67 cents a barrel, and in 1887, when the average price was 66¾ cents a barrel. The low average in 1893 was due to the low price of the early part of the year and the prices from May to September. The last three months of the year show a material increase in prices, the average for December being 78¼ cents a barrel. This increase has continued in 1894, the average for January being 79¼ cents and for February 80⅝ cents a barrel.

Well records in the Appalachian oil field.—In the following tables will be found statements showing the number of wells completed in the Appalachian oil field during each month of 1893, by months and districts, together with the initial daily production of new wells.

Total number of wells completed in the Appalachian oil fields in 1893.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest district.	Macksburg.	Total entire field.
January	2	3	7	6	24	83	10	135
February	3	3	6	5	9	58	15	99
March	6	2	5	12	13	92	13	143
April	4	2	7	16	14	84	19	146
May	3	4	5	24	25	111	24	196
June	4	6	8	28	35	132	15	228
July	5	4	10	25	38	111	26	219
August	6	2	10	25	31	71	18	163
September	4	3	11	17	32	91	21	179
October	6	5	10	21	24	73	15	154
November	4	3	7	31	23	69	7	144
December	5	4	5	33	30	90	7	174
Total	52	41	91	243	298	1,065	190	1,980

Initial daily production of new wells in the Appalachian oil fields in 1893.

[Barrels of 42 gallons.]

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest district.	Macksburg.	Total entire field.
January	16	....	7	22	442	5,214	209	5,910
February	10	10	8	14	266	6,506	168	6,982
March	24	5	18	80	160	7,254	109	7,650
April	35	5	35	58	455	6,120	254	6,962
May	30	15	20	178	641	6,942	350	8,176
June	75	18	60	147	1,664	8,641	210	10,815
July	47	5	70	108	737	6,372	323	7,662
August	41	5	95	134	418	7,642	398	8,733
September	36	13	183	140	539	5,489	240	6,640
October	30	11	135	151	320	3,629	234	4,510
November	36	13	63	235	301	5,810	37	6,495
December	30	....	50	266	402	7,014	78	7,840
Total	410	100	744	1,533	6,345	76,633	2,610	88,375

These tables do not include any wells drilled in the Franklin lubricating-oil district of Pennsylvania, nor in the Volcano and Burning Springs districts of West Virginia, nor in the Mecca-Belden district of Ohio. Nor do they include any of the initial production of the wells drilled in these several districts.

The districts in the above table have been described in other parts of this report. Here it may be said, briefly, that the Bradford district includes a portion of Cattaraugus county, New York, and forms, with the Allegany, New York, district, the Northern field. The Middle field is chiefly in Warren and Forest counties, though the Lower field includes a small portion of Warren county. The Venango and Clarion and the Butler and Armstrong are the chief districts of what is known as the Lower field. The Southwest field includes the wells in Allegheny and Washington counties, Pennsylvania, as well as those in West Virginia and eastern Ohio, except those in the neighborhood of Macksburg; that is, the Southwest district includes the Sistersville, Eureka, Mount Morris, and other fields in West Virginia and Ohio. The Macksburg district includes the wells in the vicinity of this well-known oil town.

The above tables show in the most graphic manner the localities from which new production in the oil fields was derived in 1893. It will be noted that in the most northern districts—Bradford, Pennsylvania, and Allegany, New York—comparatively little drilling was done in 1893, the total number of wells completed in these two districts in that year being but 93. This, however, is an excess of the number drilled in 1892, which was but 58. The number drilled in the Middle field in 1893 was less than in 1892, the number for the latter year being 131, for 1893 but 91. Venango and Clarion, however, showed an increase in the number of completed wells in 1893 as compared with 1892, 243 having been completed there in 1893 and but 131 in 1892. The opposite, however, is true of Butler and Armstrong, the number of completed wells in 1893 in this district being 298, whereas in 1892, 342 were completed. In the Southwest district, also, there was a smaller number of wells completed in the past year than in 1892, the totals being 1,065 in 1893 and 1,230 in 1892. The Macksburg district, however, shows a marked increase in the number of wells completed in 1893, the total being 190, as compared with 76 in 1892 and 27 in 1891. The total number of wells completed in the entire Appalachian oil field in 1893 was 1,980, as compared with 1,968 in 1892, an increase of 12.

These tables also show the difference in the producing capacity of the several districts. The average daily initial production of each well in the Bradford district was a little less than 8 barrels, in the Allegany district it was some 2½ barrels; in the Middle field, a little over 8 barrels; in the Venango and Clarion, about 7 barrels; in the Butler and Armstrong, 21 barrels; in the Southwest district, 74 barrels; and in Macksburg, 13 barrels. The total average daily initial production for the entire district was some 44 barrels. These figures do not differ materially on the whole from the figures of 1892. The average daily initial production of new wells in the Bradford district for that year was 5 barrels; in Allegany, 3½ barrels; in the Middle field, 3 barrels; in the Venango and Clarion, 4 barrels; in the Butler and Armstrong, 31 barrels; in the Southwest district, 73; in the Macksburg, 15; and in the entire field, 53 barrels.

This table also indicates that drilling has been carried on during the year with little regularity. In some districts the close of the year showed a larger number of wells completed than the beginning; in others the largest number of completed wells was in April, May, and June. For all the field it can be said that the largest number of completed wells was in May, June, and July, October and November showing less than any previous month from May and the closing month of the year marking an increase in the number of wells completed.

The total daily initial production of new wells completed in the Appalachian oil fields from 1891 to 1893, as far as it could be ascertained, is as follows:

Average daily initial production of new wells in the Appalachian oil fields, from 1891 to 1893.

[Barrels.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1891..	13,364	6,618	7,751	7,710	7,875	5,263	6,543	13,536	18,118	46,748	33,660	15,538
1892..	12,249	9,992	8,661	6,751	7,793	9,585	10,669	7,861	6,347	8,833	6,932	7,580
1893..	5,910	6,982	7,650	6,962	8,176	10,815	7,662	8,733	6,640	4.510	6,495	7,840

In the following table will be found a statement of the number of dry holes drilled in each district of the Appalachian oil field in 1893. By "dry holes" is meant wells drilled that produce neither gas nor petroleum. If, in drilling for oil, gas is found the well is not regarded as a dry hole. This table should be compared with the table given above showing the total number of wells completed in the Appalachian oil fields. The number of producing wells in each district in each month of the year will be ascertained by subtracting the number of dry holes given in the above table from the number of completed wells. A study of these two tables is interesting as indicating the differing proportions of producing wells to the total number of wells drilled in the different districts. For example, in the Bradford district 52 wells were completed in 1893, of which 8, or 15 per cent., were dry. In 1892 nearly 25 per cent. were dry. In the Allegany district 41 wells were completed in 1893, of which 22, or more than one-half, were dry; about one-third were dry in 1892. In the Southwest district 1,065 wells were completed, of which 206, or about 20 per cent., were dry; in 1892 about the same proportions were dry.

Total number of dry holes drilled in the Appalachian oil field in 1893.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest district.	Macksburg.	Total.
January	...	3	5	1	10	20	...	39
February	1	1	4	1	1	14	2	24
March	2	1	2	4	5	18	4	36
April	...	1	2	4	5	13	3	28
May	...	1	...	7	4	21	8	41
June	...	2	...	10	7	27	2	48
July	...	3	...	6	11	13	7	40
August	1	1	...	7	13	15	3	40
September	...	1	1	4	11	19	7	43
October	1	4	...	2	6	18	4	35
November	1	...	3	3	5	12	4	28
December	2	4	...	7	10	16	2	41
Total	8	22	17	56	88	206	46	443

In the following table will be found a statement of the number of dry holes drilled in each month from 1891 to 1893:

Dry holes drilled from 1891 to 1893.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	46	61	52	59	48	72	67	66	41	50	59	43	664
1892	37	36	38	40	48	33	43	31	40	37	40	39	462
1893	39	24	36	28	41	48	40	40	43	35	28	41	443

The activity with which new work is being prosecuted in the various fields and districts at the close of the month is shown more by the number of rigs or derricks building and wells drilling than by the number of wells completed. In times of great prosperity and bright outlook for the future, there is great activity in building rigs and drilling wells. In the following table will be found a statement of the number of rigs in course of construction at the close of each month of 1893 for each of the districts in the Appalachian oil field. More rigs were building at the close of the year than at any other time during the year. At the close of January, 1893, but 108 rigs were building; at the close of December, 1893, there were 193 rigs building. The greatest increase in activity was in the Butler and Armstrong districts, where but 12 rigs were in course of construction at the beginning of the year, while 53 were building at its close. A somewhat similar condition existed in Venango and Clarion. In this district 11 rigs were building at the close of January, and 31 at the close of December. The Southwest district shows an increase of about 30 per cent., 64 rigs being in course of construction at the close of January and 84 at the close of December.

Rigs building in the Appalachian oil field in 1893.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest district.	Macksburg.	Total.
January	2	0	3	11	12	64	16	108
February	2	0	2	11	17	58	17	107
March	2	0	4	16	19	68	23	132
April	3	1	7	20	21	96	11	159
May	2	3	9	13	27	86	4	144
June	4	0	9	19	30	64	9	135
July	4	1	9	13	17	60	12	116
August	2	1	9	18	15	60	9	114
September	1	3	4	17	11	42	13	91
October	3	0	6	23	15	54	9	110
November	5	0	4	25	25	71	13	143
December	3	3	6	31	53	84	13	193
Average	3	1	6	18	22	67	12	129

The average number of rigs building at the close of each month in 1893 was 129, as compared with 107 in 1892, and 182 in 1891.

In the following table will be found a statement of the number of rigs building in the entire Appalachian oil field at the close of each month from 1891 to 1893:

Rigs building in the Appalachian oil field, 1891 to 1893.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891	233	195	218	186	208	234	182	188	131	156	142	112	182
1892	110	132	111	100	108	89	96	74	98	108	130	122	107
1893	108	107	132	159	144	135	116	114	91	110	143	193	129

In the following tables will be found statements regarding the number of wells drilling but not completed at the close of each month in 1893, and also in the entire Appalachian oil field for each month from 1891 to 1893:

Wells in process of drilling in the Appalachian oil field in 1893.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest district.	Macksburg.	Total.
January	4	4	4	5	17	140	14	188
February	4	2	5	8	27	158	10	214
March	4	3	5	10	36	133	15	206
April	3	2	5	16	43	185	15	269
May	4	1	10	14	57	192	13	291
June	9	2	8	24	59	188	15	305
July	7	0	7	19	56	164	13	266
August	6	0	9	15	44	155	19	248
September	5	4	11	17	38	146	12	233
October	5	3	6	17	39	144	8	219
November	8	4	7	26	48	175	9	277
December	8	1	6	22	19	165	12	233
Average	6	2	7	16	40	162	13	246

Number of wells drilling in the Appalachian oil field at the close of each month from 1891 to 1893, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891	407	410	401	387	380	407	420	406	397	386	351	286	386
1892	264	273	251	230	233	258	204	244	236	246	228	238	242
1893	188	214	206	269	291	305	266	248	233	219	277	233	246

Stocks of crude petroleum.—In the following table is given a statement showing the total stocks of crude petroleum in the Appalachian oil fields from 1871 to 1893, inclusive, by months and years:

Total stocks of crude petroleum in the Appalachian oil fields from 1871 to 1893, by months and years.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	537, 751	587, 021	642, 000	771, 000	605, 000	554, 000	511, 220
1872	532, 971	579, 793	662, 497	877, 832	950, 803	1, 010, 302	990, 229
1873	1, 183, 728	1, 265, 373	1, 244, 657	1, 178, 643	1, 192, 541	1, 324, 493	1, 433, 620
1874	1, 948, 919	2, 283, 032	2, 648, 210	2, 623, 534	2, 594, 286	2, 701, 625	2, 279, 479
1875	4, 011, 703	4, 546, 188	4, 592, 364	4, 537, 843	4, 552, 672	4, 502, 672	4, 386, 720
1876	3, 585, 143	3, 734, 835	3, 829, 250	3, 900, 703	3, 989, 904	3, 791, 642	3, 326, 726
1877	2, 604, 128	2, 860, 636	3, 210, 454	3, 279, 731	3, 173, 008	2, 912, 674	3, 004, 728
1878	3, 555, 342	3, 875, 964	4, 342, 832	4, 692, 090	4, 996, 058	5, 078, 189	5, 031, 600
1879	5, 321, 222	5, 813, 663	6, 318, 099	6, 689, 111	6, 980, 064	7, 263, 150	7, 353, 382
1880	8, 724, 194	9, 004, 062	9, 606, 683	10, 780, 153	11, 916, 577	13, 099, 934	14, 116, 753
1881	20, 110, 903	21, 108, 003	22, 105, 789	22, 963, 171	23, 793, 028	24, 441, 191	24, 888, 337
1882	26, 716, 188	27, 059, 611	27, 822, 825	28, 547, 481	29, 206, 697	29, 859, 952	30, 715, 144
1883	35, 187, 116	35, 692, 480	35, 881, 255	37, 789, 406	35, 755, 824	35, 985, 935	36, 371, 922
1884	35, 884, 509	36, 041, 898	36, 220, 270	36, 642, 794	38, 631, 203	38, 665, 838	38, 985, 767
1885	37, 214, 274	36, 757, 137	36, 508, 236	36, 464, 800	36, 139, 072	35, 872, 257	35, 686, 909
1886	34, 186, 238	34, 082, 775	33, 954, 493	33, 823, 385	33, 969, 486	34, 187, 377	34, 428, 490
1887	33, 835, 389	33, 288, 630	32, 932, 502	32, 955, 084	32, 642, 330	32, 389, 750	32, 289, 269
1888	26, 927, 634	26, 084, 574	25, 404, 276	24, 893, 223	24, 653, 043	24, 219, 496	23, 586, 951
1889	18, 165, 607	17, 240, 428	16, 634, 437	16, 076, 501	15, 668, 331	15, 258, 863	14, 541, 696
1890	11, 060, 220	10, 990, 417	11, 170, 997	11, 178, 990	11, 062, 100	10, 866, 587	10, 663, 497
1891	10, 383, 059	10, 836, 863	10, 939, 164	11, 313, 241	11, 684, 538	12, 021, 857	12, 239, 422
1892	16, 511, 609	16, 947, 539	17, 126, 762	17, 566, 369	17, 988, 510	18, 609, 217	18, 989, 265
1893	16, 894, 486	16, 623, 732	16, 437, 405	16, 236, 822	15, 878, 139	15, 424, 326	14, 768, 615

Years.	August.	September.	October.	November.	December.	Averages.
1871	530, 146	541, 300	495, 102	502, 960	523, 000	567, 458
1872	997, 166	951, 410	914, 423	886, 909	1, 084, 423	869, 897
1873	1, 513, 890	1, 521, 185	1, 452, 777	1, 493, 875	1, 625, 157	1, 369, 162
1874	2, 932, 444	2, 758, 504	3, 134, 902	3, 449, 845	3, 705, 639	2, 755, 035
1875	4, 223, 397	3, 812, 945	3, 672, 101	3, 701, 235	3, 550, 207	4, 174, 189
1876	3, 304, 405	2, 930, 456	3, 040, 108	2, 955, 092	2, 551, 199	3, 411, 622
1877	2, 852, 544	2, 503, 657	2, 504, 012	2, 471, 798	3, 127, 837	2, 875, 434
1878	4, 717, 877	4, 599, 362	4, 221, 769	4, 289, 309	4, 615, 299	4, 501, 308
1879	7, 114, 195	7, 620, 525	7, 794, 634	8, 051, 469	8, 470, 490	7, 065, 834
1880	15, 063, 651	16, 157, 316	16, 887, 019	18, 025, 409	18, 928, 430	13 525, 848
1881	25, 005, 187	25, 066, 657	25, 309, 361	25, 509, 285	26, 019, 704	23, 860, 051
1882	31, 772, 094	32, 400, 303	32, 608, 533	33, 728, 555	34, 596, 612	30, 419, 500
1883	36, 164, 881	35, 752, 677	35, 613, 915	35, 506, 653	35, 745, 632	35, 953, 975
1884	39, 084, 561	38, 740, 734	38, 192, 317	37, 925, 756	37, 366, 126	37, 698, 481
1885	35, 343, 771	34, 939, 902	34, 763, 857	34, 668, 437	34, 428, 841	35, 732, 291
1886	34, 800, 397	35, 061, 614	35, 027, 877	34, 525, 871	34, 156, 605	34, 350, 384
1887	32, 003, 536	31, 340, 939	30, 662, 583	29, 325, 951	28, 006, 211	31, 806, 015
1888	22, 825, 298	21, 876, 681	20, 722, 024	19, 734, 132	18, 995, 814	23, 326, 929
1889	13, 859, 267	13, 198, 452	12, 468, 969	12, 021, 924	11, 562, 593	14, 724, 756
1890	10, 526, 613	10, 341, 878	10, 163, 258	10, 080, 538	9, 993, 600	10, 682, 807
1891	12, 412, 300	12, 650, 375	13, 504, 659	14, 952, 827	16, 002, 857	12, 411, 763
1892	19, 101, 330	18, 952, 748	18, 604, 588	18, 097, 631	17, 615, 244	18, 009, 234
1893	14, 304, 048	13, 817, 763	13, 100, 851	12, 457, 841	11, 900, 711	14, 820, 395

The above statement of stocks includes not only the stocks of the pipe lines that gather oil exclusively from Pennsylvania and New York, but also stocks of the Eureka and Mellon pipe lines. It has been impossible to separate the statement of stocks held by these lines from those held by the exclusively Pennsylvania lines.

PENNSYLVANIA AND NEW YORK.

In the statistics of production, shipments, stocks, etc., of the Appalachian oil field, given elsewhere in this report, are included the statistics for Pennsylvania and New York, as well as for West Virginia and eastern Ohio, these four localities making up the Appalachian field. It is important, however, to give, as far as the same can be ascertained, the statistics of production, etc., for each of these localities. This is especially necessary regarding Pennsylvania and New York, as for many years the statistics of petroleum in the United States were practically those of production in these two States.

For reasons that have been stated before, it is exceedingly difficult to ascertain the exact figures for the several States separately for certain of the items that we should include in this report. There is but little difficulty in ascertaining the production of the several States, but no little trouble has been encountered—in fact, it has been found impossible in some cases—in separating stocks, shipments, etc.

In the following table is given a statement of the production of crude petroleum in New York and Pennsylvania by districts and months. The production of New York includes the total production of Allegany county and a portion of that produced in the Bradford district. The production of Allegany, New York, is given as 733,709 barrels; the production of Bradford at 3,502,136 barrels. It is estimated that the production of Cattaraugus county, New York, which is a portion of the Bradford field, is about 8½ per cent. of the total production of the Bradford district. On this basis the production of Cattaraugus county would be 297,682 barrels, which, added to the production of Allegany county, New York, would make the total production of New York 1,031,391 barrels, and of Pennsylvania, including the Franklin lubricating-oil district and Smiths Ferry, 19,283,122 barrels. The total production of Pennsylvania and New York in 1893 is given in the table as 20,314,513 barrels.

Production of crude petroleum in Pennsylvania and New York in 1893, by districts and months.

[Barrels of 42 gallons.]

Districts.	January.	February	March.	April.	May.	June.	July.
Allegany, N. Y.	56,882	54,766	71,274	66,984	64,290	73,109	59,729
Bradford, Pa	281,801	271,843	326,508	299,002	313,633	312,200	287,440
Middle district	97,500	91,221	111,789	100,097	111,346	96,717	103,823
Clarendon and Warren	19,947	24,416	35,287	18,145	22,404	29,351	28,322
Tiona	39,355	30,021	39,286	34,433	32,593	31,861	31,160
Tidioute and Titusville	22,061	21,852	20,293	18,084	18,113	17,928	18,327
Grand Valley	4,200	5,000	5,000	4,500	4,500	4,500	4,500
Second sand	16,102	17,577	24,036	20,199	20,490	20,994	20,096
Lower district	437,911	449,195	509,504	430,529	472,492	469,033	461,028
Washington county	160,921	177,436	199,864	175,900	193,922	186,969	182,266
Beaver county	38,757	38,503	41,048	36,178	41,072	38,631	39,267
Greene county	5,038	4,906	6,727	5,933	5,554	5,062	4,867
Allegheny county	538,446	479,609	500,675	465,135	455,816	486,448	471,807
	1,718,921	1,666,345	1,891,291	1,675,119	1,756,225	1,772,803	1,712,632
Franklin district	3,716	3,814	7,056	5,567	5,555	6,356	5,737
Smiths Ferry district	1,281	1,461	2,016	1,585	1,875	1,677	1,719
Total	1,723,918	1,671,620	1,900,363	1,682,271	1,763,655	1,780,836	1,720,088

Production of crude petroleum in Pennsylvania and New York in 1893, etc.—Continued.

Districts.	August.	September.	October.	November.	December.	Total.
Allegany, N. Y	59, 927	59, 087	57, 314	52, 105	58, 242	733, 709
Bradford, Pa	294, 048	278, 640	279, 013	272, 312	285, 696	3, 502, 136
Middle district	100, 650	103, 976	120, 279	116, 210	95, 459	1, 249, 067
Clarendon and Warren	26, 122	35, 251	32, 003	27, 638	28, 794	327, 680
Tiona	31, 079	28, 493	29, 564	28, 360	30, 390	286. 595
Tidioute and Titusville	17, 678	17, 735	17, 148	18, 125	18, 004	225, 348
Grand Valley	4, 500	4, 500	4, 500	4, 500	4, 500	54, 700
Second sand	19, 669	20, 259	22, 359	21, 036	22, 388	245, 205
Lower district	461, 673	429, 359	432, 614	410, 376	433, 255	5, 396, 969
Washington county	167, 003	165, 229	158, 469	154, 236	155, 349	2, 077, 564
Beaver county	37, 162	38, 996	38, 317	34, 166	43, 203	465, 300
Greene county	6, 260	5, 121	13, 969	4, 315	6, 625	74, 377
Allegheny county	459, 113	419, 978	401, 879	383, 405	426, 481	5, 488, 792
	1, 684, 884	1, 606, 624	1, 607, 428	1, 526, 784	1, 608, 386	20, 227, 442
Franklin district	4, 932	5, 866	6, 800	4, 800	6, 079	66, 278
Smiths Ferry district	1, 836	1, 531	2, 163	1, 971	1, 678	20, 793
Total	1, 691, 652	1, 614, 021	1, 616, 391	1, 533, 555	1, 616, 143	20, 314, 513

The districts grouped in the above table are quite well known to the trade. A word about them may not be inappropriate. The Allegany district is entirely in Allegany county, New York.

The Bradford district lies chiefly in Pennsylvania, in McKean county, but the main field extends some 5 or 6 miles into New York. An outlying basin of oil rock, which properly belongs to the Bradford basin, is situated for the greater part in Carrollton township, Cattaraugus county, New York. This field also includes the small outlying district of Kinzua, which lies southwest from the main district, and contains large and long-lived wells, and the Windfall Run field, lying in Pennsylvania, near Eldred, which has only small wells. The sand from which the oil in the Allegany, New York, and Bradford districts is obtained is a gray, black, dark brown, or chocolate-brown sand of about the coarseness of the ordinary beach sand of the New Jersey coast. The oil obtained is dark amber green and occasionally black. Its gravity is generally slightly greater than that of the oil usually obtained from the Venango and Butler districts.

The Middle field, the Warren and Forest, is located in the counties from which it takes its name. It includes such pools as Cherry Grove, Balltown and Cooper, Stoneham, Clarendon, Tiona, Kane, Grand Valley, and others in these two counties. The oil in this district comes from sands of varying geological horizons, having somewhat the general appearance of the Bradford and Allegany sand, but frequently coarser grained. The late Dr. Ashburner was of the opinion that the Allegany (New York), Bradford, Warren, and Forest district oil sands were of the Chemung (Devonian) age. The oils from the several Warren and Forest pools differ very greatly in color and gravity, but they are generally spoken of as amber oils.

The Lower field begins with a few pools in the southwestern corner of Warren and the western end of Forest counties, and embraces all the oil-producing territory southward, including the fields of Venango, Clarion, and Butler counties, the field on the Ohio river in Beaver county, and the fields in Lawrence county. The oil of the Venango subdivision of the Lower district is obtained from three principal sand beds, known, respectively as the first, second, and third oil sands, contained within an interval of about 350 feet. These sands are believed to belong to the Catskill (Devonian) formation. These sands were the first discovered in Pennsylvania, and drillers from this field operating in other districts designated the sands which were found in the new districts as the first, second, and third sands, irrespective of their geological position. The Venango sands generally consist of white, gray, or yellow pebble rock. The oils vary, though generally they are green in color, sometimes black, and in a few instances amber. The gravity varies from 30° to 51°, 48° being about the average of the oil obtained from the third sand, which is the greatest producer. The Butler subdivision of the Lower district includes oil pools in Butler, Clarion, southeastern Venango, and Armstrong counties. The character of the sands and oils are very much the same as the Venango district. The Beaver subdivision of the Lower district includes chiefly the Slippery Rock and Smiths Ferry fields. In both of these pools heavy oil is obtained from the representative of the Pottsville conglomerate and amber oil from the Berea grit, in the sub-Carboniferous series.

The Southwestern district includes the wells in Allegheny, Washington, and Greene counties, in southwestern Pennsylvania. The general character of the sands and oil is similar to that of the Lower district.

As compared with 1892 there has been a falling off in every district except the Middle district and the Clarendon and Warren district. Some of these reductions are notable ones. Grand Valley has declined from 128,101 barrels in 1892 to 54,700 barrels in 1893, a reduction of more than one-half. The reduction of production in the Lower district has been, in round numbers, 1,500,000 barrels, nearly 22 per cent.; in Washington county 400,000 barrels, nearly 16 per cent.; and in Allegheny county from 10,196,856 barrels in 1892 to 5,488,792 barrels in 1893, a decline of nearly 5,000,000 barrels. This decline in Allegheny county, Pennsylvania, has been due to the falling off in production of the McDonald and adjacent fields.

In the following table is given the total production of crude petroleum in the Pennsylvania and New York oil fields for the twenty-three years from 1871 to 1893.

Total product of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1893, by months and years.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340	456, 475
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130	517, 762
1873	632, 617	608, 300	665, 291	641, 520	776, 364	793, 470	867, 473
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	621, 750	1, 033, 447
1875	852, 159	719, 824	789, 539	675, 060	696, 508	696, 210	788, 361
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600	763, 623
1877	842, 890	783, 216	901, 697	972, 810	1, 127, 594	1, 130, 790	1, 189, 005
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250	1, 283, 865
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650	1, 637, 767
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440	2, 248, 430
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860	2, 372, 678
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940	3, 258, 162
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900	2, 020, 394
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190	2, 059, 950
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210	1, 775, 804
1886	1, 748, 958	1, 604, 848	1, 928, 448	1, 938, 360	2, 178, 373	2, 335, 380	2, 418, 961
1887	1, 990, 851	1, 827, 924	2, 007, 196	1, 960, 860	1, 993, 517	1, 912, 860	1, 899, 525
1888	1, 155, 937	1, 290, 718	1, 338, 877	1, 349, 403	1, 473, 362	1, 450, 703	1, 394, 847
1889	1, 542, 806	1, 332, 482	1, 628, 661	1, 635, 933	1, 821, 776	1, 811, 485	1, 954, 168
1890	2, 108, 248	2, 055, 424	2, 313, 189	2, 328, 870	2, 378, 382	2, 370, 001	2, 524, 206
1891	2, 830, 081	2, 287, 320	2, 360, 011	2, 337, 498	2, 288, 656	2, 316, 988	2, 289, 089
1892	2, 786, 528	2, 703, 663	2, 657, 432	2, 574, 814	2, 485, 040	2, 439, 346	2, 360, 886
1893	1, 723, 918	1, 671, 620	1, 900, 363	1, 682, 271	1, 763, 655	1, 780, 836	1, 720, 088

Years.	August.	September.	October.	November.	December.	Total.
1871	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	549, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 893, 786
1874	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	718, 766	698, 940	731, 073	700. 200	720, 874	8, 787, 514
1876	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	1, 273, 759	1, 214, 910	1, 269, 326	1, 173. 420	1, 256, 058	13, 135, 475
1878	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 685, 176
1880	2, 341, 027	2, 346, 300	2, 385, 636	2, 274. 420	2, 238, 634	26, 027, 631
1881	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 053, 500
1883	1, 879, 437	1. 913, 370	2, 076, 659	1, 958, 340	1, 988, 526	23, 128, 389
1884	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041
1886	2, 413, 206	2, 418, 540	2, 408, 111	2, 222, 790	2, 181, 625	25, 798, 000
1887	1, 848, 877	1, 779, 930	1, 843, 291	1, 125, 450	1, 288, 602	*a*21, 478, 883
1888	1, 382, 077	1, 273, 080	1, 304, 518	1, 442, 405	1, 582, 741	16, 488, 668
1889	1, 964, 227	1, 867, 610	1, 959, 169	1, 913, 871	2, 055, 247	21, 487, 435
1890	2, 514, 968	2, 584, 949	2, 750, 698	2, 575, 941	2, 626, 035	*b*29, 130, 910
1891	2, 473, 398	2, 837, 562	3, 575, 911	3, 834, 262	3, 578. 460	33, 009, 236
1892	2, 328, 596	2, 125, 511	2, 072, 022	1, 950, 553	1, 937, 986	28, 422, 377
1893	1, 691, 652	1, 614, 021	1, 616, 391	1, 533, 555	1, 616, 143	20, 314, 513

a Not including 877,310 barrels dump oil and oil shipped by private lines.
b Pipe line runs.

As is stated in that portion of this report referring to the Apalachian oil fields in their entirety, the total production and pipe-line runs or receipts are not the same, and hence it will be found that the statements of production in the above table do not agree with statements of so-called production which are frequently published, these latter being simply the pipe-line runs. Those who are interested to ascertain what the pipe-line runs were in Pennsylvania can do so by referring to the statement under the appropriate head in the report on the Apalachian oil field. All of the oil run through the Eureka pipe line is

West Virginia oil; and all in the Buckeye line, Macksburg, is Ohio oil. About one-third of that run in the Mellon pipe line is West Virginia and Ohio oil; about one-half of this third being West Virginia, the balance eastern Ohio oil. All of the other oil is from Pennsylvania and New York.

Average daily production in the New York and Pennsylvania oil fields.— In the following table is given a statement of the average daily production of crude petroleum in the Pennsylvania and New York oil fields, for each month, for the years 1871 to 1893. We desire to repeat that this table does not show the daily average of receipts published by the pipe lines, but the daily average production, the total production including some oil that is not reported in the daily returns of the pipe lines.

Average daily product of crude petroleum in the Pennsylvania and New York field each month for the years 1871–'93, by months and years.

[Barrels.]

Years.	January.	February.	March.	April.	May.	June.
1871	13,497	13,306	12,914	12,866	13,187	13,678
1872	18,825	15,965	14,890	15,403	17,326	16,371
1873	20,407	21,725	21,461	21,384	25,044	26,449
1874	37,653	29,839	28,598	25,958	28,895	30,725
1875	27,489	25,708	25,469	22,502	22,468	23,207
1876	22,975	23,065	23,167	23,383	23,721	24,120
1877	27,190	27,979	29,087	32,427	36,374	37,693
1878	38,816	39,102	38,980	39,863	40,802	40,575
1879	44,191	43,515	48,365	51,015	53,062	55,855
1880	61,423	64,552	65,032	67,190	71,901	71,948
1881	72,390	68,326	73,372	73,526	77,203	79,262
1882	75,921	76,119	80,070	80,093	80,212	94,198
1883	62,849	62,721	59,054	60,551	63,292	65,930
1884	58,898	64,850	66,202	68,862	76,834	62,073
1885	53,296	51,353	52,843	59,343	59,141	58,907
1886	56,418	57,316	62,208	64,612	70,283	77,846
1887	64,221	65,283	64,716	65,372	64,307	63,762
1888	37,228	44,508	43,190	44,980	47,528	48,357
1889	49,768	47,589	52,537	54,531	58,767	60,382
1890	68,008	73,408	74,619	77,629	76,722	79,000
1891	91,293	81,690	76,129	77,917	73,828	77,233
1892	89,888	93,230	85,724	85,827	80,163	81,312
1893	55,610	59,701	61,302	56,076	56,505	59,361

Years.	July.	August.	September.	October.	November.	December.	Yearly averages.
1871	14,725	14,922	15,398	15,653	15,487	15,418	14,261
1872	16,702	17,739	16,681	14,272	21,287	20,825	17,194
1873	27,983	30,198	31,809	30,403	33,049	34,980	27,106
1874	33,337	30,049	28,021	29,669	28,702	27,682	29,937
1875	25,431	23,186	23,298	23,583	23,340	23,254	24,075
1876	24,633	25,233	26,020	26,102	26,216	25,390	24,505
1877	38,335	41,089	40,497	40,946	39,114	40,518	35,988
1878	41,415	43,288	43,857	44,187	44,965	42,538	41,544
1879	56,057	61,042	61,890	59,238	57,016	57,076	54,206
1880	72,530	75,517	78,210	76,956	75,814	72,214	71,114
1881	76,538	75,217	73,114	74,941	75,561	80,000	75,004
1882	105,102	100,145	87,346	74,118	73,098	61,210	82,338
1883	65,174	60,627	63,779	66,989	65,278	64,146	63,365
1884	66,450	67,715	64,942	63,286	60,390	58,794	65,129
1885	57,284	55,031	57,093	60,455	58,722	61,247	56,921
1886	78,031	78,426	80,618	77,681	74,093	70,375	70,679
1887	61,275	59,641	59,321	61,822	37,515	41,568	58,846
1888	44,995	44,661	42,436	43,694	48,080	51,057	45,058
1889	63,037	63,362	62,254	63,199	63,796	66,298	58,869
1890	81,426	81,128	86,165	88,732	85,865	84,710	79,810
1891	73,842	79,787	94,585	115,352	127,809	115,434	90,436
1892	76,158	75,116	70,850	66,839	65,018	62,516	77,657
1893	55,487	54,569	53,801	52,142	51,119	52,133	55,656

[Yearly average is the total product divided by the number of days in the year, *not* an average of monthly averages.]

The above table shows the average daily product of crude petroleum in the Pennsylvania and New York oil fields only, and is ascertained by dividing the product of each month as given on page 486 by the number of days in each month. The average daily production for the entire Appalachian field for the years 1892 and 1893 will be found on page 471.

Shipment of petroleum from Pennsylvania and New York.—In the following table will be found a statement of the number of barrels of crude petroleum and refined petroleum reduced to its equivalent shipped out of the Pennsylvania and New York oil regions, either by pipe line or railroad, from 1871 to 1893, inclusive. In some years, especially in the earlier ones covered by this table, a considerable portion of the oil was shipped as refined. In this table that is reduced to its equivalent in crude, a barrel of refined is regarded as being produced from 1½ barrels of crude.

Shipments of crude petroleum and refined petroleum, reduced to crude equivalent, out of the Pennsylvania and New York oil fields, for the years 1871–1893, by months and years.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	437,691	347,718	383,890	389,147	587,375	501,754	541,137
1872	476,966	407,606	276,220	428,512	510,417	529,228	591,238
1873	573,124	527,440	668,374	708,191	768,176	696,414	814,449
1874	843,663	501,220	518,246	803,409	899,027	815,413	940,281
1875	453,095	327,776	693,918	729,581	681,679	745,986	904,537
1876	677,289	519,193	623,762	603,037	646,150	921,862	1,228,539
1877	743,461	484,904	913,919	903,526	1,234,324	1,391,124	1,096,951
1878	775,791	774,234	3,741,512	846,632	960,894	1,135,119	1,330,454
1879	663,998	702,729	973,879	1,136,188	1,331,469	1,369,314	1,625,035
1880	1,650,409	1,395,151	1,613,371	842,268	1,095,259	975,083	1,231,611
1881	1,061,617	915,028	1,276,746	1,348,398	1,563,436	1,729,697	1,925,532
1882	1,657,067	1,787,909	1,718,956	1,678,134	1,827,356	2,172,685	2,402,970
1883	1,357,815	1,250,824	1,641,899	1,908,379	1,995,634	1,747,789	1,634,407
1884	1,686,961	1,723,261	1,873,890	1,643,336	1,899,329	1,827,553	1,740,021
1885	1,804,028	1,895,021	1,887,034	1,823,726	2,097,099	2,034,025	1,961,152
1886	1,991,561	2,032,794	2,055,750	2,070,468	2,032,672	2,117,489	2,418,961
1887	2,312,067	1,995,757	2,332,324	1,938,278	2,328,564	2,165,439	2,000,173
1888	2,265,109	2,163,957	1,979,753	1,928,435	1,773,994	1,956,115	2,098,531
1889	2,388,609	2,272,060	2,263,009	2,236,004	2,256,120	2,268,280	2,949,597
1890	2,637,339	2,146,108	2,148,977	2,317,410	2,474,966	2,486,205	2,640,668
1891	2,421,419	2,133,068	2,384,720	2,123,461	2,022,510	2,086,985	2,212,908
1892	2,363,380	2,391,162	2,534,230	2,314,082	2,246,579	2,017,080	2,261,716
1893	2,910,650	2,534,311	2,808,577	2,643,906	2,965,269	3,025,473	3,264,391

Years.	August.	September.	October.	November.	December.	Total.
1871	528,134	551,075	505,071	480,977	410,822	5,664,791
1872	621,954	541,607	607,468	477,945	430,786	5,899,947
1873	864,768	952,955	1,010,852	959,589	955,443	9,499,775
1874	793,865	1,014,570	543,341	546,117	602,348	8,821,500
1875	882,089	1,109,392	871,917	671,066	871,902	8,942,938
1876	1,203,402	1,154,549	524,190	871,496	1,190,983	10,164,452
1877	1,425,943	1,563,797	1,268,971	1,205,634	600,019	12,832,573
1878	1,655,651	1,434,225	1,747,390	1,281,410	992,688	13,676,000
1879	1,808,239	1,627,120	1,662,269	1,453,645	1,532,585	15,886,470
1880	1,394,129	1,252,635	1,665,933	1,226,030	1,335,613	15,677,492
1881	2,214,877	2,131,950	2,080,467	2,066,906	1,969,581	20,284,235
1882	2,047,545	1,992,171	2,089,428	1,404,640	1,121,453	21,900,314
1883	2,086,478	2,325,574	2,215,421	2,065,602	1,749,547	21,979,369
1884	2,000,371	2,292,087	2,510,283	2,078,261	2,382,244	23,657,597
1885	2,049,099	2,116,659	2,050,150	1,857,080	2,138,253	23,713,326
1886	2,059,299	2,157,323	2,441,848	2,724,796	2,550,891	26,653,852
1887	2,220,768	2,342,227	2,573,008	3,462,082	2,608,341	27,279,028
1888	2,223,263	2,289,486	1,558,115	2,503,491	2,397,782	25,138,031
1889	2,625,825	2,567,459	2,747,284	2,393,131	2,671,518	29,638,898
1890	2,538,224	3,648,418	2,725,341	2,662,898	2,889,525	30,116,075
1891	2,445,092	2,648,522	2,740,859	2,539,848	2,725,993	28,485,385
1892	2,582,075	2.717,104	2,759,516	2,860,266	2,925,671	29,972,861
1893	3,200,585	2,962,345	3,269,325	3,039,318	3,105,047	35,729,197

For the latest years the shipments in the above table are pipe-line deliveries. This table is not accurate, but is sufficiently so to indicate shipments in Pennsylvania and New York. From this table are excluded all the pipe-line deliveries made by the Eureka and Buckeye pipe lines, but it includes all the deliveries of the Mellon line. It would be safe to assume, therefore, that the total shipments of crude petroleum from the Pennsylvania and New York oil regions for 1893 were about a million barrels less than the total given in the table, this million barrels being the amount of West Virginia and eastern Ohio oils that would be included in the deliveries of the Mellon pipe line.

Drilling wells in the Pennsylvania and New York oil regions.—In the following table will be found a statement of the number of drilling wells completed in each month from January, 1872, to the close of 1893, in Pennsylvania, New York, and West Virginia, by months and years:

Number of drilling wells completed in the Pennsylvania, New York, and northern West Virginia oil fields each month from 1872 to 1893, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1872	37	120	89	121	135	84	128	118	82	100	64	105	1,183
1873	93	94	100	105	102	130	114	120	106	101	100	98	1,263
1874	102	104	110	113	109	101	121	107	104	120	106	120	1,317
1875	190	187	195	186	172	190	200	210	201	220	217	230	2,398
1876	240	231	242	200	202	261	248	270	209	273	272	272	2,920
1877	281	241	291	269	320	403	317	255	322	467	391	382	3,939
1878	274	226	211	409	470	269	203	186	174	229	248	165	3,064
1879	136	132	238	270	402	330	327	283	210	232	227	261	3,048
1880	320	230	367	500	426	310	338	368	356	364	336	302	4,217
1881	222	220	271	316	406	374	336	332	312	322	363	406	3,880
1882	347	340	385	432	469	340	185	253	164	117	150	122	3,304
1883	125	126	142	209	231	228	261	309	321	321	302	272	2,847
1884	229	227	256	298	311	244	268	145	89	59	73	66	2,265
1885	64	62	82	116	213	242	217	283	356	397	384	345	2,761
1886	270	280	291	328	343	365	357	313	253	272	221	185	3,478
1887	158	162	138	160	148	162	159	142	134	100	101	96	1,660
1888	57	52	56	49	56	97	82	96	132	229	307	302	1,515
1889	284	288	353	401	431	537	549	508	478	559	540	471	*a* 5,435
1890	553	482	522	556	534	571	555	579	571	567	520	348	6,358
1891	310	243	275	288	314	304	334	333	281	237	245	197	3,361
1892	175	171	137	167	170	154	174	141	142	158	160	143	1,892
1893	125	84	130	127	172	213	193	145	158	139	137	167	1,790

a Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

OHIO.

In the volumes of Mineral Resources up to 1891 the oil-producing territory of Ohio had been divided into three districts, namely, Lima, Macksburg, and Mecca-Belden. An extension of the Appalachian oil fields southward has developed a large producing territory north of Macksburg, in the Sistersville, Eureka, and adjacent districts. This has led to the introduction of a new field, named the Eastern Ohio, in the reports of 1891 and 1892. In 1893, however, the Macksburg and Eastern Ohio districts had been united under the general name Eastern Ohio district. The Eastern Ohio district is really an extension of the West Virginia district. The Sistersville, Eureka, and other districts are on both sides of the Ohio, some wells being in West Virginia and others in Ohio. This makes it extremely difficult to distribute the production properly between the States. In the accompanying tables the best distribution possible has been made.

The first and most important of the oil-producing districts of Ohio is the Lima or Northwestern, which includes the remarkable developments in the section of country of which Lima may be regarded as the center, and which extends in a southwesterly direction into Indiana. The oil in this district is found in the Trenton limestone. Quite a number of distinct pools have been noted, and it is found that the oil in these different pools varies somewhat in character, that of certain pools having more of the sulphur compounds than that of the others.

The Eastern Ohio district includes the wells along the extreme eastern boundary of Ohio contiguous to Pennsylvania and West Virginia. Most of the oil produced from this district in past years, when Macksburg was the center of production, was from the Berea grit. The more recent discoveries of oil, however, have been in the sand rocks that have been such large producers in western Pennsylvania and eastern Ohio, notably in the Big Injun.

The Mecca-Belden district is named from the chief towns in which the oil is found, Mecca being in Trumbull county and Belden in Lorain county, both in the northeastern portion of the State. While the districts are somewhat separated, the character of the oil is similar, and hence, as the production is small, they are united in the reports. The oil is entirely lubricating, derived from the Berea grit.

Until quite recently all the oil produced in the Lima district was classed as fuel oil. This is no longer true, owing to the improved methods of distillation. The illuminating oils produced from the limestone oils of the Lima field are considered better than those produced from the sandstone oils of the Appalachian fields. The percentage yield of the Lima oil in illuminants, however, is still considerably less than the yield of the Appalachian oils.

Production of petroleum in Ohio.—The total amount and value of the petroleum produced in Ohio in the years 1889, 1890, 1891, 1892, and 1893 is shown in the following table:

Total amount and value of petroleum produced in Ohio from 1889 to 1893.

Districts.	1889.			1890.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.
	Barrels.			*Barrels.*		
Lima	12,153,189	$1,822,978	$0.15	15,014,882	$4,504,465	$0.30
Macksburg	317,037	340,683	1.07½	1,108,334	1,127,730	1.01¾
Eastern Ohio						
Mecca-Belden	1,240	10,334	8.33⅓	1,440	12,000	8.33⅓
Total	12,471,466	2,173,995	.17⅜	16,124,656	5,644,195	.35

Total amount and value of petroleum produced in Ohio from 1889 to 1893—Continued.

Districts.	1891.			1892.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.
	Barrels.			*Barrels.*		
Lima	17,315,978	$5,281,373	$0.30½	15,169,507	$5,555,832	0.36\frac{6}{10}$
Macksburg	400,024	283,332	.67	197,556	662,106	.55$\frac{6}{10}$
Eastern Ohio	22,859			992,746		
Mecca-Belden	1,440	12,000	8.33⅓	3,112	21,101	6.78
Total	17,740,301	5,576,705	.31$\frac{4}{10}$	16,362,921	6,239,039	.38

Districts.	1893.		
	Total production.	Total value.	Price per barrel.
	Barrels.		
Lima	13,646,804	$6,448,115	$0.47¼
Macksburg	2,601,394	1,664,892	.64
Eastern Ohio			
Mecca-Belden	1,571	11,335	7.21½
Total	16,249,769	8,124,342	.50

From the above table it appears that, owing to the increase of production in the Eastern Ohio field, the total production of Ohio in 1893 was only 113,152 barrels less than in 1892, though the production of Lima had fallen off nearly a million and a half barrels. The value of the oil produced in Ohio in 1893, notwithstanding the reduction in production, was nearly $2,000,000 more than in 1892. This was due to the fact that the value both of Lima and Eastern Ohio oil increased materially during the year. A notable feature in this connection is the increase in the average price per barrel of all the oil produced in Ohio during the years covered by this table. In 1889 the average value of Lima oil was but 15 cents a barrel, of Eastern Ohio $1.07½ a barrel, the average of all oil produced in the State being 17⅝ cents a barrel. In 1890 the average value of Lima oil had increased to 30 cents a barrel; the average of Eastern Ohio oil had decreased to $1.01¾ a barrel, while the average value of all the oil increased to 35 cents a barrel, double the average price of 1889. In 1891 the increase in the price of Lima oil over that of 1890 was but half a cent per barrel, but the price of the Eastern Ohio oil had fallen to 67 cents a barrel, making the average value of oil in 1891 but 31$\frac{4}{10}$ cents, as compared with 35 cents in 1890. In 1892, however, Lima oil again advanced, the average value being 36$\frac{6}{10}$ cents, while Eastern Ohio still further declined to 55$\frac{6}{10}$ cents a barrel, the average value of the production of Ohio in this year being 38 cents. The year 1893 marked an advance all around. The average price of Lima increased to 47¼ cents a barrel, Eastern Ohio to 64 cents, and the average of the year to 50 cents, nearly three times the average value of the oil produced in 1889.

Of the total production of petroleum in 1893 of 16,249,769 barrels, 13,646,804 barrels, or nearly 84 per cent., came from the Lima field. The proportion of the Lima production in 1892 was 93 per cent. The total production of Eastern Ohio oil in 1893 was 2,601,394 barrels, or 16 per cent. of the total. The production of the Mecca-Belden district shows a considerable falling off in 1893.

In the following tables will be found statements of the total production of crude petroleum in Ohio in 1890, 1891, 1892, and 1893, by months and districts. In determining the total by months an average production for each month in the Mecca-Belden district has been assumed.

Total productions of crude petroleum in Ohio from 1890 to 1893, by months and districts.

[Barrels of 42 gallons.]

Months.	Lima.	Eastern. Ohio and Macksburg.	Mecca-Belden.	Total.
1890.				
January	911,947	36,713	....	948,780
February	888,978	40,712	....	929,810
March	955,620	53,193	....	1,008,933
April	1,040,924	60,729	....	1,101,773
May	1,142,954	80,167	....	1,223,241
June	1,175,821	98,268	....	1,274,209
July	1,354,672	118,182	....	1,472,974
August	1,411,998	132,173	....	1,544,291
September	1,559,473	140,634	....	1,700,227
October	1,660,069	138,224	....	1,798,413
November	1,495,099	113,664	....	1,608,883
December	1,417,327	95,675	....	1,513,122
Total	15,014,882	1,108,334	1,440	16,124,656
1891.				
January	1,471,858	89,061	....	1,561,039
February	1,355,734	40,620	....	1,396,474
March	1,455,628	28,297	....	1,484,045
April	1,470,661	29,361	....	1,500,142
May	1,446,284	28,935	....	1,475,339
June	1,491,228	25,014	....	1,516,362
July	1,514,607	30,571	....	1,545,298
August	1,509,262	28,828	....	1,538,210
September	1,492,115	31,591	....	1,523,826
October	1,499,834	27,536	....	1,527,490
November	1,271,189	28,428	....	1,299,737
December	1,337,578	34,641	....	1,372,339
Total	17,315,978	422,883	1,440	17,740,301
1892.				
January	1,090,173	33,762	....	1,124,194
February	1,127,481	32,894	....	1,160,634
March	1,200,305	42,371	....	1,242,936
April	1,128,253	45,439	....	1,173,952
May	1,165,750	50,407	....	1,216,416
June	1,210,523	55,930	....	1,266,712
July	1,300,197	69,678	....	1,370,135
August	1,461,020	111,377	....	1,572,657
September	1,422,534	151,543	....	1,574,336
October	1,379,909	206,005	....	1,586,173
November	1,328,548	188,391	....	1,517,198
December	1,354,814	202,505	....	1,557,578
Total	15,169,507	1,190,302	3,112	16,362,921
1893.				
January	1,037,358	189,874	....	1,227,363
February	985,620	209,948	....	1,195,698
March	1,161,384	238,133	....	1,399,648
April	1,072,850	217,001	....	1,289,982
May	1,179,808	204,151	....	1,384,090
June	1,213,521	206,106	....	1,419,758
July	1,231,010	213,431	....	1,444,572
August	1,258,289	221,865	....	1,480,285
September	1,181,493	220,589	....	1,402,213
October	1,154,641	242,353	....	1,397,125
November	1,084,324	222,428	....	1,306,883
December	1,086,506	215,515	....	1,302,152
Total	13,646,804	2,601,394	1,571	16,249,769

The following table gives the prod uction of petroleum in Ohio from the beginning of operations in that State to the close of 1893:

Production of petroleum in Ohio.

Years.	Barrels.	Years.	Barrels.
Previous to 1876	200, 000	1886	1, 782, 970
1876	31, 763	1887	5, 018, 015
1877	29, 888	1888	10, 010, 868
1878	38, 179	1889	12, 471, 466
1879	29, 112	1890	16, 124, 656
1880	38, 940	1891	17, 740, 301
1881	33, 867	1892	16, 362, 921
1882	39, 761	1893	16, 249, 769
1883	47, 632		
1884	90, 181	Total	96, 990, 189
1885	650, 000		

Lima district.—Possibly the most remarkable oil district ever developed in this country is that known as the Lima, or Northwestern Ohio district. Not only has its development been most rapid since it began to assume prominence in 1885, but it has been found that the oil produced in this district, which, because of its peculiar character, containing as it does a portion of sulphur, it was believed could not be used for illuminating purposes, now furnishes most of the illuminating oil used in the United States, though the yield of the oil in illuminants is less than from Pennsylvania oil.

The reservoir of the oil is the Trenton limestone which lies as near a level terrace as an area of this sort ever becomes. The oil is found at Lima at a depth of 1,300 feet. It is dark or black and rather heavy, and contains sulphur compounds, in these respects resembling the oils of Canada and Tennessee.

The production of petroleum in the Lima, Ohio, oil fields from 1886 to 1893 is as follows:

Production of petroleum in the Lima, Ohio, district from 1886 to 1893.

Years.	Barrels.
1886	1, 064, 025
1887	4, 650, 375
1888	9, 682, 683
1889	12, 153, 189
1890	15, 014, 882
1891	17, 315, 978
1892	15, 169, 507
1893	13, 646, 804

In the following table is found the production of petroleum in the Lima, Ohio, field from 1887 to 1893, by months, so far as the same was obtainable:

Product of petroleum in the Lima, Ohio, field from 1887 to 1893.

[Barrels of 42 gallons.]

Months.	1887.	1888.	1889.	1890.	1891.	1892.	1893.
January	131, 011	422, 125	....	911, 947	1, 471, 858	1, 090, 173	1, 037, 358
February	206, 026	479, 824	....	888, 978	1, 355, 734	1, 127, 481	985, 620
March	303, 084	586, 781	....	955, 620	1, 455, 628	1, 200, 305	1, 161, 384
April	352, 798	629, 932	....	1, 040, 924	1, 470, 661	1, 128, 253	1, 072, 850
May	449, 062	745, 896	....	1, 142, 954	1, 446, 284	1, 165, 750	1, 179, 808
June	474, 535	862, 106	....	1, 175, 821	1, 491, 228	1, 210, 523	1, 213, 521
July	389, 997	905, 218	....	1, 354, 672	1, 514, 607	1, 300, 197	1, 231, 010
August	490, 862	995, 938	....	1, 411, 998	1, 509, 262	1, 461, 020	1, 258, 289
September	465, 743	979, 943	....	1, 559, 473	1, 492, 115	1, 422, 534	1, 181, 493
October	444, 941	1, 036, 712	....	1, 660, 069	1, 499, 834	1, 379, 909	1, 154, 641
November	458, 612	988, 997	....	1, 495, 099	1, 271, 189	1, 328, 548	1, 084, 324
December	483, 704	1, 049, 211	....	1, 417, 327	1, 337, 578	1, 354, 814	1, 086, 506
Total	4, 650, 375	9, 682, 683	12, 153, 189	15, 014, 882	17, 315, 978	15, 169, 507	13, 646, 804

Pipe-line runs in the Lima-Indiana field.—There are no statements of pipe-line runs and shipments in the Lima-Indiana field that distinguish between oil produced in Ohio and that produced in Indiana. Therefore, the following statements of pipe-line runs and shipments will include the report for both Lima and Indiana. As has been so frequently stated in this report, pipe-line runs are not production. This is especially true of the runs of the Lima-Indiana field.

Pipe-line runs, Lima-Indiana field, from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.
1889	973, 980	800, 828	830, 559	845, 377	932, 067	843, 844
1890	683, 750	622, 799	676, 175	842, 416	887, 590	916, 289
1891	1, 241, 154	1, 147, 947	1, 255, 611	1, 202, 583	1, 191, 147	1, 207, 884
1892	971, 607	1, 008, 069	1, 083, 801	1, 042, 087	1, 064, 478	1, 099, 145
1893	1, 049, 778	974, 944	1, 163, 641	1, 074, 290	1, 187, 939	1, 245, 880

Years.	July.	August.	September.	October.	November.	December.	Total.
1889	805, 744	968, 449	875, 201	850, 077	774, 073	755, 553	10, 255, 752
1890	1, 105, 885	1, 149, 877	1, 289, 577	1, 342, 158	1, 215, 960	1, 186, 434	11, 918, 910
1891	1, 236, 291	1, 240, 841	1, 252, 375	1, 257, 986	1, 070, 131	1, 211, 820	14, 515, 770
1892	1, 190, 015	1, 346, 949	1, 232, 385	1, 264, 536	1, 209, 953	1, 244, 712	13, 657, 737
1893	1, 289, 991	1, 390, 894	1, 315, 933	1, 302, 295	1, 230, 658	1, 224, 952	14, 451, 195

Shipments of crude petroleum from the Lima-Indiana field, from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.
1889	367, 524	362, 807	391, 026	340, 889	309, 238	352, 886
1890	156, 085	111, 604	123, 125	115, 223	169, 662	700, 422
1891	968, 887	837, 928	330, 448	336, 854	1, 078, 489	923, 605
1892	1, 355, 362	1, 346, 541	1, 532, 606	1, 512, 358	1, 427, 753	1, 492, 543
1893	1, 306, 612	1, 270, 595	1, 390, 646	1, 205, 748	1, 321, 782	1, 235, 843

Years.	July.	August.	September.	October.	November.	December.	Total.
1889	361, 694	464, 325	626, 207	715, 386	759, 702	750, 244	5, 801, 928
1890	874, 121	846, 360	813, 817	723, 725	657, 614	907, 548	6, 199, 306
1891	997, 681	1, 166, 054	1, 260, 598	1, 408, 343	1, 391, 400	1, 454, 578	12, 154, 865
1892	1, 389, 501	1, 342, 949	1, 125, 335	1, 315, 994	1, 323, 204	1, 340, 734	16, 504, 880
1893	1, 152, 374	1, 040, 860	1, 038, 819	1, 196, 018	1, 262, 130	1, 230, 216	14, 651, 643

It will be noted that the pipe-line runs and the shipments in the Lima-Indiana field in 1893 were very nearly equal, and that the shipments in 1892 were nearly 3,000,000 barrels in excess of the runs.

Well records in the Lima district.—The number of completed wells in the Lima district in 1893 was 1,569, as compared with 1,446 in 1892, and 1,575 in 1891. The total initial daily production in 1893 was 71,763 barrels, as compared with 94,460 barrels in 1892, and 74,738 barrels in 1891. That is, with 123 more wells completed in 1893 than in 1892, the total initial daily production was 22,697 barrels less. This is not due to an increasing number of dry holes, there being but 20 more dry holes drilled in 1893 than in 1892. The fact is that the wells drilled in the Lima region in 1893 were not as great producers as those drilled in 1892.

Total number of wells completed in the Lima, Ohio, district in 1893.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	1	11	2	13	68	5	100
February	0	8	2	15	58	2	85
March	0	40	9	26	84	4	163
April	0	27	3	34	63	8	135
May	1	23	8	30	60	6	128
June	3	20	4	47	80	6	160
July	4	19	3	53	64	9	152
August	2	14	2	36	75	4	133
September	4	13	6	47	58	3	131
October	2	16	7	42	49	4	120
November	2	12	16	44	52	6	132
December	1	11	18	41	49	10	130
Total	20	214	80	428	760	67	1,569

Initial daily production of wells completed in the Lima, Ohio, district in 1893.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	10	545	40	695	4,150	70	5,510
February	0	492	35	470	3,812	0	4,809
March	0	1,875	170	960	3,156	80	6,241
April	0	1,380	90	1,018	2,970	19	5,477
May	0	718	180	2,406	3,494	60	6,858
June	97	867	190	2,734	5,628	185	9,701
July	70	727	145	2,447	5,974	225	9,588
August	40	640	25	1,748	2,624	47	5,124
September	135	486	190	2,648	3,238	55	6,752
October	5	330	265	1,990	1,583	50	4,223
November	25	310	685	1,937	1,168	80	4,205
December	10	185	580	1,050	1,270	180	3,275
Total	392	8,555	2,595	20,103	39,067	1,051	71,763

It will be seen from the following table that of the 1,569 wells completed in the Lima district in 1893, 203 were dry holes; in 1892, of 1,446 wells completed, 183 were dry holes.

Total number of dry holes drilled in the Lima, Ohio, district in 1893.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	0	1	0	0	8	3	12
February	0	0	0	2	11	2	15
March	0	3	2	3	11	1	20
April	0	2	0	8	10	4	24
May	1	6	2	0	7	2	18
June	0	2	0	3	12	2	19
July	0	4	0	6	5	3	18
August	0	0	0	1	10	1	12
September	1	2	0	6	4	1	14
October	1	5	0	3	6	1	16
November	1	0	0	2	7	3	13
December	0	5	0	5	6	6	22
Total	4	30	4	39	97	29	203

The number of rigs building and the number of wells drilling in the Lima, Ohio, district at the close of each month in 1893, is shown in the two following tables:

Total number of rigs building in the Lima, Ohio, field in 1893.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	0	10	2	3	45	2	62
February	0	5	1	11	51	2	70
March	0	9	1	8	45	0	63
April	0	10	6	10	29	3	58
May	2	17	3	17	51	0	90
June	3	9	3	17	38	2	72
July	1	9	2	7	32	1	52
August	1	4	3	12	30	2	52
September	3	9	6	13	30	0	61
October	0	10	10	13	35	8	76
November	1	8	6	13	36	2	66
December	0	3	10	10	37	9	69
Average	1	9	4	11	38	3	66

Total number of wells drilling in the Lima, Ohio, field in 1893.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	0	13	2	5	48	4	72
February	0	9	2	11	53	3	78
March	0	23	3	20	35	7	88
April	0	9	8	20	52	3	92
May	3	17	9	30	57	1	117
June	4	13	3	33	63	3	119
July	3	14	5	21	56	4	103
August	5	16	2	30	48	0	101
September	2	11	9	23	40	4	89
October	3	14	8	33	42	2	102
November	1	13	15	28	52	9	118
December	2	11	15	19	56	11	114
Average	2	13	7	23	50	4	99

The average number of rigs building at the close of each month in 1893 was 66, as compared with 108 in 1892, while the total number of wells drilling at the close of each month in 1893 was 99, as compared with 88 in 1892.

In the following tables are given the well records in the Lima, Ohio, district for 1890, 1891, 1892, and 1893:

Number of wells completed in the Lima, Ohio, district, from 1890 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1890	44	62	......	......	147	165	224	271	307	319	243	187	1,969
1891	142	123	129	156	116	143	144	138	157	134	104	88	1,574
1892	67	82	93	93	93	121	134	166	171	174	147	105	1,446
1893	100	85	163	135	128	160	152	133	131	120	132	130	1,569

Initial daily production of new wells in the Lima, Ohio, district, from 1890 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1890	......	......	......	......	......	......	......	18,944	16,309	17,426	13,779	8,424	14,976
1891	5,858	5,474	4,428	6,543	4,411	6,667	8,461	8,427	7,855	8,033	5,592	2,989	6,228
1892	2,853	4,485	3,973	4,665	4,750	8,314	11,648	14,631	12,908	13,772	7,554	4,907	7,872
1893	5,510	4,809	6,241	5,477	6,858	9,701	9,588	5,124	6,752	4,223	4,205	3,275	5,980

Total number of dry holes drilled in the Lima, Ohio, district, from 1890 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1890	3	2	......	......	4	11	10	23	30	32	37	41	193
1891	28	27	23	28	14	18	22	14	26	20	17	13	250
1892	9	9	8	13	10	18	16	18	27	22	18	15	183
1893	12	15	20	24	18	19	18	12	14	16	13	22	203

Number of wells drilling in the Lima, Ohio, district, at the close of each month, from 1890 to 1893.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1890	47	59	......	......	135	188	237	182	238	294	148	111	164
1891	90	105	94	82	79	90	90	93	85	88	67	53	85
1892	61	78	76	51	64	95	101	112	120	114	106	81	88
1893	72	78	88	92	117	119	103	101	89	102	118	114	99

Rigs building in the Lima, Ohio, district, from 1890 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1890	56	69	......	......	173	239	248	212	210	194	149	109	166
1891	120	137	155	117	115	123	137	120	117	106	91	99	120
1892	95	115	106	112	113	104	128	126	121	112	112	49	108
1893	62	70	63	58	90	72	52	52	61	76	66	69	66

Eastern Ohio district.—In this district is included the old Macksburg field and the new developments in the territory adjacent to West Virginia and western Pennsylvania.

The production of the Macksburg, or Eastern Ohio, district for the last nine years is given in the following table:

Production of petroleum in the Macksburg, Ohio, district, from 1885 to 1893.

Years.	Barrels.
1885	661,580
1886	703,945
1887	372,257
1888	291,585
1889	317,037
1890	1,108,334
1891	*a* 422,883
1892	*b* 1,190,302
1893	2,601,394

a This includes 22,859 barrels of petroleum produced in Eastern Ohio.
b This includes 992,746 barrels of petroleum produced in Eastern Ohio.

In the following table the pipe-line runs and the shipments from the Eastern Ohio district are given from 1889 to 1893:

Pipe-line runs in the Eastern Ohio district, from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.
1889	18,174	16,239	19,676	20,144	20,283	18,536
1890	29,872	34,022	45,362	53,905	72,158	90,827
1891	86,058	45,618	23,055	25,070	24,263	21,689
1892	24,801	27,620	39,010	40,424	43,569	50,007
1893	183,781	211,658	235,177	211,102	199,929	146,626

Years.	July.	August.	September.	October.	November.	December.	Total.
1889	16,705	16,607	16,875	21,555	25,415	28,567	238,776
1890	111,584	121,349	138,310	129,717	106,552	87,955	1,021,613
1891	24,858	24,432	27,006	23,428	23,073	28,682	377,232
1892	64,107	106,082	135,353	212,470	176,852	196,852	1,117,147
1893	148,622	152,912	156,124	149,773	134,923	144,488	2,075,115

Shipments of crude petroleum and refined petroleum reduced to crude equivalent from Eastern Ohio district, from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	January.	February.	March.	April.	May.	June.
1889	11,847	16,168	23,939	8,611	9,027	8,934
1890	44,306	38,898	35,041	30,975	13,070	22,851
1891	54,363	27,160	1,040	2,094	1,060	41,725
1892	2,591	2,200	1,763	1,600	252	37,989
1893	7,174	6,556	8,218	5,906	2,338	1,123

Years.	July.	August.	September.	October.	November.	December.	Total.
1889	15,269	14,507	22,669	50,447	47,924	47,090	276,432
1890	46,394	107,175	73,469	57,780	54,540	53,704	578,203
1891	820	2,318	3,283	3,040	2,700	2,236	141,839
1892	1,834	1,555	2,102	3,773	4,358	6,443	66,463
1893	1,025	586	1,964	2,524	4,538	2,563	44,515

In the following tables are given the well records in the Eastern Ohio district for 1891, 1892, and 1893:

Number of wells completed in the Eastern Ohio district in 1891, 1892, and 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	......	......	......	......	......	......	......	......	......	9	10	8	27
1892	7	9	12	7	4	8	5	2	4	2	14	2	76
1893	10	15	13	19	24	15	26	18	21	15	7	7	190

Initial daily production of new wells in the Eastern Ohio district in 1891, 1892, and 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	......	......	......	......	......	......	......	......	......	36	265	70	371
1892	60	152	393	65	291	25	43	2	0	20	117	0	1,168
1893	209	168	109	254	350	210	323	398	240	234	37	78	2,610

Total number of dry holes drilled in the Eastern Ohio district, 1891, 1892, and 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	......	......	......	......	......	......	......	......	......	5	5	4	14
1892	2	3	4	4	4	5	1	0	4	1	4	2	34
1893	0	2	4	3	8	2	7	3	7	4	4	2	46

Number of wells drilling in the Eastern Ohio district at the close of each month in 1891, 1892, and 1893.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891	......	......	......	......	......	......	......	......	......	15	14	10	13
1892	15	15	12	9	14	9	6	6	6	10	7	9	10
1893	14	10	15	15	13	15	13	19	12	8	9	12	13

Rigs building in the Eastern Ohio district in 1891, 1892, and 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891	......	......	......	......	......	......	......	......	......	20	20	4	15
1892	18	17	14	13	21	10	8	11	13	16	13	13	14
1893	16	17	23	11	4	9	12	9	13	9	13	13	12

In the following table is given the well statement, showing the wells completed, the initial production, the dry holes, wells drilling, and rigs building in the Macksburg district of the Eastern Ohio field in 1893:

Well record in the Macksburg, Ohio, district in 1893.

Months.	Wells completed.	Initial production.	Dry holes.	Wells drilling.	Rigs building.
		Barrels.			
January	10	209	0	14	16
February	15	168	2	10	17
March	13	109	4	15	23
April	19	254	3	15	11
May	24	350	8	13	4
June	15	210	2	15	9
July	26	323	7	13	12
August	18	398	3	19	9
September	21	240	7	12	13
October	15	234	4	8	9
November	7	37	4	9	13
December	7	78	2	12	13
Total	190	*a* 218	46	*a* 13	*a* 12

a Average.

It should be noted that this includes the well records only of the Macksburg district of the Eastern Ohio field. The well records of the other districts in the Eastern Ohio field are included in the Southwest district of the Appalachian field report.

Mecca-Belden district.—As has been stated, the wells in this district are located in Trumbull and Lorain counties. The oil is a lubricating oil from a few shallow wells. There were but 13 wells yielding oil at the close of 1892, and 10 at the close of 1893.

In the following table is given the production and value of the crude petroleum in this district in 1892 and 1893.

Production and value of crude petroleum in the Mecca-Belden district of Ohio in 1892, and 1893.

	1892.			1893.		
	Barrels of 42 gallons.	Value.	Price per barrel.	Barrels of 42 gallons.	Value.	Price per barrel.
Lorain county, Belden district	1,732	$9,280	$5.36	1,120	$8,014	$7.15
Trumbull county, Mecca district	1,380	11,821	8.57	451	3,321	7.36
Total	3,112	21,101	6.78	1,571	11,335	7.21½

Stocks at wells in the Mecca-Belden district of Ohio.

Years ending December 31—	Barrels.
1891	4,048
1892	161
1893	403

WEST VIRGINIA.

The oil fields of West Virginia are extensions of the fields of southwestern Pennsylvania and form a part of what the writer has elsewhere called the Appalachian oil field. The character of the petroleum produced is identical with that of Pennsylvania, except a portion of that from the Volcano and Burning Springs districts, where a natural lubricating oil of high grade is produced. Though certain districts in West Virginia, as the Sistersville and Eureka, are on both sides of the Ohio river, and the oil is run indiscriminately into pipe lines and storage tanks, nevertheless it has been found practical to approximate very closely the production of West Virginia as distinguished from Ohio and Pennsylvania. As is stated elsewhere, it is not so feasible to separate shipments and stocks by States.

The following table gives the total amount and value of petroleum produced in West Virginia from 1889 to 1893:

Total amount and value of petroleum produced in West Virginia from 1889 to 1893.

Districts.	1889.			1890.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.
	Barrels.			*Barrels.*		
Turkey Foot	199, 460	$243, 192	$1. 21⅞	....	....	....
Mount Morris	174, 758	194, 949	1. 11½	....	....	....
Volcano and Eureka	165, 735	211, 526	1. 27⅝	....	....	....
Burning Springs	4, 160	4, 160	1. 00	....	....	....
Total	544, 113	653, 827	1. 20⅛	492, 578	$501, 198	$1. 01¾

Districts.	1891.			1892.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.
	Barrels.			*Barrels.*		
Turkey Foot, Mount Morris, Volcano and Eureka	2, 404, 218	$1, 610, 826	$0. 67	3, 807, 068	$2, 117, 692	$0. 55⅝
Burning Springs	2, 000	2, 000	1. 00	3, 000	2, 209	. 73 6/10
Total	2, 406, 218	1, 612, 826	. 67	3, 810, 086	2, 119, 901	. 55 6/10

Districts.	1893.		
	Total production.	Total value.	Price per barrel.
	Barrels.		
Turkey Foot, Mount Morris, Eureka, etc	8, 427, 448	$5, 393, 567	$0. 64
Volcano	12, 000	27, 000	2. 25
Burning Springs	5, 964	4, 955	. 83
Total	8, 445, 412	5, 425, 522	. 64

The production of crude petroleum in West Virginia by months from 1890 to 1893 is shown in the following table:

Total production of crude petroleum in West Virginia by months, from 1890 to 1893.

Months.	1890.	1891.	1892.	1893.
January	38,644	48,902	195,512	577,933
February	38,061	123,841	186,455	468,794
March	44,842	229,966	185,468	630,877
April	39,804	226,020	181,708	594,190
May	39,160	232,076	206,142	705,714
June	35,610	223,734	261,900	682,040
July	34,096	221,127	328,485	724,494
August	31,505	238,451	411,114	843,706
September	50,342	219,528	420,882	847,558
October	46,387	220,076	451,157	792,719
November	45,062	207,477	467,446	757,170
December	49,065	215,020	513,817	820,217
Total	492,578	2,406,218	3,810,086	8,445,412

It is interesting to compare the production of petroleum in 1893 by months with the production of the corresponding months in the three preceding years. It will be noted that the increase in production began in February, 1891, and has shown on the whole a marked increase, month by month, until September, 1893, when the highest production, 847,558 barrels, was reached. There was a decline in October and November of 1893, but December again showed a marked increase, bringing the production of this month within 27,341 barrels of the highest production reached in the State.

In the following table is given a statement of the pipe-line runs of the Eureka pipe lines in 1891, 1892, and 1893. By comparing these pipe-line runs with the statement of total production it will be seen that very nearly all of the oil produced in West Virginia passes through the Eureka pipe line. Of the 8,427,448 barrels of the common grades of crude oil produced in this State in 1893, 7,554,866 barrels passed through the Eureka pipe line. Of the 3,807,086 barrels of similar production in 1892, 3,666,062 barrels passed through the same pipe line.

Pipe-line runs of the Eureka, West Virginia, pipe lines from 1891 to 1893, by months.

[Barrels.]

Months.	1891.	1892.	1893.
January	....	182,558	520,164
February	93,847	173,897	502,657
March	216,503	174,260	629,575
April	212,192	169,247	538,751
May	218,397	194,887	567,731
June	206,941	250,807	574,535
July	209,968	319,023	601,369
August	218,137	394,251	745,899
September	201,352	404,654	743,807
October	205,702	446,050	720,573
November	194,811	448,244	685,333
December	206,523	508,184	724,472
Total	2,184,373	3,666,062	7,554,866

As a matter of interest we give the following statement showing the shipments or deliveries of crude petroleum by the Eureka pipe line for the same months and years as given in the above table of pipe-line runs. This, it will be noted, shows the total shipments in 1893 to be 521,662 barrels, while the total receipts were 7,554,866 barrels. This would indicate a stock on hand of about 7,000,000 barrels were all deliveries covered by the table of shipments. There were actually in stock in the tanks of this pipe line at the close of the year but 714,447 barrels. This is due to the fact that we have explained elsewhere, namely, that in the table of shipments or deliveries are included only those shipments or deliveries that are intended for consumption and not the shipments or deliveries of the pipe lines to other pipe lines.

Shipments of crude petroleum by the Eureka pipe line (West Virginia) from 1891 to 1893, by months.

[Barrels of 42 gallons.]

Months.	1891.	1892.	1893.
January	....	54, 851	39, 534
February	10, 544	50, 184	43, 875
March	44, 944	50, 082	27, 142
April	32, 050	22, 739	16, 386
May	49, 629	31, 196	66, 093
June	35, 101	53, 317	47, 846
July	47, 268	50, 855	54, 242
August	51, 163	42, 413	47, 701
September	52, 839	51, 265	36, 431
October	58, 355	61, 219	45, 064
November	61, 587	51, 641	52, 721
December	55, 538	46, 808	44, 627
Total	499, 018	566, 570	521, 662

In the following table is given the production of oil in West Virginia from the beginning of operations, so far as obtainable:

Production of petroleum in West Virginia.

Years.	Barrels.	Years.	Barrels.
Previous to 1876	3, 000, 000	1886	102, 000
1876	120, 000	1887	145, 000
1877	172, 000	1888	119, 448
1878	180, 000	1889	544, 113
1879	180, 000	1890	492, 578
1880	179, 000	1891	2, 406, 218
1881	151, 000	1892	3, 810, 086
1882	128, 000	1893	8, 445, 412
1883	126, 000		
1884	90, 000	Total	20, 481, 855
1885	91, 000		

INDIANA.

Indiana shares with West Virginia the credit of showing a remarkable increase in the production of petroleum in 1893 over 1892. The production of West Virginia in 1893 was some two and a half times that of 1892, while the output of Indiana in 1893 was more than three times its production in 1892, which was 698,068 barrels, as compared with 2,335,293 barrels in 1893. This puts Indiana fifth in rank of producing States, Pennsylvania being the first, Ohio second, West Virginia third, New York fourth, and Indiana fifth, displacing Colorado, which has dropped to the sixth place in rank of producing States.

With the exception of a small amount of oil produced near Terre Haute, Vigo county, the oil produced in Indiana is from an extension of the Lima district of Ohio. The producing wells are in Blackford, Jay, Wells, Adams, and Grant counties, though but little oil was produced in the last county in 1893. Four wells were drilled in this county, all of which were dry holes. Extensive developments are, however, being made there and they are likely to extend from the present fields into Howard and Tipton counties. Similar deposits of petroleum also occur in Royal Center, Cass county, and near Francisville, Pulaski county.

In the following tables will be found a statement of the production of petroleum in Indiana from 1889 to 1893:

Product of petroleum in Indiana from 1889 to 1893.

	1889.	1890.	1891.	1892.	1893.
Total production (barrels of 42 gallons)	33,375	63,496	136,634	698,068	2,335,293
Total value at wells of all oils produced, excluding pipage	$10,881	$32,462	$54,787	$260,620	$1,050,882
Value per barrel	$0.32⅝	$0.51⅛	$0.40	$0.37	$0.45

It is hardly necessary to call attention to the remarkable increase in production shown in the above table.

In the following table is shown the total production of petroleum in Indiana by months in the years 1891, 1892, and 1893. The highest production seems to have been in the month of October, 1893, when 252,568 barrels were produced:

Total production of petroleum in Indiana, by months, from 1891 to 1893.

Months.	1891.	1892.	1893.
	Barrels.	*Barrels.*	*Barrels.*
January	6,171	15,841	111,824
February	5,981	18,946	96,025
March	5,159	24,794	134,549
April	4,973	26,184	146,493
May	5,757	31,033	186,939
June	8,136	40,888	209,616
July	10,809	49,203	221,666
August	11,603	56,109	248,353
September	16,500	66,034	245,615
October	19,029	95,699	252,568
November	20,801	129,270	245,607
December	21,715	144,067	236,038
Total	136,634	698,068	2,335,293

In the following tables are given statistics of the total number of producing wells drilled, total number of new wells completed, total number of dry holes, and total number of wells drilling and rigs building in the Indiana oil fields for each month in 1893:

Total number of wells completed in Indiana in 1893, by counties.

Months.	Blackford.	Jay.	Wells.	Adams.	Total.
January	0	5	8	7	20
February	2	14	7	7	30
March	1	17	10	3	31
April	0	22	9	5	36
May	0	28	11	6	45
June	0	22	16	9	47
July	1	19	16	11	47
August	6	26	16	7	55
September	0	7	12	8	27
October	10	25	27	10	72
November	10	7	34	5	56
December	10	10	46	10	76
Total	40	202	212	88	542

Initial daily production of wells completed in Indiana in 1893, by counties.

Months.	Blackford.	Jay.	Wells.	Adams.	Total.
January	0	345	605	70	1,020
February	0	622	176	115	913
March	5	1,770	1,000	30	2,805
April	0	3,100	680	355	4,135
May	0	2,040	815	300	3,155
June	0	3,245	1,760	590	5,595
July	0	2,205	1,190	485	3,880
August	365	2,449	945	425	4,184
September	0	835	715	505	2,055
October	505	1,000	1,215	722	3,442
November	480	250	1,365	210	2,305
December	305	580	1,598	485	2,968
Average	138	1,537	1,005	358	3,038

Total number of dry holes drilled in Indiana in 1893, by counties.

Months.	Blackford.	Jay.	Wells.	Adams.	Total.
January	0	2	0	5	7
February	2	2	2	4	10
March	0	6	2	2	10
April	0	5	0	1	6
May	0	5	6	3	14
June	0	4	0	2	6
July	1	3	2	5	11
August	1	5	2	1	9
September	0	3	1	1	5
October	1	8	4	1	14
November	0	2	6	2	10
December	1	2	5	1	9
Total	6	47	30	28	111

Total number of wells drilling in Indiana in 1893, by counties.

Months.	Blackford.	Jay.	Wells.	Adams.	Total.
January	2	10	6	6	24
February	0	7	8	4	19
March	0	15	4	3	22
April	0	11	4	3	18
May	0	6	6	8	20
June	0	9	14	5	28
July	3	19	4	3	29
August	5	30	6	4	45
September	0	19	6	2	27
October	7	9	26	8	50
November	7	2	23	4	36
December	3	9	31	7	50
Average	2	12	12	5	31

Total number of rigs building in Indiana in 1893, by counties.

Months.	Blackford.	Jay.	Wells.	Adams.	Total.
January	0	8	3	1	12
February	0	9	1	5	15
March	0	9	6	2	17
April	0	9	4	1	14
May	0	7	10	0	17
June	0	16	6	4	26
July	7	18	7	0	32
August	3	19	2	4	28
September	0	4	3	2	9
October	1	3	18	3	25
November	1	0	24	2	27
December	1	7	17	5	30
Average	1	9	9	2	21

In the above table we have omitted Grant county, which has appeared in these tables in previous reports, for the reason, as stated elsewhere, that but four wells were drilled there in 1893, all of which were dry holes.

In the following tables are given the well records in the Indiana oil fields for 1891, 1892, and 1893:

Number of wells completed in the Indiana oil fields from 1891 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	......	......	......	......	......	......	6	6	15	15	15	8	65
1892	11	13	18	13	17	19	17	30	25	52	33	47	295
1893	20	30	31	36	45	47	47	55	27	72	56	76	542

Initial daily production of new wells in Indiana oil fields from 1891 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891	......	......	......	......	......	......	253	135	875	330	390	175	2, 158
1892	342	250	289	316	505	545	595	1, 295	2, 145	4, 155	3, 050	3, 160	16, 647
1893	1, 020	913	2, 805	4, 135	3, 155	5, 595	3, 880	4, 184	2, 055	3, 442	2, 305	2, 968	36, 457

Total number of dry holes drilled in Indiana oil fields from 1891 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891 ...	......	......	......	......	......	......	0	2	5	4	3	1	15
1892 ...	2	6	6	2	3	4	2	3	3	18	6	21	76
1893 ...	7	10	10	6	14	6	11	9	5	14	10	9	111

Number of wells drilling in the Indiana oil fields at the close of each month from 1891 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891 ...	......	......	......	......	......	......	5	13	12	8	4	12	9
1892 ...	17	15	11	12	13	16	11	16	23	23	26	24	17
1893 ...	24	19	22	18	20	28	29	45	27	50	36	50	31

Rigs building in the Indiana oil fields from 1891 to 1893, by months.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1891 ...	......	......	......	......	......	......	7	2	12	8	6	6	7
1892 ...	8	18	23	23	17	21	16	15	29	31	39	19	22
1893 ...	12	15	17	14	17	26	32	28	9	25	27	30	21

COLORADO.

All of the oil produced in Colorado is from what is known as the Florence field. Oil in Colorado is found under very different conditions from those which occur in Pennsylvania and Ohio. There are no pools, as the word is understood in the East, but the oil seems to flow through crevices or shattered strata to the drill hole. The oil is a heavy one, being about 31° B. It contains little or none of the lighter hydrocarbons, all the products that pass over in refining being sold as illuminating oil. Nor does the oil deposit any B. S. It yields in refining from 35 to 44 per cent. of illuminating oils of about 125° fire test.

In the following table will be found a statement of the production of crude oil in Colorado from 1887 to 1893:

Product of crude oil in Colorado from 1887 to 1893.

Years.	Barrels.
1887	76,295
1888	297,612
1889	316,476
1890	368.842
1891	665,482
1892	824,000
1893	594,390

There is little demand for this oil except at the local refineries of the producing companies. Therefore the price is a nominal one. The several companies producing oil, however, have placed a price upon it which makes the average value of the production 83¾ cents a barrel. This makes the total value of the production in Colorado in 1893, $497,802.

It will be noted that in the last three years there has been a decided decline in the production of oil in Colorado. In 1891 there were 665,482 barrels produced, which increased to 842,000 barrels in 1892, but fell to 594,390 barrels in 1893.

CALIFORNIA.

The petroleum fields of California, where oil was found in merchantable quantities in 1892, were exclusively within the boundaries of the southern counties, though oil has been found in many other parts of the State. The most important of these districts are the Santa Paula region, in which are found the Ojai, Sespe, Ex-Mission (which includes the Adams and other districts), the Torry Cañon, in the San Fernando mountains, 22 miles west of Newhall, the San Fernando district, including the Pico, Wiley, and Elsemere fields, and the Puente district, in which only one field, the Puente, is found; the wells in the Santa Paula subdistrict of the southern fields are in Ventura county; the Puente and Pico subdistricts are in Los Angeles county. Oil has also been found in Bakersfield, Kern county. The chief production at this point is asphalt, but some maltha or asphaltic oil is also produced.

The petroleum fields of California are the most interesting in the United States. In many respects they differ entirely from any other fields yet opened. The oil, with the exception of that from Santa Clara, has usually, as its base, asphaltum instead of paraffine. The Pacific Coast Oil Company at one time pressed paraffine wax from the Santa Clara oil, but the low price of the wax and the reduction in the production of the crude compelled them to discontinue this product. The strata in which the oil is found are tilted at a high angle. Drilling is difficult and expensive, owing to the character of the rock and angle at which the oil-bearing strata stand. The oil, while carrying but a small proportion of the illuminating hydrocarbons, finds a ready market as fuel, owing to the high price of coal in California, and it contains practically no sediment.

Notwithstanding the price of coal in California, the increase in production in petroleum, and other causes, have led to a decrease in price, and the value of the petroleum produced in 1893 in California was but $1.29 a barrel at the wells.

The oil fields of southern California were so thoroughly described in "Mineral Resources of the United States, 1892," that it is not necessary to repeat the description here.

Production of petroleum in California.

Years.	Barrels.	Years.	Barrels.
Previous to 1876	175,000	1885	325,000
1876	12,000	1886	377,145
1877	13,000	1887	678,572
1878	15,227	1888	690,333
1879	19,858	1889	303,220
1880	40,552	1890	307,360
1881	99,862	1891	323,600
1882	128,636	1892	385,049
1883	142,857	1893	470,179
1884	262,000		

ALABAMA.

The following contribution to the knowledge of the oil fields of Northern Alabama has been contributed by Dr. C. Willard Hayes, of the Geological Survey, as the result of his geological work in this region:

But little exact information concerning the geology of the region between Decatur and Florence is obtainable. Most of it is contained in Smith's Outline of the Geology of Alabama, 1878, and McCalley's Report on the Coal Measures of the Plateau region of Alabama, 1891.

The rocks of Northern Alabama west of Brown's valley are wholly of Carboniferous age with the exception of a few narrow points of devonian and silurian rocks which extend southward in an anticlinal arch, which is the southward continuation of the broad arch forming the basin of central Tennessee. From observations made by McCalley in the southern formation of Franklin and Lawrence counties it seems probable that this broad arch dies out toward the south in a number of narrower anticlinal arches whose axes extend northeast and southwest in a general way parallel with Brown's valley.

The geological conditions therefore seem highly favorable for oil and gas in this region.

In the first place the whole region is underlain by the Chicamauga (Trenton) limestone, similar to that which is elsewhere highly productive. The limestone is overlain by 300 to 500 feet of impervious argyllaceous shales. Where these formations are exposed by the erosion of a sharp anticlinal a few miles eastward in Brown's valley, there is a stratum of coarse, porous sandstone between the limestone and shale. This is often saturated with bitumen at the surface. If this bed of sandstone is continuous to the westward it will probably be found acting as a receptacle for petroleum derived from the underlying limestone. It was probably from this bed that the oil was obtained in the Moulton valley well, described in Mineral Resources of the United States, 1889 and 1890, page 363.

The second favorable condition in this region is that the strata apparently form gentle folds which afford the conditions necessary for the accumulation of large quantities of oil and gas. Also, the strata west of Brown's valley are not so fractured by faulting as to permit the escape of these products.

The distance from the surface to the possibly productive horizon depends on the location of the well and in general increases southward, since the general dip of the strata and pitch of the anticlinal axes are in that direction. The thickness of the strata to be penetrated is approximately as follows: Bangor limestone, including the Oxmoor sandstone which is variable in position and thickness, 1,000 to 1,200 feet; Fort Payne chert, 200 to 300 feet; Chattanooga black shale (Devonian), 35 to 60 feet; and Rockwood shale, 300 to 500 feet. The location of the well would determine how much of the Bangor would have to be penetrated. If it were near the edge of the coal measures which occupy the plateau the whole formation would have to be drilled, while near the Tennessee River, where the Fort Payne chert is exposed, the thickness would be correspondingly decreased. It is a comparatively easy matter, however, to determine approximately the depth of the Trenton at any point.

In the exploration of this field it is of the utmost importance to recognize the fact that the location of accumulations of oil is determined by the underground structure and that if such accumulations exist they may or may not coincide with the surface indications such as oil or tar springs. The source of this tar is comparatively superficial in the Limestone from which it flows. And in this particular region this carboniferous limestone is too far eroded to contain accumulations of commercial importance, although it may be productive further south where it is covered by a continuous sheet of Coal Measure rock. Hence a very careful examination of the region should precede the location of test wells. Its geological structure should be worked out so far as possible from surface dips and the anticlinal axes carefully located. By this method a small number of test wells will fully establish the possibilities of the region more satisfactorily than a much larger number located at random, and at a fraction of the cost.

KANSAS.

About the first of January, 1894, considerable attention was directed to the southeastern portion of Kansas as a promising field for oil and gas. A large area of land has been leased and a number of wells drilled. These wells have been put down over a wide area in order to define the limits of the field. The territory is both an oil and gas district, and generally gas is found if oil is not. The gas sand is white or greyish pebble, usually about 120 feet below the oil sand. The latter is found at 750 to 900 feet and is from 10 to 30 feet thick; lying in the carboniferous or Upper Coal Measures, the color of the sand is similar to that in the Bradford field. The oil, however, resembles the Lima product, except that it has an asphalt base, like California oil, though not as strong, and it probably will be used largely for fuel as it gives only about 45 per cent of refined. The gravity of the crude is about 38°.

The situation in April, 1894, is as follows: "Neodesha, in Wilson county, is at present the center of operations. Here 5 wells, not far from each other, have been fitted up for pumping, 4 of them having been shot lightly. They pump on an average 12 barrels a day each. Recently there have been drilled perhaps 15 test wells within this field but 16 miles from Neodesha, which are as good producers as those at the latter place. Some were drilled to the gas sand and show a rock pressure of 400 pounds with a volume of 1,000,000 feet. A well drilled 2 miles south of Thayer, in Neosho county, is virtually dry. One drilled at Chanute, in the northern edge of the county, about on the line between Neosho and Allen counties, and 16 miles north of Thayer, showed regular formations but the tools were lost in the top of the sand, resulting in a long fishing job. There is a well at Earleton, midway between Thayer and Chanute, which is nearly down and is showing good prospects. The chief operators in this territory have the material on the ground to drill 40 additional wells and they will proceed to give the territory a thorough test. They also have a 35,000-barrel iron tank."

OTHER STATES.

For statements regarding the production of petroleum in States other than those already described, in which the production has been exceedingly small, those interested are referred to previous volumes of Mineral Resources and the report of the Eleventh Census on the "Mineral Industries in the United States." The statements regarding production in these States in 1893 will be found on page 5, and for the years prior to 1893 in the table on the production of petroleum in the United States given on page 7.

CANADA.

The petroleum of Canada partakes somewhat of the character of that from the Lima-Indiana field of the United States. Most of the commercial oil produced in Canada is from Lambton county in Ontario, in which two distinct pools have been developed, known as the Oil Springs and Petrolia, both in the township of Enniskillen. The larger, the Petrolia field, has an area of some 26 square miles; the smaller, the Oil Springs field, covers about 2 square miles near Oil Springs. According to the report of Mr. H. P. H. Brumell, of the Geological Survey of Canada, to which we are indebted for many of the facts of this statement, these pools are divided by a very distinct synclinal structure. The oil horizon of Petrolia lies at a depth of from 450 to 480 feet beneath the surface of the main part of the town of this name, the oil being pumped in all instances from what is known as the lower vein at a point about 65 feet in the Corniferous limestone. The following record may be taken as typical of the wells sunk in the Petrolia field:

Well sunk near the Imperial refinery, Petrolia, Ontario.

Character of beds.	Feet.	Formation.
Surface	104	Hamilton.
Limestone (upper lime)	40	
Shale (upper soapstone)	130	
Limestone (middle lime)	15	
Shale (lower soapstone)	43	
Limestone (lower lime)	68	
Limestone, soft	40	Corniferous.
Limestone, gray	25	

Wells have been sunk deeper in the expectation of finding oil; in all cases, however, without success.

At Oil Springs the petroleum is found at some 370 feet from the surface, or about 60 feet below the summit of the Corniferous limestone. The following record is given by Mr. Brumell as illustrating the geology of the wells in the Oil Springs pools:

Record of a well sunk in the Oil Springs pool, Ontario.

Character of beds.	Feet.	Formation.
EAST SIDE OF FIELD.		
Surface	60	Hamilton.
Limestone (upper lime)	35	
Shale (upper soapstone)	101	
Limestone (middle lime)	27	
Shale (lower soapstone)	17	
Limestone (lower lime)	130	
WEST SIDE OF FIELD.		
Surface	80	Hamilton.
Shale (upper soapstone)	116	
Limestone (middle lime)	27	
Shale (lower soapstone)	17	
Limestone (lower lime)	130	

The petroleum from these wells is a dark brown heavy oil, ranging in gravity from 31½° to 35° Baumé the heavier oil being obtained in the Petrolia field, while the lighter is produced at Oil Springs and a small pool of Euphemia township. In the latter township some forty or fifty wells have been sunk and small quantities of oil obtained. The field is small, the largest flow from an individual well being but a barrel a day.

The crude oil has a peculiar odor of sulphur compounds, though the form in which the sulphur exists has not yet been determined. The actual commercial results of refining Canadian oil in 1889, according to the returns of the refiners made to the Government during that year, were as follows:

Products obtained in refining Canadian petroleum in 1889.

Products.	Per cent.
Illuminating oils	38.7
Benzine and naphtha	1.6
Paraffine and other oils (including gas, paraffine black and other lubricating oils, and paraffine wax).	25.3
Waste (including coke, tar, and heavy residuum)	34.4
Total	100.00

Attention was first drawn to the oil fields of Ontario in 1860 or 1861 by what was known as black rock oil accumulating in considerable quantities on the surface of water in certain wells near Oil Springs. Search for oil began by increasing the depth of the wells, it being found that the deeper the wells were sunk the greater accumulation of oil. Drilling was then resorted to and wells were bored into the rock. The first flowing well was struck on February 19, 1862, at Oil Springs, at a depth of 160 feet in what is known as the upper vein. The usual excitement and speculation followed. In 1867, with the discovery of the King wells, the business reached a solid foundation. The price of oil fell to 20 cents a barrel, but means were found to store the surplus. Dr. Alexander Winchell gives a list of thirty-three flowing wells in Enniskillen township and their capacity, prior to 1867. The daily flow of these wells was from 200 to 7,500 barrels, fifteen of them showing a daily production of over 1,000 barrels.

The statistics of production in the Ontario oil fields are not all satisfactory. In the following table is given a statement of the shipments of petroleum from Petrolia, Ontario, for each month in 1892 and 1893. Part of the oil, it will be noticed, is reported as shipped crude and part as refined, the refined being reduced to its crude equivalent and added to the amount of crude shipped given in the third column under each year, which is the total crude equivalent of all the oil shipped. Comparison of this table with the reports compiled by the Geological Survey Department of Canada would indicate that these reports of shipment are in excess of the actual production from year to year, probably as the result of duplications. The shipments are given in barrels of 35 imperial gallons, this being practically the equivalent of the American barrel of 42 Winchester gallons.

Shipments of crude petroleum and refined petroleum reduced to crude equivalent from Canada in 1892 and 1893.

Months.	1892.			1893.		
	Crude.	Refined.	Crude equivalent.	Crude.	Refined.	Crude equivalent.
January	17,441	24,731	79,218	23,671	28,834	96,756
February	14,577	18,073	59,759	22,905	19,809	77,070
March	16,570	19,469	65,217	17,891	22,405	73,903
April	12,542	15,145	51,704	16,131	16,532	57,460
May	15,045	8,665	61,897	19,031	19,476	67,721
June	15,225	17,510	58,000	16,023	16,793	58,025
July	13,289	19,562	62,193	16,945	19,510	67,520
August	15,370	28,077	85,562	17,511	26,860	84,661
September	17,264	39,736	117,605	19,109	35,967	109,027
October	20,517	44,010	130,542	23,407	49,266	146,572
November	21,787	39,005	129,299	26,455	39,766	125,870
December	19,011	30,383	95,168	25,685	30,354	100,570
Total	198,409	308,910	1,007,271	244,763	325,572	1,066,155

In the following table is given a statement of the production of petroleum in Canada in the years 1886 to 1891, and the value of the same. These figures, it is stated, are calculated from the official inspection returns, and the values are computed at the average yearly price per barrel of 35 imperial gallons.

Production and value of petroleum in Canada from 1886 to 1893.

[Barrels of 35 imperial gallons.]

Years.	Production.	Value.
1886	486,441	$437,797
1887	763,933	595,868
1888	733,564	755,571
1889	639,991	612,101
1890	765,029	902,734
1891	755,298	1,004,596
1892	779,753	982,489
1893	798,406	834,344

The average closing prices of petroleum for each year from 1887 to 1891 on the Petrolia Oil Exchange, together with the total sales for the year on this exchange, are as follows:

Average price and sales of crude petroleum in the Petrolia Oil Exchange from 1887 to 1891.

Years.	Price.	Sales.
1887	$0.78	406,203
1888	1.02¾	516,007
1889	.92¾	400,932
1890	1.18	394,924
1891	1.33¾	377,453

In the following table will be found a statement of the average closing prices for crude oil on the Petrolia Oil Exchange for each month in 1892 and 1893 and for the first three months of 1894.

Average closing price of crude petroleum on the Petrolia Oil Exchange in 1892 and 1893 and part of 1894, by months.

Months.	1892.	1893.	1894.
January	\$1.29½	\$1.18¼	\$1.01½
February	1.29	1.18¾	1.01
March	1.27¾	1.19	1.00
April	1.26¼	1.19	....
May	1.25¾	1.07	....
June	1.27¼	1.07	....
July	1.26¾	1.06	....
August	1.26	1.05	....
September	1.26	1.04½	....
October	1.26¾	1.04	....
November	1.25	1.04	....
December	1.18½	1.02	....

The stocks of petroleum on hand in warehouse tanks at the close of 1893 was 77,000 barrels.

As a matter of interest, the following statement is included of the operations of the refineries of Canada for the years 1890 and 1891:

Production of Canadian oil refineries in 1890 and 1891.

[Imperial gallons.]

Products.	1890.		1891.	
	Quantity.	Value.	Quantity.	Value.
Illuminating oils ....gallons..	11,129,277	\$1,264,677	10,427,040	\$1,170,241
Benzine and naphtha ....do....	636,247	37,026	603,971	36,790
Paraffine oils ....do....	446,888	64,713	622,287	75,772
Gas oil ....do....	4,246,447	84,752	3,373,720	89,267
Lubricating oils and tar............do....	2,877,388	130,349	2,500,000	101,752
Paraffine wax............pounds..	913,730	56,903	741,611	60,687
Total	....	1,638,420	....	1,534,509

The following table shows the amount of Canadian oils and naphtha inspected, together with the amount of crude that is assumed as the equivalent of the refined oils and the ratio of crude to refined.

Canadian oils and naphtha inspected and corresponding quantities of crude oil.

Fiscal years.	Refined oils inspected.	Crude equivalent calculated.	Ratio of crude to refined.
	Gallons.	*Gallons.*	
1881	6,406,783	12,813,566	100:50
1882	5,910,787	13,134,993	100:45
1883	6,970,550	15,490,111	100:45
1884	7,656,011	19,140,027	100:40
1885	7,661,617	19,154,042	100:40
1886	8,149,472	21,445,979	100:38
1887	8,243,962	21,694,637	100:38
1888	9,545,895	25,120,776	100:38
1889	9,462,834	24,902,195	100:38
1890	10,121,210	26,634,763	100:38
1891	10,270,107	27,026,597	100:38

PERU.

Quite recently the Peruvian petroleum fields have assumed considerable importance. The oil from those fields is of a good grade and the refined is displacing that of the United States in many of the Pacific coast markets, and recently it has been asserted that arrangements are being made to send it in quantities to California for fuel. Through the kindness of Mr. J. C. Tweddle, jr., we are enabled to give the following description of the Peruvian fields:

"The probable petroleum-bearing zone of Peru extends from Sechura on the south to Ecuador on the north, or, say, a distance of 200 miles, more or less. The width of the available belt is limited between the first outcrop of volcanic rock and the seashore, being widest probably about Point Parinas, the most westerly extremity of South America, and from there gradually tapering in width toward each extremity where the belt dips under the sea. It is to be remarked that the petroleum-bearing stratum lies under a marine deposit, or what has been an old sea bed, and which, judging from its level and unbroken surface, has been raised very gradually to its present position, and forms an entirely distinct geological district from the rest of the coast, which consists mostly of eruptive and metamorphic rock. In fact, it may be said that the whole of this district consists of an overlying crust torn away from the sea bottom as the land rose from under the ocean bed. Whether petroleum exists in sufficient quantity in all parts of this zone to render its extraction profitable, is problematic. To the writer it appears that both the northern and southern extremities approach too near to the volcanic or eruptive rocks to allow petroleum to exist in large quantities. Experience seems to bear this out, since the only well that has been sunk near Sechura, the southern extremity, was a failure and has been abandoned, oil having been met in only small quantities. In the northern portion the position is more or less the same, and the writer has been informed that the several companies which have worked there have met with but indifferent success.

"In the central zone some twenty wells have been sunk within the last three years at Negritos, all of which have proved very productive; the last well, finished in April of the present year [1893], flowed consecutively upwards of a thousand barrels a day from a depth of 500 feet. This is the largest well yet found, and leads one to believe that the Negritos wells are approaching more productive strata.

"It is impossible to speak authoritatively as to the extent of territory where petroleum exists in sufficient quantity to repay the prospector. The certainty is that from Point Parinas, on the sea, to a distance inland of at least 16 to 20 miles there are continuous oil-bearing strata which have been worked since the times of the Incas, here and there, where the petroleum comes to the surface. The wells which have been drilled in this zone have been very productive and long lived, though only averaging 500 feet deep. A peculiarity about the wells at Negritos is that if pumping on any well is stopped it soon fills up to the surface and overflows very gently, thus showing that there must be a very great pressure tending to force the oil to the surface. Another peculiarity is that, though within a few hundred yards of the sea, water is never met with in any of the bore holes. In the writer's opinion, there exists no petroleum region better situated than that of Peru, both from its close proximity to the sea and its healthy and equable climate; and it is certain that in the near future it will be extensively worked, and no doubt when once the business has been developed in a large and comprehensive manner, petroleum will be produced and sold at a very cheap rate.

"The western coast of South America is devoid of coal within workable distance of the ports (except in the south of Chile, and there the quality is poor). The price of coal fluctuates greatly, owing to change in freight rates both in Australia and England, but a very fair low average price for coal in cargo lots may be taken at 25 shillings a ton or, say, $6 in gold. If a ton of oil is equal in calorific value to two tons of coal, then coal at $6 a ton would be equal to oil at $1.70 a barrel.

"The writer has not the slightest doubt but that oil can be produced and sold free on board in Peru for one-half the above price, as soon as the business will have been properly developed. Peruvian petroleum is admirably adapted for fuel, since it has a very high calorific value, and by distilling off 30 to 40 per cent. of the lighter products a residuum with a fire test of 300° is obtained. This residuum is known on the coast by the name of 'fuel oil,' and is being extensively used for fuel in various factories, mills, and railroads. The gravity of the oil as it comes from the wells is 38° to 39° Baumé, and is of green color.

"Peruvian petroleum can hardly be distinguished from Franklin oil, and possesses the same peculiarities, namely, a very fine natural lubricating oil and no paraffine."

From another source it is learned that in 1888, 23 mining claims for petroleum were registered; in 1889, 36; in 1890, 97; and in 1891, 613.

The first shipments of refined petroleum from Talara, which is near Payta, was in December, 1889. The following figures will give an idea of the shipments of Peruvian petroleum in the years 1889 and 1890.

Exports of Peruvian petroleum in 1889 and 1890.

Grade.	1889.	1890.
	Kilos.	*Kilos.*
Crude	2,151,874	2,324,219
Kerosene (illuminating oil)	999,658	1,199,161
Lubricating (clear oil)	457,799	1,115,677

The above exports were from Zorritos. From Talara the exports in 1890 consisted of 1,100 tons of crude oil in tanks, 46,589 cases of kerosene, and 4,000 barrels of lubricating oil. This would indicate a production in 1890 of some 350,000 barrels of oil.

RUSSIA.

Though crude petroleum, or naphtha, as it is termed in Russia, has been found in quantities in a number of localities in that country, chiefly in the Caucasian region, it is only near Baku, on the Caspian sea, that it is produced in large amounts, and it is only the oil from this district that at present comes into competition, outside of Russia, with oil from the United States. More than 90 per cent. of all the oil produced in Russia, and all the exports are, from Baku.

Extent of the Baku oil fields.—The Baku oil fields, so called from the chief city of the district, though no oil is found at Baku, are on the Apsheron peninsula, a bold promontory that thrusts itself out some 50 miles into the Caspian sea, near its southwestern shores. This peninsula, which is some 20 miles wide, is the eastern terminus of the Caucasus mountains, which here pass under the waters of the Caspian. The chief producing localities in this field are two, one near and in the clustered villages of Balakhany, Saboontchy, and Romany, some 10 miles northeast of Baku, and the second at Bibi-Eibat, some 6 miles southeast of Baku. The oil-producing territory in the first field, which has been well defined, does not exceed 1,496 acres (544 dessiatines), while the Bibi-Eibat district is less than 300 acres. From this small area of less than 1,800 acres all of the enormous production of the Baku field has been derived.

Production.—The data regarding the production of crude petroleum in Russia is only approximately correct. Statements made by different authorities differ considerably. I have taken the figures of the Council of the Congress of Russian Petroleum Producers, which are given in millions of pouds. In reducing these to barrels I have assumed that the average gravity of Russian oil is 0.875 and that an American barrel of 42 gallons contains 10.18 pouds.

Two distinct statements of production of Russian crude petroleum are given, one known as "total production," which includes not only the crude collected and refined or sold as fuel oil, but also an estimate of the oil wasted or not collected, as well as that used for fuel for pumping at the wells. The second statement shows "profitable production," that is, the amount of crude oil put into tanks or reservoirs.

The "total production" of crude petroleum on the Apsheron peninsula and the shipments of the chief petroleum products from Baku from 1880 to 1893 have been as follows:

"Total production" of crude petroleum on the Apsheron peninsula and shipments of petroleum products from Baku from 1880 to 1893.

Years.	Production.	Shipments from Baku.			
		Illuminating.	Lubricating.	Residuum.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1880	2, 455, 000	785, 000	....	697, 000	1, 482, 000
1881	3, 929, 000	1, 257, 000	....	913, 000	2, 170, 000
1882	4, 911, 000	1, 326, 000	30, 000	1, 768, 000	3, 124, 000
1883	5, 893, 000	1, 473, 000	112, 000	1, 846, 000	3, 431, 000
1884	8, 841, 000	2, 161, 000	147, 000	2, 868, 000	5, 176, 000
1885	11, 394, 000	2, 946, 000	157, 000	3, 330, 000	6, 433, 000
1886	14, 734, 000	3, 438, 000	167, 000	3, 555, 000	7, 160, 000
1887	16, 208, 000	4, 322, 000	226, 000	4, 076, 000	8, 624, 000
1888	18, 860, 000	4, 911, 000	255, 000	5, 746, 000	10, 912, 000
1889	20, 137, 000	6, 001, 000	324, 000	8, 703, 000	15, 028, 000
1890	23, 477, 000	6, 611, 000	452, 000	9, 538, 000	16, 601, 000
1891	28, 290, 000	7, 269, 000	501, 000	10, 157, 000	17, 927, 000
1892	29, 273, 000	7, 730, 000	551, 000	11, 473, 000	19, 754, 000
1893	33, 104, 126	8, 430, 255	....	14, 096, 267	24, 381, 139

This table gives the total production and the total shipments from Baku both to Russian ports and to other countries and may be regarded as showing the total production of crude and refined oils and residuum in the district and in the years named.

The "profitable production" for the last five years is shown in the following table:

"Profitable production" of crude petroleum in the Apsheron peninsula from 1889 to 1893.

[Barrels of 42 gallons.]

Years.	Production.
1889	18, 882, 000
1890	22, 229, 000
1891	26, 926, 000
1892	28, 132, 000
1893	31, 888, 000

The divisions of this profitable production among the four subfields on the Apsheron peninsula are as follows:

"Profitable production" of the several fields of the Apsheron peninsula from 1889 to 1893.

Fields.	Production in barrels.				
	1889.	1890.	1891.	1892.	1893.
Balakhany	6, 760, 000	6, 218, 000	6, 289, 000	5, 648, 000	5, 677, 000
Saboontchy	10, 373, 000	14, 096, 000	16, 012, 000	15, 196, 000	14, 365, 000
Romany	....	147, 000	1, 277, 000	4, 027, 000	7, 180, 000
Bibi-Eibat	1, 749, 000	1, 768, 000	3, 348, 000	3, 261, 000	4, 666, 000
Total	18, 882, 000	22, 229, 000	26, 926, 000	28, 132, 000	31, 888, 000

Wells and their production.—There are two classes of so-called wells in the Baku district, "pumping" and "flowing," or wells worked by "bucketing," and those that flow. In the former, pumping is by means of large, deep buckets or pumps, with valves which are operated by windlass or steam and which bring to the surface at a "stroke" as much as a barrel of crude oil and water. This empties itself into a gutter and the oil, after separation from the water, is conducted into reservoirs. A shift of workmen at these wells is never less than three.

The flowing wells are the well-known Baku fountains, some of which have given and continue to give some hundred thousand pouds a day, say 10,000 barrels.

The production of crude petroleum from pumping and flowing wells in the last five years is as follows:

Production of crude oil from pumping and flowing wells from 1889 to 1893.

Years.	Pumping.	Flowing.
	Barrels.	*Barrels.*
1889	14,705,000	4,184,000
1890	17,347,000	4,872,000
1891	23,123,000	3,831,000
1892	20,707,000	7,436,000
1893	21,168,000	10,726,000

While for some years prior to 1892 the percentage of crude from flowing wells decreased, it will be seen that in 1892 and 1893 it has increased rapidly. In 1890 it was only about 15 per cent. In 1892 it was over 26 per cent., and in 1893 it was nearly 34 per cent. Indeed, according to Mendeljeef, to whose report on Russian naphtha we are indebted for much of the information made use of in this statement, the more recent flowing wells "are more abundant in naphtha than formerly."

Number of producing wells and their average production.—The total number of wells that produced crude petroleum during any part of the years named was as follows:

Number of producing wells on the Apsheron peninsula from 1889 to 1893.

Years.	Wells.
1889	278
1890	356
1891	458
1892	448
1893	458

Out of the 458 wells which yielded crude oil in 1891 but 132 produced the entire year, 188 six to eleven months, and 136 less than half the year. Production can be stopped at the pumping wells without serious injury to the well. Of the 458 wells in 1891, 308 were old wells and 150 new. The average yield of the former was 59,000 barrels a year; of the latter, 58,000 barrels.

The average depth of wells worked in 1891 was 715 feet. Quite a number were from 300 to 450 feet, and a few from 975 to 1,050 feet.

The largest number of wells in operation in any one month during 1893 was 332, the number producing in March of that year. The statement of the number of producing wells for each of the months in 1893 is as follows:

Number of producing wells in Russia in 1893 by months.

Months.	Number of wells.	Months.	Number of wells.
January	322	August	294
February	326	September	298
March	332	October	310
April	323	November	316
May	325	December	324
June	310		
July	307	Total	458

It should be understood that these figures represent the number of wells in operation during any one month, the total representing the total number of wells that were operated at any time during the year.

The number of wells drilling during each month of 1892 and 1893 and the number completed during year were as follows:

Number of wells drilling and completed in Russia in 1892 and 1893, by months.

Months	1892.	1893.
January	141	62
February	131	57
March	127	69
April	117	64
May	94	69
June	84	73
July	44	69
August	45	64
September	52	58
October	45	59
November	50	58
December	58	59
Total completed	200	175

In the following table is given a statement of the deep wells drilled in each year from 1890 to 1893, together with the total depth, in sagenes of seven feet, that the wells were drilled, and the average depth of the wells in feet:

Total number of wells and deep wells drilled in Russia from 1890 to 1893, with length in sagenes and average depth in feet.

Years.	Total number of wells.	Number of deep wells.	Total length in sagenes.	Average depth in feet.
1890	231	50	14,810	449
1891	292	87	19,980	478
1892	200	111	11,670	408
1893	175	102	10,984	439

Refining statement.—The latest complete statement regarding refining petroleum in Russia is as follows:

Statement of the number of petroleum refineries, their product, etc., in Russia in 1890 and 1891.

At the Apsheron peninsula.	1890.	1891.
Total number of works	149	135
Number of works active	103	100
Number of works inactive	46	35
Amount of crude treated at these works in barrels	21,611,000	24,263,000
Amount of naphtha obtained at these works in barrels	50,000	50,000
Amount of kerosene of different kinds, barrels	6,876,000	7,760,000
Amount of lubricating oil obtained	541,000	609,000
Total production of distillation products	7,467,000	8,419,000
Percentage of distillation products obtained	34·5	34·7

Price of crude oil.—The latest statement at hand of the price of crude oil is for 1892. At the close of this year the price was 2¾ copecks per poud for crude, or about 11 cents per barrel of 42 gallons. It is stated that in this year refined oil free on board cars at Baku sold for 9 copecks per poud, or about nine-tenths of a cent a gallon. The party from whom this report was received states that refined oil sold in 1891 at one-half a cent a gallon. The advance in 1892 over 1891 was stated to be due to large contracts having been made by refiners for the delivery, for a term of five years, of refined oil to a foreign firm heavily engaged in the foreign trade at a price of 9 copecks per poud, or nine-tenths of a cent a gallon, upon a basis of 2 copecks per poud, or 8½ cents per barrel of 42 gallons, as the market price of crude. The quantity of refined they contracted for was said to have been 100,000,000 gallons per annum, or about four-fifteenths of the total refined production of 1892.

From a reliable party we have the following statement as to the prices of Russian refined oil per gallon in bulk at Batoum for each month from 1890 to the close of 1893. It should be said that these figures are simply general averages and must not be understood to be accurate to close decimals. It is difficult to convert Russian quotations into American equivalents, owing to the frequent and marked fluctuations in the rates of exchange. The price at Baku is figured to be on an average $2\frac{1}{10}$ cents per gallon less than at Batoum, the freight and charges between the two points averaging that figure. This made the price of refined oil at Baku at the close of 1893 a little over one-half cent a gallon.

Price of Russian refined oil in bulk at Batoum from 1890 to 1893, by months.

[Cents per gallon.]

Months.	1890.	1891.	1892.	1893.
January	5.14	3.92	2.97	2.95
February	5.03	3.53	2.94	2.84
March	4.86	3.53	3.13	2.95
April	4.89	3.44	2.80	....
May	4.57	3.28	2.62	....
June	4.55	3.20	2.46	2.63
July	4.66	2.88	2.47	2.71
August	4.77	2.67	2.50	2.63
September	5.21	2.63	2.77	2.66
October	4.73	2.73	2.71	2.63
November	4.55	2.92	2.65	2.63
December	4.29	....	2.85	2.68

The authority giving the above statement writes: "There are no regular quotations on Russian crude oil. The prices are usually so little that they are hardly worth considering. They range to-day (January 8, 1894) from $1\frac{1}{4}$ to 2 copecks per poud, the equivalent of from $5\frac{2}{10}$ to $8\frac{3}{10}$ cents per barrel of 42 gallons.

From the report on the industries of Russia, prepared for the World's Columbian Exposition, the following statement as to the yield of Russian oil when distilled in the usual manner, without cracking, is given:

Products of Russian crude petroleum.

Products.	Per cent.
Light oils	5 to 7
Kerosene (illuminating oils)	27 to 30
Solar (heavy illuminating oil)	13 to 15
Lubricating oils:	
Spindle	7
Machine	18 to 25
Cylinder	2 to 5
Vaseline	1

When the petroleum is refined for the purpose of producing illuminating oil the following is said to be the result:

Products of Russian petroleum when refined for illuminating oil.

Products.	Per cent.
Kerosene	35·00
Residuum	55·00
Light oils and waste	10·00
	100·00

The largest refining works at Baku belong to the Nobel Brothers. In 1890 these works produced 17,964,400 pouds of various petroleum products.

The total number of persons employed in the petroleum industry in Russia in 1890 was 10,503, of which number 4,509 were employed at refineries.

Though, as has been stated heretofore, almost all of the petroleum produced in Russia is from the Baku field, there are a number of other fields which promise largely in the way of production. In the following table will be found a statement of the production of crude petroleum in pouds in the governments and provinces other than Baku in the years 1889 and 1890:

Production of crude petroleum in Russia, in governments and provinces other than Baku, in 1889 and 1890.

Governments and provinces.	1889.	1890.
	Pouds.	*Pouds.*
Kouban	1,381,942	1,813,327
Trans-Caspia	286,400	285,000
Tersk	275,721	370,800
Tiflis	55,296	46,444
Daghestan	3,955	2,780
Tauride	3,603	29,168
Elisabetpol	3,000	11,000
Fergan	1,425	2,106
Total	2,011,342	2,560,625

GALICIA.

The oil zone of Galicia is situated on the northern flank of the Carpathians, and extends from Neusandez, on the west, to Sloboda-Rungorska, near Kolomea, on the east, a distance of about 220 miles, the oil belt being about 40 miles in width.

From a paper by Mr. Boverton Redwood, published in the Journal of the Society of Chemical Industry, we condense the following brief statement regarding Galician petroleum:

From the earliest times of which there are any historical records, crude oil seems to have been collected and used in Galicia, which is a part of Poland that fell to Austria in the division of that country. It was used for cart grease and as a remedial agent, and later was mixed with small coals to form briquettes. It was not, however, until the manufacture of oil for use in lamps was commenced that the industry assumed commercial importance. Between 1810 and 1818 systematic attempts were made in Galicia to establish the industry of refining oil. A refinery was built in Kabicza, which supplied Prague with 300 cwt. of oil annually, which was sold at 35 florins a hundredweight. In 1853 Galician petroleum was substituted for candles in lighting the stations of Emperor Ferdinand's North Railroad. In 1854, five years before Drake drilled the first well in the Pennsylvania petroleum regions, refined oil was an article of commerce in Vienna.

The petroleum of Galicia occurs in both coarse and fine sandstone, chiefly of the Eocene and Miocene ages. The oil-bearing formation lies in parallel folds, and the petroleum is found in great abundance under or near to the crests of the anticlines.

The crude petroleum found in Galicia varies in density and other characteristics within wide limits. This is due to the fact that the oils are obtained from wells of various depths; that from shallow pits, or surface oil, has lost its more volatile constituents by evaporation. In some places a light brown or reddish-brown oil, known as red oil, occurs, which may be burnt in ordinary lamps in the crude state, but the greater part of Galician oil is dark brown in color by transmitted light and exhibits a marked fluorescence. Oil from the drilled wells is very fluid, but the surface oil from the shallow pits is somewhat viscuous. According to Stribblemann, the extreme limits of specific gravity are 0.778 to 0.930 for west Galician oil, and 0.750 to 0.950 for east Galician.

In the following table will be found a statement of the quantities of crude petroleum produced in Austria-Hungary from 1883 to 1890:

Production of crude petroleum in Austria-Hungary from 1883 to 1890.

Years.	Production.
	Barrels.
1883	166,500
1884	233,000
1885	333,000
1886	433,000
1887	532,000
1888	665,000
1889	746,000
1890	816,000

The figures in this table, though taken from official sources, are regarded as largely understated.

The average price of crude oil at the wells in 1892 was 3 florins, 45 kreutzer per hundred kilos, which would be equal to about $2 a barrel.

GERMANY.

Through the kindness of Dr. Herman Wedding the writer is enabled to give the following brief statement regarding the production of petroleum in Germany.

Petroleum occurs in Germany only in small quantities. The largest production is in Alsace; smaller quantities are produced in the province of Hanover, in Prussia, in Hildeshiem (Peine), and Luneberge. Petroleum is quite extensively distributed in the last-named districts from Holstein, on the coast of the East sea, to the south of Hanover, but it occurs in such small quantities that it does not pay to work it. Asphalt occurs in connection with the petroleum and is mined. The petroleum is of a heavy gravity and is used chiefly for lubricating purposes.

The following statement gives the amount of petroleum produced in Germany in 1890, 1891, and 1892, the figures being in metric tons:

Production of petroleum in Germany in 1890, 1891, and 1892.

Years.	Tons.
1890	15,226
1891	15,315
1892	14,527

Of the petroleum produced in 1891, 2,498 tons were Hildesheim and Luneberge and 12,817 tons from Alsace.

Just how many gallons or barrels there is to a ton of German petroleum would be difficult to state. The only statement we have seen recently as to the gravity of this oil was that the Hildesheim and Luneberge oil was about 0.888 specific gravity. This equals about 28° Baumé and would be 7.38 pounds to the gallon. On this basis the production of petroleum in Germany in 1890 would be, 4,548,406 gallons, or 108,295 barrels of 42 gallons each. On this basis of 7.38 pounds to a gallon, the production of Germany in the three years named above would be as follows:

Production of petroleum in Germany in 1890, 1891, and 1892, in barrels of 42 gallons each.

Years.	Production.
1890	108,295
1891	108,927
1892	103,323

ITALY.

There are in Italy three petroliferous districts, one between Voghera and Imola, in Emilia, another in the valley of Pescara, and the third in the Liri valley, near San Giovanni, Incarico. A fourth basin has lately been discovered at Vallega, near Piacenza, where there are about 40 wells in active operation. Besides these sources of petroleum, naphtha is distilled from the asphaltic or bituminous shales; but this product is used for lubrication and carburizing gas. Emiia supplies by far the best petroleum. It is stated to be opal colored and to yield 50 per cent of illuminants. The oil is sold retail for 65 centesimi per liter (60 cents per gallon,) of which sum the government duty amounts to 50 centesimi, while the cost of carriage is 10 centesimi, leaving only 5 centesimi for profit. The total product in 1891 was 1,155 tons, say 8,085 barrels. The principal refinery is in Parma.

Production of petroleum in Italy from 1887 to 1891.

[Barrels.]

Years.	Production.
1887	1,456
1888	1,218
1889	1,239
1890	2,919
1891	8,085

ENGLAND.

In the official catalogue of the British section at the World's Columbian Exposition of 1893, the entire statement regarding the occurrence of petroleum in Great Britain is as follows:

"Petroleum is mentioned to show that it is not absolutely wanting in Great Britain. The oil oozes out from a bed of sandstone which forms the roof of a coal seam in Derbyshire."

Notwithstanding this brief mention, historically and technically the petroleum of Great Britain has been of considerable importance. We cannot repeat the story here in detail, but the development of the present extensive shale oil industry in Great Britain resulted from the early attempts to refine this English petroleum that oozed out from the roof of the coal seams.

This petroleum is found in the deep main pit at Riddings colliery, Alfriton, Derbyshire, and in larger quantities in Southgate colliery, near Chesterfield, oozing out from the roof of the "top hard" coal. Petroleum has also been found in some quantities in the Derbyshire mines, which are worked in the Carboniferous limestone. The Mineral Statistics of the United Kingdom give the production of petroleum from 1886 to 1892 as follows:

Production of petroleum in Derbyshire, England, from 1886 to 1892.

Years.	Tons.
1886	43
1887	66
1888	35
1889	30
1890	35
1891	100
1892	218

The total production in 1892 was from North Staffordshire. On the basis we have adopted elsewhere in this report—that is, that a ton of petroleum is equal to 7 barrels, of 42 gallons each—the production of petroleum in England in 1892 would be 1,526 barrels.

While this report is being prepared a statement comes of the discovery of crude petroleum on the Ashwick estate, Somerset. It is reported that this deposit has been examined by Mr. Boverton Redwood, a well-known expert in petroleum, and Mr. W. Topley, a government geologist. They are reported to have said, as a result of their investigation, that oil exists in this locality in sufficient quantities to justify drilling. The well in which the oil was found, which was a water well, was torpedoed with a $1\frac{1}{2}$-ounce dynamite cartridge, which resulted in largely increased flow, both of water and petroleum. The specimens of oil obtained from the well were of a straw color with an odor resembling refined rather than crude. It had a specific gravity of 0.816 and a flashing point of 175° F. by closed test.

A specific gravity of 0.816 would mean about $41\frac{1}{2}$° Baumé, which would be equal to about 6 $\frac{8}{10}$ pounds to a gallon.

BURMAH.

Probably the oldest petroleum fields in the world are those of Yenangyoung (earth oil) creek, a small tributary of the Irawady river. For an unknown period the whole of Burma and portions of India have been supplied with illuminating oil from this source, particularly those regions which are reached by the Irawady and its tributaries. The wells were described by Major Symes in the journal of his embassy to the court of Ava in Burma in 1765. In an account published in 1795 Major Symes, then a colonel, mentions that there were five hundred wells in operation, the estimated annual yield being 90,900 tons. Two years later Captain Cox estimated the yield at 92,781 tons.

Later Captain Hanny described the output at about 93,000 tons a year. In 1881 Rev. J. N. Cushing describes the region, stating that there were some two hundred wells in the district, though all were not producing.

The oil is of a dark-green color with a specific gravity of 0.810, which would indicate that a gallon weighed about $6\frac{3}{4}$ pounds. The petroleum from this and adjacent districts was sent down the river to Rangoon, and hence the product acquired the name of Rangoon oil, though no petroleum is produced there. There is a refinery at Rangoon to which most of the oil brought down the river is taken. The quantity which arrived there in 1883–'84 was nearly a million gallons, most of which was taken by the Rangoon refinery, which produced 640,000 gallons of refined oil during the year. The Yenangyoung field can be regarded as extending from Palo, on the Irawady, to Yandabo, southwest of Ava, not far from Mandalay. There are two other fields in Burma, one on the Ramree island, and the other on the Boronga island; both of these islands are in the Bay of Bengal, in Lower Burmah. The Yenangyoung field is in Upper Burma.

The geologic strata of the Yenangyoung field is Miocene. The oil-bearing rocks, therefore, resemble those of South Russia and Galicia. Mr. Boverton Redwood examined a number of the oils from this district and they ranged in specific gravity, at 60° F., from 0.854 to 0.913.

In addition to Burma, petroleum is also found in Assam, where in 1890, 13,664 gallons were produced, in Punjab, where, in 1890, 3,661 gallons were produced, and in the native States, where, in 1890, 272,460 gallons were produced.

The production of petroleum in India from 1889 to 1891 was as follows:

Production of petroleum in India from 1889 to 1891.

Years.	Production.
	Gallons.
1889	3,298,737
1890	4,931,093
1891	6,136,495

JAPAN.

The principal production of petroleum in Japan is in the province of Echigo, in the prefecture of Niigata. Of the 2,017,116 gallons of petroleum produced in Japan in 1890, 1,858,950 gallons were from this province. This field is generally known as the Amaze. Petroleum has been known to exist in this territory from time immemorial. Many years ago it was collected by means of straws for use in lighting purposes, but there was a superstitious idea that its odor might offend their tutelary god, and its use was abandoned. In 1872, however, attempts were made by sinking wells, to produce oil in quantities, but with little result. In 1882 and 1883 a joint stock company was formed; wells were sunk and oil obtained in quantities. At one time, in 1886, the product of the wells reached 20 koku, or about 900 gallons, or something like 21 barrels, a day. In February, 1888, a company known as the Japan Petroleum Company was organized. An agent was sent to New York, who purchased modern well-drilling machinery, and sunk, in 1890, three wells varying in depth from 800 to 1,000 feet. Refineries were also established on the American principle.

The rock in which the oil is found is soft sandstone, light brown in color, with a dip of about 20°. The crude oil is from 38° to 40° Baumé. In refining it usually yields 85 per cent. of illuminating oil, 12 to 15 per cent. of heavy oils and paraffine, and 3 per cent. waste. The fuel used is largely natural gas supplied by the oil wells themselves.

The following are the statistics of production by the Japan Petroleum Company since its organization in 1888:

Production of petroleum in the Amaze field, Japan, from 1888 to 1892.

Years.	Production.
	Sho.(a)
1888	578
1889	4,522
1890	5,228
1891	5,077
1892 (to November)	5,920

a A "sho" is about $1\frac{8}{10}$ quarts.

The production of petroleum in Japan in 1890 is shown in the following table:

Production of petroleum in Japan in 1890.

Province.	Prefecture.	Production.
		Gallons.
Ishikari	Hokkaido	1,213
Ugo	Akita	11,400
Do	Yamagata	7,341
Echigo	Niigata	1,858,950
Shinano	Nagano	45,670
Totomi	Shizkuoka	92,542
Total		2,017,116

Production of petroleum in Japan from 1881 to 1890.

Years.	Production.
	Gallons.
1881	703,217
1882	814,078
1883	859,501
1884	246,647
1885	290,699
1886	535,210
1887	350,394
1888	1,429,971
1889	1,960,924
1890	2,017,116

JAVA.

But little information can ever be secured regarding the results of mining in the Dutch possessions in the East Indies. It is well known, however, that petroleum is found in considerable quantities in these possessions. The most important workings in Java are by the Dordtsch Petroleum Company of Java. This company possesses drilling rights in Java of over 262,800 acres. Their principal refinery is at Wonakrona. The crude oil refined here is obtained from a number of oil wells, twenty-seven being the number in 1893, which are drilled to depths varying from 100 to 800 feet in a village some 4 miles from Wonakrona. The oil, which varies in gravity from 23° to 40° Baumé, is conveyed to the refinery in pipe lines. In Gogoa other wells produce both gas and oil. The deepest well here is 1,850 feet deep, and produces gas at a pressure of 438 pounds to the square inch. A Chinese company is reported as having concessions to the amount of 438 acres. The wells of this company vary from 75 to 350 feet in depth. Quite a number of wells are drilled in other portions of Java.

The statistics of production in Java are very imperfect and are evidently estimates. For example, it is stated that the output of the Dordtsch Petroleum Company, Java, is 45,000 cases of refined oil a month, and of the Chinese company above referred to 400 liters a day of crude of 17° Baumé. If the latter figure be regarded as crude production and the former as refined, on the basis of 4 liters to the gallon and of a yield of 33⅓ per cent of refined, the latter production would be equal to about 3,000,000 gallons a month, and the former 13,500,000 gallons a month, a total of 16,500,000 a month or about 400,000 barrels, which is beyond any doubt greatly in excess of the production.

SUMATRA.

During the year 1893 the journals of Europe, and especially those of Holland and England, contained occasional references to a new petroleum field that had been discovered near Langkat, on the island of Sumatra. A Dutch syndicate, known as the Royal Netherlands-India Petroleum Company of Sumatra, obtained concessions, it is reported, covering a territory of some 320 square miles, the field being situated on the seaboard and producing an oil yielding a large quantity of illuminating oil by distillation, differing in this respect from the petroleum of the neighboring island of Java, which was a heavy oil giving but a small quantity of illuminating oil and large quantities of heavy oils and paraffin. Near the close of 1893 it was reported that this company was producing 1,600 cases of refined oil daily, the crude coming from three wells and being refined near the wells. If this statement is true and the yield of petroleum be assumed at 50 per cent. of the crude, this would be equivalent to a yield of 32,000 gallons a day. There are no actual figures, however, in justifying us in forming any estimate of production.

NEW ZEALAND.

The excitement that followed the boring of the Drake well at Titusville, in Pennsylvania, which was indicated by the exploration for petroleum in all parts of the United States, in time reached other portions of the globe as well, and in 1866 attention was directed to the occurrence of petroleum in New Zealand. It is reported that there are localities in this colony in which petroleum has been found: First, the Sugarloaves, in the Taranaki Provincial district; second, Poverty Bay, on the east coast of the Provincial district of Aukland; third, Manutahi, Waiapu, East Cape.

The oil from the first district has a very high specific gravity, 0.960 to 0.964, which would be from 15° to 16° Baumé. The oil is a lubricating oil, and is stated by those who have examined it to resemble that from southern California.

The oil from the second district resembles Canadian oil, yielding by distillation and treatment about 65 per cent. of illuminating oil.

The third district produces a pale brown oil, having a specific gravity of 0.829, or about 39° Baumé, which yields about 84 per cent. of illuminating oil.

A bonus of 6*d.* per gallon for production of illuminating oil, or kerosene as it is usually termed, up to 50,000 gallons in quantities of not less than 10,000 gallons at a time, was offered in 1874 and 1885; but no applications were received for the bonus.

OTHER COUNTRIES.

Quantities of petroleum are produced in countries other than those named above, but we have no details of the same.

Beginning at the extreme northwestern point in South America a petroleum belt seems to extend through the northwestern portion of this continent to Peru.

In the Argentine Republic pits have been sunk in the department of Lugan, in the province of Mendoza. The company working these mines produced in 1890 about 1,500 tons of petroleum. At Cachenta, in the same province, a number of wells have been sunk which produce an oil used in gas works in enriching water gas and on railways for fuel. It is estimated that the total output of the Argentine Republic in 1891 was some 21,000 barrels.

In Equador a syndicate has been formed with the object of obtaining concessions to work petroleum deposits known to exist in several parts of this Republic.

In addition to the petroleum found in Galicia, Germany, and Italy, which have been referred to somewhat at length in the body of this report, petroleum is also found in considerable quantities in France, Spain, and along the Carpathians at other points than in Galicia.

THE WORLD'S PRODUCTION OF PETROLEUM.

In the following table is given for the first time an estimate of the world's production of petroleum. It is not claimed that this is complete, but simply an approximation to the actual facts. It will probably be found to be an underestimate rather than an overestimate. The production is given in barrels. Often reports of production are in tons. In such cases, as has already been stated, we have assumed, in the absence of definite information, that a ton produced 7 barrels of crude petroleum.

World's production of petroleum.

Countries.	Production.
	Barrels.
United States (1893)	48,412,666
Russia, Baku (1893)	33,104,126
Russia, elsewhere (1890)	251,543
Austria-Hungary (1890)	816,000
Canada (1893)	798,406
Peru (1890)	350,000
India (1891)	146,107
Germany (1892)	103,323
France (1891)	70,000
Japan (1890)	48,027
Argentina (1891)	21,000
Italy (1891)	8,085
Great Britain (1892)	1,526
Other countries (estimated)	200,000
Total	84,330,809

From the above table it appears that the total production of petroleum in the world can be estimated at about 84,330,809 barrels. Of this the United States produced 48,412,666, or 57 per cent.; Russia produced 33,355,669 barrels, or nearly 40 per cent.; Austria-Hungary is third in point of production, its output in 1890 being 816,000 barrels, or less than 1 per cent.; while the production of Canada in 1893 was 798,406 barrels, or a little less than nine-tenths of 1 per cent.

NATURAL GAS

By Joseph D. Weeks.

The report on natural gas in the United States in 1893 will be little more than statistical. No new fields of importance have been opened during the year. There have been some minor extensions of old fields and pools, and new pools, which have been practically connecting links between the older pools in the well known fields, have been discovered, but there have been no developments during the year that demand special descriptions. Therefore, the statements as to the geology, occurrence and other details regarding natural gas given in previous volumes of Mineral Resources, and especially in the volume for 1892, may be accepted as describing the conditions existing in 1893.

The same conditions regarding the supply and prices of natural gas that were noted as existing in 1892 still continue, though they are more marked than during that year. The consumption of natural gas is, each year, especially in New York, Pennsylvania, and Ohio, more and more for domestic use. In Indiana alone has there been an increase or even the same consumption for manufacturing purposes as in the past, and it is only in the gas fields of Indiana that manufacturers are locating in order to obtain a supply of this natural gaseous fuel.

Another feature of the situation is the increase in the price of the fuel to the consumers. In Pittsburg to-day (April, 1894) the price charged for natural gas to manufacturers is such that, ignoring the cost of the plant, producer gas can be made from coal and supplied to these works as cheap as natural gas is being furnished, if not cheaper.

VALUE OF NATURAL GAS CONSUMED IN THE UNITED STATES.

No statement as to the actual production of natural gas in cubic feet has been obtained, nor is it obtainable. Certain wells have been measured and the production of these wells for a brief period has been ascertained, and from this production so found an estimate of the total production of these wells and of the field in which they are located has been determined. But it is evident that this is only an estimate concerning which it is impossible to say it is even approximate. The production of a well varies, not only from month to month and week to week but from hour to hour, so that what would be a fair estimate of the production for a given minute would not be at all a correct estimate for an hour later.

In discussing the production of natural gas in the United States, therefore, it is impossible to give more than an approximate value of the gas used. Even here there is difficulty. In many instances gas wells are owned by the parties using the fuel; in other cases gas is supplied to industrial works as an inducement to these works to locate in a certain section. In these cases the only method of arriving at the value of the gas consumed would be to estimate what would be the value of the coal or wood that would be required to do the same amount of work. Oftentimes in cases where the gas is sold the price is a mere nominal one, though in other cases it is fully equal to its value as compared with the amount of coal or wood required to do the same work.

Assuming, therefore, that it is impossible to give the actual production of natural gas in cubic feet and also that statements of money received for the gas would not indicate the value of the gas consumed, though in some cases it might, it is believed that the best basis of calculation of the value of the natural gas consumed in the United States is that of the value of the fuel displaced, checked, and extended in some cases by the actual amount received for the gas. Where gas is used in industrial establishments we are able to get at a fairly accurate value of the gas used on the basis of fuel displacement. It is quite well known what amount of coal is necessary to perform a given work, that is, to raise steam in boilers, to produce a ton of iron or steel, or to operate an 8 or 10 pot glass furnace. The value of coal or wood required to do this work is assumed to be the value of the natural gas used to perform the same work. This method of ascertaining the value by fuel displacement was the only one used in the early reports of Mineral Resources. In 1891, however, changes in the methods of selling gas were introduced. Meters were used and a price fairly indicative of the value of the fuel has been charged. We have the reports of the amounts so charged and received, and these values are taken where they are regarded as showing the value of the gas. Where they are not regarded as accurately indicating its value, the method of estimating the value by fuel displacement is used.

On the basis, then, of the best information obtainable the conclusion is reached that the total value of natural gas consumed in the United States in 1893 was $14,346,250, as compared with $14,800,714 in 1892. While our reports indicate that the consumption of natural gas in the United States in 1893, measured in cubic feet, was considerably less than in 1892, yet owing to the fact that higher prices were in many cases charged for the gas in 1893, the difference in values between 1892 and 1893 is not as great as the difference in actual consumption in cubic feet.

In the following table is given the total value of natural gas consumed in the United States from 1885 to 1893, by States:

Value of natural gas consumed in the United States, 1885 to 1893.

Localities.	1885.	1886.	1887.	1888.
Pennsylvania	$4,500,000	$9,000,000	$13,749,500	$19,282,375
New York	196,000	210,000	333,000	332,500
Ohio	100,000	400,000	1,000,000	1,500,000
West Virginia	40,000	60,000	120,000	120,000
Indiana	....	300,000	600,000	1,320,000
Illinois	1,200	4,000	....	....
Kentucky	....	....	....	....
Kansas	....	6,000	....	....
Michigan	....	12,000	....	....
Missouri	....	....	....	....
Arkansas	....	....	....	....
Texas	....	....	....	....
Utah	....	....	....	....
South Dakota	....	....	....	....
California	....	....	....	....
Elsewhere	20,000	20,000	15,000	75,000
Total	4,857,200	10,012,000	15,817,500	22,629,875

Localities.	1889.	1890.	1891.	1892.	1893.
Pennsylvania	$11,593,989	$9,551,025	$7,834,016	$7,376,281	$6,488,000
New York	530,026	552,000	280,000	216,000	210,000
Ohio	5,215,669	4,684,300	3,076,325	2,136,000	1,510,000
West Virginia	12,000	5,400	35,000	500	123,000
Indiana	2,075,702	2,302,500	3,942,500	4,716,000	5,718,000
Illinois	10,615	6,000	6,000	12,988	14,000
Kentucky	2,580	30,000	38,993	43,175	68,500
Kansas	15,873	12,000	5,500	40,795	50,000
Michigan	....	....	....	....	....
Missouri	35,687	10,500	1,500	3,775	2,100
Arkansas	375		250	100	100
Texas	1,728	6,000	....	100	50
Utah	150			....	500
South Dakota	25		....	....	....
California	12,680	33,000	30,000	55,000	62,000
Elsewhere	1,600,000	1,600,000	250,000	200,000	100,000
Total	21,107,099	18,792,725	15,500,084	14,800,714	14,346,250

From this table it will be seen that the greatest value of natural gas consumed in any one year was in 1888, when it was $22,629,875. From this time there has been a gradual decline in the value until 1893, when the total was $14,346,250, or some $8,300,000 less than in 1888.

CONSUMPTION AND DISTRIBUTION OF NATURAL GAS.

There are a great many details regarding the production of natural gas in the United States that would be exceedingly interesting could they be secured. Unfortunately, however, many of the natural-gas companies keep their records in such a way that it is impossible for them to give any information other than the amount of money received for the gas consumed. They do not even know the number of consumers. From quite a number of companies, however, 218 in all, very interesting statistics have been received, which are given in the following table. It should be distinctly understood that this does not indicate all of the companies from which reports have been received, but only includes the reports from the companies in the three States of Pennsylvania, Indiana, and Ohio, which have furnished the Survey with all of the information asked. From many other companies the information covers a portion of the items named in the table.

Natural gas records in 1892 and 1893.

	Pennsylvania.		Indiana.		Ohio.	
	1893.	1892.	1893.	1892.	1893.	1892.
Amount received for sale of gas or value of gas consumed	$3,641,095	$4,077,799	$1,052,818	$964,366	$215,440	$281,510
Value of coal or wood displaced	$4,022,834	$4,468,254	$1,621,063	$1,622,337	$320,498	$368,290
Number of domestic fires supplied	119,524	153,058	55,852	55,821	11,749	9,270
Number of iron and steel works supplied	33	31	1	3	....	1
Number of glass works supplied	43	41	15	9	....	2
Number of other establishments supplied	223	252	226	244	65	88
Total number of establishments supplied	299	324	242	256	65	91
Total number of wells producing January 1	805	748	411	323	166	166
Total number of producing wells drilled	157	160	114	75	50	27
Total number of wells producing December 31	841	806	498	380	207	173
Total number of feet of pipe laid	11,989,657	11,858,605	5,720,373	5,317,103	1,404,098	648,622
Total number of establishments reporting	53	53	116	116	49	49

The above table covers reports from 218 companies, these 218 companies reporting concerning all of the items included in the table, both in 1892 and 1893. From this table it seems that the amount actually received for gas by these 218 companies in 1892 was $5,323,675, and in 1893 $4,909,353; that is, as will appear from the statements afterwards given, although these companies had a larger number of wells in operation and a much greater length of pipe laid, they received $414,322 less for gas in 1893 than in 1892. This falling off was in Ohio and Pennsylvania, the Indiana report showing an increase in amount received for gas of a little less than $100,000.

In the value of coal or wood displaced there is also a falling off of $494,486, all three States showing a falling off in this respect. In Pennsylvania the reduction in the value of coal or wood displaced was some $445,000; in Ohio it was $48,000, while in Indiana the falling off was only about $1,300. A comparison of the Indiana figures will show that, though there was a falling off of $1,300 in the value of coal or wood displaced, there was nearly $100,000 increase in the amount received for the sale of gas. The falling off in the value of coal or wood displaced and in the amount received for the sale of gas in Pennsylvania were about the same, while in Ohio the falling off in the amount received for the sale of gas was comparatively greater than the reduction in the value of the coal or wood displaced.

An examination of the statement regarding the number of domestic fires supplied shows an interesting feature. In Pennsylvania this number has been materially reduced, falling from 153,058 in 1892 to 119,524 in 1893, a reduction of 33,534, or 20 per cent. The reports of

Indiana show about the same condition in 1893 as in 1892; while Ohio shows a decided increase, the number of domestic fires supplied by the companies reporting increasing from 9,270 in 1892 to 11,749 in 1893, an increase of 2,479, or a little less than 25 per cent. The total number of manufacturing establishments supplied with gas by these 218 companies shows a great reduction in 1893 as compared with 1892. In Pennsylvania the number has been reduced from 324 in 1892 to 299 in 1893; in Indiana the number has decreased from 256 in 1892 to 242 in 1893; while Ohio showed a decrease from 91 in 1892 to 65 in 1893.

The number of producing wells is in every case greater at the close of 1893 that it was at the beginning of the year. It should be said in regard to these figures that the numbers in the two years do not always correspond for reasons that will be evident.

The number of producing wells owned by the companies reporting on the 1st of January, 1893, in Pennsylvania, was 805; at the close of the year it had increased to 841. In Indiana, at the beginning of the year, the number of producing wells was 411; at the close of the year it was 498. Ohio showed an increase in producing wells in 1893 of from 166, at the beginning of the year, to 207 at its close.

The number of feet of pipe laid also shows an increase in every case. In Pennsylvania, the number of feet of pipe laid by the companies reporting, at the close of 1892, was 11,858,605. This had increased to 11,989,657 feet at the close of the year. At the beginning of the year in Indiana, the amount of pipe laid by the companies reporting was 5,317,103 feet. This increased to 5,720,373 feet at the close of the year; while in Ohio the amount increased from 648,622 feet, at the beginning of 1893, to 1,404,098 feet at the close of the year.

PENNSYLVANIA.

It was in this State that natural gas first began to be used extensively as a domestic and industrial fuel. Indeed, it was the drilling of the Westinghouse well at Homewood, a suburb of Pittsburg, that led to the great extension of its use that marked the years 1885 and 1886.

As will be seen from the following table, the largest production of natural gas in Pennsylvania, measured by the value of the gas consumed, was in 1888, when its value reached $19,282,375. This has fallen to $6,488,000 in 1893, about one-third the amount it was in 1888.

In the following table is given the value of natural gas consumed in Pennsylvania in the years from 1885 to 1893:

Value of natural gas consumed in Pennsylvania from 1885 to 1893.

Years.	Value of gas consumed.	Years.	Value of gas consumed.
1885	$4,500,000	1890	$9,551,025
1886	9,000,000	1891	7,834,016
1887	13,749,500	1892	7,376,281
1888	19,282,375	1893	6,488,000
1889	11,593,989		

OHIO.

In none of the important gas-producing States was there such a falling off in production in 1893 as in Ohio. During the year the gas-producers in the Lima district who furnish gas to manufacturing establishments found it necessary, in order to maintain the supply for domestic and similar consumption, to cut off, in many instances, almost without warning, the supplies of gas furnished the manufacturing establishments. The result was injurious, and in some cases disastrous, and has led to the removal of some establishments to sections of the country where the supply of gas can be depended upon.

In the following table will be found a statement of the value of the natural gas consumed in Ohio from 1885 to 1893:

Value of natural gas consumed in Ohio from 1885 to 1893.

Years.	Value of gas consumed.	Years.	Value of gas consumed.
1885	$100,000	1890	$4,684,300
1886	400,000	1891	3,076,325
1887	1,000,000	1892	2,136,000
1888	1,500,000	1893	1,510,000
1889	5,215,669		

INDIANA.

There is no doubt that to-day the most important gas field in any State is that of Indiana. It is estimated that this State possesses about 2,500 square miles of what may be regarded as productive gas territory; that is, territory in which gas has been or probably will be obtained in paying quantities. While the supply of natural gas is falling very far below the demand in other notable gas fields of the country, especially in Ohio and Pennsylvania, the supply of gas in Indiana seems to be well sustained, and factories that have been located in other gas territories are seeking their supplies in Indiana.

In the following table will be found a statement of the value of the natural gas consumed in Indiana from 1886 to 1893:

Value of natural gas consumed in Indiana from 1886 to 1893.

Years.	Value of gas consumed.	Years.	Value of gas consumed.
1886	$300,000	1890	$2,302.500
1887	600,000	1891	3.942.500
1888	1,320,000	1892	4,716,000
1889	2,075,702	1893	5,718,000

KENTUCKY.

The chief source of supply of natural gas in Kentucky continues to be Meade county, in what is known as the Brandenburg district. Some gas is found in other counties, but it is utilized to only a small extent.

The production of natural gas in Kentucky from 1889 to 1893 was as follows:

Value of natural gas consumed in Kentucky from 1889 to 1893.

Years.	Value of gas consumed.
1889	$2,580
1890	30,000
1891	38,993
1892	43,175
1893	68,500

CALIFORNIA.

The production of natural gas in California assumed considerable importance in 1893, though it is still only in the neighborhood of Stockton and in the oil regions of southern California that it is produced in commercial quantities. These fields have been described in previous reports, and it is not necessary to repeat what has been said.

The production of natural gas in California from 1889 to 1893 is as follows:

Value of natural gas consumed in California from 1889 to 1893.

Years.	Value of gas consumed.
1889	$12,680
1890	33,000
1891	30,000
1892	55,000
1893	62,000

OTHER STATES.

As will be seen from the table of production of natural gas given elsewhere in this report, natural gas is found in commercial quantities in quite a number of the other States, especially in New York, Illinois, Kansas, and Missouri.

The New York natural-gas fields are simply extensions of those of Pennsylvania. In Missouri but small quantities of natural gas have been produced, though gas springs are known to exist in a number of the counties. In Kansas gas has been found in several sections, chiefly in the neighborhood of Paoli, Fort Scott, Coffeyville, and Cherry Vale.

Some gas, but not in sufficient quantities to require a discussion of its production here, has been found in Illinois, West Virginia, Texas, Arkansas, Utah, South Dakota, New Mexico, Tennessee, and Wisconsin. Those interested in learning of the occurrence and production of natural gas in these States are referred to previous volumes of Mineral Resources and to the report in the Mineral Industries in the United States at the Eleventh Census, 1890.

CANADA.

It is interesting to know that natural gas was produced to a considerable extent in Canada in 1893. The report on the Mineral Production of the Dominion of Canada for that year shows that natural gas to the value of $366,233 was produced. Most of this was consumed in Canada, though some was piped to the United States.

A description of the natural gas fields of Canada is given in Mineral Resources of the United States, 1892. In addition to the sources of natural gas there mentioned, it should be said that some gas is found in connection with the petroleum wells. It is probable that the value of this is not included in the value of the total production given above.

IMPORTS.

In the following table will be found a statement of the value of the natural gas imported into the United States from 1891, when it was first enumerated:

Value of natural gas imported into the United States from 1891 to 1893.

Calendar years.	Value.
1891 (latter half)	$25,540
1892	74,737
1893	90,653

STONE.

By William C. Day. (a)

General condition.—In view of the universal financial depression that prevailed during a part of the year 1893, it is, of course, unnecessary to state that the stone industry underwent its full measure of suffering. In the New England States production in 1892 had suffered on account of serious labor disturbances, so that many contracts which should have been fulfilled in that year were held over until the following year. That was one of the causes which made production unusually brisk in the early part of 1893, i. e., until about the 1st of June, and it may be emphatically asserted that, had these conditions been maintained throughout the year, 1893 would have gone far ahead of any previous year in the amount of product, as well as in general prosperity for both employers and employés.

Answers to statistical inquiries addressed to stone producers have been carefully prepared and are exceptionally full, and they show, for the great majority of the States, a heavy falling off in product, due in all cases to the same cause—financial stringency.

An increase in the total value will be noticed in the tables of production for some States. It will, however, be also noticed that such States include those in which the stone industry is comparatively new and which have not yielded a large amount of product in any year. Some individual firms have reported quite decided improvements in business for the year, but in every case the reason for such increased prosperity has been exceptional, and in many cases consists in the fact that the stone has been supplied for public works, such as Government buildings, harbor and coast improvements, or State and municipal building, paving, etc. In the South, even public improvements, such as paving in cities, etc., were curtailed or entirely interrupted because of the impossibility of selling bonds for the purpose of securing cash for the maintenance of such work. Thus, for instance, the granite block paving industry of the South suffered to the extent made manifest in the tables of production in this report.

In view of the depressed condition of the stone industry, it might naturally be supposed that the number of operators in 1893 is much less than for previous years. This supposition applied to the latter half

a The very efficient aid furnished by Mr. Wm. A. Raborg, of the U. S. Geological Survey, in the preparation of this report, is hereby gratefully acknowledged.—W. C. D.

of 1893 is quite true. A great many operators went out of business after June or July, but a large proportion had done very well until that time, so that when the number of operators for the year as a whole is considered it makes a good showing; but at the same time, when we consider the future, it is very evident that the year 1894 will run behind even still more than 1893, unless there is a revival of the general conditions of trade greater than it is reasonable to expect.

Production of stone, by kinds, in 1892 and 1893.

Kinds.	1892.	1893.
Granite	$12,627,000	$8,808,934
Sandstone	8,265,500	5,195,151
Limestone	18,392,000	13,947,223
Marble	3,705,000	2,411,092
Slate	4,117,125	2,523,173
Bluestone	1,600,000	1,000,000
Total	48,706,625	33,885,573

This table shows a decrease of $14,841,052, or 30.5 per cent. For the individual kinds of stone the percentage decreases are as follows: Granite, 30.1; sandstone, 37.1; limestone, 24.3; marble, 34.9; slate, 38.7; bluestone, 37.5.

The limestone industry has fallen off least. This is easily understood when we consider the essential uses to which limestone is put, such as the manufacture of lime, both for building and agricultural purposes, building, road-making, and blast-furnace flux. The falling off in the other kinds of stone shows no great percentage of variation.

Among the trade developments which may be considered of general interest to the stone producers was the movement towards a change in the methods of measuring stone. This was brought forward significantly by Mr. Sylvester Marshall, president of the National Association of Quarry Owners, at the Indianapolis meeting of the Ohio Valley Cut Stone Contractors' and Quarrymen's Association. He spoke of the confusion of the units of measurement as a disadvantage to the stone producers, second only to lack of practical experience in the stone business among the factors which go to make stone production unprofitable. A uniform standard of measurement should be adopted. The prevailing sentiment among the quarrymen of the country seems to favor selling stone by weight and discarding the old form of selling by the cubic foot, cord, perch, or yard, as being too cumbersome and allowing too many leaks, and especially as the railroads have largely adopted this weight system in transporting stone, as with other merchandise. Mr. Marshall called attention also to such great differences in price, as between 20 cents received at the quarry by a producer of buff Bedford limestone and $1.50 paid at the building in Chicago, where it is used after having passed through too many hands. He insisted that prices should be quoted at the quarry and should be on a uniform standard of measurement by weight.

GRANITE.

The following table shows the production of granite by States in 1893. The total for 1892 was $12,627,000, showing for 1893 a decrease of $3,818,066, or 30.1 per cent. The general reasons for this decline have already been discussed and shown to be the severe financial stringency which began to be felt about June 1.

The product of granite in 1893, by States.

States.	Value.	States.	Value.
Arkansas	....	New York	$181,449
California	$531,322	North Carolina	122,707
Colorado	77,182	Oregon	11,255
Connecticut	652,459	Pennsylvania	206,493
Delaware	215,964	Rhode Island	509,799
Georgia	476,387	South Carolina	95,443
Maine	1,274,954	South Dakota	27,828
Maryland	260,855	Texas	38,991
Massachusetts	1,631,204	Utah	590
Minnesota	270,296	Vermont	778,459
Missouri	388,803	Virginia	103,703
Montana	1,000	Wisconsin	133,220
New Hampshire	442,424		
New Jersey	373,147	Total	8,808,934
Nevada	3,000		

The following is a consideration of the individual granite-producing States:

Arkansas.—While the granite output in 1892 was valued at $40,000, practically nothing was done in 1893.

The possibilities of successful granite quarrying in the Fourche mountain region are apparently very great.

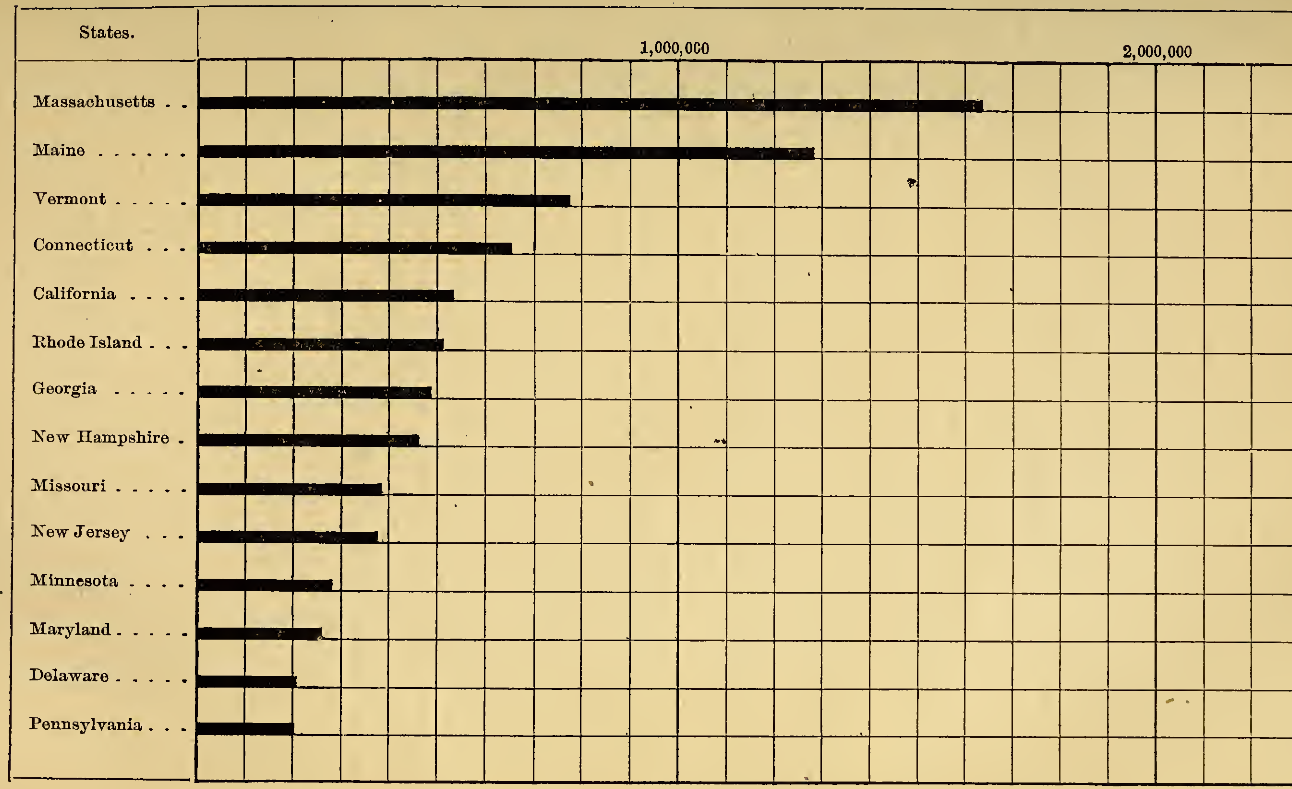
The Braddock quarry, owned by Mr. James S. Braddock, consists of a 200-foot front, with the possibility of extending this to half a mile. The quarry runs into the side of the mountain, and the depth reached is 10 to 12 feet. The stone, although very hard, is easily quarried on account of its natural joints. Increased capital is needed for successful working.

California.—Granite production in California has fallen off from $1,000,000 in 1892 to $531,222 in 1893. Although the agricultural interests were prosperous, the year has been an exceedingly poor one for the granite industry, some producers pronouncing it the worst in the history of the industry in the State. Prices were low and money hard to get. Many quarries shut down during the year.

The establishments employing convict labor were occupied, as in the past, in the construction of the Folsom dam and canal by the Folsom Water-Power Company.

Colorado.—The value of the output in 1892 was $100,000; in 1893, $77,182.

Although certain firms in this State made an increase in their output during the year, such gain appeared to be due to the fulfillment of



VALUE OF GRANITE PRODUCED IN THE VARIOUS STATES DURING THE YEAR 1893.

[In millions of dollars.]

Government, State, or municipal contracts. Private contracts were hard to obtain and business was very much depressed after July 1.

Connecticut.—The falling off in this State from $700,000 in 1892 to $652,459 in 1893 is not so great as might have been expected, judging from the serious losses in other States. Business for the year commenced in May and was very good until about the 1st of August, when it dropped off materially. In some cases in Connecticut, as well as other New England States, contracts were held over from 1892 because the strikes in that year prevented their fulfillment, so that business for 1893 was correspondingly increased. Everything indicates that but for the financial depression of the latter half of the year a large output would have been secured.

Delaware.—Production fell off from $250,000 in 1892 to $215,964 in 1893. This product comes from a small number of quarries which, all things considered, did fairly well during the year.

Georgia.—Much of the granite produced in this State is used for paving blocks. The failure of certain Southern cities to sell bonds for cash to continue paving operations contributed largely to the falling off in the granite industry from $700,000 in 1892 to $476,387 in 1893. The prospects are so very poor that some of the producers predict even a worse condition of the industry in 1894. Quite a number of quarries stopped operations entirely.

The Diamond Blue Granite Company was organized early in 1893 for the purpose of operating granite quarries at Hutchins Station, Georgia. The following gentlemen are the officers of the company: Charles Estes, president; E. S. Johnson, secretary, and J. O. Mathewson, treasurer. The capital stock of the company is $80,000 paid in, with the privilege of increasing it to $300,000. Sixty-three acres of land have been secured, and operations on quite a large scale are looked for.

Maine.—The depressed condition of finances was felt in Maine a elsewhere. Many quarries stopped operations altogether in the latter part of the year. Not only was there much less demand for paving blocks, but the prices were much lower. The product of 1893 was valued at $1,274,954, while in 1892 the figure was $2,300,000. Present indications for 1894 are not good. Some of the business of 1893 was the result of delay in filling contracts in 1892 because of the labor troubles.

Maryland.—The value of the output in 1893 is $260,855, against $450,000 worth for 1892. As in many other States, business was very good until June 1, and even considerably in excess of that for the same period of the previous year, but after that time demand for stone collapsed, making the outlook for 1894 very poor.

Massachusetts.—In this State a product valued at $1,631,204 was secured, while that for 1892 was valued at $2,200,000. Strikes in 1892 caused some contracts to be held over until 1893, making a good volume of business for the early part of the year. Dull trade, low prices, and slow collections were the universal characteristics of the trade business for the latter part of the year.

Minnesota.—Without any exception the stone producers of this State report a depressed state of affairs for the year, and particularly the latter half. The value for 1893 was $270,296; for 1892 the figure was $360,000.

Missouri.—The value of the output in 1893 was $388,803; in 1892 the corresponding figure was $325,000. A decided gain for this State is evident, and was due to the extensive operations of one or two firms, one of which was filling a contract for the new city hall at Saint Louis. A number of the producers in the State, however, reported business as depressed.

Montana.—Production in this State dropped from a valuation of $36,000 in 1892 to $1,000 in 1893.

New Hampshire.—The value of the product of 1893 was $442,424, while for the previous year it was $725,000. Certain producers at Concord report exceptionally good business, but at most other producing localities in the State reports very much resemble the discouraging ones from other parts of the country. Considerable business was done in the early part of the year, some of which was in fulfillment of contracts held over from 1892 by reason of the strikes in that year.

New Jersey.—The falling off in this State was not so great as in many others; this is due largely to the extended operations of a single firm. The total for 1893 was $373,147 and for 1892, $400,000.

New York.—Prospects in this State were unusually good in the early part of the year, but the financial troubles asserted themselves as elsewhere, with the usual results, reducing the total of $200,000 for 1892 to $181,449 in 1893.

North Carolina.—The conditions which prevailed in this State during 1893 very much resemble those of Georgia. Much of the output is for paving and curbing, and owing to the restricted sale of city bonds operations in this line were reduced. The figures, however, for 1893, namely, $122,707, are only slightly behind those ($130,000) for 1892. From this it may be inferred that but for the financial troubles the output would have considerably exceeded that for 1892.

Oregon.—Production increased from $6,000 in 1892 to $11,255 in 1893. These figures are, however, so small as to be of very little significance further than to indicate that under favorable conditions a much greater advance would have been made.

Pennsylvania.—In 1892 the total output was valued at $550,000; in 1893, $206,493. Low prices, slow collections, and restricted demand were reported from all parts of the State.

Rhode Island.—It is interesting to note that while in this State production declined from $600,000 in 1892 to $509,799 in 1893, the decline is not so great as in many other States long recognized as among the leading granite producers. The cause of the comparatively prosperous condition of Rhode Island in the past year is, perhaps, that the strikes of 1892, which were quite severely felt, left a number of contracts to be filled in 1893.

A number of the producers, although not the largest, report very dull business. The first half of the year was considered unusually good.

South Carolina.—The volume of the output increased from $60,000 in 1892 to $95,443 in 1893. The number of producers in the State is at present small.

The jetties in course of construction at Charleston were supplied with granite from the quarries of the State.

North Dakota.—Production fell off from $50,000 in 1892 to $27,828 in 1893.

Texas.—Production in 1892, $50,000; in 1893, $38,991.

Vermont.—In spite of hard times a decided advance was made, namely, from $675,000 in 1892 to $778,459 in 1893.

This increase resulted mainly from the achievements of the first eight months; business in the last four was generally pronounced dull. The number of producers and also of granite cutters and workers is increasing at Barre. Few, if any, localities in the country stood the financial depression any better than Barre.

Virginia.—The industry in this State suffered quite markedly, production falling off from $300,000 in 1892 to $103,703 in 1893. While a few important producers did quite good business, others report very serious losses owing to the prevailing troubles.

Wisconsin.—In 1892 the product was valued at $400,000; in 1893 at $133,220. The year opened up well, but fell off very much later on.

MARBLE.

The total value of the product in 1892 was $3,705,000; in 1893 the total was $2,411,092, a decrease of $1,293,908, or 34.9 per cent.

The following table shows the product of marble by States in 1893.

Product of marble in 1893, by States.

States.	Value.
California	$10,000
Georgia	261,666
Idaho	4,500
Maryland	130,000
Pennsylvania	27,000
New York	206,926
Tennessee	150,000
Vermont	1,621,000
Total	2,411,092

The following statements relative to the conditions of the marble industry in the several States show how the year 1893 stands as compared with 1892.

California.—The decline from $115,000 in 1892 to $10,000 in 1893 simply means that a number of the quarries have shut down entirely, owing to the prevalent dullness in all kinds of stone production. The product includes about $27,000 worth of onyx from the celebrated quarries of Messrs. Kesseler Brothers.

Mr. Frank A. Kimball, of National City, California, has taken out samples of variegated marble, some of which have been worked to a finish. The prospects of future development seem to be good, and an effort is being made to develop the property on a commercial scale.

According to the Mining and Scientific Press specimens of a number of varieties of marble, notably a dark, mottled specimen suitable for building purposes, have been taken from what is designated the Caldwell Consolidated Marble Mine, Calaveras county, six miles from Valley Spring, and midway between the latter place and San Andreas. A narrow-gauge railway has been surveyed within 1 mile of the quarry, which is elevated above the road, making it possible to transport stone by tramway to the railroad. Blocks of the stone have been tested by marble-workers at Stockton and San José, and the results are favorable to the product.

It is said that slabs of any desired size can be obtained.

Arizona.—The well-known deposits of onyx in the Big Bug Mining district, Yavapai county, have not been worked since 1891. The large amount of waste material associated with the onyx, as at present developed, makes the quarrying expense heavy, and has discouraged the investment of capital until further developments shall demonstrate a better condition as the deposit deepens.

Georgia.—The value of the output in 1892 was $280,000; in 1893, $261,666. During the first six months of 1893, the marble industry in this State was pronounced by the leading producers as in the most flourishing condition it had ever enjoyed, but after that demand was very light and business exceedingly dull. Two of the producing firms have shut down entirely.

It is said that the Piedmont Marble Company at Marble Hill, near Tate, Georgia, is to furnish all the marble required by the proposed new Saint Luke's hospital in New York City. This will mean a very important stimulus to the further development of the Georgia marble.

Idaho.—Production in this State is of quite recent date and the volume of the output in 1893 is $4,500. Indications are that this amount would have been exceeded but for the general depression.

Maryland.—The value of the product in 1892 was $105,000; in 1893, $130,000, a gain of $25,000. Much of the work done was upon contracts made in 1892. Very little new business was offered in the latter part of 1893, and the indications for 1894 are consequently not encouraging.

Michigan.—The Northern Michigan Marble Company has been engaged in the preliminary work of opening up a marble quarry in Dickinson county. A spur track 1¾ miles long connects it with the Metropolitan branch of the Chicago and Northwestern railroad. The officers of the company are: Edwin Porter, of Chicago, president; Robert C. Harper, vice-president; F. W. Woodruff, treasurer; L. Soule, secretary; and A. L. Foster, superintendent. The general office is in Chicago and the local office at Foster City, Dickinson county.

During the summer of 1893 a considerable quantity of the product was shipped to various marble works for test as to its capabilities for polish and ornamentation, with satisfactory results. The quarry has been equipped with modern machinery and a force of 17 men has been employed with the intention of putting the stone on the market in 1894. Sawing and polishing mills are to be erected at the quarry.

Pennsylvania.—The value of the output in 1892 was $50,000; in 1893, $27,000. The explanation for this decrease is the same as for all other States.

New York.—In 1892 $380,000 worth of marble was quarried, and although production in 1893 fell off to $206,926 the general tone of the reports made is not so gloomy as that which characterizes many other States. It is said that one of the quarries of black marble at Glens Falls has been entirely exhausted. The last of it was quarried in 1892. A number of quarries at Tuckahoe, although reporting light demands, seem to have done fairly well.

Tennessee.—From a product valued at $350,000 in 1892 there was a decrease of $200,000 in 1893. This was due to poor business for the latter half of the year for all quarries which continued in operation, and to the complete shutting down of a number of quarries before the end of the year.

Vermont.—The value of the output in 1892 was $2,275,000; in 1893, $1,621,000. Business was universally reported good for the first part of the year, but very much depressed for the latter half. A number of quarries suspended operations and others curtailed work and reduced the number of employés quite materially.

Virginia.—Development work is being prosecuted on the onyx quarries of the Virginia Onyx Company in Rockingham county. The quarries are about 4 miles from Mount Crawford station on the Shenandoah Valley branch of the Baltimore and Ohio Railroad. The company is now prepared to fill orders, and a considerable product in 1894 is anticipated.

SLATE.

This industry seems to have suffered severely from the same causes which have made production of other kinds of stone exceptionally low. The total value of the output for the United States in 1892 was $4,117,125, while the corresponding figure for 1893 was but $2,523,173.

The following table gives the output of the year by States:

Product of slate, by States, in 1893.

States.	Roofing squares.	Value.	Other kinds of slate (value).	Total value.
Georgia	2,500	$11,250	....	$11,250
Maine	18,184	124,200	$15,000	139,200
Maryland	7,422	37,884	....	37,884
New Jersey	900	3,653	....	3,653
New York	69,640	204,776	206	204,982
Pennsylvania	364,051	1,314,451	157,824	1,472,275
Utah	75	450	400	850
Vermont	132,061	407,538	128,194	535,732
Virginia	27,106	104,847	12,500	117,347
Total	621,939	2,209,049	314,124	2,523,173

The following paragraphs show the condition of the slate industry in the various productive States:

Georgia.—Twenty-five hundred squares of roofing slate were the output of each of the years 1892 and 1893; the value for the latter year is $11,250; for 1892, $10,625.

The Georgia Slate Company has been formed for the purpose of consolidating under one management all the Rockmart slate quarries from which the entire output of the State is taken. Success in these quarries, operated on a larger scale than heretofore, depends upon the favor found for them in Southern cities. Among the latter, Atlanta has been the most liberal buyer, having secured the entire output of 1892. The prospect for 1894 is said to be fair. The general manager is Mr. W. L. Craig.

Maine.—The number of slate producers in this State is limited to less than half a dozen, but production of fine roofing slate has been progressing for a long term of years. The value of the output in 1893 was $139,200; of this amount $124,200 was the value of 18,184 squares of roofing slate. The value of the output in 1892 was $250,000, all for roofing purposes.

Maryland.—The value of the product quarried in 1892 was $116,250, nearly all for roofing purposes. The corresponding figure for 1893 was $237,884. The Maryland quarries are immediately on the line dividing Maryland and Pennsylvania, and together with the quarries on the Pennsylvania side of the line constitute what is known commercially as the Peach Bottom slate region. Most of the slate is at present from quarries on the Maryland side; of these there are 4 active quarries, and 2 on the Pennsylvania side.

New Jersey.—The slate business of this State is not a very important industry, the productive region being really a continuation of a much larger field in Pennsylvania. Twelve thousand dollars represents the value of the output in 1892, and $3,653 that of the product in 1893. It is entirely used for roofing purposes.

New York.—The figures, $210,000 for 1892, and $204,982 for 1893, indicate comparatively little decrease in activity for this State. Of the unique and valuable red slate of Washington county only about

3,500 squares were quarried; this slate commands a price of $9 or $10 per square, and is produced at no other locality in the world.

In October the slate quarries of Granville stopped all quarrying until the demand for their product should increase. Considerable stock on hand had accumulated at that date.

Pennsylvania.—The value of the slate product in 1892 was $2,333,000; of this amount $1,925,000 was the value of 550,000 squares of roofing slate, and the difference, $408,000, that of manufactured articles. In 1893 the value of the output was $1,472,275, $1,314,451 being the value of 364,051 squares of roofing slate, while the balance, $157,824, was the value of slate for all other purposes. The decline is very considerable and the outlook for 1894 is not encouraging.

Early in the year the industry was in unusually flourishing condition and the product for the twelve months would doubtless have quite largely exceeded that of any year previous had it not been for the general depression in business of all kinds.

Utah.—The slate of Utah comes entirely from quarries near Provo City. These quarries are still in the stage of preliminary development and the product can not yet be considered as on the market. Seventy-five squares valued at $6 per square, and $400 worth of flagging were produced during the year.

Vermont.—Owing to the same general causes of business stagnation the output of Vermont fell off from $1,014,000 in 1892 to $535,732 in 1893. Business was unusually good during the early part of the year, but came to almost a complete standstill in the latter half. Many quarries stopped entirely, after having accumulated large quantities of stocks on the banks. Others reduced force and continued to operate on diminished time. Still others quit the business entirely with no apparent intention of resuming operations.

Virginia.—The total value of the output in 1892 was $150,000; in 1893 the figure was $117,347. Of this amount $12,500 represents the value of slate for purposes other than roofing. While roofing slate constitutes the greater part of the product, it is nevertheless interesting to note that the production of mill stock has commenced. Heretofore roofing slate only has formed the entire output.

SLATE IN GREAT BRITAIN.

Wales.—Next to coal, iron ore, and salt, slate ranks highest in value in the mineral products. The flourishing condition of the slate industry in North Wales is well shown in an article in the English Mining Journal, Railway and Commercial Gazette, written late in 1893. It is of interest, especially as much of our slate quarrying is fashioned after the Welsh methods. For many years the slate trade was injured by the high wages which followed the war between France and Germany, although the first effect of this war was to increase the demand in

Germany for slate for repairing damages to property. But this led also to the opening of many new small quarries, and the consequent unsettled state of prices. A long period of depressed prices followed, and the usual extinction of small companies. The only good effects to the producers was a reduction in royalties of from 25 to 75 cents on the ton according to the quality of the slate vein. With the low prices production declined, and stocks were reduced in 1891 and in 1892. There were practically no stocks in 1893. Thus, in 1891, Port Madoc (from which point shipments are best available), shipped 133,145 long tons, against an output of only 118,273 long tons at the Festiniog quarries, the point of production.

In 1892 the deliveries were 153,837 tons, against a production of 122,108 tons.

The following tables show the production of slate in the United Kingdom for 1892.

The first table shows the total slate product.

Production of slate in the United Kingdom, 1892.

	Quantity.	Value.
	Long tons.	
Mines under the metalliferous mines regulation act	141,993	$2,114,226
Open work	276,248	2,878,413
Total for 1892	418,241	4,992,639
Total for previous year	415,029	4,803,235

The following table shows the production of roofing slate, by districts, from open works included in the above table.

Production of roofing slate in the United Kingdom, in 1892, by districts.

Districts.	Quantity.	Value.
	Long tons.	
Cardiganshire	319	$2,385
Carnarvonshire (including Denbighshire)	256,240	2,627,837
Cornwall	930	6,930
Lancashire	6,380	93,397
Merionethshire	9,841	119,327
Montgomeryshire	2,022	24,731
Westmoreland	516	3,806
Total	276,248	2,878,413

SANDSTONE.

The following table, giving the production of sandstone by States for the year 1893, shows a total of $5,195,151. The total for 1892 was $8,265,500. A decrease in value of $3,070,349 is evident. The causes which brought about this falling off are identical with those which have produced similar disastrous results in all other kinds of stone.

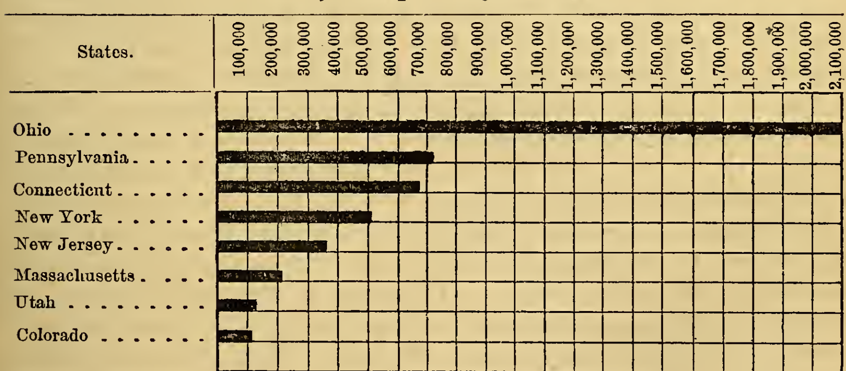
Very complete and satisfactory replies from the producers show the same state of affairs in all parts of the United States. Firms which did a really thriving business are few, and their prosperity was due in all cases to exceptional circumstances, such as the fulfillment of contracts on Government or other public buildings. Many railroad developments were discontinued in the latter half of the year, thus materially affecting the production of sandstone for bridge building, which ordinarily calls for a large amount of sandstone in sections where it is to be obtained.

Production of sandstone in 1893, by States.

States.	Value.	States.	Value.
Alabama	$5,400	Missouri	$75,701
Arizona	46,400	Montana	42,300
Arkansas	3,292	New Jersey	267,514
California	26,314	New Mexico	4,922
Colorado	126,077	New York	415,318
Connecticut	570,346	Ohio	2,101,932
Georgia		Oregon	
Idaho	2,005	Pennsylvania	622,552
Illinois	16,859	South Dakota	36,165
Indiana	20,000	Texas	77,675
Iowa	18,347	Utah	136,462
Kansas	24,761	Virginia	3,830
Kentucky	18,000	Washington	15,000
Maryland	360	West Virginia	46,135
Massachusetts	223,348	Wisconsin	92,193
Michigan	75,547	Wyoming	100
Minnesota	80,296		
		Total	5,195,151

It would be mere repetition to discuss for each State the condition of the sandstone industry, and only those States which present some feature of particular and exceptional interest will be individually considered. The predominance of Ohio is well shown by the following graphic table:

Rank of States producing sandstone.



VALUE OF THE SANDSTONE PRODUCT IN THE PRINCIPAL PRODUCING STATES IN 1893.

Ohio.—The following facts relative to the important sandstone interests of Ohio have been gleaned from articles in Stone for March and July, 1893:

Eight years ago a number (nearly half) of the sandstone producers in northern Ohio united under one management, forming what has since been known as the Cleveland Stone Company, which has been steadily increasing in the extent of its real estate possessions, quarry property, and (with the exception of 1893) in the magnitude of its annual sales.

In February, 1893, a number of firms which had declined to join in the formation of the Cleveland Stone Company, united, forming the Northern Ohio Stone Company.

The names of the firms forming this combination are: The Ohio Stone Company, the Malone Stone Company, the Grafton Stone Company, the Forest City Stone Company, the Baillie Stone Company, and the Elyria Stone Company. The capital stock of the new combination is stated as $25,000. Mr. W. C. Stewart, general manager of the new company, says:

"The various companies have been working under a disadvantage, and it has been felt for a long time that if our interests could be united it would be beneficial to all concerned—the public as well as ourselves. The various companies will retain their individuality as before, but the new arrangement will make it possible to carry on the business in a more economical manner. In the past each company has been obliged to keep men on the road to sell stone, maintain a distributing yard at Cleveland, and bear the other expenses of a complete business organization. This business will be transacted in the future by this new company. Half the yards in Cleveland will be closed, traveling salesmen will be called in, and other expenses will be correspondingly reduced. As an example of the saving, it might be said that to keep a man on the road costs about $3,000 a year. The different companies have arranged to sell their product to this central company, and the latter will dispose of it to dealers. While the capital stock of the new company is placed at only $25,000, it is in fact backed by the resources of all the other companies, so that the amount of money actually invested in the business will approximate $2,000,000. There will be no increase in prices; the tendency will be rather to the contrary. There will be no lack of competition, because the Cleveland Stone Company deals in the same kind of stone as is obtained from our quarries. Another advantage will be the fact that the new company will carry different kinds of stone. At present a contractor usually has to deal with several of our companies, but in the future all his wants will be supplied by the new company. The latter is also authorized by its charter to operate quarries and to deal in stone other than that produced by the auxiliary companies. We have already embarked in business, as it is neither a trust nor a monopoly, but an improved system of transacting business that will be of general advantage."

Later in the year the Central Ohio Stone Company was formed with headquarters at 9 North Cleveland avenue, Canton, Ohio. The officers of this combination are Mr. Joseph B. K. Turner, president; Mr. Wilber Winfield, secretary, and Mr. J. B. Gabriel, treasurer.

The great bulk, if not all, of the sandstone interests of northern and central Ohio, is thus seen to be under the control of three combinations. The future of these companies will doubtless be regarded with interest by those engaged in the production of sandstone.

The value of Ohio's sandstone output in 1893 was $2,101,932; the value of the product in 1892 was $3,300,000.

This State stands far ahead of any other in the amount of sandstone produced. The next State in order of output is Pennsylvania, in which the sandstone product was valued at $622,552. An important use of some of the sandstone of Ohio and Michigan is for grindstones and whetstones. A large part of the product of the country in this line of manufacture, and practically all of the grindstone output, comes from Ohio and Michigan, which together yielded in 1893 a product valued at $338,787. Of this amount $60,615 covers the output in Michigan, while the remainder belongs to that of Ohio.

LIMESTONE.

The limestone output in 1893 is valued at $13,920,223. The corresponding total for 1892 was $18,392,000. A decrease of $4,471,777 is apparent from these figures. The percentage decrease is 24.3, which is less than that for any other of the various kinds of stone quarried in the United States. The above figures include the values of limestone used as such for building, road-making, and blast-furnace flux.

When we consider the importance of limestone as such and the indispensability of lime in building of all kinds, as well as its use for agricultural purposes, it is not surprising that the limestone industry, as a whole, should more nearly hold its own in times of severe financial stringency than work in other kinds of stone which depend mainly upon building alone for their application.

The suspension of many building operations which, but for the hard times, would have been carried through during 1893, affects both the quarrying of limestone for structural purposes as such and the production of building lime. Many blast furnaces have shut down during the year, thus curtailing the output of stone for use as blast-furnace flux. The universal verdict from all parts of the country is good business for the first half of the year and little demand, low prices, slow collections (causing failures), suspension of operations, reduction of working force, for the second half.

The following table gives, by States, the values of limestone quarried in 1893:

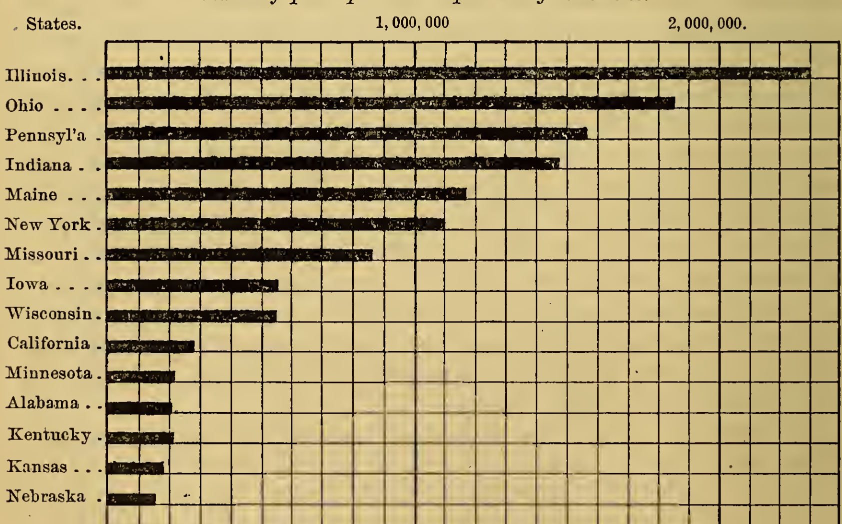
Product of limestone in 1893, by States.

States.	Value.	States.	Value.
Alabama	$205,000	Montana	$4,100
Arizona	15,000	Nebraska	158,927
Arkansas	7,611	New Jersey	149,416
California	288,626	New York	1,103,529
Colorado	60,000	Ohio	1,848,063
Connecticut	155,000	Oregon	15,100
Florida	35,000	Pennsylvania	1,552,336
Georgia	34,500	Rhode Island	24,800
Idaho	1,000	South Carolina	22,070
Illinois	2,305,000	South Dakota	100
Indiana	1,474,695	Tennessee	126,089
Iowa	547,000	Texas	28,100
Kansas	175,173	Utah	17,446
Kentucky	203,000	Vermont	151,067
Maine	1,175,000	Virginia	82,685
Maryland	....	Washington	139,862
Massachusetts	156,528	West Virginia	19,184
Michigan	53,282	Wisconsin	543,283
Minnesota	208,088		
Missouri	861,563	Total	13,920,223

Gains in production have been made in a few States in which limestone quarrying is a new industry, but in practically all States where the stone has been produced a falling off in output has been the result.

The leading State in limestone-quarrying is Illinois. Operations in this State produced in 1892 an output valued at $3,185,000 and in 1893 at $2,305,000. The formation within the last two or three years of the Western Stone Company, composed of previously existing firms operating quarries at Lemont, Lockport, and Joliet, is the most significant act bearing upon the limestone interests of the State that has recently occurred.

Rank of principal States producing limestone.



VALUE OF LIMESTONE PRODUCED IN THE UNITED STATES DURING THE YEAR 1893.

[In millions of dollars].

Indiana.—The limestone industry of Indiana owes its magnitude and importance to the enormous deposits of oolitic stone, known as Bedford stone. The oolitic-stone production has suffered quite severely from the hard times, and a number of suspensions and even failures were the result. The first half of the year showed up better than for the same fraction of any previous year, but in July, August, and September there was almost no demand. From September until the close of the year business improved somewhat.

Ohio.—In Ohio the total values of products in 1892 and 1893 were, respectively, $2,025,000 and $1,848,063, making a decline in activity apparent, but not so serious a falling off as has been experienced in other States of large production. About one-third of the total value in Ohio is that of lime produced; the remainder is used for building, blast-furnace flux, and road-making.

Maine.—Considerable interest attaches to the figures representing the output of the State of Maine, for the reason that all the quarried limestone in this State is converted into building lime, which supplies many of the large markets on or near the Atlantic coast. The value of the lime output in 1892 was $1,600,000; in 1893 the figure was $1,175,000. This comparison may be regarded as some measure of the relative activities in building in the large Eastern cities, which depend chiefly upon Maine as a source of lime supply.

Pennsylvania.—In Pennsylvania limestone is quarried for the same large variety of purposes as in Ohio, although the annual output has never been so great as in the last-named State. The output of limestone and its products in 1892 was valued at $1,552,336. Much of the lime made in this State is used for agricultural purposes. Blast furnaces annually consume a large quantity of limestone as flux. The curtailed operations of many of the furnaces caused, of course, a considerable reduction in the quarrying operations for this purpose.

New York.—New York State seems to have suffered in its quarrying interests less than many other of the important States. The output of 1892 was valued at $1,200,000 and that of 1893 at $1,103,529. Business flourished in the early part of the year to a greater extent than in the same period of 1892, but the falling off of the latter part of the year much more than neutralized the gain.

BLUESTONE.

The value of bluestone quarried in 1893 is estimated at $1,000,000, while for 1892 the product was valued at $1,600,000.

It is impossible to obtain, by direct canvass of the bluestone producers, figures which are comparable in accuracy to those easily obtained in all other kinds of stone. The difficulty above indicated is due to the peculiarities of the bluestone industry as prosecuted in the productive States—New York, Pennsylvania, and New Jersey. A certain amount of the stone is quarried from regularly organized quarries with a definitely invested capital and plant or facilities for quarrying, but in addition to the stone taken from these regularly operated quarries a large amount is quarried irregularly and spasmodically by men who invest no capital and have no organization as producers of stone. Their operations are conducted as follows: Provided with a very simple equipment of the most ordinary quarry tools, they dislodge the stone found on land belonging to other persons and transport it to a number of shipping points, selling it there to dealers who make a business of collecting it in this manner and then shipping it to the place of consumption. The dealers pay the individuals who quarry the stone an amount which compensates them for their time and labor, while the owner of the property receives a certain definite percentage from the dealer for the amount of stone thus taken from his land.

The following article, which appeared originally in the Kingston (New York) Foreman, and which later appeared in the January (1894) number of Stone, gives a very fair statement of the bluestone industry for the year 1893:

"The bluestone industry has not resulted as satisfactorily at the close as was expected at its beginning. The money panic in July, August, and September seriously affected the building trades all over the country, and in consequence the dealers in building materials began to reduce stock and builders to suspend work where it was possible to do so. Prices of bluestone at quarries were reduced and a corresponding reduction in selling prices followed. Some of the wholesale dealers who were caught with large stocks on hand at this time were heavy losers, and in some instances partial suspension of shipments followed. An effort to stimulate the market by making a reduction in prices resulted in loss to the dealers in many cases, and as usually follows such a course, still deeper depression followed in every department of trade, the purchaser being tempted to buy when no real demand existed. As a result the wholesale dealers find they have large numbers of accounts on their books which are unpaid, in place of the stocks they were so anxious to get rid of. Besides this, prices were so low that the margin of profit was entirely lost on forced sales. The retail dealers in all the cities go into the winter with smaller stocks than have ever been known. The quarrymen in the Ulster section have suffered more probably in proportion than the wholesale dealers, for the reason that the drought of midsummer cut off some of their grains and hay, besides the garden vegetables upon which they depended for food. In a measure, to compensate for this loss, it is the intention of the wholesale dealers to keep their yards open all the present winter and receive stone for cost. This will make quarrymen quite comfortable through the winter and will enable them to strip large blocks for the season of 1894. The outlook is quite promising in the amount of stone that will be required next season, but the prices that will prevail will undoubtedly be low. In the absence of any form of a combination dealers become over anxious to make sales, and so they dispose of their stock, often to a disadvantage. Already prices have been quoted for next season's delivery, which are much below any that have been given since 1886. Such conditions are not usually alarming to the quarrymen, as in such cases sales are increased, orders are delayed, production stimulated, and in consequence the prices realized by the quarrymen are good. Shipments of bluestone for the season of 1893 have been far below those of previous years."

The following article in the July number of Stone is of interest as showing the peculiarities of the bluestone quarrying industry:

"The quarrying of bluestone probably requires as much skill if not more than any other kind of stone, a fact often overlooked, and a potent factor in the success or failure of a quarryman. It seems to be the general impression among a great many users and perhaps a few of the producers of this most useful and durable stone that a man need only find a deposit of salable quality of bluestone, and no more than usual proportion of top to bed, with the usual shipping facilities, and success is assured, but for any one who has been closely connected with this especially interesting business it is easy to find the reason why a quarry has not paid. The causes are usually radical, and one of the first flaws after ascertaining that the quarry contains stone in fair quantity will be found by looking into the system of quarrying, and here is frequently a drawback to the prosperity of the quarry.

"The peculiar formation of bluestone and the fact of its being found in comparatively small deposits, make machinery impracticable, a quarry in Chenango county, New York, probably being the only one which uses any of the modern machinery or blasting devices in quarrying, such as the Knox system in use at this place. Some few of the other large quarries, perhaps, are using the Knox system in blasting their top rock, and quite a number are equipped with steam drills. It is safe to say 90 per cent. of all the bluestone is quarried by hand wedges and sledges. Flagging is a large percentage of the kind produced and runs from one-fourth inch thick up. The beds usually produce the thinner stone on top, running heavier as the bed is worked down. Nearly every quarry has its own peculiar formation. Quarries within 400 or 500 yards of each other frequently differ greatly as to quality and formation. As a rule the best quarrymen have worked in the quarries from the time they have been able to do anything, and as that is usually pretty early in life, many of them have gained such knowledge of the work that they know to a certainty how the stone will work as soon as they see the bed, without raising a lift. It is only after long work at quarrying that a man becomes expert. In raising the flag is is very necessary that they come up in as large pieces as possible, that the cutters may get the larger-sized stone most in demand and for which the best prices are obtained. A good quarryman will handle a lift with utmost skill, driving the wedges just enough to give it the proper strain to free itself from the bed of stone, and yet not so to strain it that it will break under the stonecutter's tool, or perhaps before it is raised. There are no general rules or directions to follow out, but only to use the knowledge and skill obtained by long and close attention to the work."

EXHIBITS OF STONE AT THE WORLD'S COLUMBIAN EXPOSITION.

In response to the timely suggestion of Mr. F. J. V. Skiff, Chief of the Mining Department, nearly every State which made a display of mineral products exhibited some kind of building stone, so that profusion and wide distribution of stones suitable for building purposes made one of the impressive features of the Exposition. Not only was the United States well represented, but also many other countries, and in a number of cases these foreign exhibits were surprisingly comprehensive. This is particularly a matter of congratulation, considering the great expense and risk incident to transporting such heavy and yet fragile material as stone, especially in the form of slabs.

The following States were represented by exhibits of building stones: Arizona, California, Colorado, Connecticut, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Among the specimens exhibited were many which represent well-known sources of supply which have their essential characteristics fully set forth in the several volumes of Mineral Resources, but, in addition, many new sources of fine building stone were brought to notice. In fact, there was a greater contribution of new material in this line than in any other.

Arizona.—The kinds of stone represented were sandstone, lithographic stone, and onyx.

The sandstone came from Flagstaff, and is of a brown and unchangeable color, fine grained, and moderately hard. The quarries are actively worked.

The lithographic stone and the onyx are satisfactory as far as the present developments show.

California.—Included in the display from this State were specimens of sandstone from Sespe, Ventura county; greenish colored sandstone from Niles; serpentine from Amador county; onyx from Kesseler's quarry; marble from Colton, San Bernardino county, and from the Inyo Marble Company in Inyo county, and slate from the Chili Bar Slate Company.

The exhibit of onyx was very fine and showed well the capabilities of the product for ornamental uses. Some of the slabs were so cut and polished as to give the effect of landscape drawings or paintings. Artistically the work on the stone was of a high order.

The marble from Colton, San Bernardino county, is coarsely crystalline. Its color is white streaked with black; in the form of columns it presented a handsome appearance. The marble from Inyo county shows quite a number of varieties in color and its adaptability to interior decoration, as well as for outside building, was apparent.

Colorado.—The chief exhibit included a variety of granites, marble, sandstone, and lava stone. Among the granites may be mentioned what is known as Platte canyon granite, which was shown in columns over 6 feet high and 1 foot in diameter. This stone seems to be highly feldspathic. It is quite coarse grained. The prevailing color is due to feldspar. The polish is very satisfactory and there is no evidence of knots or streaks.

The so-called Arkins gray granite was exhibited in the form of a polished column. It is quite fine grained and has occasional dark spots. It takes a fine polish. Arkins red granite is medium grained, polishes well, and contains occasional dark spots and streaks of a pinkish brown shade.

Cotopaxi granite is quite fine grained. The specimens shown were not so well polished as others. Aggregations of feldspar in places give white spots here and there.

A fine 12-foot column of rose granite formed an important item of the exhibit. This stone is beautiful in color, takes a fine polish, and is, in general, free from knots and streaks. There are a few places where a lack of transparency in the quartz gives the appearance of spots, but these are not sufficiently pronounced to interfere with the uniformity of color. The workmanship involved in turning and polishing this column is very fine.

Among the marbles was a polished column surmounted by a carved cap. The stone is mixed blue and white and quite similar in appearance to some of the Vermont marble. The stone takes a fine polish and is quite fine grained. It was taken from the quarries of the Western Granite and Marble Company. The other samples of marble exhibited are hardly deserving of special mention, some of them being only imperfectly crystallized and not specially attractive. As marble quarrying in this State is still in its infancy better products may be looked for.

The Colorado Marble and Mining Company, of Denver, displayed specimens of ornamented and polished marble from quarries at the head of Youle creek, Gunnison county. This marble is nearly white in color, polishes very well, carves to a line, and seems well adapted for ornamental purposes.

The exhibit of sandstones was quite full and satisfactory. Columns of Kenmuir red sandstone exhibited by Greenlee & Son, of Denver, consisted of sandstone of medium grain and which cuts well into ornamental work.

A column of Coal Creek sandstone consisted of buff stone susceptible of ornamentation. Pleasant valley red sandstone is of a purplish color, finer grained than the two just considered, and probably has greater crushing strength.

A specimen of St. Vrain red sandstone showed medium grain and was susceptible of rubbing down to a fairly smooth surface.

The Pleasant valley quarries are in Larimer county, within 10 miles of Fort Collins. They are well equipped with steam drills and other first-class quarrying machinery. The stone is said to be free from alkalies and any substances which tend toward disintegration. Its weight is 160 pounds to the cubic foot, crushing strength 12,000 to 15,000 pounds to the square inch. It has been used in quite a number of buildings in Denver, Pueblo, Kansas City, Chicago, St. Louis, Omaha, and New York City.

The so-called lava stone is light in color and also in weight. It is cheap and is used to some extent in Denver for foundations and for interior construction.

Connecticut.—Granite and sandstone were represented in the stone exhibits from this State. The granites were from New Preston, New London, Sterling, Niantic, and Stony Creek. The sandstones were from Cromwell, Portland, and Rockland. The specimens showed satisfactorily the desirable qualities of these well-known building stones.

Idaho.—The exhibit from this State included so-called marble, sandstone, and magnesian limestone. Very little information was obtainable.

Indiana.—The well-known oolitic limestone of this State was exhibited by columns about 20 feet high and by a large number of variously tooled, rubbed, polished, lettered, and ornamented specimens which showed well the capabilities of the stone in all the uses to which it is put. A comparison of this stone with the Kentucky oolite showed that they differ markedly in the average size of the constituent granules, those of the Indiana stone being noticeably smaller. The Indiana oolite is known as the buff and the blue; the latter is said to come from the greater depth.

Sandstone and oilstone were shown from Paoli. This stone is very uniform in texture and of fine grain.

Iowa.—Many specimens of stone were exhibited, but information in regard to operations of quarries or analyses and tests of stone new to the trade outside of local business was entirely lacking, and hence the exhibit necessarily lost much of the interest which might have otherwise attached to it.

Kansas.—A large number of specimens of limestone and sandstone from many localities in the State was displayed. An unusual amount of pains in testing, analyzing, and labeling these specimens had been taken, and the collection was therefore of much interest. The following tables were compiled from the labeled specimens. The determinations were made by Dr. S. W. Williston, of Lawrence, Kansas.

Tests and analyses of Kansas building stones.

LIMESTONE. (*See* note, p. 565.)

Counties.	Formations.	Crushing strength.	Weight per cubic foot.	Specific gravity.	Ratio of absorption.	Analyses. Insoluble matter.	Oxides of iron and alumina.	Calcium carbonates.	Magnesium carbonates.	Sulphates.	Moisture.	Remarks.
		Pounds.	*Pounds.*			*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Johnson		19,279	165.4	2.65	.01	8	1.35	90	.12	0.02		From Ottawa; average from 3 blocks.
Allen						1.53	1.75	94.12	2.72			From Humboldt.
Leavenworth		7,862	168.5	2.70	.02	5.91	2.47	89.88	1.11	.38		From Lansing; average from 5 blocks.
Do		15,961	169.1	2.71	.004	6.20	3.31	88.17	1.88	.28	.04	From Lansing.
Cowley	Permian		165.4	2.65	.045	13.60	2.55	76.16	7.63			From Arkansas City; fine-grained and homogeneous; no appearance of fossils.
Do	do	4,555	157.3	2.52	.07	4.25	.85	94.06	.62			From Winfield.
Marion	do		167	2.67	.07	5.13	3.15	53.16	38.33			From Marion; this stone appears to have nearly the composition of dolomite. It is fine-grained, takes a smooth surface, and is gray is color.
Do	Carboniferous	5,824	169.8	2.72	.01	6.85	1.91	59.21	30.09	.95	.90	From Marion.
Do	Permian	8,136	167.6	2.68	.05	13.51	1.65	61.64	22.72			From Marion; produced by I. Kuhn & Co.; dark gray; not perfectly homogeneous, occasional spots.
Do	do	13,711	170.7	2.73	.04	6.75	1.59	51.05	40.51			Produced by I. Kuhn & Co.; average from 4 blocks, 5 miles northeast of Marion.
Do	do	12,364	168.2	2.69	.03	5.51	1.24	91.50	1.62			
Clay	do	10,291	170.4	2.73	.05	9.50	6.40	60.04	24.72			From Clay Center; average from 3 blocks.
Butler	do	2,727	162.9	2.61	.01	5.04	.96	93.32	1.06			From El Dorado.
Douglas	Carboniferous	11,630	167.6	2.68	.007	3.53	1.07	91.18	1.16			Crushing strength is the average from 5 blocks; from Lawrence.
Franklin		2,940	162	2.59	.03	1.18	3.09	92.71	2.64			From Greeley.
Leavenworth		8,223	170.4	2.73	.01	12.97	3.06	78.46	1.16	2.32		From Lansing.
Marshall		4,216	158.8	2.54	.06	13.89	4.29	80.10	1	.39		From Beattie; average from 5 blocks.
Do		9,810	163.2	2.61	.03	8.75	2.37	84.80	2.80	.78	.25	Do.
Do	Carboniferous	6,543	163.5	2.62	.05	14.01	1.34	80.31	3.87			From Beattie; average from 4 blocks.
Riley	Permian	3,272	159.1	2.55	.07							From Monterey; quarried by Ulrich Bros.
Wabaunsee			166.3	2.67	.01	6.22	1.74	89.68	1.99			From Alma.
Do	Carboniferous	7,646	161.3	2.58	.05	9.12	.70	88.55	1.25			From Alma; quarried by A. Zechser.
Do		2,891	154.4	2.49	.06	10.37	2.49	84.53	2.35			Crushing strength is the average from 5 blocks.
Chase	Carboniferous	7,907	162.9	2.61	.04	7.30	1.05	90	1.60	.03		From Strong City; average from 6 blocks.
Do		6,800	161.6	2.59	.04	8.57	3.62	84.72	1.75	.90		From Cottonwood Falls; quarried by Bittiger Bros.; crushing strength, average from 4 blocks.

Tests and analyses of Kansas building stones—Continued.

LIMESTONE—Continued.

Counties.	Formations.	Crushing strength.	Weight per cubic foot.	Specific gravity.	Ratio of absorption.	Analyses. Insoluble matter.	Oxides of iron and alumina.	Calcium carbonates.	Magnesium Carbonate.	Sulphates.	Moisture.	Remarks.
		Pounds.	*Pounds.*			*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Cowley		12,567	164.5	2.63	.01	3.34	1.69	93.98	.94			From Cambridge; quarried by H. Heddeman; average from 5 blocks.
Do.	Carboniferous	3,649	153.5	2.46	.08							From Cambridge; average from 5 blocks.
Lincoln	Benton Cretaceous											No data; known as Lincoln marble, but is hardly a marble, not being sufficiently crystalline.
Hodgeman						5.06	2.08	91.30	.87	not det.	.44	From Jetmore.
Hamilton	Benton Cretaceous					4.81	3.07	90.63	.84	do	.08	From Coolidge.
Norton	Loop Fork Tertiary	4,277	156.3	2.51	.06	8.29	*a*.90	89	2.00			From Norton; crushing strength, average from 4 blocks.
Cherokee	Subcarboniferous	9,520	166	2.66	.003	8	.69	97.32	.80			From Galena.
Allen			167.3	2.68	.02	2.75	5.91	91.02	.14			Iola Marble Company.
Do.		7,683	166	2.66	.02	2.63	1.76	94.10	1.54			Average crushing strength from 5 blocks.
Montgomery		7,731	169.8	2.72	.006	16.15	1.91	79.25	1.80			From Independence.
Barber		10,349	163.5	2.62	.01	1.85	1.95	94.62	1.40			Average from 6 blocks.
Franklin		12,809	167.3	2.68	.008	1.18	2.38	94.77	1.07			From Lane; quarried by Hanway.
Do.		{14,415 / 16,609}	169.8	2.72	.005	3.82	*a*.77	94.21	1.30			Do.
Do.		10,469	167.9	2.69	.009	3.94	1.20	93.61	1.20			Do.
Do.		12,354	167.9	2.69	.006	4.79	1.18	93.30	1.26			Do.
Anderson	Carboniferous	14,647	168.2	2.69	.004	4.30	.81	92.76	.95	.23	.43	From Garnett.
Do.		4,399	154.2	2.47	.04	.61	*a*1.51	97.32	.32	.43		Do.
Jackson		11,005	163.5	2.62	.02	10.93	2.02	83.99	2.66	.14		Quarried by A. W. Charles.
Woodson		14,145	168.2	2.69	.007	6.80	2.60	88.03	2.04	.21		From Yates Center.
Elk		10,162	166.2	2.66	.008	.66	2.13	93.49	3.04	.36		From Moline.
Leavenworth		5,515	160.4	2.57	.02	17.49	4.09	69.07	3.06	.37		From Soldiers' Home.
Wabaunsee		5,273	156.3	2.50	.06	3.27	2.61	92.50	1.62			From McFarland; average from 5 blocks.
Micami		2,036	128.2	2.50	.06	1.50	.95	96.50	.74			From Fontana.
Do.		13,802	165.4	2.65	.004	1.35	1.32	96.09	1			From Fontana; crushing strength, average from 4 blocks.
Do.		4,625	145.4	2.33	.04	2.44	.82	95.57	.80			From Fontana; crushing strength, average from 5 blocks.
Jefferson		8,767	169.8	2.72	.005	6.98	1.04	90.01	1.66			From Winchester.
Nemaha		6,757	161.6	2.59	.05	11.97	3.59	81.98	1.20	.55	.29	From Sabetha.

Leavenworth	....	12,266	161.1	2.71	.01	....	....	....	....	....	....	From Lansing; crushing strength, average from 5 blocks.
Brown	....	4,721	164.5	2.63	.06	11.83	5.53	81.91	1.56	.05	....	From Horton; owners, Frey Bros.; crushing strength, average from 5 blocks.
Douglas	....	10,339	166.6	2.67	.01	2.29	1.79	95.02	.79	....	....	From Lawrence; crushing strength, average from 5 blocks.
Do	....	11,038	166.6	2.67	.01	8.02	2.05	88.54	1.29			From Lawrence.
Allen	....	17,160	168.8	2.70	.008	1.99	1.21	95.20	1.10	....	....	From Humboldt; crushing strength, average from 3 blocks.
Do	....	11,267	166	2.66	.02	3.79	1.07	93.20	1.01	.20	....	From Humboldt; crushing strength, average from 5 blocks.

a Iron in ferrous state.

All of these limestones are fossiliferous in appearance. The surface appears to polish very well. Fossil outlines are very distinct in most of them. The prevailing color of the samples is a sort of gray, occasionally brownish. The polished surface of certain bluish-gray specimens is quite dark. The polish of some of these stones is very good indeed.

Tests and analyses of Kansas building stones—Continued.

SANDSTONE.

Counties.	Formations.	Crushing strength.	Weight per cubic foot.	Specific gravity.	Ratio of sandstone absorption.	Analyses. Insoluble matter.	Analyses. Oxides of iron and alumina.	Analyses. Calcium carbonates.	Analyses. Magneseum carbonates.	Analyses. Sulphates.	Analyses. Moisture.	Remarks.
		Pounds.	*Pounds.*			*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Jefferson		1,612	152.3	2.44	.12	94.35	2.35	1.14	1.01	.42		From Valley Falls; quarried by James McGinty.
Barber	Jurassic	2,623	159.5	2.55	.08	91.12	6.80	1.21	.80			
Osborne		1,323	154.5	2.47	.11	87.25	9.13	1.90	1.20	.27		From Natoma; average from 3 blocks.
Phillips	Loop Fork Tertiary	13,619	150.7	2.41	.01	97.38	2.20	.28	.10			From Woodruff; appears to be a conglomerate, general color greenish gray; average from 5 blocks.
Do	do			*a* 2.28	.16	97.22	1.11	.75	.76	.08		From Long Island.
Jefferson	Carboniferous	8,057	153.2	2.45	.01	97.71	1.31	.21	.54	23		Quarried by Ezekiel Marsh; average from 5 blocks.
Neosho		6,526	161.3	2.58	.06	86.29	5.85	4.11	2.61			From South Mound; average from 4 blocks.
Do						64.64	5.01	29.82	.47			Do.
Do		6,161	161.3	2.58	.04	82.58	5.70	9.78	1.88			From South Mound.
Montgomery			152.3	2.44	.09	95.35	2.69	undet.	undet.	1.39		From Independence.
Crawford		6,756	163.5	2.62	.04	86.57	6.78	4.12	1.55	.20	*b* .59	From Farlington; quarried by Armstrong; argillaceous; average from 4 blocks; sample has a petroleum odor, dark gray color, greasy; average from 3 blocks.
Linn		3,887	132.9	2.31	.005	87.91	.89	2.23	1.75	1.41	*c* 7.13	
Woodson		3,526	145.7	2.33	.09	98.71	.63	.27	.03			From Yates Center; crushing strength, average from 7 blocks.
Linn		6,962	147.3	2.36	.02	82.69	3.07	6.50	1.55	.41	*c* 5.59	From Pleasanton; crushing strength, average from 5 blocks.
Crawford						84.04	3.67	8.94	3.23			From Farlington.
Neosho		6,526	161.3	2.58	.06	86.29	5.85	4.11	2.61			From South Mound; crushing strength, average from 4 blocks.
Do		6,161	161.3	2.58	.04	82.58	5.70	9.78	1.88			From South Mound; crushing strength, average from 6 blocks.
Crawford		6,756	163.5	2.62	.04	86.59	6.78	4.12	1.55	.20		From Farlington; crushing strength, average from 4 stones.
Linn		3,696	144.2	2.31	.02	76.57	4.09	9.11	.31	.22		From Pleasanton; organic matter, bitumen, etc., 9.20 per cent.

a Specimen contains a good many cavities, which accounts for its low specific gravity. *b* Organic matter. *c* Bitumen, etc.

Kentucky.—The exhibit from this State included a large number of specimens of limestone and a smaller number of sandstone. Of the limestones the Bowling Green oolite is the most interesting and important. The capabilities of the stone were well shown. An oolitic stone known as Craneyville stone, from Caldwell county, is quite distinctly different from the Bowling Green stone. It has a good cleavage, which makes it valuable for splitting into curbing and flagging stones. A decidedly hard limestone is that quarried by the Hopkinsville Stone Company in Christian county.

Maine.—A very large number of specimens of granite from this State were displayed in the form of a collective exhibit which formed an item of much interest among the stone displays. The celebrated roofing slate from Brownville was also on exhibition.

Massachusetts.—The extensive resources of Massachusetts in granite, sandstone, marble, and serpentine were well shown by representative and well-prepared specimens. Granites from all the numerous quarry regions were shown, also sandstone from Longmeadow and marble from the following localities: North Adams, Van Deusen, West Roxbury, Stoneham, Bolton, and Lee.

Michigan.—The display of stone included handsome exhibits of Portage entry stone and brownstone quarried by the Detroit Brownstone Company. Also buff sandstone known as Waverly sandstone.

One of the most interesting stone specimens is a serpentine found near Ishpeming. This stone is not yet on the market, but considerable has been done in the way of securing opinions from experts at home and abroad.

The following is an analysis of the stone:

Analysis of serpentine from Ishpeming, Michigan.

Constituents.	Per cent.
Silica, SiO_2	33.80
Alumina, Al_2O_3	1.65
Chromic oxide, Cr_2O_3	0.42
Ferrous oxide FeO	9.79
Oxide of zinc, ZnO	0.30
Lime, CaO	3.46
Magnesia, MgO	31.74
Sodium oxide, No_2O	0.32
Manganese and nickel	Trace.
Carbon dioxide CO_2	5.66
Water	12.86
Total	100.00

Opinions from European experts indicate that this stone could compete, perhaps at a slightly lower price, with popular European products, even with the Italian Verde des Alpes. The supply appears to be considerable and the stone occurs in masses which are said to be capable of yielding blocks or slabs large enough for any uses to which the stone would be put. Transportation facilities are at hand and the commercial production of the material may be expected.

Minnesota.—The kinds of stone represented in the exhibit from Minnesota included granite, quartzite, jasper, slate, and marble. Among the Minnesota products the most important and interesting at present is the so-called "pipestone red jasper," a metamorphic quartzite rock of intense hardness, varying in color from cherry to violet. With a crushing strength of 23,000 pounds to the square inch, the stone is not only beautiful, but of great durability. Some fine polished specimens, as well as rough stones, were displayed.

Missouri.—Sandstone, marble, onyx, limestone, lithographic stone, and granite were on exhibition. The collective exhibit was a very instructive one, as showing the varied stone resources of the State.

The marbles exhibited were variegated, the prevailing color in some being gray and in others brown. Some of them look much like Tennessee marbles. While some of the specimens showed a fair polish, others were somewhat pitted and non-homogenous. A sample of onyx from Pulaski county indicated some possibilities of getting fine material, though the sample shown was not more than fair.

A sample of lithographic stone from Cape Girardeau appeared to be very satisfactory indeed; a specimen of lithographer's work done upon it seemed to leave little, if anything, to be desired; the impression exhibited was very perfect in all details. The abundant and well-known limestones of the State were fully shown, as also a number of granites, including notably a cube of pinkish red coarse-grained highly feldspathic granite from the Syenite Granite Company, of Saint Louis.

Montana and Nevada.—Both of these States were represented in the stone exhibit, but many of the specimens indicated nothing more than future possibilities, and information in regard to scientific examinations and tests was not available. The exhibits were, however, sufficient to show that granite, porphyry, jasper, marble, limestone, sandstone, and onyx are well worth further investigation and test.

New Hampshire.—The well-known New Hampshire quarries were represented, and while the collection might have been much more complete, it was satisfactory so far as it went.

A cube exhibited by the Great Falls Granite Company was particularly beautiful, somewhat resembling one of the dark Swedish granites. It showed a beautiful polish and a marked contrast between the polished and cut surfaces, so that lettering and ornamentation showed. The granites of this State are so well and favorably known that extended comment is unnecessary.

In addition to the natural granites, some so-called artificial molded granite was exhibited by the New Hampshire Molded Granite Company, of Keene. The product seemed to be strong and durable.

New Jersey.—The stone on exhibition was mainly sandstone from well-known sources. Some granite and trap rock were also shown, as well as hand specimens of granite, marble, limestone, barite, and conglomerate, by the State Geological Survey.

New Mexico.—A number of beautiful specimens of ricolite and some serpentine marble and onyx were shown. A specimen of landscape serpentine giving the effect of a painting was very unique and beautiful. For special information in regard to the serpentine, the reader is referred to Mrs. Lydia J. Cadwell, Adams Express Building, Chicago. Mr. Owen McDonald, of Hillsboro, New Mexico, can give information in general with regard to the State's resources in stone.

New York.—From both the commercial and purely scientific standpoints New York's exhibit of stone of every kind was very complete and satisfactory. Many of the sandstones shown were so compact and fine grained as to be susceptible of not only an exceedingly smooth surface, but almost a polish. The celebrated red slate of Washington county was shown in the collective exhibit, and also by a special exhibit from Pritchard's quarry in Middle Granville. Marbles from nearly all the quarrying localities were well displayed. A collection of road-making materials was also shown, together with information as to results of practical experience with them. From the educational standpoint the New York stone collection was unquestionably the finest at the Exposition.

North Carolina.—The stone resources of this State were exhibited in a manner highly creditable to those in charge of the State's exhibit. Fifty-seven different exhibits are on record in the official Exposition catalogue, and much care and interest in selecting and preparing specimens were apparent to the visitor. The kinds of stone included granite, sandstone, limestone, marble, serpentine, and slate. Among the granites may be mentioned a fine black (probably biotite) granite from Lilesville. This stone polishes beautifully and shows a strong contrast between the polished and rough surfaces. A highly feldspathic pink granite from Dunn's mountain, Rowan county, is one that for beauty would commend itself to consumers. The exhibit of the Mount Airy Granite Company consisted of a circular wall of rough stone, presenting a fine appearance. The quarries of this company were represented by photographs, which show such location of the quarries as would promote ease of quarrying. The granite collection showed clearly that the people of the State are alive to the fact that they possess not only durable but beautiful granite and in enormous quantities. Although quarrying operations on a thoroughly modern scale as to equipment are of recent date, rapid strides have been made in transportation facilities, the lack of which offered at first the most formidable obstacle to development. Near Raleigh are several quarries, among which may be mentioned the so-called graystone quarries, which are in active operation. The Henderson quarry in Granville county is a hard, dark-colored granite, eminently suited for paving blocks. Near Wilson, in Wilson county, is a reddish granite resembling Scotch granite and suitable for monumental purposes. In Alamance county, near Graham, is a dark-gray granite suitable for fine work. In Surry county, near Mount

Airy, are the Mount Airy granite quarries, the stone from which is used for heavy masonry and for paving. A granite quarry near Kernersville furnishes stone suitable for and used in monumental work. Dunn's mountain, near Salisbury, is a mass of white, highly feldspathic granite, which has been used with good results in the Government building at Raleigh. A notable granite is also that taken from quarries near Mooresville, Iredell county. This stone is well adapted to monumental work as well as rough building.

Both brown and gray sandstone were exhibited, showing well the resources of the State in this line.

North Carolina marble, taken from the gorge of the Nantahala river, is beginning to attract general attention as a marble similar to the Georgia marble, and said to be sold under that name. It varies in color, being white, black, rose colored, and variegated. A Georgia company is now operating quarries in this region.

Although no slate is quarried in the State it exists near Egypt, at Goldston, and is found at a third point, 4 miles from the mouth of Rocky river.

Ohio.—The well known sandstones and limestones of Ohio were fully represented. Among the sandstones were exhibits of the Ohio grindstones, which are too well known to need special mention here. Limestone was shown in great abundance, not only for building but also, by many specimens of stone, for burning into lime. These latter were accompanied by specimens of lime made from the stone. Columns of Berea stone, furnished by the Cleveland Stone Company, were used in the edifice erected on the space allotted to Ohio in the Mining building.

Oregon.—The kinds of stone exhibited included a few specimens of granite, sandstone, limestone, and marble. Of these the most interesting is perhaps that of marble which came from the quarries of the Variety Marble Company, in Douglas county. About 30 men are employed at these quarries. The operations are of quite recent date.

Pennsylvania.—Pennsylvania's exhibit of stone of all kinds was one of the best as a collective exhibit. A very large number of specimens were displayed in a single collection, while there were in addition several special exhibits of a notable character. It is to be regretted, however, that satisfactory information in regard to many of the specimens was wanting. The same remark applies equally well to a number of State exhibits. All of the kinds of stone known to the general trade were abundantly represented. Among the well known quarrying centers represented were the Avondale limestone quarries; Schweyer and Liess, of King of Prussia; the old Bangor Slate Company, the Big Bed Slate Company, the Hard Vein Slate Company, the Pen Argyl Slate Company, the Peach Bottom Slate Producers' Association, the East Bangor Consolidated Slate Company, the Blue Valley Slate Company, Globe Hard Vein Slate Company, E. W. Evans & Company, F. M. Hower, Imperial

Slate Company, of Wind Gap; Jackson Brothers, of Pen Argyl; R. L. Jones & Company, of Delta, and W. W. Jones, of Belfast. From this enumeration it is evident that the slate of the leading slate-producing State was well represented. Among other well known producers of other kinds of stone may be mentioned the Conshohocken Stone Company, the Hummelstown Brownstone Company, the Swatara Brownstone Company, Leiper & Lewis, of Chester, and a number of producers of Beaver Valley sandstone, which for certain uses has made an enviable reputation.

Schweyer & Liess, of King of Prussia, exhibited a 2-inch-thick slab of marble, 16 feet 2 inches by 6 feet 9 inches, probably one of the largest slabs of marble of that thickness ever quarried. An analysis of this marble shows the following composition:

Analysis of marble from King of Prussia, Pennsylvania.

	Per cent.
Calcium carbonate $CaCo_3$	98.157
Silica SiO_2	.771
Alumina Al_2O_3	.167
Ferrous oxide FeO	.542
Magnesia MgO	.509
Phosphoric acid P_2O_5	.048
Organic matter	.132
Total	100.326

The following is an analysis of Meriontown refractory firestone:

Analysis of firestone from Meriontown, Pennsylvania.

	Per cent.
Silica SiO_2	92.75
Alumina Al_2O_3	4.685
Oxide of iron	1.785
Lime CaO	trace.
Magnesia MgO	.270
Total	99.490

One of the most interesting items of the State's exhibit was a small core of the recently discovered Avondale marble. Analysis shows this to be a dolomite. It shows a crushing strength of over 22,000 pounds to the square inch and an exceedingly low percentage of absorption. This stone will undoubtedly prove to be a valuable building marble, although it is too coarsely crystalline for fine statuary work.

A specimen of green and white mottled serpentine of considerable hardness formed an interesting exhibit. The specimen was taken from a source near Easton.

An exhibit of sandstone by Paul A. Oliver, of Oliver's Mills, was shown in the form of a window jamb. A portion of the stone was beautifully polished, showing the specimen to be a very fine-grained, hard, and durable sandstone. This specimen is decidedly unique.

A small but fine specimen of black marble was exhibited by the Brookside Club of Williamsport. No quarrying operations have been undertaken, but the stone merits further investigation.

South Carolina.—The Winsboro Granite Company, of Winsboro, exhibited three one-foot cubes of two grades of light, highly feldspathic, fine-grained granite. The polished surface is much darker in color than the rough surface, and lettering shows well. The coloring is not always perfectly uniform, owing to white knots. The stone is undoubtedly a valuable building stone.

South Dakota.—In the exhibit from South Dakota were samples of a uniform, but rather soft, red sandstone, which was shown in a number of carved figures. Besides this were some polished samples of Sioux Falls quartzite in the form of polished columns. This stone shows occasional small knots, which will not take a polish, but these do not seriously interfere with its beauty. The stone, although beautiful enough for ornamental work, is at present quarried for paving purposes, the blocks being in use in Chicago, where they have given satisfaction. The stone splits easily into paving blocks, and it is claimed that it can be worked for this purpose more cheaply than granite. A crushing strength test gave about 22,000 pounds to the square inch. The quarrying of this stone has been going on for about ten years, and is becoming fairly well known to the country at large as well as to such of the Western cities as have had practical experience with it.

Tennessee.—Two exhibits, one of sandstone and the other of marble, were shown. The necessity, however, for exhibiting Tennessee marbles was not great, since these marbles were in use in the Exposition buildings themselves.

Utah.—Granite, sandstone, slate, and onyx were included in the exhibit from Utah. The onyx varies in color from white to brown, green, and variegated. Only small samples were shown, and none of it is as yet quarried. It contains here and there opaque, chalky looking spots, which, of course, form a drawback. It is said to occur in seams from 3 or 4 inches in width to several feet and to extend for long distances. It is believed that commercially successful quarrying will result from further development of the deposits. The slate exhibits from Provo City revealed some samples which somewhat resemble Vermont slate in color, which is purple and green. The specimens showed good cleavage, and there seems to be no doubt that good roofing slates could be made.

Vermont.—In the abundance, variety, and beauty of its marble exhibits Vermont, of course, far surpassed all other States. In the Mining building was a collective exhibit in which the following well-known firms were represented: Bardillo Marble Company, of Brandon; Barney Marble Company, of Swanton; Brandon Italian Marble Company, of Brandon; Columbian Marble Company, of Rutland; Corona Marble Company, of Brandon; J. K. Freedley & Son, of East Dorset;

Mallet's Bay Marble Company, of Colchester; S. F. Prince and Company, of South Dorset; Smith and Brainerd Marble Company, of Middlebury; True Blue Marble Company, of Rutland, and the Vermont Marble Company, of Proctor. The specimens were well selected and included a great variety of shades of color. Educationally this collection was very satisfactory indeed. In addition to its display in the Mining building, the Vermont Marble Company had another of manufactured articles and works of art in the Manufactures building.

Granite was exhibited in the Mining building by the Ascutney Granite Company, of Windsor; the Co-operative Granite Company, of Calais; Jones Brothers, of Williamstown; Lyon Granite Company, of Dummerston; North Haverhill Granite Company, of Montpelier; W. A. Rice, of Woodbury; C. H. Stearns, of Hardwick; Vermont Granite Company, of Montpelier; Vermont Quarry Company, of Montpelier, and the Wetmore and Morse Granite Company, of Barre.

In the Manufactures building a cooperative association of granite producers in Barre made a fine display of their carved, polished, and dressed products, such as monuments, tombstones, etc.

It is safe to say that the Barre granite, for uniformity, fineness of grain, beauty of polish, susceptibility to carving, freedom from knots, streaks, or flaws, had no superior at the Exposition from any part of the United States.

The well-known Vermont slate was represented by specimens from the Eureka slate quarries at Fair Haven.

Virginia.—Granite, marble, onyx, and slate were included in three exhibits from this State. It must be said, however, that justice was hardly done to Virginia's well-known and extensive resources in the line of building and ornamental stone.

Washington.—Some possibilities in the way of slate, marble, and other building stones were shown, but information in regard to the specimens was not obtainable.

West Virginia.—Collectively the exhibit of stone from this State showed well its quite abundant resources in sandstone and limestone. Among the sandstones may be mentioned exhibits by the Alderson Brownstone Company, headquarters at Richmond, and the Virginia Brownstone Company, of Hinton. A number of sandstones in West Virginia have won good reputations as bridge stone and some of them are valuable material in the erection of buildings.

Wisconsin.—Granite, sandstone, and limestone were shown. Granite was displayed by the Amberg Granite Company, the Berlin and Montello Granite Company, the Cohn Granite Company, and the French Granite Company. These firms made a very creditable showing, large blocks of beautifully polished stone being used in the construction of a railing around the State exhibit in the Mining building and in a pavilion.

The Marblehead Limestone Company showed their product in the form of a series of steps which demonstrated the desirability of the stone for such use.

Of the sandstones the Ashland Stone Company, the Prentice Brownstone Company, and the Superior Stone Company had very creditable exhibits.

Wyoming.—Much credit is due to the enterprise shown in getting up the best obtainable collection of building stones to show the resources of this Territory. Granite, marble, sandstone, and onyx were shown, Very little actual quarrying has been done, and naturally many of the specimens being taken from the surface did not show the best stone, which would doubtless be obtained by going deeper. It was, however, definitely shown that the above-mentioned stones are to be obtained in large quantity and probably, in many cases, of fine quality.

SOME OF THE FOREIGN STONE EXHIBITS AT THE WORLD'S COLUMBIAN EXPOSITION.

MEXICO.

Lower California.—The exhibit of the New Pedrara Onyx Company in the east gallery of the Mining building was most remarkable, both for the quality and quantity of its material. Onyx, both in rough and polished state, was shown in solid blocks and slabs up to 6 feet in length, while the space was inclosed by a balustrade 3 feet high of solid onyx of the most delicate pearl-white and greenish tints, with pink and red veins and markings. The striking feature of the onyx, aside from its beauty of color and translucency, is its freedom from flaws, cracks, or holes, as well as from inclosures of flint, which detract so much from the value of most Mexican onyx. Every piece rings under the hammer like a bell. The company claims that slabs of great size, up to 9 or 10 feet square, can readily be obtained from its quarries. The quarries are located in Lower California, in latitude 30°, or about 200 miles south of the international boundary. The region, though rich in mineral resources, is as yet undeveloped, and the onyx is hauled at present by wagon to the bay of San Carlos on the Pacific coast, a distance of about 60 miles on a down grade, and thence shipped by water. The onyx occurs in several layers or beds, from 1 to 3 feet in thickness, lying on or near the surface, interbedded with calcareous conglomerate and tufa. It it evidently a thermal spring deposit, of comparatively recent geological formation. On the company's property, which comprises about 5,000 acres, are two deposits about 3 miles apart. The one now being worked extends over about 20 acres, and on it in places three distinct beds or layers of onyx have been opened within 20 feet of the surface, so that an immense amount of the material is readily available. Prof. S. P. Merrill, of the National Museum and author of "Stones for building and decoration," who examined this property in the summer of 1892 for the purchasers, considered it the most remarkable deposit of onyx yet discovered.

ITALY.

The Italian display of marbles and of rough and carved alabaster in the Mining building constituted an attractive and instructive exhibit of the varied resources in lines which have made Italy famous. For the finest carving and most delicate statuary work the Italian marble is acknowledged the world over to have no superior. The possession of this high grade of statuary marble and the artistic temperament of its people have together conspired to make this country the headquarters not only for talented sculptors but for skilled artisans and stonecutters. In view of these facts there naturally exists in all countries where art is prized a demand for Italian marble, both rough and manufactured. While this demand for the finest statuary marble and its products from Italy is unquestionably well founded and legitimate, it should be remembered that for the great majority of purposes, such as building and interior decoration, our own country is just as well able to supply the demand for marble of the greatest variety in color and the most perfect susceptibility to polish and fine finish. The variety in the marbles found in the United States is very great indeed, and the prosperity of the industry in the past is a sufficient testimonial to the acceptability of our own products for all the uses to which marble is put.

The following item relative to the marble industry in the valleys of Carrara, Massa, and Seravezza will be found of interest as showing the extent of the industry and the nature of the product quarried:

"The marble quarries belong to the Upper Trias formation, and are found between more or less crystalline schists. Below these marbles there is a zone of compact limestone one called 'grezzoni,' belonging to the Middle Trias. The marble-bearing zone extends over an eliptical-shaped area covering more than 78 square miles. At the present time marble quarrying on a large scale is carried on only in the valleys of Carrara, Massa, and Seravezza. In recent years quarrying has also been carried on in the valleys of Arno and Vinea with increasing success. Of the various kinds of marble quarried in the Italian Alps, common white marble is largely predominant, and constitutes the principal part of this trade. It is used for all kinds of purposes, such as for monuments, architecture, staircases, and pavements. Next in importance is the 'bardiglio,' a grayish marble, of which there is a beautiful variety with black and white veins called 'bardiglio fiorito.' This variety is largely used for tombstones, monuments, and furniture. The statuary marbles form an important class. In consequence of their very fine grain and white color, they are used for sculpture, museums, churches, and all other places which are protected from the effects of the atmosphere. There are also the colored marbles, which are expensive. The trade in these marbles is very limited, and the same may be said of the black and of some Cipolin marbles. The total number of quarries actually worked in the above-mentioned provinces is about 500, and there are more than 700 either not at present being worked or abandoned. There are also about 170 establishments for working and sawing the marble. The marble trade gives employment to 9,104 workmen, of whom 5,899 are employed in the quarries, 900 in carrying and loading the marble, 675 in the sawmills, and 1,630 in the studios and works."

EGYPT.

Among the foreign stone exhibits of special interest should be mentioned one by Messrs. Farmer and Brindley, of London, of carved and polished samples of ancient Egyptian porphyry, which, however, instead of remaining ancient, promises to become one of the most modern products in this highly prized kind of stone.

From a publication by Mr. W. Brindley on this subject, it appears that, important as these ancient Egyptian porphyry quarries were under the Cæsars, they became lost to history on the decline of Roman power in Egypt, and for fifteen centuries the world has been ignorant of their whereabouts and has had to obtain supplies in this line by the shameful destruction of the beautiful work of the ancients.

"The old quarries have now been rediscovered and are found to contain immense masses of the most beautiful porphyry, the supply being practically inexhaustible. A concession for their reworking has been granted to me [W. Brindley] by the Khedival Government of Egypt for a long period of years on advantageous terms.

"These ancient quarries of imperial porphyry are situated at the Mons Porphyrities (now called by the Arabs, Gebel Duchan) of the old geographer, Ptolemy. This mountain is on the Egyptian Red Sea coast, about 20 miles inland from the ancient port of Myos Hormos, which port is opposite the island and light-house of Shadwan and near the entrance to the Gulf of Suez. This harbor (now called Abu Shaar) is sheltered from the north winds, and has ample depth of water for barges to load alongside.

"The old Roman route from India and Persia to Europe began the caravan journey at the port of Myos Hormos and passed alongside of Mons Porphyrities, where it joined the old Porphyry road from the quarries to the Nile; the old caravanseries and reservoirs for water still exist all along the route through the desert to Keneh on the Nile.

"The first stage of this road was from Myos Hormos to a station at the foot of the Porphyry mountain, a distance of about 20 miles. The road has a gentle gradient of about 1 in 80, and all the way it is smooth and level, being composed of shingle, made solid with sand which is firm enough for a carriage to drive over. If a narrow-gauge railroad were laid on the surface, loaded trucks would descend, requiring only slight brake power to regulate their speed, the empties being sent back by oxen or camels.

"On the sides of the mountain are some six or seven ancient quarries with the various roads up to them. Some of the quarries are a little above the level of the valley. The largest of them is on the peak, Lykabettus, near the top of the mountain, up to which there was a wide-pitched road or slide, used for the descent of the large blocks, some of which must have been over 20 tons in weight. This peak is one high solid mass of choice red porphyry, about 120 feet broad and 60 feet high, and it is still capable of producing an almost unlimited supply, and blocks of immense size are still obtainable.

"The road for their removal requires either repair or a new block slide, as, owing to the rainstorms of twelve or fifteen hundred years, the old broad-pitched road is in part destroyed. The quarries have not been worked, at the latest, since the Mohammedan invasion of Egypt. The great columns as seen in Rome and Constantinople, the huge sarcophagi and basin (16 feet across) of the Vatican, all, no doubt, came from this quarry at Lykabettus.

"Mitchell, the geologist lately in the employ of the Egyptian Government, specially surveyed one quarry for Mr. Brindley, which the latter had not time to visit, and he reports that there are in that quarry alone 2,000 cubic yards of porphyry obtainable at little cost, the value of which in Europe, reckoned at only half the price now paid for porphyry, would be worth at least £162,000 ($810,000).

"It is proposed to do all the quarry work by the aid of native workmen, who are both abundant and cheap, first-class practical quarrymen and masons being obtainable at half a crown a day and laborers at much less.

"In working porphyry it splits up readily with wedges, and this was the ancient method. Now, blocks can be divided quicker and truer by the aid of 'plug and feathers,' a hold being made 3 inches deep in twenty-five minutes, simply by hand power. It can be sawed into slabs quickly by the aid of chilled iron shot, as now used in granite cutting. Turning can be done about as cheaply as for granite by the new system of Brinton's revolving cutters, and it injures the cutters less than granite, as the latter contains quartz, while porphyry is only of feldspar hardness.

"The present average price of antique porphyry is about £7 per cubic foot; two new columns, 7 feet in length and 1 foot in diameter, recently made in Venice for a Paris house, sold for £800. The supply is a monopoly and the quantity practically unlimited.

"It is intended to take the blocks from the harbor to Abu Shaar by native sailing barges to Suez, where it would be measured by the Egyptian Government for royalty dues. From Suez it would be shipped direct to London."

NEW SOUTH WALES.

The exhibits of stone of all kinds from this country at the World's Columbian Exposition were very fine and impressive. The various rough and manufactured products showed the fact that almost any desired kind of stone may be obtained in abundance. Most of the public and private stone buildings of the city of Sydney are built of Triassic sandstone taken from quarries in the vicinity of the city. This stone is pleasing in color and entirely satisfactory as to durability. It is easily worked and is susceptible of ornamentation. Blocks weighing 50 tons may be quarried without difficulty.

Granite from Mornya and Trial bay was shown. The former is of even texture and good quality. It has been used in the form of columns in the Sydney post-office. The Trial bay granite is of pink color, due to flesh-colored feldspar, and has been used in a breakwater and in public buildings at Trial bay. Syenite from the Bowral quarries is a stone of great hardness and durability, and on account of these qualities was selected as the material of which to construct the buttress and piers of the Hawkesbury railway bridge between Sydney and Newcastle, the largest bridge in Australia. The foundations of some of these piers extend 190 feet below the bed of the Hawkesbury river. This stone has been adopted as the best for all railway construction. It is also used for curbing in Sydney. Serpentine is obtainable, but is not quarried at present.

In the Cowra district diabase porphyry (verde antique) is obtainable, but is not worked.

Marbles are found in considerable variety from the Mullion, Momlam, and Cow Flat districts. White marble from the Cow Flat quarries has been used in the form of tiles constituting the flooring of the great hall of the Sydney University, but is at present used only for lime burning.

Black and light mottled marble from the Marulan quarries has been used with the Cow Flat marble in the flooring of the University of Sydney. Like the latter, it is used only for lime burning.

The marble from Moonbi is red and white coralline marble. These quarries were worked at one time, but not at present.

Black marble with white coral markings, presenting a handsome appearance, is obtainable at Briar Park, Rockley. No quarries have yet been operated.

Roofing slates of excellent quality have been obtained in the Goulburn, Bathurst, and Gundagai districts.

OTHER COUNTRIES.

The following information relative to foreign building stones is taken from a number of monographs by Mr Hjalmar Lundbohm, of the Geological Survey of Sweden. Mr. Lundbohm has had exceptional opportunities as the result of extensive travels to become an authority as to the merits of the various kinds of stone in the leading producing centers of the world, and also to become familiar with the quarrying methods and the processes used in dressing, cutting, and polishing the products for use. His publications are of special interest, since few scientists, if any, before him, have given so much attention to the study of stone from the economic as well as the scientific side over so large an area of the globe. His travels included visits to the leading quarrying centers of the United States, as well as to those treated by him in the following pages.

QUARRY PRODUCTS, BUILDING AND ORNAMENTAL STONES OF SWEDEN

"Though the stone industry, as one of the more important means of livelihood, is of a comparatively recent origin in Sweden, the use of rocks for constructive and decorative purposes dates back to an early period. During the mediæval age, when church architecture was flourishing, the comparatively soft rocks, such as limestones and sandstones, were used very extensively. The cathedrals of Upsala, Linköping, Skara, Lund, and other cities, as well as the ninety-four country churches of Gotland built before 1350, and well known to all who are interested in the Gothic and Roman style of architecture, show that the builders of that period possessed good judgment as to quality of stone and methods of use as well as skill in masonry, which has not been surpassed in later times. During the following centuries, at various periods, the stone industry showed high development, especially in the seventeenth century and the early part of the eighteenth, when Swedish architecture reached its most flourishing condition, and fine buildings such as the royal castle in Stockholm and others were erected. This period was followed by one of decadence, characterized by a tendency to substitute for natural stone the cheaper artificial stone and plaster. In a large and sparsely populated country like Sweden this was quite natural so long as means of transportation were undeveloped. Later, as the country became traversed by numerous railways and canals, the stone industry again became more prominent, thus benefiting the national architecture as well as constituting an important item among the industries of the nation.

"The stone industry has to do with the following rocks, mentioned in the order of their commercial importance: Granite and some other crystalline siliceous rocks, Silurian limestone, Cambrian and Silurian sandstones, Archæan crystalline limestone, clay slates, mica schists, etc. In addition porphyry is used for decorative purposes.

"The Archæan rocks, especially granites and gneisses, occupy very extensive areas, and as these rocks show such variety as regards color and structure, there is an ample supply of the most excellent materials. Probably no other country in Europe presents so many different kinds of granite suitable for building and decoration.

"The term granite is generally applied by stonecutters and architects to a great number of different rocks, such as gneiss, hyperite, diorite, gabbro, diabase, and others. Using the term in its commercial sense, the most important granite quarrying districts are to be found in the provinces of Bohuslän and Halland, on the west coast of Sweden, and Skåne, Blekinge, Östergötland, and Upland, on the Baltic Sea.

"In Bohuslan a true granite occupying a large area along the coast is quarried. The color of the rock is generally light gray, sometimes light red, and the structure, varying from very fine grained to medium and coarse grained, is in most cases very homogeneous. As types of the granites of this region may be mentioned one of red color, coarse, and somewhat resembling the famous granite of Peterhead in Scotland, and another gray or pink in color, of fine and close grain. There are many varieties of this latter type, some of which are very soft, some rather hard, of the same character as the granite of Westerly, Rhode Island. In consequence of the favorable situation of this district and the excellent quality of the granite, it has been quarried extensively and exported to Germany, Denmark, and England. The principal products are building stone for docks, harbors, and bridges, paving stone and monuments. The most important quarries are at Malmön, Näset, and Lysekil, in the southern part of the district, and at Iddefjorden, near the Norwegian border.

"In Halland two different kinds of gneiss occur, and are quarried at many places on the coast. One of these varieties, found at Varberg, contains pyroxene, and is dark green and very granitic; it takes a high polish, and has a reputation as one of the most beautiful monumental stones. Large quantities are exported to Germany, Scotland, and during recent years, to a small extent, to America. The other gneiss in Halland is rather hard, fine grained, and variable in color. It is used almost entirely for street work, the products being exported to Germany and Denmark.

"The province of Blekinge takes a prominent position among the productive granite districts, not only on account of its geographical situation, near one of the principal purchasers, Germany, but also because of the superiority of its granites and gneisses. These are red and gray, generally fine grained and suitable for building and street work. Large parts of Berlin and other cities in Germany are paved with stone from one firm, which has employed for many years more than 1,000 workmen.

"In Småland occur numerous varieties of red granite, the most important of which are found at Vanevik and Visbö, south and north, respectively, from Oskarshamm. One of these, medium grained and containing blue quartz, is very extensively used for monuments in Germany, and during recent years has been shipped to Scotland and America, where it is known as 'Red Swede.'

"In a small area at Graversfors in Östergötland were several granites of extraordinary beauty. One of these is coarse grained, contains brownish feldspar and blue quartz; another, well known by American monument dealers under the name Swedish Rose, contains dark red feldspar and deep blue quartz. Both are used chiefly for monumental purposes in Sweden, as well as elsewhere.

"In the vicinity of Stockholm are numerous quarries of a gray, fine or medium grained granite, very much resembling those of Aberdeen and Dyce in Scotland. The capital has some very fine quays, bridges, and pedestals of this stone.

"Near Norrtelje, in Upland, are quarried red and gray granites used for building in Stockholm.

"Within the last few years it has become customary in Germany to use black granite for tombstones and monuments, and in consequence of this quite a number of diorite, hyperite, and diabase quarries have been opened, especially in the southern part of Sweden. The most important of these are near Lake Immeln in Skåne, and near Vestervik in Småland.

"Owing to the abundance of good granite in Sweden quarrying has been undertaken only at places where circumstances were favorable. Thus it is that the more important quarries are all situated in the vicinity of good harbors; ease of quarrying has also been considered, resulting in the selection of places where the rock showed regular bedding and jointing and homogeneous structure. Production is consequently inexpensive, although methods of quarrying are in many cases not so advanced as in America and Scotland. Steam cranes are used only to a limited extent, and steam drills have hardly been tried for the reason that wages are very low, and hand drillers exceedingly clever. Even dressing and polishing are carried on very slowly, though generally with great accuracy. It may be said that too much work is often expended upon finishing.

"Some of the larger works are engaged chiefly in the production of paving blocks. German cities are the principal purchasers, and as their requirements as to quality of the blocks are severe and inflexible and as competition is keen, the paving-block industry has advanced to a high degree of excellence in its products.

"The price of labor in the granite industry is generally a little higher than for other kinds of work in Sweden, but as compared with wages in America, those of Sweden are very low. A skilled stonecutter earns about $220 per year.

"The great markets for the granite industry are in Germany, Denmark, and England. In the northern part of Germany most of the large cities have many large structures of Swedish granite. As examples of these may be mentioned bridges and docks, etc., in Hamburg, Kiel, Wilhelmshafen, and a large number of houses and monuments in Berlin. The high duty which is placed in Germany upon sawed or polished granite work has been very unfavorable to the Swedish stone industry, and in consequence of this large quantities of raw stock are at present exported to Germany. Official statistics furnish the following figures on exports of Swedish stone, the greater part of which is granite:

Exports of stone from Sweden.

Period.	Annual average.
1881-1885	$340,000
1886-1890	670,000

"The enormous masses of felsite porphyry and some other hard rocks occurring in the province of Dalarne attracted attention on account of the great beauty of the rock as early as the last century. After careful investigations at that time a plant was established at Elfdalen and supplied with ingenious machinery for polishing, and the enterprise was carried on with great interest. Not less than thirty different varieties of rock have been worked; many of those are fully comparable to the ancient porphyries or even more beautiful. Many of the products, such as urns, vases, table tops, tombstones, etc., were exported, making the porphyry works at Elfdalen famous all over Europe. One of the most remarkable works is the great sarcophagus of the Swedish King, Carl XIV, Johan. On account of the hardness of the rocks and other difficulties, the economic result became gradually less successful until a few years ago, when the plant at Orsa, in Dalarne, was re-equipped with more modern appliances and success was again attained.

"The Silurian limestone being of excellent quality for both constructive and decorative purposes is quarried at a large number of places, and no other rock is at present used as building material to so great an extent.

"Among the numerous Archean crystalline limestones in Sweden there is only one which has been used to any extent, viz, the beautiful green ophicalcite, occurring in large quantities in the mountain range, Kolmarden. The rock is very desirable for interior work and has been used in the royal castle of Stockholm, the great opera house of Paris, and many other monumental buildings.

"The pre-Cambrian and Silurian sandstones are quarried at a few places for building purposes, and the same rocks are also used for grindstones and whetstones, and scythestones of silica schist and clay slate are manufactured on a small scale."

ENGLAND.

The principal granite quarries in England are situated at Shap Fell, in Westmoreland, at Mount Sorrel, in Leicestershire, in Cornwall and Devonshire. The peculiar porphyritic granite from Shap Fell is a fine-grained reddish-brown mass, with numerous crystals of a red feldspar from 2 to 4 centimeters long, often well developed. This granite is capable of being quarried in very large blocks and has been used, to a great extent, both in and outside of England, for architectural purposes. No other granite of this kind is at present used.

At Mount Sorrel a very fine-grained red, hornblendic granite is quarried, which is used very extensively, principally for paving stone and macadamizing. At the close of 1889 the quantity of stone produced was about 120,000 tons annually. More than half of this was for macadam.

Cornwall.—The largest granite areas of England, and those of greatest importance from a technical point of view, are situated in Cornwall and Devonshire, in the southwest corner of the country, where the rock forms five large and several small ranges of heights, surrounded by clay slates and other species of rock. The granite there is of a peculiar quality, and, although somewhat varying in different localities, it is nevertheless always clearly distinct from the other granites of Great Britain and from at least the majority of continental granites. This is true, not only as regards petrographic condition, but also in a technical sense. A quality common to most of its varieties is a light gray, at times almost white color, due to its principal constituents, white feldspar and gray quartz. (*a*) Besides these it generally contains both white and black mica, and, not rarely, tourmaline. The structure is generally medium grained, in certain tracts porphyritic, owing to the occurrence of well-developed feldspar crystals, up to 2½ to 4 inches long, which become especially distinct after polishing.

That which, above all, determines the value of the rock is its regular cleavage and its well-developed fissility in three directions perpendicular to each other. In most quarries there are found horizontal joints or bottom joints, which often follow the external forms of the land, and approach more or less to the horizontal plane; and two systems of vertical joints, forming very nearly right angles with each other. Blocks of all desirable dimensions may, as a rule, be prepared with exceeding ease. As an example, we may take the following: At Colcorrow, Tregarden, and Cottage the interval between the bottom joints varies, as a general thing, between 4 and 10 feet; at Colcorrow, which is one of Mr. John Freeman's best quarries, a block 23 by 20 by 16 feet was taken out; another was 61 feet long and 4½ by 4½ feet at one end and 3 by 3 feet at the other; a rock mass lying in place and free from joints was 42 by 31 by 57 feet in dimensions, and one at Cottage 17 by 12 by 17 feet. At Polkanuggo, near Penryn, at one time there was taken out a block 9 by 9 by 90 feet, and, as a newspaper notice cast doubts on the correctness of the statement, the owner offered to furnish blocks 115 feet long.

In the five areas mentioned, granite is obtained, according to report, in several hundred quarries, of which the author visited 13. The firm of John Freeman & Sons, in Penryn, which, in all respects, is the most prominent, is stated to work nearly 60 quarries with about 1,000 men. The method of quarrying differs essentially from that used in Scot-

(*a*) A Swedish granite, resembling the one in question, occurs on Gåsö, in Bohuslän.

land, and rather resembles that used in Sweden. All the quarries are comparatively small, and, as a rule, employ no more than 20 or 30 workmen. Advantage is taken of natural slope, and where this is lacking the work has not been pushed deeper than 18 to 27 feet, except in a few places. A consequence, or rather, perhaps, a cause of this is the fact that steam cranes as a general thing are not used, which, however, at least as regards the largest firm, is due to altogether peculiar conditions, which need not be touched on here.

Rock quarrying is generally so conducted that colossal blocks are first loosened by blasting and afterwards subdivided. The mode of procedure will be best illustrated by a few examples.

In a quarry at Sheffield, near Penryn, the block was gotten out in the following manner: After being loosened from the inclosing rock on the surface and on two vertical sides, a hole 4½ inches in diameter was drilled to a depth of 4 feet, where a sloping crack was encountered. In that hole a single charge of 8 pounds of powder was exploded, with the effect of liberating and moving the block without causing any notable new cracks. The movement carried it, respectively, 4½ inches and 3 inches from the side walls. Thereupon it was wedged apart in place by vertical and horizontal wedge nails.

At Tregarden, where the vertical systems of cracks do not always coincide with the directions of cleavage, a block about 11½ feet high was blasted out by means of a charge of powder of nearly 30 pounds, in a hole about 11½ feet deep and 4½ inches in diameter. No other large blast cracks could be discovered besides those by which the block was liberated. When there are no horizontal cracks, horizontal holes are drilled. At Cheesewring, north of Liskeard, however, the cleavage in this direction is slight, so that horizontal charges do not accomplish the object aimed at, without splintering the rock. Accordingly the hole is generally vertical, but is made deeper than the intended block by an amount equal to the height of the charge, and in this way a crack is generally formed, departing more or less from the horizontal plane, on a level with the top of the charge.

The following examples of rocks blasted out will further elucidate the method, as well as the quality of the rock:

Rock blasting for quarry purposes in Cornwall, England.

Quarries.	Dimensions of blocks.	Drill, depth.	Hole, diameter.	Charge.
	Feet.	*Feet.*	*Inches*	*Pounds.*
Polkanuggo	19 by 28½ by 16½	18	....	18
Colcerrow	30½ by 23 by 14¼	14	3	30
Do	*a*2,000	....	....	30
Cheesewring	16 by 12¼ by 6 to 9	8	4	{ *b*25 *b*54

a Tons. *b* Two charges.

The drill hole at present is made with drills 2 to 4 inches broad—sometimes still broader. It is stated that three men can drill a hole 33 inches deep with a 4-inch drill. As, however, it is difficult to produce round holes with so large a diameter, it is preferred at times to make them triangular, placing them so that one side of the triangle in a cross section at the charge becomes parallel with the cleavage in the rock. In one of Mr. Freeman's quarries a machine drill was employed, constructed in the firm's own workshop; it was fed from the boiler of a steam crane.

That a mode of quarrying like the one here described involves various advantages, under the supposition that the durability of the granite is not thereby impaired, is evident. It renders possible a much more rapid extraction of large quantities of stone than by the ordinary wedging method, but it also presupposes certain qualities in the latter which are probably not possessed by other granites. It is certain, however, that the drilling of such wide and deep holes is very expensive, and in many cases, therefore, it is probable that the method employed in the granite quarries of Stockholm, of using small holes and charging these with powder and very little dynamite, is preferable.

In Mr. Freeman's quarry, as well as in those mentioned in Scotland, the rock is taken out at the owner's expense by day laborers, and the stonecutter, whose work is always by the job, receives the wedged-out blocks. In this way it is easier to keep the quarry in good condition than if it were all job work. The larger quarries in Cornwall, in fact, are very well managed, all refuse rock being carried off, and no useless rock left behind in case it should be apt to present a hindrance. At the same time, owing to the position of the quarry, there is lacking the advantage of being able to dispose of smaller blocks, and as paving stone is not produced to any large extent the piles of rubbish have quite a different appearance from what they have in Scotland. As a general thing none but hand cranes are used, which are fastened with chain guys so stretched that the arm can be swung around. All quarries are situated at a greater or less distance from the ports, with which some are in direct connection by means of railways, while from the larger number the rock has first to be hauled from 1 to 6 miles by means of horses. Notwithstanding this, the granite from Cornwall is considerably cheaper than that from Scotland.

No long wedges are ever used in Cornwall, and deep guiding holes only when thin plates are to be wedged out. The ordinary small wedge holes are oftenest made with a peculiar drill called a jumper. It consists of a bar of steel or steeled iron, sharpened at both ends in the same manner as an ordinary rock drill, 4 to 5 feet long and provided in the middle with a ball-shaped thickening serving in part to increase the weight, which sometimes amounts to 20 pounds, and in part to permit the tool to be held firm. With this tool the workman pounds out the hole, standing on or (if the hole is sloping or horizontal) by the stone and grasping the drill with one hand above, with the other below the ball. For a hole 2½ inches deep there were required at Carnsew 112 blows when the drilling was done *against* the cleavage. The two points of the tool are somewhat different from each other in breadth. Ordinarily four men work together in such manner that the first begins each hole and the others continue in their turn, so that it is finished by the last. The hole is usually 1 inch wide at the mouth and one-half inch at the bottom.

In the quarry at Sheffield it was stated that one man is able with the jumper to drill 20 holes, each 2½ inches deep, in one hour, and that four men in most cases drill 400 vertical of 200 to 240 horizontal holes, 2½ to 3 inches deep, in ten hours. At another place 80 holes were stated as the average for each workman per day (ten hours).

In any case it seems hardly probable that this tool affords a larger product of work than the small Scotch wedge drill. Whether it admits of comparison with the pointed chisels used in Sweden for cutting out small broad-wedge holes, I will not venture to say.

In Cornwall the wedges are 4 to 5 inches long, at the upper end nearly 1½ inches thick, and have a four-sided, slowly tapering point. The plates resemble the Scotch, but are coarser. A deep groove is generally cut before wedging.

Examples of borings with jumpers and wedging.

Dimensions of blocks.		Number of holes.		Time spent in drilling and wedging.	Number of workmen.
Length.	Height.	Vertical.	Horizontal.		
Feet.	*Feet.*			*Minutes.*	
7¼	4½	21	....	....	....
6	6	26	....	....	....
5	2½	11	....	9	4
5	2½	17	....	17½	4
5½	4	15	....	15	4
4½	2	15	....	13	4
6	2½	15	5	30	3

SCOTLAND.

In Scotland and some parts of Ireland granite is of common occurrence, while in England it occurs in comparatively small quantities. In Scotland it is quarried in Aberdeenshire, Kincardine, Kircudbrightshire, Argyleshire, and to a small extent on the island of Mull, in Perthshire, Banffshire, Sutherland, and on the Hebrides. The large quarries in Aberdeenshire, which, without question, occupy the first place among those of Great Britain, are situated in two districts, one in the neighborhood of Aberdeen, and the other near Peterhead. The granite quarried in the former district is generally gray but occasionally red. In the Peterhead district the granite quarried is generally white. In Kincardine, south of Aberdeen, the granite is partly gray, medium-grained, used for paving stones and curbing, and partly red, finer grained with dark quartz at Hill O'Fair. This latter granite is principally used for polished monuments in Aberdeen. In Kircudbrightshire, southeastern Scotland, granite occurs in very large quantities. The principal quarries are situated at Dalbeattie. The rock is a light grayish-red, medium-grained, and beautiful. It is used for building stone and monumental purposes. A large export trade has been carried on, not only to English cities, but even to Russia and South America. At Argyleshire, in the west of Scotland, granite is quarried at a number of places, but is generally sent elsewhere to be dressed. The largest quarries are at Loch Awe, where several kinds of dark and light colored granite have been quarried for bridge building and monumental work. In the latter case the blocks are sent to Aberdeen. The granite from the southwestern part of the isle of Mull is coarse-grained and of a red color. It was formerly used very extenssively for polished columns, etc., in London.

On the islands of Guernsey and Jersey, Herm and Sark, in the English Channel, are numerous quarries of red and gray fine grained hornblendic granite, which is almost entirely used for paving stone, curbing, and macadam. The quantity of granite sent from Guernsey is stated to be at least 220,000 tons annually.

Ireland is said to have large deposits of good and beautiful granite, but the granite industry of that country seems not to have been developed to any great extent. The most important granite districts are situated in the vicinity of Newry on the east coast in Wicklow, Carlow, and Wexford, south of Dublin, in Galway on the west coast, and at Donegal on the northwest coast.

Scotch quarrying.—The quarries at Kemnay, northwest of Aberdeen, occupy the first place in point of size, methods of work and mechanical appliances, among all those in Great Britain, and beyond doubt have few rivals in Europe. Like the neighboring quarries at Corrennie, Toms Forest, and Cove, they are worked by John Fyfe, of Aberdeen. The first named are situated at the railway station of Kemnay, 16 to 19 miles from Aberdeen, whither all the stone is sent that is intended for polishing, or to be sent elsewhere by vessel. The rock is a light gray or almost white, fine grained granite, at times somewhat veined with white mica. It bears no little resemblance to certain of the light colored granites occurring pretty generally in Ångermanland, Sweden.

The cleavage of the rock is on the whole irregular, but vertical, and highly inclined cracks predominate. The quarrying is carried on in three open quarries, situated high up on the slope of a hill, the largest of which is stated to be about 300 feet deep. On the floor of the quarry there is a steam crane movable on rails; on the gallery, two fixed steam cranes. The hoisting of the broken and wedged-apart rock and of the chips is effected partly by two iron wire trolleys, partly by a colossal fixed steam crane. In the two smaller quarries the work is done by 6 steam cranes and one iron wire trolley; thus there are altogether 10 steam cranes and three wire trolleys. The latter consist of strong stands of iron wire, either single or double, and on these run small trucks which carry up the hoppers of strong plates, in which the stones are loaded. By means of a special line the wagon may be stopped at any point of the track and the basket dropped to the bottom of the quarry to be filled; after this has been done by means of a steam crane or by hand, the line is hauled in till the basket reaches the truck, whereupon the latter is drawn up. It is impracticable, for several reasons, to give here a more detailed account of this ingenious arrangement. The stone hoisted up in one or the other way is loaded directly on railway cars and conveyed along the slope to a side track coming from the railway, or, if it is to be farther worked up, to the workshops situated farther up, which is done by means of a steam winch with ropes of iron wire.

About 500 workmen are here employed. It is a remarkable circumstance that not a single horse is employed in this or the other quarries belonging to the firm, but all work not done by hand is performed by steam power, which is here employed to such an extent and in so practical a manner as to be equal to anything that can at present be imagined.

Of the enormous quantities of stone quarried and moved from the deep quarry to the workshops and thence to the railway, in an incredibly short time, as compared to what is done in Sweden, the larger part is used for building bridges, harbors, and docks, and similar large works; a considerable amount is sent to Aberdeen to be used as building stone and for monumental purposes. The chips produced in quarrying, and small pieces, are worked up into paving stones. To illustrate the magnitude of the operations, it may suffice to mention that in August of last year there were sent from Kemnay, according to statement, 4,000 tons of granite. The owner of this quarry furnished all the granite used for the Forth bridge, near Edinburgh, amounting to 56,000 cubic feet. Another one of the larger orders of the firm is said to have had a value of £80,000.

Mr. John Fyfe began forty years ago to work up the granite at Kemnay, which at that time was almost an uninhabited place, but is now a well-built town of considerable size. Ten years later the steam crane was introduced, and with this the Scotch granite industry may be said to have entered on an entirely new stage.

The hewing is done at Kemnay mostly by hand, although there is also found there a machine constructed by Brunton & Trier for working on plane surfaces, of which more will be said farther on.

The granite quarry of Corrennie lies near the top of a high mountain ridge, south of the railway station of Tillyfourie, about 20 miles northwest of Aberdeen. The granite is medium-grained, consists of pale red feldspar and gray quartz and very little mica. In general it has a massive and homogeneous structure and is easily worked. Among Swedish granites the one that most resembles it is perhaps the red medium-grained granite (No. 1) at Graversfors, in which, however, the feldspar is of a darker red and the quartz blue, but of less brilliant color.

The jointed structure, which is somewhat irregular and in some places strongly developed, impedes the quarrying at Corrennie. In a certain part of the quarry the systems of cracks are few and rather regular but always much inclined. There are no horizontal cracks. In exceptional cases blocks 13 to 19 feet long have been furnished from this quarry. The natural dip, or the slope of the rock compared to the horizontal plane, is rather slight, and it has been only partly used in quarrying, by penetrating in straight against the dip for some distance and then turning toward both sides, by which method deep pits were formed out of which the stone is lifted with three steam cranes of respectively 7, 10 and 15 tons' carrying power, to be next loaded on trucks and distributed below the slope. This is done in pretty much the same way as in the quarry at Tillyfourie described farther on. The larger part of the stone is sent away in the form of hewn blocks, to be worked up at Aberdeen and elsewhere, especially for monuments and as building stone. The smaller blocks and the chips are made into paving stones. The output was stated to be about 100 tons a month.

Among the quarries of Tillyfourie, belonging to Messrs. Mowlem & Co., of London, only one is at present worked, which lies high up on the slope of the mountain ridge north of the station. The rock is a medium-grained, gray, micaceous and veined granite, with small, scanty, pale red crystals of feldspar, but slightly marked. It is comparatively loose, cleaves easily in the direction of the cleavage, less easily across the cleavage, is not suitable for monumental purposes, and is employed exclusively for coarser building stone, curbstone, paving stone, etc. The patches of gneiss appearing here and there do not for the present cause any notable inconvenience. The jointed structure is quite irregular and the cracks are sometimes numerous, pretty much as in the Stockholm granite. The largest block ever taken out weighed 30 tons. As a rule it is not possible to produce blocks weighing more than 10 tons.

The rock resembles somewhat the coarse granite on Sterno in Blekinge which, however, is coarser and contains less mica.

The quarrying is done in a quarry about 115 feet broad and more than twice as long and at most 30 feet deep, which is being rapidly widened both downward and toward the sides. Here, too, it might have been possible, though not without difficulty, to obtain a natural down grade, but it has been thought preferable to push the quarrying downward. The taking out and loading is done by three steam cranes, each of about 10 tons carrying power, which, like the drilling machines, are fed from two fixed steam boilers. The cutting is done for the most part in open sheds, situated at the lading places near the railway. Thither the blocks are conveyed along the steep slope on a railway which has a double track above, and is so arranged that the descending loaded trucks draw up the empty ones. The wagons are drawn by means of a steel wire line running through two horizontal covered sheaves, where there is a brake. The line is kept in the track by means of steering sheaves and vertical rollers. The slope of the railway track is from 8° to 13°.

The granite, which is, perhaps, most prized among all Scotch granites for monumental purposes, is quarried 3 to 5 miles south of Peterhead, in two quarries at Stirlinghill and in seven at Longhaven. The rock is red and coarse to medium-grained; its main ingredients are bright red feldspar and dark gray quartz, the latter mineral forming large granular aggregates. At the same time it contains yellowish white feldspar with a very subordinate amount of small grains of dark green hornblende. The combination of minerals with so different and striking colors gives to the rock a characteristic "lifelike" appearance, which in Scotland is regarded as one of the most important qualities in material intended for monuments and similar purposes. The principal color of the rock, however, is red, although it varies somewhat; the darkest rock is most highly esteemed, and is the only kind used for work intended to be polished, while the lighter-colored kind, often occurring in the same quarry with the former, is used as building stone and is sold cheaper. The difference in color between the "polish quality" and "dress quality" is often very slight. In general the rock is usually homogeneous, in as much as the minerals above mentioned are everywhere uniformly blended, a peculiarity on which great (perhaps too great) value is placed. Large or small patches of hornblende, etc., occur at times, but, as a general thing, offer no great inconvenience.

The Peterhead granite is more regular in its cleavage than that described above. The dominant system of cracks, however, is vertical, and true horizontal cracks occur but exceptionally.

The older quarries at Stirlinghill, together with those that are now worked there, testify to an incredibly large output. Like those at Kemnay, these are worked in deep quarries.

The rock is hoisted up with two steam cranes, chips and refuse are conveyed by rail to the neighboring seashore, and the blocks are hauled by road to Peterhead. A railway to that point, however, is in process of construction.

The quarry is owned by Messrs. Alex. Macdonald & Co., Limited, the oldest and largest firm for the production of monuments in Aberdeen, which at the present time, for its own account and for sale, ships from here every month from 100 to 150 tons of granite, suitable for monumental purposes, and still larger quantities of "dress quality" for building purposes.

Some of the quarries at Longhaven are very large, one being about 90 feet deep, and these, too, as a general thing, form vertical shafts, out of which the stone is hoisted by means of steam cranes. In all the quarries thus far named in the Peterhead tract, altogether 14 such steam cranes are at work, out of 10 to 15 tons' carrying power. A workman estimated the amount of stone here quarried at 140 tons per month for each one of the 9 quarries, a figure which, however, can not claim any great accuracy.

One of the oldest large granite quarries in Great Britain is that of Rubislaw, near Aberdeen. Already one hundred years ago this work is said to have developed considerable activity. The rock is gray, of uniform fine grain, and bears no little resemblance to the Stockholm granite, but is somewhat darker, and not rarely verges upon red. It is regarded, and with undoubted justice, as an unusually strong and good granite, and has obtained an exceedingly extensive employment, both as building material and paving stone, in Aberdeen and elsewhere, and for monuments, etc. The cleavage as a general thing is irregular and of about the same nature as in the Stockholm granite. Vertical or highly inclined systems of cracks often occur.

The quarry occupies an area of 6 to 7½ acres. At the east and west end of the large opening granite posts 30 to 60 feet high are worked out in shafts driven down at least 140 feet below the surface. In one of these shafts one steam crane works on the bottom and three on the upper rim, one of them lifting the stone to a height of 130 feet.

From the description of the quarry thus given it is seen that the quarrying is here done in a way different from that practiced in Sweden. There the quarrymen endeavor, wherever there is a possibility, to utilize the natural slope, whereby, however, the quarry becomes widely extended whenever the work is conducted on a large scale. The Scotch prefer to concentrate the work on a single point; ordinarily some slope is found, and then the work is pushed straight against the slope and afterwards toward the sides, so that the quarry assumes a kettle-shaped appearance. As soon as it becomes too extensive a shaft is sunk from the bottom to a depth of 60 to 100 feet or more, and this is widened until it is as wide as is deemed suitable. Then a new shaft is sunk from the bottom, and from this the work is again pushed out towards the sides. Such a system would be impossible without steam cranes or other apparatus similar to them in point of working capacity. That which in mining terminology is called the getting out, the getting up, and the getting off, or, in other words, the moving of the quarried stone in the quarry, its hoisting out of the quarry, and the transportation of it to the workshop and the lading places, in cases where the space is so confined and the quantity so great as here, could not be done by hand power, which, moreover, would be too costly. Accordingly, as stated before, the steam crane is here employed to an unheard-of extent. One or more of such cranes, fixed or movable, are placed on the bottom of the quarry or on its edge, so as to control the whole quarry with their arms. This secures the quick, safe, and cheap performance of most of the work which elsewhere, with great waste of time and power, is performed by crowbar and hand power, or at least by slow-working hand cranes; that is to say, the turning and moving of the block in and out of the quarry, etc.

Another necessary requisite for the systematic conduct of the work of quarrying by the method in question is that rubbish shall be promptly removed from the quarry, and that useless portions of rock shall not be left behind there, in case they should become a hindrance to the work, either at once or afterward. What is called "quarry-robbing" must not occur. In order to avoid it the steam crane is indispensable.

For steam cranes of 1 to 20 tons the price at Aberdeen varies between £100 and £750.

The Swedish granites as a general thing have a more favorable cleavage than the Scotch, and for that reason the method of quarrying described above will not perhaps be found advantageous in all cases. The list of prices at the end of the paper shows that even now the cost of quarrying is lower in Sweden, but it would most certainly be still further reduced by a more systematic method, which moreover would always hasten the rate of output.

Even the loosening of the stone is done in Scotland in a manner more or less different from that in use in the most of the Swedish granite quarries. In the latter the rock is for the most part divided into slabs, and the quarrying is easily done by wedging and by a very small amount of blasting. If it is proposed in this way to take out a block of certain dimensions, the attempt as a rule is successful. But we also have granites with irregular cleavage in which the same method as in Scotland might be employed, and it is proper therefore to describe them by means of some examples. The method consists in this, that large masses of the rock are loosened at once by blasting, whereupon they are first divided along the natural cracks, and then, by wedging and "setting," into regular blocks, a method of work which is in great degree facilitated by the fact that the demand for granite is great, so that the producer may count on finding a market for blocks of all possible dimensions. The blasting itself is done in rather a remarkable way.

Along the crack in a portion of rock bounded by a perpendicular crack situated, say, 10 or 15 feet from the free side, a number of holes are drilled, say 3, about 20 feet deep. These are first charged with a very small quantity of powder, and fired simultaneously by means of fuses of equal length, or still better by wires from an electric battery. The charge is so small that the explosion can not do more than simply widen the hole and open the cracks near it. Next, the same hole is filled with a somewhat larger charge, and this is repeated three, four, or five times, until the connection between the desired block and the adjoining rock is so completely severed, and the drill hole so large, that the block can be thrown down on the bottom of the quarry by a single powerful charge in each drill hole.

At Stirlinghill a block 8 to 10 feet broad, 15 to 18 feet long, and 20 feet high, free on one side, which was perpendicular, and on the other sides bounded by more or less distinct cracks, had been blasted out by means of a single hole 3 inches in diameter and 24 feet deep. According to foreman's statement there were used in that hole for the first charge about 5 pounds of powder, for the second 10, for the third 12, for the fourth and last 100 pounds. The position of the drill hole and the size of the charge are of course determined by the condition of the rock masses and the natural cleavage, of which as much advantage is taken as possible. The result therefore depends in high degree on the workmen's judgment and their knowledge of the rock. The advantage of this mode of blasting, as may readily be imagined, lies in this, that large quantities may be gotten out with few drill holes, without at the same time giving rise to new cracks, which would be the case if the whole mass was blasted out with a single charge. (*a*)

The division of the blocks is everywhere effected by wedging in round holes with very small wedges and steel plate. These have now begun to be used in Sweden, but as they are entirely unknown in many, if not in most of the quarries, it may be well to describe them here.

1. The wedge usually employed is four-sided, three-fourths inch long, one-half inch each way at the upper end, two-fifths by one-sixth inch at the point; the plate is semicircular in section, as broad as the wedge below, and gradually narrowing upward. When wedge and plate are set up as shown in the drawing, the wedge in being driven down works along a large part of the length of the drill hole.

When high blocks are wedged, it is customary to drill either all the holes, or every other, or every third, or still fewer, very deep, and into these are introduced jointed wedges, consisting of gradually narrowing bars, hammered flat, and semicircular plates, which may be 8 feet or more in length. Broad wedges are hardly ever used.

Judging by the number and depth of the wedge holes, the granites in most of the quarries above named are not easy to wedge. It may be interesting to compare the Scotch with the Swedish granites as regards

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a Another method, first proposed by Mr. George Elliott, of Newcastle, for avoiding too many blasting cracks, is based on the employment of unslaked lime as blasting material (Journal of Iron and Steel Institute, 1882, N. 1). This is accomplished by forcing finely pulverized burnt lime under high pressure into cylindric cartridges $2\frac{1}{2}$ inches in diameter, inclosed in air-tight and water-tight shells. The cartridges having been placed in the drill holes, and these having been packed, water is pumped into the cartridges by means of iron tubes fixed in them and provided with fine holes. The lime is slaked, and by its slow but powerful expansion the rock is parted. The method has been employed with advantage in coal mines, but to what extent it has been found practicable in granite quarries the writer does not know.

toughness, and for that purpose will here introduce some observations from various quarries:

Quarry.	Block.		Wedge hole.		
	Height.	Length.	Interval.	Depth.	
	Feet.	*Feet.*	*Inches.*	*Ft.*	*In.*
Peterhead	2⅕	6	4.7	2	2
Do	2⅕	22	5	2	2
Tillyfourie	....	....	4½–5¼		2
Kemnay	4½	....	5¼	4	
Rubislaw	....	....	3		2
Do	3¾	15¼	3¼	*a* 2 *b*	10 3

a Sixteen holes. *b* Thirty-four holes.

The holes intended for blasting, generally 2½ to 3 inches in diameter and about 20 feet deep, are mostly drilled by hand with chisel drill. A gang of 3 men drill on an average 1 foot per hour, sometimes a little more. In several places an attempt has been made to use machine drills, but for such large diameters and depths this is said in general not to be very advantageous; this may be due to difficulty in applying the drill, etc. At Tillyfourie, however, one machine drill is used, driven by an engine. It was mounted on a pedestal with three legs, easy to place in different positions, and, when set up, required one man for attendance. With a cross-shaped bit of 3 inches it was stated that up to 3 feet were accomplished; with a bit of 2½ inches, 3⅔ feet an hour. The drill had been used to a depth of 13 feet, but was guaranteed by the manufacturer for a depth of 20 feet. After drilling down 1⅓ to 1½ feet, a sharpened bit had to be set in.

Wedge holes on the other hand, at least when they are deep, are mostly drilled in the quarry above mentioned by means of machine drills, always driven by steam, either from fixed boilers or from the steam cranes. These smaller drill machines are usually mounted on a small wagon, which may be moved to and fro on a plank road or a railway. This wagon is placed directly on the block, in case it is large, otherwise it is put on a scaffolding over the block. The drilling is easily managed by one person. The product of the work was stated at Corrennie with a drill of 1½-inch to be as much as 10 feet per hour, and a workman there had drilled 80 feet in eleven hours, including the time of moving the drill, a result which was not regarded as uncommonly high. At Peterhead for a drill of nine-tenths to 1 inch, 11 feet per hour and 90 to 110 feet per day were recorded, when holes 3 feet deep were drilled.

Evidently these machines are most applicable when there is question of getting out thin slabs in great number, and of working granite that is difficult to wedge, having ill-defined cleavage, and requiring deep wedge holes, for not only can these be thus drilled faster than by hand, but they are more easily kept in the same plane, whereby the wedging is facilitated and the work of dressing is saved.

Cost of English steam drills.

For holes of a maximum diameter of—	Depth.	Cost.
	Feet.	
$1\frac{1}{2}$ inches	9 to 11	*£32
2 inches	11 14	36
$2\frac{1}{2}$ inches	14 20	44
3 inches	20 23	48
$3\frac{3}{8}$ inches	23 28	56

* At J. Henderson's, in Aberdeen.

Mounted on three legs these machines are 20 per cent. dearer.

Smaller wedge holes are often drilled in Scotland by hand, and as the diameter rarely exceeds seven-tenths to nine-tenths inch, the work proceeds very rapidly. At times two workmen drill in company, one beginning and the other continuing in the same hole.

The following table shows the production of all kinds of stone in the United Kingdom in 1892 by countries and for the whole Kingdom in 1891.

Production of stone (all kinds) in the United Kingdom, 1892.

	Value.
England and Wales	$35,727,704
Scotland	5,058,921
Ireland	1,394,856
United Kingdom	42,181,481
United Kingdom for 1891	42,308,100

GERMANY.

Granite occurs only in the middle and southern portions of the kingdom, but it is quarried in numerous places. The principal districts are Silesia, Saxony, Bavaria, Baden, Hesse, Rhenpfalz, and in Alsace near the French border, and finally in the Hartz. The largest quarries are in Silesia, Saxony, and Bavaria. The German granites are with few exceptions gray, and vary from fine to medium grain. Some of them are unusually soft and easily worked. On account of this softness they are generally thought in the northern part of Germany to be less qualified for paving stone than the hard granite, which is brought from Sweden. In Bavaria and some other places diorites and other green stones are quarried for paving stone and monumental purposes. The granite industry of Germany is very closely connected with that of Sweden. Some of the largest German granite firms have their own quarries in Sweden, and many buy their raw material from these or other Swedish quarries.

FRANCE.

In France, at least in Paris, comparatively small quantities of granite are used, on account of the comparative ease and cheapness with which limestone is worked. Large granite quarries are, however, worked principally in Normandie, Bretagne, and Voges. The granite from Normandie, which seems to be the one used most, is quarried at Montjou, in the neighborhood of Vire. This is gray, fine grained, of about the same structure and color as the granite of Vermont.

In Bretagne and Voges medium and coarse-grained granite of a gray and reddish gray is quarried.

BELGIUM.

The famous paving-stone quarries at Quenast are, with regard to size, production, and methods of working, probably better developed than any other paving-stone quarries in Europe, and these quarries show in a very striking way how important a systematic arrangement of work is, and how an industry which in itself seems to be of so little importance can, by a proper system, become so great as these quarries are. A good detailed description of them is given by Prof. E. Dietrich, of Bremen, in a volume entitled "Die Baumaterialien der Steinstrassen."

Quenast.—The Quenast quarries are situated at the station of the same name, 14 miles south-southwest from Brussels, 2½ miles from the station Tubize on the line Brussels-Mons-Paris. A track 3 miles long makes connection with the canal from Charleroi to Brussels and other places.

It is thought that the quarry was worked as far back as the sixteenth century, but it was only since the beginning of the present century that paving stones were quarried to any considerable extent. In 1846 steam power began to be employed, the numerous earlier quarries were gradually united under one ownership, communication was improved, and since the present wealthy company, the Societe anonyme des Carrieres de Porphyre de Quenast, took the business in hand, in 1864, and bought up the larger part of the tract in which the rock can be gotten out, the quarrying was organized on the present exemplary plan. The company is said to own 438 acres of land, of which the quarries in operation and begun and the workshops occupy about 175 acres.

The rock here obtained is dense, sometimes quartz-bearing syenite or diorite (usually, however, called porphyry), somewhat variable in color, mostly greenish gray. The structure may most aptly be compared with that of some of the Swedish diabases. Like these, the rock has no definite directions of cleavage, but yet, in small pieces, cleaves pretty straight; otherwise the fracture is spherical. The hardness is far greater than that of granite, and would seem to be most nearly equal to that of the dense diabase; and at the same time the rock possesses great toughness, so that the edges wear off but slowly.

Worn surfaces become smooth. It is mostly used for paving stones and macadam, etc., of which further mention will be made.

In the largest quarry visited, which is about 1,800 to 2,400 feet long by about 600 feet broad and nearly 240 feet deep, the quarrying goes on simultaneously on 6 or 7 stair-like benches or galleries about 21 feet high, and of course greatly varying in breadth. The quarried stone, which is worked up in part inside and in part outside the quarry, is put on small wagons and by means of hoisting apparatus is carried up an inclined plane to one of the galleries, where the wagons are put on rails and drawn by endless chains up and out through the little tunnel which connects the quarry with the workshops and the lading places. No cranes are used. The rock is always loosened by means of blasting. The drilling at the time of my visit was done merely by hand, inasmuch as it was necessary to limit the production; otherwise machine drills are used. The drilling was done at first by three persons working by the day; now it is done by two, working by the job. One drilling set consists of 8 drills, whose dimensions are given in the following table:

Dimensions of Belgian stone drills.

Number.	Length.	Diameter of drilling rod.	Diameter of bit.
	Feet.	*Inches.*	*Inches.*
1	$1\frac{1}{2}$	$1\frac{1}{10}$	$1\frac{1}{2}$
2	$1\frac{1}{2}$	$1\frac{1}{10}$	1_{5}
3	$2\frac{1}{4}$	1	$1\frac{3}{10}$
4	3	1	$1\frac{1}{5}$
5	$3\frac{3}{4}$	1	$1\frac{1}{6}$
6	$4\frac{1}{2}$	1	$1\frac{1}{8}$
7	$5\frac{1}{4}$	1	$1\frac{1}{10}$
8	6	$\frac{9}{10}$	$1\frac{1}{20}$

At present the drilling is not carried deeper than 6 feet. The section of the drill is cross shaped. The hammer weighs 26 to 30 pounds. Two men, working by the job, accomplish 8 to 10 feet in ten hours, or as much as three men formerly did when paid by the day. Machine drilling saves time and power, and permits the boring of much deeper holes, and is therefore employed to a large extent. After trying most of the drilling machines constructed for such purposes, selection was made, according to Dietrich, of Dunn's and Ingersoll's, which work with a pressure of $3\frac{1}{2}$ atmospheres and delivers about 3,000 blows in a minute. The machines weigh respectively 286 and 484 pounds, are simple and easily managed, and seldom need repairing. A new machine, constituting a medium between the two systems named, was constructed in the shops of the quarry itself. It weighs $3\frac{1}{2}$ pounds.[a]

[a] In the work by Dietrich, above cited, a more complete description is given, both of the construction of the drilling machines and of the drills themselves, and of the arrangement of the driving gear, etc. Various kinds of drilling machines are described in a number of essays by Prof. G. Nordenstrom and Prof. C. A. Angstrom in the annals of the Iron Exchange and in the Transactions of the Society of Engineers, to which those interested in the subject are referred.

The bit of the drills used is cross shaped, and so arranged that the hole can be cleaned out without removing the drill. For vertical holes a set of 20 drilling rods is used, the least of them, which is used first, being $2\frac{1}{2}$ feet long with $4\frac{1}{2}$ inches in diameter on the bit; the largest, 20 feet long with a bit of $2\frac{1}{2}$ inches. A drilling set for horizontal, or nearly horizontal holes, which for the most part are not so deep, consists of 10 drills, the smallest and largest of which are respectively 2 and 9 feet in length and $2\frac{1}{2}$ and $1\frac{1}{2}$ inches in diameter of bit. The drilling rods are always of steel.

The power used for the drilling machines is generally compressed air, which can be conducted without difficulty over greater distances, and presents several other material advantages over the direct employment of steam power.

With one of the drilling machines above named, of which there were about twenty in use in 1885, 20 to 25 feet can be drilled in ten hours, all loss of time in moving the machine, changing the drilling rods, etc., being included.

A necessary condition for maintaining the system of quarrying and transportation above described is that the surfaces of the galleries shall always be kept at the same height, and as the quarrying is now done by the job, a constant and careful supervision of the work must be exercised in order that this condition may be fulfilled. Otherwise the galleries would quickly cease to be horizontal, for the loosening of the stone which lies nearest the foot of every bench requires the greatest amount of work. However, this object is obtained by moving the tracks on each gallery inward from the edge of the gallery before the continuation of the work strictly requires it, the removal of any remaining portions of the rock being done at the expense of the workmen. As the rock is mainly used as paving stone, no pains are taken to get large blocks, the aim being to get out a large number of stones of indefinite dimensions as quickly and cheaply as possible.

In working up, the largest pieces, after being blasted out, are again divided by blasting; wedging is not practiced. The cleaving or division into paving stones is somewhat different from that used in the case of granite. By means of a hammer provided with a sharp edge, weighing 26 to 33 pounds, a fine groove is hewn on one side of the generally irregular stone, and then a few blows on the smaller end of the block generally suffice to split it along the groove with a pretty even surface. Hammers of less weight, 13 to 26 pounds, are also used. When regular blocks have been obtained, they are worked up in the usual way with the dressing hammer (weight, 7 pounds). The workman who does the grooving keeps his right foot stuck in a colossal flat wooden shoe, the bottom of which is at least 0.1 meter square in size, and against this the block is braced while working. While dressing the blocks the workman is generally seated. The cheaper paving stone, only roughly dressed, is finished in the quarry, while the finely-dressed kinds are finished at the lading places. The dressing is always done by the job. The workmen, united into gangs of 3 to 12, generally 4 men, do the blasting and other work at their own expense, and deliver the stone finished for a certain price at the storage in the quarry. The machine drilling is done by the company at the expense of the workmen and upon their demand.

In Quenast, contrary to what is done in most other quarries, as a general thing only paving stone of certain dimensions is produced, which is kept in store and sold at a fixed price. If special dimensions are ordered a higher price is asked. Of course this arrangement, which is remarkably favorable to the company, is rendered possible by the superior qualities which the rock in question is thought to possess. The various kinds kept in store may be divided into four classes, distinguished by the ratio between the thickness of the stone at the "cup" and at the "root" (upper and lower side):

(1) Ordinary paving stones, diminishing downward by 1.1 inch on each side.

(2) Ordinary rough-dressed paving stones, diminishing downward by nine-tenths inch on each side.

(3) Half-fine dressed paving stones, diminishing downward by seven-tenths inch on each side.

(4) Fine-dressed paving stones, diminishing downward by one-half inch on each side.

Within each one of these classes there are found partly cubic and partly prismatic stones of various dimensions, so that by form and size the various kinds may be divided into 8 classes. All in all, 27 different kinds are worked.

By way of example a table is given of the average selling prices on the railway car at Quenast (according to Dietrich, 1885).

Average prices of Belgian blocks on cars at the quarry in Belgium.

	Number of stones per square yard of street surface.	Price of stones required for 1 square yard of street surface.
Ordinary paving stones:		
6 to 8 inches	30 to 31	$1.17
Edges, 5 to $5\frac{1}{2}$ by 8 to 9 by $5\frac{1}{2}$ to 6 inches	30 31	1.09
Ordinary rough-dressed paving stones:		
6 to 8 inches	30 32	1.34
Edges, 5 to $5\frac{1}{2}$ by 8 to 9 by $5\frac{1}{2}$ to 6 inches	30 32	1.24
Half-fine dressed paving stones:		
6 to 8 inches	31 33	1.53
Edges, 5 to $5\frac{1}{2}$ by 8 to 9 by $5\frac{1}{2}$ to 6 inches	32 34	1.54
Edges, 4 to $4\frac{1}{2}$ by 6 to 7 by 5 to $5\frac{1}{2}$ inches	49 51	1.46
Fine-dressed paving stones:		
6 to 8 inches	31 33	1.64
Edges, 5 to $5\frac{1}{2}$ by 8 to 9 by $5\frac{1}{2}$ to 6 inches	32 34	1.65
Edges, 4 to $4\frac{1}{2}$ by 6 to 7 by 5 to $5\frac{1}{2}$ inches	49 51	1.56
Edges, 4 to $4\frac{1}{2}$ by 6 to 7 by $5\frac{1}{2}$ to 6 inches	49 51	1.94

The most interesting feature of this quarry is the system of transportation, which could hardly be more complete anywhere else.

Transportation between the various galleries of the quarries, the freight platforms, the crushers, and the dumps is effected by a system of double tracks, which all converge at a single point. At this point cars may be run upon a trackless cast iron turntable and switched from one to any other track. The cars are drawn by endless overhead chains which are seized by a grip attachment on the car. This grip consists of a forked-shape incision in a strong iron arch stretched across the car. The chains are kept in motion by a number of perpendicular axles rotated by steam power. Empty cars are raised by the descent of loaded cars where possible, and in other cases by transmission of power through the medium of compressed air. If, for any reason, the chain should let slip a car on any of the inclined tracks, it is caught by a simple automatic device and thus prevented from doing harm.

The greatest grade in the case of tracks for chain transportation is 35 per cent. In the following table, after Dietrich, data are given concerning the material of transportation:

	Pounds.
Weight of rails per running yard	22
Weight of wagon, empty	858
Weight of wagon, loaded	2,178
Weight of chain per running yard for main tracks, thickness of link 1 inch	30
Weight of chain per running yard for side tracks, thickness of link nine-tenths inch	21
	Feet.
Speed of chain per second on main tracks	3
Speed of chain per second on side tracks	2
Interval between wagons	30–60

In 1885 there existed in this quarry 5,500 yards of track for chain transportation and 15,000 yards of other track, and 10,000 yards of railway track of normal gauge between the platforms and thence to the station. For the chain transportation 700 wagons are used, each holding one-half cubic yard, on the platforms 60 dumping wagons, and in and around the quarry 200 other track wagons. Of all the stone quarried at Quenast, about 50 per cent. is sent off in the form of paving stone of various kinds. The remainder is worked up by means of a stone crusher in a very practically arranged factory into macadam and finer gravel, for which the rock, owing to its toughness, is very suitable.

The trucks, laden with cast-off material from the quarry, are carried forward by means of chains to the factory, are placed on dumping apparatus, and emptied into large funnels discharging into the stone crushers. After the stone has passed through these it drops into a somewhat inclined rotating cylinder provided with holes, and is there sorted into gravel of the following grades: (1) Macadam, four-fifths to to 2½ inches in size; (2) ballast gravel for railways, one-fifth to four-fifths of an inch; (3) sand for gardens and promenades, one-fifth of an inch. From the sorting drum the gravel falls through large funnels directly down into the railway trucks. The sand, however, is once more subjected to sorting in flat sieves. The stone crusher itself, constructed after the Blake system, is stated by Dietrich to have jaws 2 feet high. The upper opening or mouth is 1½ feet long and 1 foot broad; the lower can be made narrow or wide at pleasure. The movable jaw strikes 300 blows a minute. There are 6 crushers of this kind in the factory, only 2 of which are held in reserve. Each pair of stone crushers, with a sorting drum belonging to it, is driven by a steam engine of 100-horse power. It was stated that each crusher could work up in one hour 31 tons of stone, which agrees pretty closely with Dietrich's statement of 10 cubic yards. The sorting drums, which make 15 revolutions a minute, are 36 to 40 feet in length and 3½ feet in diameter. The upper part, which drops the sand, has round holes; the middle part, for the ballast gravel, has rectangular holes; the lowest, for macadam, round holes. By making the last-named part somewhat longer than the others, and by giving to the drum a suitable inclination, it has been possible to make the ratio between the more valuable macadam and the less valuable fine-grained product equal to 3:2. The cost of production in the stone-crushing factory of 1 cubic yard of macadam, ballast gravel, and sand together was stated by Dietrich to be 41 cents, of which wages were 14 cents; coal and oil, 6 cents; rent, etc., 21 cents. The selling price, which of course varies, was in 1885 stated to be—

	Per 10 tons.
Macadam	\$5.83
Fine sand	5.83
Ballast gravel	2.90 to \$3.90

At the time of Mr. Lundbohm's visit in 1888 the number of workmen was about 2,000. Dietrich mentions 2,200, divided as follows:

In the quarry:	
Drilling, blasting and dressing	1,075
Sorting, accounting, and lading	440
Working up the stone on the platforms	350
Chain transportation, turning trucks	40
Transportation on platforms and lading	90
In crushing factory and for transportation thither	100
In repairing shop	50
For removal of earth, etc., in the quarry	55

A stone-worker employed in the quarry was stated to earn on an average 68 cents per day, but sometimes even \$1.17 or \$1.36; an ordinary workman in the quarry, on the average, 50 cents, and occasionally 58 cents a day. These wages are comparatively low, but it must be noted that the workmen enjoy the advantage of cheap and comfortable dwellings, erected by the company, which also takes care that the means of living are obtained cheaply, has established schools, etc.

The amount of paving stone worked up is stated to be 180,000 to 190,000 tons annually. According to a table given by Dietrich, it has increased between 1873 and 1884 from 16,497,135 pieces of paving stone (120,852 tons) to nearly 24,500,000 pieces (222,000 tons) per year. Of this 33 per cent. belong to classes 2, 3, and 4, that is to say, they are dressed; the rest is only coarsely hewn. Assuming 250 actual working days per year, the daily production amounts to nearly 100,000 pieces of paving stone.

The production of macadam is stated at 90,000 cubic yards, that of ballast gravel and sand at 60,000 cubic yards per year.

The area supplied by the products of Quenast, despite the rather high freight charges, extends far beyond the boundaries of Belgium. Thus large quantities of paving stone are sent to Holland and France, and even to more remote places, such as Cologne, Berlin, Petersburg, Bucharest, etc. The same is true of the other products, or, at any rate, of macadam. The manager of the Mount Sorrel Granite Company in England reported that even along the east coast of England the great Belgian work competes with English firms in this article.

CLAY MATERIALS OF THE UNITED STATES.

By Robert T. Hill.

PRODUCTION.

The industries dependent upon clay mining shared in the general business depression of the year, especially brickmaking, which is so largely dependent upon the building industry. Development and prospecting of clay materials showed its usual activity, however. These statistics for the year were as follows:

Amount and value of potters' materials from 1887 to 1893.

	1887.		1888.		1889. (*a*)		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*	
Kaolin and china clay	22,000	$231,000	18,000	$189,000				
Ball clay	6,000	36,000	5,250	31,500	294,344	$635,578	350,000	$756,000
Fire clay	15,000	45,000	13,500	40,500				
Ground flint	19,800	168,000	16,250	138,125	11,113	49,137	13,000	57,400
Ground feldspar	10,200	112,200	8,700	95,700	6,970	39,370	8,000	45,200

	1891.		1892.		1893.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
Kaolin and china clay, Ball clay, Fire clay	400,000	$900,000	420,000	$1,000,000	400,000	$900,000
Ground flint	15,000	60,000	20,000	80,000	29,671	63,792
Ground feldspar	10,000	50,000	15,000	75,000	18,391	68,037

a From 1889 all clays burned in kilns are considered.

Clay imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fire clay.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280.25	$3,113			6,383.75	$72,204	$75,317
1868	211.00	2,522			8,383.75	66,958	69,480
1869	324.10	3,587			12,963.75	84,645	88,232
1870	239.40	2,619			8,014.15	76,057	78,676
1871	290.20	3,383			10,900.48	103,144	106,527
1872	274.00	3,358			13,081.20	128,130	131,488
1873	251.18	2,978	1,378.30	$13,091	12,883.82	141,927	157,996
1874	277.20	3,440	89.21	1,378	12,909.14	147,782	152,600
1875	300.06	3,694	130.47	1,977	10,374.65	116,307	121,978
1876	246.73	3,097	142.00	2,152	11,799.12	126,738	131,987
1877	400.00	4,460	204.26	3,009	11,680.14	129,016	136,485
1878	335.07	4,095	3,499.30	38,899	9,406.74	95,877	138,871
1879	361.21	4,269	4,774.60	45,272	8,477.80	87,948	137,489
1880	578.00	6,925	7,823.66	67,740	11,899.80	117,350	192,015
1881	267.55	3,207	6,887.37	66,654	12,444.28	123,545	193,406
1882	908.27	11,444	13,954.85	135,448	12,181.39	119,620	266,512
1883	1,241.27	14,309	12,870.60	115,492	7,841.32	74,673	204,474

Classified imports of clay during the calendar years ending December 31, from 1885 to 1893.

Kinds.	1885.		1886.		1887.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	10,626	$83,722	16,590	$123,093	23,486	$141,360
All others:						
Unwrought	9,736	76,899	13,740	113,875	17,645	139,405
Wrought	3,554	29,839	1,654	20,730	2,187	22,287
Total	23,916	190,460	31,984	257,698	43,318	303,052

Kinds.	1888.		1889.		1890.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	18,150	$102,050	19,843	$113,538	29,923	$270,141
All others:						
Unwrought	20,604	152,694	19,237	145,983	21,049	155,486
Wrought	6,832	53,245	8,142	64,971	2,978	29,143
Total	45,586	307,989	47,222	324,492	53,950	454,770

Kinds.	1891.		1892.		1893.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	39,901	$294,458	49,468	$375,175	49,713	$374,460
All others:						
Unwrought	16,094	118,689	20,132	155,047	14,949	113,029
Wrought	6,297	56,482	4,551	64,818	6,090	67,280
Total	62,292	469,629	74,151	*a* 595,040	*b* 70,752	554,769

a In addition, 5,172 long tons of common blue clay, worth $59,971, were imported.
b In addition, 4,304 long tons of common blue clay, worth $51,889, were imported.

IMPORTS.

Earthenware and china imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Brown earthen and common stoneware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen, stone, or crockery, glazed, etc.	Total.
June 30, 1867	$48,618	$418,493	$439,824	$4,280,924	$5,187,859
1868	47,208	309,960	403,555	3,244,958	4,005,712
1869	34,260	400,894	555,425	3,468,970	4,459,549
1870	47,457	420,442	530,805	3,461,524	4,460,228
1871	96,695	391,374	571,032	3,573,254	4,632,355
1872	127,346	470,749	814,134	3,896,664	5,308,893
1873	115,253	479,617	867,206	4,289,868	5,751,944
1874	70,544	397,730	676,656	3,686,794	4,831,724
1875	68,501	436,883	654,965	3,280,867	4,441,216
1876	36,744	409,539	718,156	2,948,517	4,112,956
1877	30,403	326,956	668,514	2,746,186	3,772,059
1878	18,714	289,133	657,485	3,031,393	3,996,725
1879	19,868	296,591	813,850	2,914,567	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175
Dec. 31, 1886	37,820	865,446	3,350,145	951,293	5,204,704
1887	43,079	967,694	3,888,509	1,008,360	5,907,642
1888	55,558	1,054,854	4,207,598	886,314	6,204,324
1889	48,824	1,148,026	4,580,321	788,391	6,565,562
1890	56,730	974,627	3,562,851	563,568	5,157,776
1891	99,983	1,921,643	6,288,088	353,736	8,663,450
1892	63,003	2,022,814	6,555,172	380,520	9,021,509
1893	57,017	1,732,481	6,248,255	338,143	8,375,896

TECHNOLOGY.

The uses, application, and improvement in processes of manufacture of clay are increasing with rapidity. Not only is this in the direction of machinery for the more economic manipulation of the standard clays, but in methods of using materials hitherto not serviceable, or known to contain deleterious ingredients, such as clays containing an excess of lime or silica.

Use of calcareous clays.—It is known that in this country, especially in the chalky Cretaceous regions of Alabama, Mississippi, Texas, and the Great Plains region, there are many clays now unworked on account of containing a supposed excess of lime. In a previous volume we have spoken of the making of malm from the marls of England. Prof. George Lunge, of Zürich, Switzerland, has communicated the following description of how bricks of a superior quality are made from the calcareous marls of Germany. For comparison I have added analyses of clays from the Upper Cretaceous of Arkansas to his table.

Analyses of clay from the brickyard belonging to the Mechanische Backsteinfabrik, Zürich, Switzerland.

	Top layer (yellow clay).	Third layer (blue clay).	Cretaceous clay of Arkansas.
	Per cent.	*Per cent.*	*Per cent.*
Calcium carbonate	23.68	27.80	22.04
Magnesium carbonate	....	5.70	2
Carbon dioxide otherwise present	2.85	1.55	....
Silica	42.39	38.25	53.07
Alumina	18.16	12.44	7.99
Ferric oxide	3.66	.73	7.42
Lime (as silicate)	....	1.85	....
Magnesia (as silicate)	....	.15	....
Potash	2.14	1.54	1.93
Soda	1.27	3.05	.30
Moisture (at 100° C.)	1.27	1.37	2.15
Chemically combined water and organic substances	3.85	4.72	....
Total	99.28	99.15	....

"The bricks made from this clay, if burned at the ordinary heat, say a moderate red heat, are *red*, and do not keep in the air, but crumble away very soon, as the quicklime slackens by the moisture. When burned at a *bright* red heat, about 200° C. above the former, they are nearly white. The lime is then present as a ferri-alumina-calcic silicate, which causes the red color of the Fe^2O^3 to vanish, and at the same time entirely prevents any action of the moisture, free lime being no longer present. Many millions of bricks and roofing tiles have been made every year from this clay for more than twenty years past, and they have always kept perfectly well. My predecessor, Bolley, once analyzed clay from the same brickyard containing 32 per cent. of calcium and magnesium carbonate, and yet yielding very good bricks by burning them hot enough to turn yellowish white."

Siliceous fire brick.—The manufacture of brick from sand and glass has attracted much attention. Mr. Joseph Khern, the Austrian metallurgist, has introduced a plan for the manufacture of refractory fire brick. The chief ingredient employed is quartz, which must be of the highest degree of purity, especial care and watchfulness being exercised to reject all such portions as show any admixture of iron or copper pyrites, carbonate of lime, or even mica or feldspar. This preparation is similar to that observed in the manufacture of Dinas and the siliceous fire bricks made at Stolburg, near Aix. The quartz, having been selected in the manner described, is heated in quantities of from 12 to 15 tons in a Rumford oven or in a continuous kiln, such as used for lime. At the end of twelve hours, having reached a full red heat, it is thrown into water. The best fragments are then selected and afterward cleaned by a simple jigging process, and then subsequently crushed under a tilt hammer until sufficiently fine to pass through a sieve having 60 holes to the square inch, which leaves the particles coarse and sharp. Two varieties of fat clay are used to bind the coarsely pulverized quartz. The clays differ slightly in plasticity, and are very carefully prepared by thorough weathering, pulverization under light stamp heads, and fine grinding under edge rollers. A final sifting is performed through a very fine sieve of 600 meshes to the square inch. The tilt hammer used for pulverizing the quartz weighs 250 pounds, and is capable of crushing 3½ tons of the burned quartz in twelve hours.

In selecting the quartz the purest quality is reserved for the first quality of bricks, which have to resist the greatest temperature and sudden changes; while the second and third classes of bricks are made for less exposed positions, and are composed chiefly of the remains of bricks which have been once used and again pulverized and sifted afresh.

The following are the compounds employed for the different classes of bricks: First class, 16 parts of quartz to 1 of plastic clay, or 14 parts of quartz to 1 of leaner clay; second class, 16 parts of ground bricks of the first class to 1 of clay third class, 8 parts of ground bricks of the second and third classes to 1 of clay.

The third-class bricks are made more with an idea of their employment in portions of the furnace requiring greater mechanical strength than fire-resisting qualities. The materials are first mixed together in a dry condition on a large, clean, and tight platform of wood, and are then thrown into a tight, wooden pugging box 6 feet square and 9 inches deep. In this box the dry mixture should be about 6 inches deep, and be thoroughly incorporated by kneading with water and treading under men's feet, and occasionally turning over the mass with shovels, care being taken not to draw splinters from the wooden box into the clay. A sufficient quantity of water must be added to allow the mixture to be worked into a ball between the fingers without crumbling.

The second and third class bricks are formed in open molds, the pug being beaten down by a metal rammer of about $4\frac{1}{2}$ pounds weight; the first class, however, are subject to a pressure of about $3\frac{1}{2}$ tons to the square inch during a period of three-quarters of an hour before they are removed from the molds.

The drying is done in chambers through which a current of air passes, at the ordinary temperature in summer, but artificially warmed in winter. The bricks are fit for burning in seven days. The kilns are rectangular chambers, each having two step-grate fireplaces in one of the shorter sides and a flue communicating with a high chimney at the opposite end. The capacity is small, being only about 2,500 bricks. As soon as the kiln is filled the charging opening is partly closed and a gentle fire is kept in the grates, the damper in the flue being closed.

At the end of thirty-six hours the charging hole is entirely closed, and the draft is stimulated by opening the damper in the flue inch by inch at intervals, until at the end of seventy-two hours the whole of the bricks have attained a strong white heat. The fires are then removed, the damper closed, the grates filled with sand, and cracks that may have been discovered in the kiln are carefully luted or smeared over with soft mud.

The charging opening should also receive careful attention and be faithfully daubed. After standing in this way for thirty-six hours the charging place is gradually opened, and in sixty to seventy-five hours the burned bricks may be removed.

A somewhat novel brick has been recently introduced by a North London company under the name of Kieselguhr fire brick (infusorial earth) as a substitute for ordinary fire bricks. The chief advantage about these bricks is their lightness, which renders them specially suited for blast-furnace pipes, covering retorts, etc. They can be used for all the purposes to which an ordinary fire brick is put, as the material of which they are made, *pure* Kieselguhr, is as infusible as quartz. These bricks have been utilized for special purposes in chemical works, where nonconducting properties are desirable, with great success. They also give satisfactory results for retort settings at gas works.

The success of these bricks as fire bricks is now undoubtedly established, and as an indication of their lightness as compared with other fire bricks it may be mentioned that the brick itself has a specific gravity of 0.6. A cubic yard weighs about 12 cwt., which is about a fourth of the weight of a cubic yard of Dinas bricks.

Some idea of the composition of the brick can be gathered from the following average analysis of the Kieselguhr from which they are made:

Analysis of Kieselguhr (infusorial earth) for fire brick.

	Per cent.
Silica	83.8
Magnesia	0.7
Lime	0.8
Alumina	1.0
Ferric oxide	2.1
Organic matter	4.5
Moisture and loss	7.1
Total	100.0

Glass sand brick.—It is found that a very superior quality of brick may be manufactured from the waste sand employed at the factories in grinding and polishing plate glass. The grinding of plate glass is accomplished by means of wooden plates covered with iron, between which quartz sand abundantly moistened with water is brought. By this manipulation of grinding, consisting in a constant moving to and fro of the grinding plate over the plate to be ground, the quartz sand becomes mixed with particles of iron and glass, and after losing its sharpness is cast aside as waste.

The sand contains about 15 per cent. of glass particles and 2 per cent. of iron, is very hygroscopic, and, before it can be used for making bricks, is dried and then pressed into the mold under a pressure of 660 pounds per 0.155 square inch, the pieces thus obtained being subjected to a temperature over 2,500° F. at which temperature the glass enters into a combination with the sand, a new product with new properties being the result. The bricks thus produced have a specific gravity of only 1.5 and are perfectly white, and as they are not attacked by acids are considered to be especially desirable for use in chemical factories and sulphuric acid works. They also resist frost, and, as shown by experiment, they possess a compressive strength of from 840 to 975 pounds per 0.155 square inch.

In Switzerland there is now being manufactured a glass brick, formed or molded flask shape with a short neck at each end, 8 inches in length, 6 inches in width, and 2½ inches in depth, with an air chamber through the center. The edges of the brick are covered, recessed, or ribbed and grooved to receive when laid a suitable cement of plastic material of such character that, after it has hardened, it will constitute a suitable frame or setting to keep the entire mass, roof or wall, solidly together. The forms or molds, of which there are two different shapes, are pleasing to the eye, the lines or ridges being clean and smooth and of a sufficient thickness or strength to stand a pressure of 150 to 200 pounds to the square foot.

Slag bricks.—According to the Industrial World for January 7, 1894, the manufacture of slag bricks for building purposes has also attained considerable dimensions in Germany.

DEVELOPMENT BY STATES.

The following notes indicate the progress made in the development of clay deposits since the publication of the last report on Mineral Resources of the United States, 1892:

OHIO.

Prof. Edwin Orton published a valuable report (*a*) on the clays of Ohio which shows that at present that State leads in most of the clay industries, especially in the manufacture of sewer pipe. The clay industries of this State now exceed in productive value the coal product, which was formerly the chief industry of the State. The State also excels in fire clays. The lowest clays worked in the State are found in the base of the Upper Silurian. The black and blue shales of the Devonian at Columbus are largely worked, but the best quality of clay belongs to the sub-Carboniferous and is used for fire brick. The terra-cotta or ornamental brick are manufactured from the Mercer clays in the Coal Measures.

The Kittanning series is another source of fire clay at Mineral Point. Paving brick are extensively made from the Freeport horizon. The increased use of shales is described. According to this report there are 44 manufactories of brick with 357 kilns, producing annually 292,000,000 of brick.

TENNESSEE.

Vitrified brick for paving are now being manufactured at Knoxville and shipped to Asheville, North Carolina, and other points. Paving brick are also being manufactured at Bristol in large quantities. Brick and pottery works have also been organized in many localities, while it is rumored that a large bed of kaolin or porcelain clay has been discovered in Stokes county.

The cost of labor in brickmaking in Tennessee is stated by the Tradesman to be as follows: Brick manufacturers, makers of drain tiles, etc., report that skilled white employés uniformly receive $4 per day, and that colored workers receive $2. Unskilled laborers in this manufacture, both white and colored, receive an average wage of $1.50 per day. In the business of sewer-pipe making the reports show that $2.12½ is the average pay per day received by white skilled workmen, the highest reported being $2.25, and the lowest $2. Colored workmen, denominated skilled, receive as an average $1.50 per day, the only price reported. Common white laborers in this business are paid as an

(*a*) Geol. Survey of Ohio, vol. 7, part 1, Columbus, 1893.

average 92½ cents, the highest reported being $1.15, and the lowest 75 cents. To common laborers of the colored race is paid an average of $1.15 per day, a price, it will be noticed, exceeding that received by white men. This is mainly owing to the fact that the labor required in this kind of manufacturing is very heavy, almost entirely in hands of stalwart and experienced colored men, and the few white laborers who seek this employment are usually inefficient.

TEXAS.

An important scientific contribution on a portion of the vast area that constitutes the Texas region was published in Science of December 1, 1893, by Mr. W. Kennedy, Austin, Texas. This article deals with the clays of the Tertiary and later formations of that State occupying the district of the Coastal plain. He shows their origin, composition, and variation, classifying them as follows: The newest or Coastal clays, the Fayette sands, the Yegua beds, the Marine sands, the lignitic and the Wills Point clays. From his brief outline it is shown that the greater portion of the Tertiary areas is made up of extensive beds of clays and sands.

The analyses of these clays show the peculiarity of having the proportions of the alkalies potash and soda reversed. In the greater number of clay analyses the proportion or percentage of potash exceeds that of the soda as 3.19 of soda to 1.18 of potash. There is a gradual decline of the two alkalies in the ascending series until the Coastal clays are reached, when one, the soda, shows an increase over the basal beds almost equal to the losses it sustains in the other members of the series.

The question of the origin of the clays is considered extensively with the conclusion that the most probable immediate source of the materials entering into the composition of these Tertiary deposits are the underlying Cretaceous beds, which are largely made up of mixtures of chalk and clay.

Numerous brick companies have been organized, notably at Morceville, near El Paso, North Galveston, and Dallas. A company has been organized at Velasco for the manufacture and export of pressed vitrified bricks, paving blocks, tiles, and drains from the peculiar blue and purple clay deposits near that town.

VIRGINIA.

The prospecting and development of the various clay fields of this State progressed materially during the year, and many companies were chartered, including two for the manufacture of terra cotta at Richmond. White brick of good quality are now being made at Richmond from a white clay said not to be affected by the weather and which will not discolor. The brick are being used in the city and exported to New York.

The clay works at Dorset, Virginia, is making North Carolina clay into ornamental brick, vitrified paving brick, drain tile, etc.

The brick works opposite Washington, near Alexandria, have continued active operations, while one company has been organized for the manufacture of a patent brick or stone facing.

WEST VIRGINIA.

Several companies were started in this State for the manufacture of fire and paving brick, notably at Bluefield, New Cumberland, Summit, and Kingwood.

ALABAMA.

Prof. Eugene Smith, State geologist, has published the following note on Alabama clays:

"The fire clays of Alabama may be discussed and classed under five heads: Clays of (1) the crystalline schists or metamorphic formation, (2) the Cambrian and Lower Silurian, (3) the sub-Carboniferous, (4) the Cretaceous formation, (5) the Tertiary.

"Under the first are the deposits of Coosa, Cleburne, and Randolph counties, the clay, or kaolin, of Louina, Randolph county, having the following composition: Silica, 37.29 per cent; alumina, 31.92 per cent; oxide of iron, trace; potash, lime, and magnesia, 0.72 per cent; water, 15.09 per cent; undecomposed mineral, 14.28 per cent. The pottery made of this clay took the first prize at the Art Institute Fair, at Philadelphia, in 1890, and brick made from it have successfully withstood the severest fire tests that could be applied at a large fire brick factory.

"It is among the second class, the Cambrian and Silurian clays, that the bauxites and kaolins of Cherokee and Calhoun counties occur. An analysis of the kaolin from near Jacksonville, Calhoun county, is as follows: Silica, 44.60 per cent; alumina, 38.92 per cent; oxide of iron, 0.78 per cent; lime, potash, etc., 1.03 per cent; water, 13.88 per cent; undecomposed mineral, 0.90 per cent.

"The third class, or sub-Carboniferous clays, occur at the base of the formation in close proximity to the underlying black shale. These clays approximate closely to halloysite, and have been opened at Valley Head, De Kalb county. The Cretaceous clays, the fourth class, occur over a very wide extent of territory in the Tuscaloosa formation (the Potomac of McGee, and the Raritan of Cook). Dr. Smith says of these clays that there is hardly a variety among the New Jersey clays that can not be exactly matched in Alabama. The Tuscaloosa clays extend entirely across the State, occupying roughly all that portion of it lying south of a line drawn from Tuscaloosa southeast to Columbus, Georgia. In admixture with other clays they are used in the manufacture of firebrick at Bessemer and at Bibbville. An analysis of a typical sample from Chalk Bluff, Marion county, is as follows: Silica, 47.20 per cent.; alumina, 37.7 per cent.; oxide of iron, 0.91 per cent.; lime, potash, etc., traces; water, 14.24 per cent.

"The clays of the Tertiary formation occur in the Buhrstone division of the Alabama Tertiary. A sample of the beds in Choctaw county had the following composition: Silica, 36.30 per cent.; alumina, 45.12 per cent.; oxide of iron, 1.60 per cent.; lime, 0.46 per cent.; water and volatile matter, 6.60 per cent. There seems to be no question of the adaptability of the Alabama clays for the manufacture of all kinds of fireproof material, and some of them have already been used in the production of the finer grades of pottery with very satisfactory results. Their wide extent and diversified nature enable one to select, with ease, whatever particular sort may be required; and the growth of metallurgical interests in the State, requiring large supplies of firebrick, indicates a profitable source of revenue from this direction alone."

Great improvement and development is noted in the firebrick works of Bessemer, Bibbville, and other places. New plants were also started at Birmingham for the manufacture of paving and ornamental brick. The Bessemer Firebrick works has doubled its plant to a daily capacity of 50,000 brick.

ARKANSAS.

A plant for the manufacture of paving, fire, pressed, and ornamental brick for building purposes and sewer tiling has been built near Hot Springs. Excellent brick material has also been reported near Magnolia and a company organized for working it.

According to Dr. John C. Branner vitrified bricks are manufactured at Fort Smith from a shale.

CALIFORNIA.

The fire-clay ledge 4 miles west of Rosamond furnished large quantities for shipment to Los Angeles for the manufacture of fire brick. This clay is said to make a splendid lining for stoves and furnaces, and for covering steam pipes, the manufacture of all kinds of pottery and queensware. It will also be largely used for well casing, conduit pipe, ditch casing, and other purposes in connection with the extensive irrigation works in California.

At Pomona a terra-cotta company has recently put in a new plant for the manufacture of terra-cotta stove pipe, drain tile, salt-glazed sewer pipe, and fire brick.

The San Joaquin Brick Company, 5 miles from Stockton, is developing the clays of that locality. Clay for the manufacture of brick is obtained at the site of the plant by dredging at a depth of 25 feet. The plant is supplied with the best modern appliances and machinery in use to carry on the business economically, including a Hoffman continuous kiln for burning common brick; another kiln is used for pressed and stock brick—only red brick is turned out. The output in 1892 was 4,500,000 brick. While the principal demand comes from the city of Stockton, a considerable amount is sold in other places where freight rates are not too high; these include Oakdale, Merced, and all points which can be reached by river boats.

COLORADO.

The clay industry in Colorado is making rapid strides. The quality is equal, if not superior, to any clays found in other States. According to the Rocky Mountain News, the principal points of production of clays are the foot hills near Golden, and Morrison, and Boulder. At Golden ten different stratifications of clay with separate characteristics are found suitable for the manufacture of the finest china, building brick, fire brick of all shades, roofing and fancy tiling, sewer pipe and pottery. At the Golden banks a glaze used by potters in glazing their ware, has been found. If well burned, the goods covered with this glaze will assume a perfectly white color. The manufacture of sewer pipe is actively carried on. Denver recently ordered the laying of 45 miles of sewer pipe. The clay used is taken from leased beds near Golden and at Morrison. Plastic clay is used in the manufacture of sewer pipe, and the Colorado variety is found to be entirely satisfactory for the purpose. The sewer-pipe company used 600 cars of this clay during the past year; 80 men are employed and $2,500 worth of coal is used each month. The value of the output for the past year is estimated at $52,000.

Denver also has a manufactory which produces fire brick, assayer's crucibles, scorifiers, muffles, and other appointments, in clay for the use of jewelers and assayers. The production for the year by this firm is estimated at $150,000. The manufacture of fire brick has been very dull, and the firm finds that the manufacture of higher-grade products is more satisfactory. Thirty-five men are employed in this trade. The goods produced are shipped to Mexico, British Columbia, and all the principal States. Refractory clay from Golden is used principally. In 1893 the company expended $10,000 in additions to the plant.

In the manufacture of useful utensils Denver pottery firms take a leading part. The total production is valued at $2,000 per month. Forty men are engaged at the factories. The largest factory in the city owns the Orahood bank, 3 miles south of Golden. The plastic clay is used in the manufacture of jugs, jars, butter firkins, milk jars, tiling, and flower pots. During the past year a plant was added for the making of tiles at an expense of $5,000. The flower pot trade by this concern reaches north, west, and south. The kilns have a capacity of 15,000 gallons of stoneware and 15,000 flower pots of various sizes per week.

The pressed-brick and fire-brick companies produce a superior quality of building brick. A brick is now being manufactured which will rapidly take the place of the "Dinas" brick manufactured in England. An idea of the favorable reception of Denver-made fire-brick can be had from the fact that brick sent out by Denver firms was recently sold in Portland, Oregon, for double the price asked by English firms.

The manufacture of common brick has not occupied the attention of many workmen during the past year. The early part of the year was a fairly good time, but the latter part shows little activity in the trade. A large stock is kept on hand by all the brickyards, sufficient for a good supply when business resumes its usual activity.

There are numerous brickyards in the suburbs adjoining Pueblo. The two fire-brick companies own large fire-clay beds and make a superior quality of fire-clay brick and tiles for coke ovens. The Pueblo Pressed Brick Company is another in that line that is furnishing the city with a building material that until a few years ago had to be purchased from abroad. This company has an invested capital of $40,000.

FLORIDA.

The superior quality of kaolin which is being found in the beds of Citrus, Lee, and Hernando counties, Florida, promises to be the basis of a very important industry. In the vicinity of Oxahumpka some very fine specimens have been found of a beautiful clear white quality, comparing favorably with that used in New Jersey in the manufacture of porcelain ware. Already the mining of this clay is furnishing labor for a large number of hands and additional freights for the several transportation lines.

A bed of potters' clay has been discovered at Bluff Springs, in Escambia county, on the Louisville and Nashville railroad. A company of business men is being organized here to establish a pottery, and have employed an expert connected with the large potteries at East Liverpool, Ohio, to make a thorough examination of the clay. The clay at Bluff Springs is suitable for the manufacture of many articles which command ready sale at a good profit. It will make a good quality of sewer pipe.

According to a report by Mr. Thomas R. Baker, in Science, there occurs near Bartow, Florida, and at other points as far south as Haines City, a deposit which has recently been found to be very valuable as a material for covering the sandy sidewalks and streets of Florida towns. It is popularly known in south Florida by the name "*clay*," but consists essentially of sand, clay, and oxide of iron.

Analysis of street-paving clay, Bartow, Florida.

	Per cent.
Moisture	4.20
Silica	69.03
Aluminum silicate	18.21
Iron oxide	8.53
Calcium carbonate	Trace.

The deposit is a sandstone rock, and, although it has to be quarried from its bed, it almost completely disintegrates in the quarrying, and needs no further preparation to fit it for the use to which it is applied. It is of a reddish color, due to the presence of oxide of iron. The material is simply spread over the sidewalk or street to which it is to be applied to the depth of several inches, and then sprinkled with water and rolled with a heavy roller. After being walked upon and driven over for a short time it becomes very compact and fully as hard as it is in its native bed.

The most valuable constituent of this material, when used as a covering for roads, is undoubtedly the oxide of iron, which acts as a cement, rendering the material capable of becoming compact and hard. That the iron serves this purpose was verified by removing it from the compound, and subjecting the mixture of the remaining constituents to tests that had been applied to the original material. The adaptation of this deposit to the improvement of roads was first brought to notice by the South Florida and other railroad companies, who used it for the improvement of railroad crossings, driveways about stations, etc., and the first extensive use made of it for streets and sidewalks was by the city of Orlando about a year ago. It has given excellent satisfaction in Orlando, nothing having been done for the place for years that has so improved it. It has been the means of converting streets so sandy that travel over them was very slow and difficult into driveways over which travel is easy and pleasant.

GEORGIA.

Mr. J. W. Spencer, late State geologist of Georgia, has published a valuable contribution to the clays of that State. (*a*)

In northwestern Georgia he reports the following types of clays: (1) The kaolin-like clays, (2) the clays derived from the decay of limestones and calcareous shales, (3) those formed from the disintegration of shales, and (4) alluvial deposits. He says the kaolin-like clays are sometimes pure white with occasional stains of iron, or again of a purple tint. They often occur in large bodies. In the cherty remains of other portions of the Knox dolomite the siliceous nodules occur in the white, chalky clay and could be separated from it by mechanical means. Halloysite occurs under similar conditions in the Fort Payne chert, and can be used for porcelain ware. The composition of some of these white clays is given. They contain only the smallest trace of undecomposed feldspar and alkalis, and it is alleged would form an infusible clay with even the amount of iron present. These clays require experimentation before their full value can be determined. They are residual in origin.

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a Geological Survey of Georgia. Paleozoic Group. J. W. Spencer, etc., Atlanta, Georgia, 1893.

Various residual clays are reported from other beds of the Paleozoic group, among which are clays derived from the disintegrated shales which Mr. Spencer thinks will be valuable for brick making. At Rockmart the decomposition of the shales has produced a buff colored hard banded material which is capable of being sawed or turned into ornaments. Samples of brick made from this clay are very fine. Good brick clays are reported from various localities.

MISSISSIPPI.

It is gratifying to note that the clays of this State are beginning to be appreciated, and it is a commendable fact that the Illinois Central Railway, which traverses the State, is advertising their merits and seeking to interest capital in their development.

A peculiar clay is reported to have been found 4 miles from Ocean Springs especially adapted to making the best fire brick, and which is said to have stood a test of 3,000° to 3,500° Fahr. without injury. A company has been organized to work the clay near Stonington, where a complete plant will be erected for the manufacture of brick, tiles, pottery, piping, etc. The manufacture of pottery will be continued at Meridian.

MISSOURI.

In connection with the investigation of the clays of Missouri, a large amount of experimental work has been done for determining their fusibility and other properties. These results have been set forth by Mr. H. A. Wheeler in the Engineering and Mining Journal. A valuable table is given showing the calculated fusibilities of 37 Missouri clays, including fire, brick, and potter's clay.

It is reported that kaolin of a fine quality has been discovered near Glen Allen, Bollinger county.

NORTH CAROLINA.

Mr. T. K. Bruner, secretary of the department of agriculture of that State, has received a considerable number of responses to his invitation to those interested in the development of kaolin to forward him samples to be treated in Japan. It has been stated that a Japanese commissioner says there would be no difficulty in securing the necessary articles, potters, and decorators from Japan to come to North Carolina. The Manufacturer's Record says that kaolin, a fine grade of potter's clay, is found in abundance in nearly all the counties west of the Blue Ridge, but in Mitchell, Yancey, and Jackson counties the clay is considered the best. It has been successfully mined for a number of years. Large amounts are shipped daily, and bring from $12 to $14 per ton at factories in East Liverpool, Ohio, Trenton, New Jersey, and other

Northern markets. Some of the finest cups and saucers, said to be equal to any foreign productions, are made from this clay. It is also largely used in manufacturing joints and for making pipes, fancy tiling, mosaic work, and sanitary appliances. The clay is in great demand and the output constantly increasing. Fortunately the supply is large and will furnish material for centuries to come.

The Dillsboro works are actively engaged in preparing the kaolin from the neighborhood for shipment to the works at Trenton, New Jersey, where most of it is used for the manufacture of porcelain.

The clays at Grover station, near Charlotte, are said to be of a very fine quality for terra-cotta work, and will be utilized by a company at Dorset, Virginia.

CEMENT.

By Spencer B. Newberry.

HYDRAULIC CEMENT.

Decreased product.—The production of hydraulic cement in 1893 shows a considerable decrease from that of the previous year. This is probably chiefly due to the depression in business that prevailed throughout the country during the latter half of the year, in consequence of which building operations were largely suspended and the use of cement of all kinds was greatly decreased. It is to be feared that the reports for the present year will show a still further decline in production, as the demand for cement has not revived and the prevailing scarcity of coal has caused several works to suspend operations. The decrease in the production of hydraulic cement during 1893 was very evenly distributed throughout the country, but is especially marked in the great centers of manufacture, the Rosendale region in New York, the Louisville region in Indiana and Kentucky, and Lehigh county, Pennsylvania. An increased production is to be noted in only one important locality, viz, Utica and La Salle, Illinois, and at this point the increase is slight.

Prices.—As to prices of hydraulic cement, the figures have fallen even lower than before. In the Louisville region sales are reported at as low a price as 22 cents per barrel of 260 pounds, in bulk, at the works. This is less than 7 cents per bushel, or lower than the usual price of common lime at the kilns. It seems almost incredible that the process of quarrying the cement rock, burning in kilns, and grinding can be carried on without loss at these figures. Only by manufacturing on an enormous scale and conducting the burning so as to secure the greatest economy of fuel is it possible to meet expenses at the present figures. In no other country has hydraulic cement of good quality been placed on the market at so low a cost.

Hydraulic cement finds its chief application in mortar for building, for which purpose it has largely replaced common lime, and in laying the foundation for asphalt and brick pavements. Even for these common uses it meets a formidable rival in Portland cement, since the latter allows the addition of a so much larger proportion of sand that the cost of Portland-cement mortar and concrete is about the same as that made from natural-rock cement.

The following table gives the amount and value of hydraulic cement produced in various localities during 1892 and 1893. The values given are, for the sake of uniformity, made to include the cost of barrels, which for hydraulic cement is about 15 cents each, although the larger part of the product is sold in paper sacks.

Product of hydraulic cement in 1892 and 1893.

	1892.			1893.		
	Number of works.	Product.	Value, including barrels.	Number of works.	Product.	Value, including barrels.
		Barrels.			*Barrels.*	
Georgia	1	50, 393	$41, 294	1	10, 273	$9, 750
Illinois	2	472, 876	236, 438	2	522, 972	283, 782
Indiana and Kentucky	13	2, 100, 000	1, 365, 000	13	1, 750. 350	962, 692
Kansas and Missouri	2	110, 000	77, 000	2	60, 000	36, 000
Maryland and West Virginia	5	252, 092	220, 991	5	231, 590	183, 451
Minnesota	1	100, 000	75, 000	1	75, 000	56, 250
New Mexico	1	10, 000	10, 000	1	1, 500	1, 500
New York:						
Onondaga county	8	240, 580	152, 550	8	161, 308	97, 721
Ulster county	17	2, 833, 107	2, 408, 141	17	2, 738, 884	2, 191, 107
Schoharie county	1	32, 000	27, 840	1	22, 566	20, 309
Erie county	4	675, 000	486, 250	4	675, 000	496, 250
Ohio	2	56, 863	53, 863	3	68, 000	60, 550
Pennsylvania	6	664, 594	502, 511	6	567, 110	406, 936
Texas	1	40, 000	40, 000	1	10, 000	27, 500
Utah	1	5, 000	7, 500	1	5, 000	7, 500
Virginia	1	10, 000	10, 000	1	17, 509	15, 084
Wisconsin	2	558, 676	284, 772	2	494, 753	248, 326
Total	68	8, 211, 181	5, 999, 150	69	7, 411, 815	5, 104, 708

PORTLAND CEMENT.

In spite of unfavorable conditions for growth, the production of Portland cement in 1893 showed a marked increase over that of the previous year. This is due to the commencement of operations in two new factories rather than to increased output at older works. There were at the close of the year 19 factories producing Portland cement in the United States, with a total output of 590,652 barrels. The imports for the year 1893 were 2,674,149 barrels. About 18 per cent. of the Portland cement consumed was, therefore, produced in this country. The following table shows the relative proportion of Portland cement made in this country and imported during the past four years:

Comparison of the domestic production of Portland cement with the imports.

	1890.	1891.	1892.	1893.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*
Production in the United States	335, 500	454, 813	547, 440	590, 652
Imports	1, 940, 186	2, 988, 313	2, 440, 654	2, 674, 149
Total	2, 275, 686	3, 443, 126	2, 988, 094	3, 264, 801
Exports			21, 536	14, 276
Total consumption	2, 275, 686	3, 443, 126	2, 966, 558	3, 250, 525
Percentage of total consumption produced in the United States	14. 7	13. 2	18. 4	18. 2

It appears from this that the domestic product has, on the whole, decidedly gained ground, though the increased production in 1893 almost exactly balanced the increased importation. There can be no doubt that future years will witness a still further growth in the ratio of production to imports, and that all the Portland cement needed in this country will ultimately be produced at home. There are several causes, however, which combine to postpone this result, the most important of which is probably the very rapid increase in the use of Portland cement in this country. There is also a widespread prejudice in favor of foreign cement, due to the great excellence which some of the German manufacturers have attained through many years of experience. The first efforts to make Portland cement in this country were not altogether successful so far as quality is concerned, and up to the present time more or less cement of poor quality has been put upon the market. It is certain, however, that some of our leading factories are now making cement which is fully equal to the best German or English Portland, and the prejudice against the American product, at no time a bitter one, is fast disappearing.

Another important obstacle to the rapid growth of the industry in this country is the low price at which foreign cements are supplied in our markets. In Europe the industry is established on an enormous scale, with correspondingly low cost of production. The Dykerhoff factories on the Rhine and those at Stettin are said to produce from 1,500 to 2,000 barrels of cement per day, while our largest works (at Coplay, Pennsylvania) do not produce more than 300 barrels per day. The cost of labor, which plays an important part in the expense of manufacture, is also much higher in this country than in Europe. Against the disadvantages of production on a small scale and high cost of labor may be set the cost of shipment to this country and the present duty of 32 cents per barrel. The first of these items is of slight importance in Eastern markets, since the ocean freight usually amounts to only a few cents per barrel. Within the past year the transportation companies engaged in shipping cement from New York to Chicago have agreed to absorb the ocean freight, making a through rate of 52 cents per barrel from Europe to Chicago. The prices of many brands of foreign cements have also fallen to a very low figure during the past year, as the following table shows:

Prices of foreign Portland cement, in large lots, alongside wharf, duty paid, at close of 1893.

	New York.	Chicago.
Belgian and cheaper English	$1.45	$1.95
Good English and German	1.75	2.25
Best German	2.00	2.50

American cements are generally classed with the cheaper English and Belgian, though in many cases fully equal to the best German. A good American cement must be sold at least 25 cents per barrel lower than a foreign cement of equal quality, in order to find a market. To meet the above figures, American manufacturers are selling at very low rates. At Eastern factories the prices are from $1.50 to $1.75, in wood, at the works; in Ohio, from $1.75 to $2. A slight advantage is gained by the domestic producer in the possibility of shipping by rail in paper or duck sacks, which is impossible in the case of foreign cement.

In conclusion, it may be said that, in order to replace foreign cements American cements must be manufactured on a very large scale, with great economy of labor and fuel, and with the closest attention to quality. It is encouraging to note that in spite of the fact that the prices of foreign cements in our markets have fallen nearly one-half during the past ten years, the industry has become permanently established in this country, and has steadily increased, while the quality of the domestic product has been very greatly improved.

Product of Portland cement in 1892 and 1893.

States.	1892. Number of works.	1892. Product.	1892. Value including barrels.	1893. Number of works.	1893. Product.	1893. Value including barrels.
		Barrels.			*Barrels.*	
Colorado	1	10,000	$30,000	1	10,000	$25,000
Dakota	1	34,000	68,000	1	33,739	69,502
Indiana	1	12,000	30,000	1	20,000	45,000
New York	4	124,000	279,000	5	137,096	287,725
New Jersey	1	20,000	40,000	1	60,000	96,000
Ohio	2	46,600	108,500	3	36,500	85,500
Pennsylvania	6	300,840	597,100	6	285,317	521,411
Texas	......	......	......	1	8,000	28,000
Total	16	547,440	1,152,600	19	590,652	1,158,138

GENERAL NOTES ON PORTLAND CEMENT.

New York.—The new factory of Messrs. Thos. Millen & Co., at Wayland, began operations in October, 1892. The materials used are marl and clay, and the burning is done in ordinary dome kilns. The works were partly destroyed by fire in July, 1893, but were soon rebuilt, and were in full operation at the close of the year.

The factory at Montezuma, described in the report for 1892, was destroyed by fire in June, 1893, and has not been rebuilt.

The works of the Warners Cement Company, near Syracuse, were totally destroyed by fire in February, 1893. The factory was immediately rebuilt on a greatly improved plan, and operations were commenced in October last. Owing to the prevailing business depression, the works were shut down early in 1894.

Ohio.—The Diamond Portland Cement Company, at Middle Branch, near Canton, began manufacturing early in 1893. Limestone and clay are the materials used, and the burning is carried on in continuous kilns of the Dietzsch type.

The Sandusky Portland Cement Company, at Portland, 5 miles west of Sandusky, began operations in August, 1893. At these works the marl and clay are mixed in revolving pans with edge-runners; the wet mixture is then ground in special steel mills and dried in rotary cylinders, from which it issues in the form of small rounded pieces. The dried material is burned in this form in rotary kilns heated by crude-oil flames.

Portland cement at the Columbian Exposition.—Very interesting displays were made by the leading English, German and French manufacturers; among them the Germania and Heidelberg factories were the most striking. Very beautiful specimens of polished slabs and mosaics of cement were shown, illustrating the growing use of Portland cement for ornamental purposes. Among American exhibitors may be mentioned the American, Coplay, Buckeye, and Sandusky cement companies. A very interesting exhibit was made by the editors of the Thonindustrie Zeitung, Dr. Seger and Mr. G. Cramer. This included all the latest appliances used in Germany for testing cements, Dr. Böhme's revolving table for determining the wear-resisting qualities of cement, Bauschingers apparatus for testing expansion, etc., and a full library of books of reference on the cement industry. The exhibit was, in fact, a complete testing laboratory, and experiments were carried on during the whole exposition. Dr. M. Gary has given in the Thonindustrie Zeitung a full review of the clay and cement industries as shown at Chicago. In a paper read before the German Cement-makers' Association at their annual meeting in February, 1894, Dr. Gary gives an extended account of the present condition of cement manufacture in the United States, and describes several factories which he visited. Speaking of the efforts that are being made to develop the manufacture of Portland cement in this country, he says:

"At present there is naturally no little difficulty in introducing a cement which has not yet had time to prove its excellence, since no architect nor engineer can be persuaded to take the risk of using an unknown material. This circumstance, and the prejudice of consumers in favor of foreign cements, are the obstacles which the American manufacturer encounters in introducing his product. 'All foreign cements are good,' says the consumer, 'no matter whether they come from small or large factories, from those thirty years or one week in operation, so long as the cements come from Europe or bear a foreign label. All American cements are bad, on the same principle, even though made by a manufacturer of long experience and provided with the best appliances.'" An American Portland cement manufacturer for his own consolation writes: "If this view really prevails, the American cement-maker can overcome it only by furnishing a faultless product. Meanwhile the German manufacturer may derive advantage from it."

In commenting on the published results of tests of American cements, he says that the figures show that the products tested were far from equalling German cements. This may be true regarding the best brands of cements sold in Germany, but is by no means applicable to the cements sent to this country. The writer has made a great number of tests of English and German cements found in our markets, following closely the German official requirements. In comparatively few cases were the cements found to stand the German Government tests (227 pounds per square inch at twenty-eight days with three parts sand). In the majority of cases the cements fell greatly below the German standard, some of the best known brands giving very poor tests indeed, while several cements of American manufacture complied fully with the German requirements. It appears that much of the cement sent to this country is of inferior quality, and evidences of adulteration of foreign cements with slag are not uncommon. With the prevailing prejudice in this country in favor of foreign cements, and the lack of general acquaintance with correct methods of testing, this state of affairs is not to be wondered at.

A paper on testing cements, by the writer of this report, containing an abstract of the official requirements of various countries, appeared in the Scientific American Supplement, April 21, 1894.

SOAPSTONE.

The amount of soapstone produced in the United States in 1893 was 21,071 short tons, valued at $255,067. In amount this was not materially different from that of 1892, when the product was 23,208 short tons, and considering the tendency to decreased production in 1893, this is a fairly favorable showing. But in the value of the product there was a very notable falling off, decreasing from $423,449 in 1892 to $255,067, a loss of $168,382, or nearly 40 per cent. This loss, however, was not entirely due to a great reduction in prices, though they were considerably depressed, particularly during the latter half of the year. The greater part of the decrease in value was due to a larger amount of the product being sold in its rough state as quarried. In 1892 the amount sold rough was 1,560 tons, whereas in 1893 5,760 tons were sold in that condition.

Following is a statement of the production of soapstone in 1893, showing the amount and value of the different conditions in which it was marketed.

Production of soapstone in 1893.

Condition in which marketed.	Short tons.	Value.
Rough	5,760	$51,600
Sawed into slabs	104	4,400
Manufactured articles (*a*)	7,070	123,600
Ground (*b*)	8,137	75,467
Total (*c*)	21,071	255,067

a Includes bath and laundry tubs; fire brick for stoves, heaters, etc.; hearthstones, mantles, sinks, griddles, slate pencils, and numerous other articles of everyday use.

b For foundry facings, paper-making, lubricators, dressing skins and leather, etc.

c Exclusive of the amount used for pigment, which is included among mineral paints.

In the following table is shown the amount and value of soapstone produced in the United States since 1880:

Annual product of soapstone since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	8,441	$66,665	1887	12,000	$225,000
1881	7,000	75,000	1888	15,000	250,000
1882	6,000	90,000	1889	12,715	231,708
1883	8,000	150,000	1890	13,670	252,309
1884	10,000	200,000	1891	16,514	243,981
1885	10,000	200,000	1892	23,208	423,449
1886	12,000	225,000	1893	21,071	255,067

Soapstone in North Carolina.—The talc or soapstone belt of western North Carolina extends from near Hewitts, along the line of the Murphy branch of the Richmond and Danville railroad to Kinsey and beyond. The talc is almost always overlaid by a capstone of itacolumite or sandstone and underlaid by marble or limestone. The deposits are inclined to be "pockety." One deposit at Valley river, 4 miles from Murphy, is 30 feet wide at one place, but is stained with iron and gritty; that is, intermixed with quartz grains and therefore not utilized. Mr. Titus Ulke, in a recent visit to this neighborhood for the Geological Survey, made the following observations regarding the mine of Mr. F. R. Hewitt, at Hewitts. They may be taken as fairly illustrative of the business in that locality.

The mine is located on a hillside, from which the crude talc is lowered in a chute to a grinding mill having a capacity of from 8 to 10 tons per day of ten and a half hours. Most of the product is ground, but some block and pencil talc cut to order is also shipped. The blocks are usually 6 by 4 by 1 inch in size; the pencil talc is cut to about 4 by $\frac{3}{4}$ by $\frac{1}{4}$ inch sizes. During 1893 the mill was running continuously for about three months only. The pencil and block talc is shipped in cases according to the amounts ordered; the ground talc is packed in sacks of 220 pounds each.

At the mill the crude talc is first passed through a "rumble," i. e., a rotary screen, 6 feet long by 4 feet in diameter, which removes the dirt from the talc, and the dirt thus removed passes through longitudinal slits into a water spout which carries it away. The good talc remaining in the rumble is dumped into a car, from which it is fed into a buhrstone grinding mill. The ground material is then hoisted to the floor above and emptied into a silk bolting cylinder. The bolted talc is caught in a dust-collecting chamber, into which it is drawn by an interposed centrifugal fan. The fine white ground talc is finally sent to an automatic packer and filled into sacks, each holding 220 pounds.

Other occurrences.—Soapstone occurs in almost every State along the Atlantic slope; also in South Dakota, Arizona, and Texas, and along the coast of California. It does not always occur, however, in deposits that can be profitably worked. In addition to North Carolina the States producing soapstone in 1893 were: Georgia, Maryland, New Hampshire, New Jersey, Pennsylvania, Vermont, and Virginia. This does not include the fibrous variety from Saint Lawrence county, New York, which is treated separately.

Fibrous talc.—Gouverneur, Saint Lawrence county, New York, continues to furnish the entire product of the fibrous variety of soapstone. This mineral is used almost exclusively as a filler in the manufacture of medium grades of paper, a small amount being used in making dynamite. The product in 1893 was 35,861 short tons, valued at $403,436, against 41,925 short tons, worth $472,485, in 1892. The year of largest production was in 1891, when an output of 53,925 short tons, valued at

$493,068, was reported. At the beginning of 1893 prospects were bright for a good year's business, and until the first of June the production was about equal to that of the first five months of 1892. After the first of June, however, the demand fell off, and while prices were fairly well maintained, the amount of business for the rest of the year was about 75 per cent. of that of the preceding year.

Annual production of fibrous talc since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	4,210	$54,730	1887	*a* 15,000	$160,000
1881	*a* 7,000	60,000	1888	*a* 20,000	210,000
1882	*a* 6,000	75,000	1889	23,746	244,170
1883	*a* 6,000	75,000	1890	41,354	389,196
1884	*a* 10,000	110,000	1891	53,054	493,068
1885	*a* 10,000	110,000	1892	41,925	472,485
1886	*a* 12,000	125,000	1893	35,861	403,436

a Estimated.

Talc imported into the United States from 1880 to 1893, inclusive.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	....	$22,807	1887	(*a*)	$49,250
1881	....	7,331	1888	24,165	22,446
1882	....	25,641	1889	19,229	30,993
1883	....	14,607	1890	1,044	1,560
1884	....	41,165	1891	81	1,121
1885	....	24,356	1892	531	5,546
1886	....	24,514	1893	1,360	12,825

a Quantity not reported previous to 1888.

ASPHALTUM.(a)

Under this generic name one finds included bituminous rock, sandstones and limestones impregnated with bitumen or asphaltum, free bitumens, either liquid, viscous, or solid, containing little or no mineral matter, and finally mixtures in various proportions, more or less intimate, of bitumens with inorganic matter or with both inorganic and organic matter.

Deposits of asphalt, of all of these varieties, are widely scattered over the United States from the Atlantic to the Pacific, principally south of latitude 40°. They have been noted in Ohio, West Virginia, North Carolina, Georgia, Alabama, Texas, Missouri, Kentucky, Tennessee, Indian Territory, New Mexico, Arizona, Wyoming, Colorado, Utah, Nevada, Idaho, Montana, Washington, California, and Oregon.

The commercial product in 1893 was from three States, California, Utah, and Kentucky, in the order of their importance.

PRODUCTION.

The product of asphaltum and allied bitumens in the United States during 1893 was 47,779 short tons, valued at $372,232. In order to protect confidential returns the product of ozokerite in Utah is included in the output of gilsonite or gum asphaltum, and for the same reason the product of liquid asphaltum or maltha in California is included with the hard. With this arrangement the production by varieties in 1893 was as follows:

Production of asphaltum and allied bitumens in 1893.

Varieties.	Short tons.	Value.
Asphaltum	11,350	$248,250
Bituminous limestone	1,500	15,000
Bituminous sandstone	34,929	108,982
Total	47,779	372,232

Divided by States the product was as follows:

Production of asphaltum, etc., in 1893 by States.

States.	Short tons.	Value.
California	42,650	$275,662
Utah	3,200	90,000
Kentucky	1,929	6,570
Total	47,779	372,232

a The technical portion of this chapter and the matter relating to Trinidad asphaltum, has been prepared by Mr. Clifford Richardson, formerly Inspector of Asphalt and Cements for the District of Columbia. The statistics of domestic production have been compiled and the text relating to properties in the United States has been prepared by E. W. Parker.

In "Mineral Resources" for 1892 the output of bituminous rock in California was given at 24,000 short tons. Later information indicates that this figure was hardly one-third the actual product. The underestimate was due to the fact that one concern operating three mines returned a report for the production of one mine only, and this was taken to be the product of all the mines. In reality the production of bituminous rock in California in 1892 was the largest on record. During that year a spirit of improvement prevailed in San Francisco, Oakland, and several other large cities in the State, resulting in the laying of many thousand square yards of asphalt street pavement and causing an unusual demand for the rock.

The production of asphaltum and bituminous rocks since 1882 is shown in the following table:

Production of asphaltum and bituminous rock since 1882.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1882	3,000	$10,500	1888	50,450	$187,500
1883	3,000	10,500	1889	51,735	171,537
1884	3,000	10,500	1890	40,841	190,416
1885	3,000	10,500	1891	45,054	242,264
1886	3,500	14,000	1892	87,680	445,375
1887	4,000	16,000	1893	47,779	372,232

IMPORTATIONS.

The importations of asphalt into this country include all the different forms of the material, free bitumen, bitumen mixed with earthy and organic matter, and rock asphalts, the two former from the West Indies and the north coast of South America, the last from the continent of Europe.

The table following gives the imports of crude asphaltum since 1867. In addition to the 120,255 short tons of crude imported in 1892, there was some of refined, the amount of which is not stated, but the value is given at $74,042:

Asphaltum imported into the United States from 1867 to 1893.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Short tons.			Short tons.	
June 30, 1867	....	$6,268	June 30, 1881	12,883	$95,410
1868	185	5,632	1882	15,015	102,698
1869	203	10,559	1883	33,116	149,999
1870	488	13,072	1884	36,078	145,571
1871	1,301	14,760	1885	18,407	88,087
1872	1,474	35,533	Dec. 31, 1886	32,565	108,528
1873	2,314	38,298	1887	30,808	95,735
1874	1,183	17,710	1888	36,494	84,045
1875	1,171	26,006	1889	61,952	138,163
1876	807	23,818	1890	73,861	223,368
1877	4,532	36,550	1891	102,433	299,350
1878	5,476	35,932	1892	120,255	336,868
1879	8,084	39,635	1893	74,774	196,314
1880	11,830	87,889			

California asphaltum and bituminous rock.—The principal producer of asphaltum and allied bitumens in the United States is California, and the related industries in that State are gradually increasing in importance from year to year as new deposits are opened and new uses found for the substances. The aborigines of California used asphaltum for making their canoes water-tight and cementing their utensils and weapons, and the Spanish Mission fathers who first civilized the country used it for making floors, walks, roofs, reservoirs, and water conduits. Some of the relics of their ancient works over one hundred years old show the asphalt portion about as perfect as ever. The Mexicans who settled the country after the establishment of the missions also found many uses for the asphalt, and there are still to be seen numerous examples of cisterns, pavements, walks, etc., in a good state of preservation. These utilizations, however, were entirely local and no steps were taken by the Americans for many years after California came into the Union to develop this branch of the mineral industry of the State. Some little asphalt was taken out for roofing purposes at different times, but no bituminous rock was mined until 1868, when at Santa Cruz some was used to cover a wooden block pavement in that town. In 1876 more or less pavement made of this material was laid in the same town, near which are large deposits of the mineral. In the year 1884 some was shipped from Santa Cruz for making pavement at other places in California, and was found to serve the purpose very well indeed. The deposits of bituminous rock in this county have the advantage of both rail and water transportation, and since these first shipments many thousands of tons have followed, until the industry of quarrying or mining bituminous rock has become a very important one.

In 1886 and 1887 some of the similar deposits in San Luis Obispo county were opened and the product shipped. In the latter year 36,000 tons were mined in the county.

The entire product of bituminous rock and asphaltum in California from 1882 to 1885, inclusive, was not over 3,000 tons a year, with a slight increase in 1886, a larger one in 1887, and still larger in 1888. It was in the latter year that the mining of these substances, particularly bituminous rock, became an important industry. Asphaltum, liquid asphaltum, and bituminous rock all came largely into notice in that year, and since then the production has shown a gradual but steady increase. This has been mainly due to the increase in demand for the substances for paving purposes in the cities and towns of the Pacific coast where more permanent pavements than those formerly in use are now being laid. Moreover, it was found that California had within her own borders an abundant supply of everything that is needed for such pavements, and with the increase of demand the supply became abundant, as owners of the deposits found it profitable to open and work them. This naturally led to a reduction in cost of the material. There are very large deposits of this rock in several counties of the State, but the main source of supply continues to be from the counties of Santa Cruz, San Luis Obispo, and Monterey, where both rail and water transportation are available and the deposits extensive and easily worked or quarried.

In addition to the natural deposits of asphalt and bituminous rock, a "liquid asphalt" or natural fluid bitumen is sold for use as a flux to the harder material used in street paving. As is well known, the base of the California petroleums is asphaltic, as distinguished from the paraffin base of the eastern oils, and the process of refining petroleum leaves the asphalt or maltha as a residue.

Several authorities on this subject argue that the use of petroleum residuum oils as a flux is detrimental to the asphalt for paving purposes, but the Trinidad asphalt, the most common and largest in use in the United States and other parts of the world, is always treated with such oils before being used for paving. The claim is made by those opposed to the use of this flux, that the volatile oils of the residuum flux gradually leave the pavement, lessening the percentage of cement, thus rendering the pavement less elastic when contraction occurs in cold weather, which is apt to cause cracking. This deterioration of the cementing factor in the pavement is said to likewise weaken its resistance to wear, and that disintegration occurs because it has not strength to resist abrasion. On the other hand the corporations which use this flux in large quantities have lately had exhaustive examinations made by competent chemists, and the result appears to show that petroleum residuum possesses excellent qualities as a flux, and that the supposition that this flux injures the Trinidad asphalt when used for fluxing purposes is quite erroneous. However this may be, up to within the past few years it has been the only substance available for a flux for asphalt and is largely in use. The discovery in California of a natural liquid bitumen supplies a new flux for the harder asphalts and one that possesses some qualities which recommend its use for this purpose. This natural liquid asphalt is not produced by distillation, but by simple extraction by mechanical means from the clear sea sand which it saturates as it oozes from the immense beds of shale which are its source. It is not heavy petroleum, but liquid asphalt.

It took several years of experimenting to ascertain the proper process for purifying the liquid asphalt or separating it from the sand which contains it. The object of the purifying process is to remove all water and sand. The result is a heavy, viscous asphalt in a semi-liquid state, resembling thick molasses in cold weather. It is semi-liquid, because of its percentage of gummy, elastic, asphaltic oils, which keep it soft.

This peculiar substance is obtained at Las Conchas mine, 13 miles east of the city of Santa Barbara, Santa Barbara county, where there are enormous beds of shale which appear to be saturated with it. A well sunk 400 feet in this material continues to ooze liquid asphalt at all points. The shale itself is not, however, worked to obtain the substance, though that appears to be, and doubtless is, the original source of supply. On top of the shale is an immense bed of sand, which at sometime has been washed clean by the waves of the ocean, for it contains no clay or dirt of any kind. The mine is right on the edge of the ocean, and the sands have evidently come from the beach, though they extend some miles back from and are higher than the present seabeach. Covering the sand deposit is a surface of light earth and soil, upon which is the ordinary vegetation. This soil is "hydraulicked" off by a 12-inch stream of clear salt water, passed through a hydraulic nozzle, such as are in common use in the hydraulic gold mines of the State.

The water supply is provided through a pipe anchored to the rocks and extending about 1,000 feet out into the ocean, large steam pumps being used to lift the water and give it the necessary pressure for the washing operation. The earth is thus washed off into the ocean until the top of the sand deposit is reached, no shoveling or handling of any kind being necessary. The sand itself, being saturated with the liquid asphalt of which the miners are in search, is then put through a patent purifying process and the asphalt removed. The waste sand, deprived of its valuable contents, is then thrown off onto the seabeach.

The theory of its presence in this sand is that the liquid asphalt flows up through the underlying shale and saturates the overlying sand deposit. This saturation of the sand varies greatly. Sometimes there is only 20 per cent. and again it is completely filled with the liquid bitumen.

The fact of a continuous upward flow of this material is proven by the existence of similar beds out under the ocean miles away from the shore. The surface of the sea for many miles along this part of the coast of California is covered with an oily film of this liquid asphalt which constantly rises in many places from the ocean bed. This is the only point of extensive production of natural liquid asphalt in the world, and the material is almost identical with the famous product of the old mine at Bechelbronn, Germany, long since worked out.

After this substance has been subjected to the mechanical treatment of separation and is ready for shipment, it consists of over 98 per cent. bitumen. It may be made in various stages of liquidity, according to the purposes for which it is to be used. It liquifies readily and makes a perfect solvent for the harder asphalts. When melted together the harder, drier asphalts, absorb the flux, making a tough but elastic cement of great adhesive power, unchangeable under normal conditions of service. This material is now used in California for fluxing the harder asphalts, being thought to be superior for the purpose to the petroleum residuum. It is also used for waterproofing the foundations of buildings and as a protection against moisture in cellars. It is first heated and then painted on, adhering tenaciously to damp surfaces.

An analysis of this liquid asphaltum made in January, 1894, by Thomas Price & Son, of San Francisco, is as follows:

Analysis of liquid asphaltum from Santa Barbara county, California.

	Per cent.
Total bitumen, soluble in bisulphide of carbon	98.26
Organic matter not bituminous	Trace.
Mineral matter (consisting of finely divided and angular quartz, with small quantities of oxide of iron and alumina)	1.74
Bitumen, soluble in petroleum naphtha (petrolene)	92.50
Per cent. total bitumen soluble in petroleum naphtha	94.13
Asphaltene	3.52
Specific gravity	1.050

The substance flashes at 280° F. and burns at 398°.

The California Petroleum and Asphalt Company, which owns and works this peculiar deposit of liquid asphalt, is also operating the most extensive deposit of rock asphalt in the State. This is at La Patera, 12 miles west of Santa Barbara, and, like the other mine, immediately at the seaside, with facilities for both water and rail transportation. There are several hundred acres of the deposit as far as known, and the material is mined much in the same manner as coal. Here, as in the other mine described, the product appears to be continually, but slowly coming up from below. In the drifts of the mine where they are in solid material at a depth of 125 feet, they have to keep cutting it off from the floor as it gradually swells up. Records kept in one drift show that in one year of the operations they cut off 52 feet from the floor of the drift as the asphalt pushed in and upward. It is not, however, soft, but is friable and breaks readily under the pick or wedge and comes out not unlike cannel coal.

Ledges or deposits of this substance extend far out under the sea and analyses show it to be the same as that half a mile inland and from the surface to 125 feet underground, which is as deep as the present workings extend.

This natural rock asphalt contains an average of 60 per cent. bitumen as it is mined, the residue being fine silica, free from clay and organic matter. In its natural state it contains as much bitumen as refined Trinidad asphalt.

An analysis of the natural substance made by Thomas Price & Son, San Francisco, shows the following:

Analysis of natural rock asphaltum from Santa Barbara county, California.

	Per cent.
Total bitumen soluble in carbon bisulphide	59.15
Organic matter not bituminous	1.10
Mineral matter (consisting of finely divided and angular quartz, with small quantities of oxide of iron and alumina)	39.75
Bitumen soluble in petroleum naphtha (petrolene)	42.50
Per cent. bitumen soluble in petroleum naphtha	71.85
Asphaltene	7.35
Specific gravity	1.250

At 70° F. this material is hard and brittle; at 105° it commences to soften; at 131° it is tough and elastic; at 140° is soft but very elastic; at 203° it is soft but still tough and elastic; and at 248° it melts but retains its elasticity.

The paving cement sold under the trade name of "Alcatraz" is prepared by combining the two materials—the natural rock asphalt and the natural liquid asphalt from the two mines owned by the same company. The combination is made at a very low indirect heat by mechanical apparatus requiring about three hours' time and which precludes the possibility of injury. This material can be varied in percentage of bitumen and degree of softness or purity to suit any requirement. The paving cement thus made may be mixed with sand or limestone for street paving; its consistency and elasticity being such that a very high percentage of inert matter—such as sand—can be mixed with it and the mixture still possess toughness and elasticity. Prepared as a cement for paving it may be shipped any distance to the point of use and there reduced with sand or limestone, the useful substance being really in a concentrated form. Many streets have been paved with this material in many cities, among them San Francisco, Santa Barbara, Pasadena, and other California towns, and in Denver, Colorado; Omaha, Nebraska; Seattle, Washington, etc.

The paving cement formed by the admixture mentioned shows: Total bitumen soluble in bisulphide of carbon, 84.65 per cent.; bitumen soluble in petroleum naphtha—petrolene, 61.56 per cent.; total bitumen soluble in petroleum naphtha, 72.48 per cent.

By combining these two natural substances in various proportions they make not only cements for paving purposes but for lining reservoirs, coating iron pipe, lining canals and ditches for electrical insulation, etc. Asphaltum gums are also refined for paint and varnish manufacturers.

The asphaltum and oil fields of Kern county, though known for many years, have only of late come into more prominent notice. As far back as 1866 the Buena Vista Petroleum Company put up works and sunk a few wells. They came across alternate layers of shale, sandstone, and asphaltum within a range of the first 30 feet. Open cuts were made, and other shallow beds of asphaltum were met with. The residuum of their small refining operations was soft asphaltum, but many difficulties were met with and work was finally abandoned for a time. Freight rates were excessive, and it was impossible to market the products. More or less prospecting has been done in this district at different times, and when, a few years ago, attention was again drawn to the value of the oil and asphalt in California, operations were resumed in various parts of the extensive oil-bearing tract. Many surface deposits of asphaltum were found and some of them opened to a greater or less extent. The building of a branch railroad to Asphalto, the center of the principal field of the district, stimulated operations on these deposits. The principal company is known as the Standard Asphalt Company of California, which commenced operations on deposits at Asphalto and Hazleton, the latter in Sunset district. These were surface deposits of great natural purity, but they are not now being worked, the cost of production being too high. The method of refining was found to be rather expensive. The surface material was only about 30 to 40 per cent. asphalt, and to get rid of the clay was so costly an operation that work on these surface deposits was finally given up by the company. Quite a large refinery was built and considerable capital invested in lands and plant. Quite recently, however, the company has discovered a ledge or vein of very pure asphalt, which is being opened and developed. The analysis of the material mined from this ledge, made by Thomas Price & Son, is as follows:

Analysis of asphaltum from Kern County, California.

	Per cent.
Bitumen soluble in carbon bisulphide	78.90
Mineral substances—sand, clay, and mica	9.40
Cokey and volatile matter	4.53
Water and loss	7.17

This percentage of bitumen is exceptionally high—higher, in fact, than in any heretofore found in California.

The vein or ledge being worked runs in a direction parallel with the mountain range. An outcrop of soft-brown rock, similar in appearance to that covering the part of the vein now being worked, can, it is said, be traced 5 or 6 miles. Where opened, the vein is narrow at the top and is wider in the lower part of the shafts. In some places it is 3 feet in width, and there are records of widths of 15 feet. The vein appears to be quite clearly and distinctly defined, as far as present operations show, though it has not yet been opened in many places. It has been sunk upon for 90 feet and opened by drift from 150 to 200 feet. It is worked much like a quartz vein, and little, if any, timbering is required. No blasting is necessary, as the material is quite readily mined out.

The asphalt as mined is quite hard, and "maltha," or heavy petroleum oil, is used as a flux for softening it for paving purposes. The material is shipped either crude in bulk in carload lots, or refined put up in light wooden boxes holding about 100 pounds each. The refined asphalt contains about 90 per cent. bitumen. At the refining works the material from the mine is refined by heating and driving off the water and volatile matter and settling some of the dross. The crude asphalt is worth, free on board, at Asphalto $15 per ton and the refined $22 per ton. Freight rates from Asphalto to San Francisco are $4 per ton for carload lots. To Missouri river points the rate is $11 per ton; to the Mississippi and common points $13. The ocean rate from San Francisco to New York is about $6 to $7 per ton.

Although this is the principal company operating at Asphalto it can not be said that there is any large commercial product as yet, the whole output for the past two years having been only about 2,000 tons, and much of that from the surface deposits not now worked. The work thus far has been exploratory and experimental. Some of the asphalt from the ledge has been used for paving in the interior towns of California. The asphalt from the original surface deposits was used to some extent in streets in Denver, Colorado; Sedalia, Missouri, and Chicago, Illinois. The company now, however, having about completed its explorations and experiments, expects to go into the business of asphalt production on a large scale. It has control of the main ledge of the district. In fact practically what asphalt is being worked at Asphalto and the Sunset field is in the hands of this company. The others at work there are mainly engaged in operations with petroleum.

If the experience of this company is any criterion, the future prospects of asphaltum in the Asphalto district of Kern county on the surface deposits are not as bright as first expectations led people to suppose. Outside of this one "ledge," as far as known at present, all the deposits are superficial, such as the Standard company first opened. With these they could make no commercial success on account of the cost of treatment. Several individuals and small companies are, however, in possession of such deposits, though little, if any, production had been made by them during the past year.

The bituminous rock of California is quite a distinct substance from the asphalts thus far spoken of. Bituminous rock is a natural mixture of asphaltic oil and sand, found in large quantities and extensive deposits in California in all degrees of richness and consistency. The various deposits show all grades of sand, from the finest to coarse gravel, and frequently with large percentages of loam, with all gravities of oil from light to heavy. It is prepared for street pavement by merely softening by heat sufficiently to spread and roll upon the street; with a material of good clean sand and a heavy oil very good results, indeed, in street paving are reached and it has come into extensive use in California in all the larger cities and towns. The production of bituminous rock in California has reached as high as 75,000 tons in a year, but the average may be said to be now between 30,000 and 40,000 tons a year, depending, however, more upon the demand than upon the resources of the mines themselves. Such is the general nature of the deposits now being worked that the supply can readily be increased as desired.

The value of bituminous rock at Santa Cruz, Santa Cruz county, the source of the largest portion of the supply, is $3.50 per ton; at San Luis Obispo, in the county of the same name, it is worth $2.25 to $3; at Kings City, Monterey county, it is $3 per ton. The standard price in San Francisco in 1893 was $6 per ton. In 1894 the standard price commenced at about $4.75 per ton. During 1893 the supply was reduced from that of the previous year by reason of the lack of demand due to the generally depressed condition of business, there being less required for street-paving purposes.

Utah.—Including ozokerite and asphaltic limestone the production in Utah in 1893 amounted to 3,200 short tons, worth $90,000 at the mines. In the production of gilsonite or gum asphaltum the operators labor under the disadvantage of having to haul the product from 60 to 90 miles in wagons to railroad transportation. Owing to the very pure nature of the gilsonite, there is a good demand for it even at the great cost occasioned by heavy transportation expenses. The market for asphaltic limestone, owing to the cost of railroad transportation, is necessarily restricted to inland cities. It is used in Denver, Salt Lake City, and other western cities for street paving, but is shut out of the market in the eastern and southern cities by the lower cost of Trinidad asphaltum and from the Pacific coast by the bituminous sandstones of California. The Utah gilsonite is used in the manufacture of black Japan, and other varnishes, and insulating compounds of various kinds. Some of the ways in which gilsonite is employed are:

For preventing electrolytic action on iron plates of ship bottoms.

For coating barbed wire fencing, etc.

For coating sea walls of brick or masonry.

For covering paving brick.

For acid-proof lining for chemical tanks.

For roofing pitch.

For insulating electric wires.

For smokestack paint.

For lubricants for heavy machinery.

For preserving iron pipes from corrosion and acids.

For coating poles, posts, and ties.

For teredo-proof pile coating.

For covering wood-block paving.

As a substitute for rubber in the manufacture of cotton garden hose.

As a binder pitch for culm in making brickette and eggette coal.

As an insulator gilsonite is unsurpassed. Mr. H. L. A. Culmer, secretary of the Wasatch Asphaltum Company, states that an electric current of 12,000 volts has been tried on a covering of one-eighth inch thickness, with perfect insulation. It is difficult, in fact practically impossible, to form any accurate estimate of the amount of asphaltum which goes into the various manufactured articles. The producers dispose of their product to manufacturers and are unable to furnish any more detailed information.

Kentucky.—The entire product from Kentucky is bituminous rock, a sandstone impregnated with bitumen and is used exclusively for street paving. The output in 1893 was 1,929 short tons, valued at $6,570.

Texas.—The owners of the extensive deposit of litho-carbon in Uvalde county had not commenced active mining at the close of 1893. They were engaged, however, in putting in the necessary machinery for developing the property and expect before the close of the current year to be mining about 60 or 70 tons daily. The mineral here found is a bituminous limestone, the limestone being in the nature of shells, the original forms of which are still maintained. The rock contains from 15 to 33 per cent. of bitumen, the average being about 20 per cent. The refined product is said to possess peculiar properties, the most important of which is elasticity, making it in this respect somewhat of the character of elaterite.

COMMERCIAL APPLICATIONS.

The commercial applications of asphalt in this country are for roadways, walks, roofs, and floors, in the form of compressed asphalt and mastic, varnish, and paints, waterproofing compositions, roofing felts, insulators, bituminous masonry and concrete. By far the larger portion of the supply is imported, mostly from Trinidad and is used for the purposes first named and especially for roadways.

It is not possible, with the facilities afforded in the preparation of this report, to ascertain the amount of asphaltum, either domestic or imported, which goes into the various manufactured articles. Compared with the amount used for street paving, the quantity made into varnishes, insulators, etc., is small, but nevertheless the industries are important ones and the value of the different products reaches a very high figure.

Asphalt varnish.—Asphalt varnish is generally made from those varieties which are free from any notable amount of mineral matter, such as glance pitch and gilsonite. It is a combination of asphalt, turpentine, and boiled linseed oil, combined in such proportions or with such additions as each manufacturer has learned to be desirable and which he retains as a trade secret; three of asphalt to four of boiled oil, with fifteen to eighteen parts of turpentine is a common formula.

Asphalt felt and roofing.—For the production of asphalt felt and roofing Trinidad pitch is in general use. It is refined and mixed with that portion of the residuum of the refining of petroleum known as wax tailings. Felt is saturated with this material by machinery, and a similar varnish or paint is supplied for subsequent application after the felt is in place.

Asphalt felt possesses an advantage over coal-tar felt in that it does not become brittle with age or through the action of heat.

Chemical constitution.—Asphalt in its appearance and chemical composition varies very much according to the different localities where it originates. It is a mineral pitch, amorphous, of very varying consistency, most of it readily affected by changes in temperature, lustrous when pure, melts at about the temperature of boiling water, evolving a characteristic odor, burns with a sooty, smoky flame, and is soluble in carbon bisulphide, and more or less in turpentine, petroleum naphtha, ether, benzol, alcohol, etc. It has a somewhat conchoidal fracture and usually presents all the characteristics of viscous flow in a very perfect and interesting way. Chemically it consists of hydrocarbons, in regard to which there is nothing absolute known. In Trinidad asphalt there are mixtures of paraffins and olefines, with a very small proportion of oxygenated compounds, in most of the latter the oxygen having been replaced by sulphur. Many of them are easily changed and polymerized by heat or more slowly by time. An examination of Trinidad pitch extending over several years in the laboratory of the Engineer Department of the District of Columbia has furnished a fair understanding of the nature of this asphalt, as well as some knowledge of several other deposits. The results of these investigations are to be found in the reports of the Inspector of Asphalt and Cements of the Engineer Department, District of Columbia.

ORIGIN AND HISTORY OF THE PAVING INDUSTRY.

Although the application of asphalt to industrial purposes on a small scale dates back to the earliest times, it is only with the introduction of rock asphalt pavements into Paris about thirty-five years ago that the asphalt-paving industry can be said to have originated.

In 1838 the first sidewalks were laid in Paris with bituminous limestone from Seyssel and Val de Travers. In 1849 Mereau, a Swiss engineer, noticed that at the quarries, pieces of the rock which fell from the carts were united under the influence of heat and traffic, so as to form a concrete mass, and on this principle he constructed a road in the village of Travers upon a macadam base. M. Darcey, inspector-general of bridges and roads in Paris in 1850, made a report recommending the use of compressed asphalt, and after some experiments a pavement of this material was laid in the Rue Bergere in 1854. In 1858 another trial was made on a larger scale in the Rue St. Honoré, and from that time on the Parisian asphalt pavements were laid. In London the first asphalt was laid in Threadneedle street in 1869. In Paris there are about 370,000 yards of asphalt pavement, and in London about 350,000. But the amount has not increased of late years, owing to the slipperiness of this form of asphalt surface. In Berlin the first asphalt pavements were laid about 1873 or 1874, and since then very large amounts have been put down, reaching about 1,221,000 square yards. Pavements of this description have never been popular however, in America.

The success of asphalt pavements in Europe led to much experimenting in this country, and at first coal tar was used as a cementing material. Between 1870 and 1873 a large area of such pavements were laid in Washington, a majority of which proved worthless, and grave suspicion was thrown upon coal tar as a cementing material. In

1870 De Smedt began experimenting with Trinidad asphalt with a view to overcoming the defects of coal tar and laid a sample pavement in Newark. He took out a patent for his invention. In 1871 or 1872 he laid an asphalt pavement around Battery Park, New York, and in 1873 one on Fifth avenue in front of the Worth monument, which remained in use, with one or two resurfacings, until 1886. At about the same time Trinidad asphalt was laid in Philadelphia, on Sixth street, in front of Independence Hall. In 1874 or 1875 Eighteenth street was paved with Trinidad asphalt between Fourth avenue and Irving Place, as were several other New York streets. The pavements were successful and attracted much attention. In 1876 Congress passed an act providing for the paving of Pennsylvania avenue in Washington, under a commission composed of Gen. H. G. Wright, Gen. Q. A. Gilmore, and Architect Edward Clark of the Capitol, with no restrictions as to price or kind of pavement. The two former gentlemen, of the Corps of Engineers, U. S. Army, had been stationed in New York and had noted the success of the asphalt surfaces. The board therefore decided to lay compressed asphalt, and divided the work in two parts, using rock asphalt from the Capitol to Sixth street and Trinidad asphalt for the remainder.

The rock was imported from the Val de Travers mines and the work done by the New York Neufchatel Asphalt Company, of which Matthew Taylor was president. The contractor for the Trinidad surface was the New York and Grahamite Asphalt Company, with which De Smedt was connected.

The rock asphalt pavement was condemned as being "too slippery for practical use," and no more of it has been laid in Washington.

The Trinidad asphalt was a success and was so satisfactory that when the permanent Board of Commissioners was organized in 1878 they decided to limit the pavement of streets to Trinidad asphalt, except where grade or traffic were prohibitory. There are now 1,767,242 yards of asphalt surface in the city.

At that time Mr. A. L. Barber entered the business of laying asphalt pavements, meeting for the first few years a keen competition, which made it unprofitable and forced most of those engaged to retire. Mr. Barber, however, persevered, and by harmonizing and uniting the interests and increasing prices brought it to a paying basis and introduced this form of pavement to the other large cities. In 1882 he laid a pavement in Buffalo, New York, which is still in fair condition. He also laid pavements in Omaha, Nebraska, and Youngstown, Ohio.

In the year 1883 the Barber Asphalt Paving Company was incorporated, and in that year pavements were laid in Washington, Baltimore, Philadelphia, Boston, Buffalo, Erie, Omaha, Saint Louis, and Louisville.

Since that time the asphalt-paving industry has gradually expanded until this company alone has laid about 6,000,000 yards of surface in thirty-three cities, and during the past year (1893) laid 1,019,964 square yards.

Other companies, most notably the Warren-Scharf Asphalt Paving Company, were organized after the Barber Asphalt Paving Company, and have constructed considerable asphalt surface in various cities, so that the entire number of square yards in this country at the close of 1893 was 14,670,286, with an aggregate length of 962 miles.

Intimately connected with the history of the development of the asphalt-paving industry is that of the source of supply of the crude asphalt.

Trinidad asphalt.—The island of Trinidad lies off the coast of Venezuela, near the mouth of the Orinoco. Two promontories extending toward the mainland nearly inclose a body of water called the Gulf of Paria, on the shore of which, being the west coast of the island, lies the deposit of pitch which has supplied the asphalt for our pavements. In the crater of an old mud volcano, 138 feet above sea level and about a mile and a half from the water, lies the pitch lake, so called, a nearly circular mass of pitch of an area of a little more than 114 acres and of uncertain depth. Soft pitch still wells up at the center of the lake, but it soon becomes hard, and over nearly the entire surface one can walk with ease, except where interrupted by deep pools of water which lie between the mushroom like masses of pitch into which the lake is divided.

In past times it appears that the continued welling up of pitch at the center of the lake filled the crater and caused it to overflow toward the sea, especially on a line toward the village of La Brea in an easterly and northerly direction. This pitch mingled with the soil, and, together with other deposits of similar nature, but different origin, forms another source of supply, and in commerce we thus meet two varieties called "lake pitch" and "land pitch" or overflow asphalt. In the early days of the industry the pitch lake was leased by the Crown, Trinidad being a Crown colony of Great Britain, in 5-acre lots under certain regulations for fourteen years to the highest bidder, one lot being reserved for the colonial government. The leases were held by diverse interests in Trinidad, London, and New York, and competition was extremely keen between the holders. Mr. Barber, with a view to increasing the trade instead of ruining it from the producer's standpoint, as seemed then probable, brought about a unification of interest between the principal shippers. This succeeded very well until, in 1885, the government announced its intention of entering the market with the pitch from its reserve lot. The lessees of the other lots claimed that the government had only the right to employ the asphalt for its own use and not to sell it, but the case was decided against them. At this time, however, several persons interested in the industry proposed to the colonial government to lease the entire pitch lake for a long term of years on a guaranteed minimum payment which would yield more revenue to the colony in one year than it had previously received in fifteen. After considerable negotiation the proposition was accepted, and a concession issued from February 1, 1888. The original concessionaires then sold their rights under the concession to the Trinidad Asphalt Company, a corporation organized under the laws of the State of New Jersey, and this company proceeded to purchase all the available land about the lake so that they should control the deposits of land pitch, and this they were able to do with the exception of some few small lots in the village of La Brea. The Crown at the same time by the terms of the concession agreed not to allow the removal of any pitch from crown lands.

The source of supply being thus assured and protected from disastrous competition, and the industry developing rapidly in consequence in the United States, the exports of pitch from Trinidad increased. In 1891 the terms of the concession were slightly modified, and the original term of twenty-one years was extended for a possible additional period of the same length.

Following is a statement of the exports of asphalt from Trinidad up to 1886, most of which apparently came from the pitch lake, according to the harbor masters' reports:

Exports of asphaltum from Trinidad from 1867 to 1886.

Years.	To America.	To Europe.	Total.
	Tons.	*Tons.*	*Tons.*
1867	700	3,027	3,727
1868	200	1,325	1,525
1869	....	5,297	5,297
1870	2,953	5,857	8,810
1871	828	3,222	4,050
1872	2,144	9,854	11,998
1873	746	6,913	7,659
1874	711	9,204	9,915
1875	1,100	13,632	14,732
1876	3,979	11,715	15,694
1877	1,441	11,576	13,017
1878	5,860	9,926	15,786
1879	9,078	13,633	22,711
1880	7,178	15,614	22,792
1881	8,525	17,753	26,276
1882	15,075	14,878	29,953
1883	24,781	15,025	39,806
1884	19,685	17,913	37,598
1885	15,704	19,040	34,744
1886	25,835	11,298	37,133
Total	146,521	216,702	363,223

Since 1886 the amounts of lake or land pitch have been separated. From the lake were exported:

Exports of lake asphaltum from Trinidad since 1887.

Years.	To America.	To Europe.	Total.
	Tons.	*Tons.*	*Tons.*
1887	22,099	21,277	43,376
1888	27,902	17,386	45,288
1889	40,666	23,472	64,138
1890	40,692	28,685	69,377
1891	50,594	23,010	73,604
1892	70,744	25,575	96,319
1893	65,420	*a*23,461	88,881
Prior to 1887	146,521	216,702	363,223
Total	464,638	379,568	844,206

a Includes 1,076 tons exported to Australia.

In the first table the records are of amounts shipped from Trinidad during the year named, one ton of *épurée*, or refined asphalt being counted the same as a ton of crude. In the second table the figures are those of amounts landed in the countries named, and one ton of *épurée* is counted as a ton and a half of crude.

These figures show how enormously the consumption of Trinidad pitch has increased, and especially since the business was put upon a firm foundation at the time of granting the concession. As, however, the concession limited the supply and right of shipping pitch to the concessionaires, it was natural that those outside should look for some means of competition. Their only resource lay in the deposits of land pitch on private lands which had not been acquired by the Trinidad Asphalt Company or by poaching on Crown land or from land of other parties.

Early in the shipment of asphalt to this country for pavements there was probably a certain amount taken from the Point d'Or estate, but digging from the lake was so much easier that the land deposits were scarcely a commercial factor until the lake was monopolized. The first excavation for land pitch in the village of La Brea was begun in 1886 by Messrs Turnbull, Stewart & Co. on land of the Countess Dundonald, very near the sea. They followed this up with work upon various other lots, the nearest being about 3,000 feet from the pitch lake. Others soon began shipments, and a great increase in the amount of village pitch dug took place. Encroachment on Crown land and upon property to which fictitious titles had been passed enlarged the field of operation, and the courts of Trinidad, which, on subsequent inquiry, were pronounced unjudicial in their method, failing to put a stop to this, considerable land pitch was brought to the United States, not, however, exceeding 70,000 tons.

In July, 1889, a cargo of land pitch was discharged in Washington, which was condemned as not suitable for paving purposes, as it did not compare favorably with that from the lake. The grounds of this condemnation were that it contained cokey matter and chocolate and iron pitch, which are of no cementitious value, and that the bitumen of even the better portion was decidedly inferior to that of the lake asphalt, having a higher softening point, less of the lighter oils, and requiring a larger proportion of petroleum oil to produce a cement of the proper consistency.

With the short amount of experience in the scientific examination of asphalt as a cement, extending at that time over less than three years, some suspicion had been previously cast on land pitch, but so little was known in this country as to the true relation of the lake and land deposits that it was not until the very inferior and plainly indifferent quality of the cargo of the *Teneriffe* revealed the difficulty that the subject began to be thoroughly investigated.

The shippers of the land pitch were naturally indignant and assured the authorities that there was no difference between the asphalt from the *Teneriffe* and from previous cargoes and, although the examinations and demonstrations in the laboratory convinced the engineer department of the District of Columbia that there was such a difference, the cargo of the *Teneriffe* was finally accepted, owing to an uncertainty in regard to the specifications, but with a provision that no more of this asphalt should be brought to Washington, and since that time none has been used there. Those interested in land pitch continued, however, to ship it to this country, and companies were formed for laying pavements with it. The struggle for the maintenance of the equality of the lake and land pitch was very active in 1890, 1891, and 1892, but with the failure of streets in Denver and New York, laid with land pitch, and with the reorganization of the courts in Trinidad, by which the terms of the concession were enforced, thus narrowing down the available supply, the question has ceased to be so important. Conclusive chemical and physical evidence was obtained by careful examination of the deposits in the field and laboratory, and during the past year no land pitch has been shipped to this country for paving purposes.

The Trinidad Asphalt Company, that is to say the concessionaires, ships large amounts of lake pitch to this country and after refining it supply such companies or persons as are believed to be sufficiently experienced to lay asphalt pavements which shall not be a discredit or prove injurious to the reputation of the industry. From its origin until 1887 the asphalt paving industry was conducted in a purely empyrical manner, but from that time to the present several chemists have made a special study of asphalt and its application and the improvements which have resulted are shown on later pages where the technology of the industry is described. It can certainly be said to be carried on, at least by the best companies, in as rational a manner and with as thorough an understanding of methods of control as many other industries. There yet remains, however, much to learn, as, for example, the adapting of the surface mixture to variation in traffic, climate, and other changeable conditions.

TECHNOLOGY OF ROCK ASPHALT.

The principal mines of asphalt rock are at Seyssel, Department de l'Arn, France; Val de Travers, Neufchatel, Switzerland; Ragusa in Sicily, and in Germany at Vorwohle and Limmer.

Following is the composition of several of these rocks: (*a*)

Analyses of various crude asphalts.

	Sicilian.	Vorwohle.	Seyssel.	Val de Travers Neufchatel.
Bitumen	9.72	5.37	9.10	7.20
Volatile at 100° C	.54	.34	.40	....
Carbonate of lime	88.75	90.80	90.35	....
Iron and alumina	.23	.59	.05	....
Silica and insoluble	.53	2.55	.10	....

a The first two analyses are of rock submitted by the Sicilian Asphalt Paving Company of New York, the others are from scattered literature.

The mere relation of bitumen to carbonate of lime may prove misleading as much depends on the character of the asphalt and of the limestone, whether gritty or soft and spongy. The granular varieties are the best, while it is also very important that the bitumen should not contain much oil volatile at temperatures below 400° F.

The nature of the bitumen may be learned by heating the powdered rock to 400° F. for several hours and noting the loss, and on removing it with solvents, especially carbon disulphide, the character of the limestone is revealed.

A bituminous limestone to be suitable for paving purposes should be as coarse-grained as possible, should contain between 9 and 10 per cent. of bitumen soluble in carbon disulphide, and should volatilize very little at 400° F.

The best rock asphalt is said to come from the Seyssel mines, and these will serve as an illustration of how the material is obtained and prepared for use.

There are eight strata of bituminous rock at these mines separated by beds of ordinary white limestone. One of the strata, about 100 feet above the level of the Rhone, is 23 feet thick. Galleries are driven through this, reaching more than 7 miles in length, it being the largest known bed of asphaltic limestone.

The rock, as it comes from the mines at a temperature of from 53° to 55° F., is carried by rail to the crushing plant, care being taken not to expose it to sun or rain and not to pile it up so that crushing and loss will ensue. The heat of the sun even in winter warms the rocks too much for good results in the crushers, and the absorption of rainwater makes it difficult to work.

The blocks of rock are crushed to egg size by rollers revolving at different speed and provided with teeth. These pieces are reduced to powder in Carré disintegrators and this sifted to uniform fineness, and is then ready for application to paving purposes.

Bituminous limestone pavements are laid upon a hydraulic cement base from 15 to 20 centimeters thick, in this country usually 6 inches, the base being quite the same as with Trinidad surface.

The powdered limestone is dropped through a hopper into a revolving cylinder like a coffee roaster about 6½ feet in diameter and which is surrounded by a chamber the air of which is heated by a movable furnace placed just below the cylinder. The cylinder itself revolves and being provided with blocks arranged in screw form, the powdered rock is well mixed with the hot air and thus thoroughly heated to a temperature of about 300° but not higher than 350° F. The capacity of the heaters is quite large, working nearly 2 tons every fifteen to twenty minutes. When the powder is warm enough the furnace is removed from under the heater and a cart replaces it into which the asphalt powder is discharged and hauled upon the work. It will retain its heat for several hours and so admits of being carted while hot a long distance, doing away with the necessity of having roasters at the point where the surface is to be laid, as was at one time the practice.

The heated powder is spread upon the base with shovels and raked with hot rakes to a uniform thickness about 40 per cent. greater than that required in the finished pavement. This must be done with great care in order that the material, which while hot has a great tendency to self-compaction, may not be denser in one spot than another.

The joints and edges are first compacted and united with hot irons made for this purpose, after which the whole surface, while still hot, is rammed with round ramming irons, 6 to 8 inches in diameter and 50 pounds in weight, in the hands of a number of men. It is thus prepared for rolling, which is done with iron rollers heated by an internal basket of burning coke or coal and varying in weight from 800 to 1,800 pounds. This is continued in different directions until a solid surface is obtained. If any elevations or depressions are noticed the former are tamped out with irons and the latter removed by filling in with some hot powder.

The surface of the street is then smoothed and polished to make it pleasing to the eye and to close up the pores upon the surface by softening the bitumen.

The asphalt cools in a few hours and the street can soon be thrown open to traffic. For from eight to fourteen days the appearance is more or less unsightly, but traffic soon gives the street its customary appearance and gray color, instead of the original brown.

Considerable compression is also found to be brought about by traffic.

MASTIC.

Another form of asphalt pavement, known on the continent as *asphalte coulé* in distinction from the preceding called *asphalte comprimé*, is known here as mastic. It has been chiefly used for sidewalks, of which in Paris there are about 5,000,000 square yards. The rock after having been powdered as for the previously-described process is put in round kettles in which about 8 per cent. of its weight of refined Trinidad asphalt has been melted. It is thoroughly mixed with this at about 280° F. for five hours and is then run into molds where it is formed into square or hexagonal blocks of about 50 pounds weight, bearing the name of the source of the rock. From these, which are supplied to the trade for the purpose, the mastic surface is prepared as follows:

The cakes are broken up to a small size and reheated with the addition of bitumen, composed of Trinidad refined asphalt, oiled with petroleum or with heavy coal-tar oil. This addition is necessary to make the asphalt rock melt which it would not otherwise do. The mass is constantly stirred and when soft a certain proportion of sand and fine gravel are added and the mixture cooked with stirring for about two hours, at a temperature of 300° F. and over. Great care must be exercised in this operation to avoid burning and to obtain a thorough mixture in the right proportions which are:

Composition of mastic pavement.

	Pounds.
Mastic	60
Bitumen	4 to 8
Fine gravel and sand	36 to 32

From the kettle the hot mastic is carried to the base in buckets, and being of a consistency to flow slowly, is poured out upon the foundation. It is spread to the desired thickness, five-eighths of an inch for sidewalks, with a wooden trowel, smoothed with wooden floats, and rubbed down with rather coarse quartz sand. When cool, it is ready for use.

THE ASPHALT-BLOCK PAVING INDUSTRY.

The manufacture of paving blocks from crushed stone and Trinidad asphalt was begun in San Francisco in 1869. The appliances in use were of the crudest description, including hand molds, in which the poorly-prepared mixture was placed and compressed by hand, the quality of the resulting block of course being inferior and the quantity too insignificant to meet any large demand. They served only to attract attention to the subject and considerable capital was sunk in the business, especially between 1876 and 1881, when a large number of plants were put in operation all over the country which were not successful.

In 1881 the International Pavement Company was organized and the business put upon a better basis, but it is only within recent years that blocks have been made on rational principles and in a manner to compare with sheet surface. The first blocks were laid in Washington in 1878 and these were replaced in 1888. Now there are 288,226 square yards in that city, and much more in Baltimore and Philadelphia.

Factories are in operation in Hastings, New York; Camden, New Jersey; Philadelphia, Norristown, and New Castle, Pennsylvania; Baltimore, Maryland; Washington, District of Columbia; Fort Payne, Alabama; City of Mexico, Mexico, and Sydney, New South Wales.

Over 250,000 square yards of blocks were laid in the years 1892–'93, and over a 1,000,000 yards are now in use.

TECHNOLOGY OF THE ASPHALT-BLOCK INDUSTRY.

The method of manufacturing asphalt paving blocks now in vogue consists of crushing trap or other hard rock in any of the ordinary forms of crusher, then passing it through rolls in a mill such as is used for crushing ore until it will all pass through a sieve of one-quarter-inch mesh, and about one-third of it is reduced to powder. To this is added 10 per cent. of powdered limestone, which is produced by crushing limestone in a special crusher provided for this purpose, and grinding the crushed material in an emery mill so that all of it will pass a fifty-mesh sieve and 75 per cent. a hundred-mesh sieve.

The mixture, made in the proper proportions, is carried by conveyors to a heating drum, where, while being slowly rotated, it is heated to about 300° F.

A weighed portion of the hot aggregate is then mixed with 13 per cent. of asphalt cement prepared from Trinidad lake asphalt in exactly the same manner as that for use in sheet surface, except that the consistency is much harder, the penetration being about 40 degrees as compared with 70 degrees for the sheet surface cement.

The mixing is done in a double-bladed pug mill quite like those mentioned in connection with the sheet surface plants. The hot mixture is dropped into a hopper from which it is supplied to the mold of the press. The press subjects the mixture to a pressure of 130 tons on the 4 and 12 inch face of the block, or about 5,400 pounds to the square inch, the resulting block being solid and homogeneous 4 by 12 by 5 inches in dimensions, and weighing about 23.5 to 24 pounds as now made, according to the rock in use.

The press delivers them upon a conveyor, which carries them immediately under water to cool them, whence, after traveling 60 feet, they are removed in a condition for stacking.

A suitable plant, consisting of boilers, engines, crushers, rolls, stone heater, mixer, press and carrier, refining and melting tanks, elevators, shafting, and all necessary appliances, weighing in all about 100 tons, will cost, with suitable building, from $35,000 to $40,000, according to locality. This would be known as a single-press plant. The largest plant hitherto erected is a double-press plant at Camden, New Jersey, which, with substantial brick building, cost $90,000. One at Newcastle, Pennsylvania, cost $80,000, and one in the City of Mexico, including a large lot of land, $180,000 in Mexican silver.

Owing to the depth and weight of each asphalt block no hydraulic concrete foundation is usually required. Gravel to the depth of 4 inches and sharp paving sand to the depth of 3 inches afford a thoroughly reliable foundation when properly laid. This pavement also possesses the advantage that it can be taken up and replaced without great expense, and if the work is carefully done it will be practically as good as ever.

The great weight of the blocks forbids transportation to any distance, so that the establishment of a plant at the locality where they are to be laid seems to be essential to economy.

THE TECHNOLOGY OF TRINIDAD ASPHALT PAVEMENTS.

The crude pitch is shipped from La Brea in Trinidad in both sailing vessels and steamers. The latter to New York and the former to Philadelphia and Washington, where large refineries are situated. Several other refineries have handled land pitch in past years; but with the decline in the demand for this form of pitch and stoppage of its export to this country they now do little, and refining is confined to that of lake pitch under the control of the Barber Asphalt Paving Company.

The crude pitch on the voyage from Trinidad, by a pure viscous flow, runs together into a compact and solid mass, and it must be picked out of the hold of the vessel in the same way as originally from the lake. It seems in no way sticky, but flakes off readily with the pick, and in cool weather can be crumbled with the fingers, while in summer it presents all the phenomena seen at the lake, being both easily flaked like ice and yet slowly taking the impression of the heel and bending when not too sudden pressure is applied.

Dumped for storage in a heap it solidifies in a few days, and then begins to spread in every direction unless restrained, and when of any depth it takes a strong barrier to withstand the pressure. In practice this tendency to run about is counteracted by heaping it in the form of a hollow cone, where the tendency is more to flow into itself than outward, so that if the material for refining be always taken from the middle there is little spreading. If this is not done with the richer lake asphalt the labor of several men is required daily in shoveling the pitch back upon itself.

Originally refining was carried on at La Brea, as now, when *épurée* or refined asphalt is exported, in ordinary open cast-iron sugar kettles. Of course the quality of the asphalt is much injured in this way.

In this country the earlier refineries were upright cylindrical kettles about 7½ feet in diameter and 7½ feet deep, holding 10 tons of crude pitch. These were heated from beneath by a coal fire, from which the kettle was protected by a brick arch, the products of combustion being conducted by flues around the sides of the kettles or stills. They were provided with conical covers, which could be lifted on, thus enabling the vapors and gases evolved from the pitch to be exhausted and consumed where it was thought objectionable to allow them to escape.

In this form of still the refining process was slow and occupied from one hundred and twenty to one hundred and forty hours, and as the plant became deteriorated, much longer; sediment collected on the bottom and caused much waste of fuel and the burning out of the still itself. At several refineries the upright were replaced by rectangular horizontal kettles, which furnished a larger heating and a greater evaporating surface. Some of these were provided with cylindrical flues passing through in the direction of the longer dimension.

In a few places these kettles are in use to-day. They are generally about 6 by 6 by 12 feet in size, but have been made as large as 20 by 10 by 10 feet, and hold from 15 to 60 tons of refined material. The smaller forms seem most economical.

For refining lake pitch for paving purposes the open kettles began to be abandoned about 1888 or 1889, and their place was filled by cylindrical flue boilers, the only opening to the air being three manholes 2 feet in diameter, which can be tightly closed. Their dimensions are, length 20 feet, diameter 10 feet, the two flues being 18 inches in diameter and running through the stills at a height of 4 feet at centers. Larger stills than these, reaching 30 feet in length and of the same diameter, have been constructed, but they possess no advantages. The cylindrical stills hold about 30 to 35 tons of crude asphalt, and after recharging, as the refining proceeds and the crude settles, yield in refined material an equivalent of 62 to 65 tons of crude.

The firing of these stills, which are set up in brickwork and surrounded with loam to prevent radiation, is so arranged by a series of flues that the heat of the fire passes first along one side of the still then back along the other, repeating this at a higher level, then through one flue in the still and back through the other, and finally under the bottom. In this way overheating on the bottom is prevented and better results are obtained in evaporating the water from the upper layers of crude material.

Asphalt is such a viscous material, even when melted, that convection currents move very slowly and necessitate some such provision, otherwise the crude pitch lying against the bottom would be coked before the upper portions had melted.

With this improved form of still the time of refining was considerably reduced and the quality of the product improved.

After some years' practice of this method of refining an advance was made by introducing agitation of the asphalt during the process, so that all portions should be uniformly heated and better opportunities given for evaporation of the water. This was accomplished by the use of a steam pump, which forces a large current of air into the stills from the time the pitch is first charged in until the refining is finished. In this way the time of refining and the possibility of injury to the asphalt were again reduced. In all these methods of refining firing with a coal fire has been the source of heat. Within the past year a departure has been taken from this practice and steam refining has been successfully introduced into the industry, promising to be a great success.

Instead of the large stills smaller rectangular kettles are used, holding about 25 tons. These are provided with large gangs of pipe for the circulation of steam at a pressure of about 100 pounds per square inch. At the same time there are provisions for the thorough agitation of the mass by dry live steam from the same source issuing directly into the asphalt through pipes with small perforations. The return of the condensed water to the boilers is accomplished by the steam loop, or other effective devices.

The entire process goes on with great regularity and celerity, a charge of 25 tons being finished or, "off," as the term is, in about twelve hours, instead of one hundred, as in the old method.

A much smaller plant, of one still of 25 tons capacity, can do, therefore, the same amount of work, with economy of space and expense, as probably three of the large cylindrical stills. This process is being slowly substituted for the older ones, and seems to be the most important step forward for the asphalt industry in 1893.

Refining asphalt consists primarily in removing the water which it contains, amounting to about 28 per cent. At the same time vegetable matter rises to the top of the melted pitch and is skimmed off. Some oil is lost, being carried over with the steam, and where no agitation is used considerable of the heavier mineral matter settles out.

The amount of oil is very small, probably not exceeding 1 per cent., but depending somewhat on temperature.

In the old method of refining the amount of sediment was quite large, sometimes reaching 10 per cent. It, of course, retained much good pitch, which was a total loss. With agitation this is all retained in suspension, and, as it is just as desirable for a part of the surface mixture as the sand which is eventually added, and perhaps, from its state of division and intimate mixture with the asphalt, more valuable, it can not be considered an injury to the finished product to retain it. The temperature reached in refining varies with the process employed. It should not exceed 400° F., but with the cruder method frequently reached 500°. With the more modern methods excessive temperatures are avoided, and with steam, of course, no part of the mass can become hotter than that of the steam employed.

The refined product, if for local use, is generally converted into cement in the still, but if intended for shipment, owing to the difficulties of transporting asphalt cement, due to its susceptibility to high temperatures, it is run off into old cement and flour barrels, which are filled half full, allowed to solidify, and then topped off, as the barrels when filled up at once can not be coopered sufficiently tight to prevent excessive leakage.

ASPHALT PAVING CEMENT.

Refined Trinidad asphalt is in itself too brittle and hard to be used at once as a cementing material. To prepare it for such a use a certain amount of heavy petroleum oil is mixed with it.

Heavy petroleum.—In the early days of the paving industry it was found that the residuum from the distillation of crude petroleum, obtained in producing illuminating oil, was the most suitable material for giving the desirable consistency and viscosity to refined asphalt. The use of this heavy oil is still continued, but as the by-products were very variable in character, and as no particular attention was paid to making a residuum suitable for paving purposes, there was a great deal of difference in asphalt cements nominally prepared in exactly the same way. With the extension of the industry the demand for heavy petroleum oil or residuum became large enough for the refining companies to find it profitable to make a uniform product for this special purpose, so that now a very uniform oil is obtained.

The desirable characteristics of residuum are that it shall contain but little oil volatile below 400° F., in order that loss may not occur during the making of the cement, and more especially that there may be no change in the consistency of the cement (owing to loss of volatile products) while it is melted and in use. At the same time the residuum should not be too dense, for then too much of it is required to obtain a cement of the proper consistency. It should not contain large amounts of hard scale paraffin, for in this case, while it may be of suitable nature for making cement at ordinary temperatures, it is susceptible to changes and makes the resulting cement too brittle at low temperature and too soft in the heat of hot summer sun. The more the oil is of a vaseline nature the better it is. While the oil now in use is a great advance over that of some years ago, there still seems to be room for improvement.

The character of an oil may be learned by determining—

1. Specific gravity.
2. Flash point.
3. Percentage volatile in seven hours at 400° F.
4. Susceptibility to changes in temperature as revealed by changes in viscosity.
5. Presence of crystals of paraffin scale.

Residuum oil is added to the refined asphalt in the proportion of 16 to 20 pounds of oil, depending on its character and more or less on how the pitch has been refined, to 100 pounds of refined asphalt. Before mixing, the asphalt is raised to a temperature of 300° F., or thereabout, and to produce rapidly a smooth mixture the oil should be heated as hot as is convenient. The oil is then pumped or in other ways added to the still, and the mixture agitated for several hours with a current of air until it is quite homogeneous. This agitation must be done with great thoroughness to insure a uniform cement, and must be continued whenever the material is in a melted condition, as a certain amount of separation takes place when the melted cement stands at rest. It is, therefore, customary to agitate it constantly with an air blast when in use as well as in its preparation.

While it is known about how much of any particular lot of residuum must be used to make a suitable cement, a better scientific control must be exercised to obtain the desired accuracy and uniformity, and as a means of keeping a record of the character of the cement in use in any particular locality. For this purpose the penetration machine, invented and patented by Professor Bowen, of New York, has come into use where the best work is done. This machine consists of a lever about 17 inches long, the fulcrum at the rear and a cambric needle inserted in the other end, above which is placed a weight of 100 grams. The end near the needle is connected by a steel rod and waxed cord with a spindle having a long hand which moves about a dial divided into 360 degrees. Another cord and weight upon an enlarged part of the spindle keeps the first mentioned cord taut. By a suitably-contrived spring clip the steel rod can be released for any length of time, and the needle, which has first been brought to coincide with the surface of the asphalt cement placed under it in a tin box, allowed to penetrate under the action of the weight into the cement. The number of degrees through which the hand moves on the dial record the penetration of the cement, but as asphalt is very susceptible to changes of temperature, the tests must always be made at the same degree. It has been agreed that a room temperature of 77° F. shall be accepted as the standard, and that the length of time that the needle is released be one second. This interval can readily be determined by the beats of a half-second pendulum, or by one of the cheap forms of clock with a quarter-second hand. Electrical appliances have also been arranged for accomplishing the release, but after a little practice no difficulty is experienced in several observers obtaining concordant readings with ordinary forms of release.

As it is sometimes inconvenient or impossible to have a room temperature of 77°, other temperatures may be made available by placing the tin sample box of asphalt cement in water at 77° and allowing it to acquire that temperature. It is then quickly penetrated under the needle as before, but as the needle is not at the normal temperature an allowance must be made.

Depending on the construction of the machine each one will vary in its reading, but for the several now in use in Washington, District of Columbia, and all of which have been weighted to agree, the correction has been found to be a deduction of one degree from the reading when the air and needle are above the normal temperature as is generally the case in summer and the addition of a degree for every degree of temperature that the air is below normal. Thus a cement which penetrates 77 degrees when the temperature of the room is normal would penetrate 66 degrees when taken from water at 77° F. and penetrated in a room at 66° F. and so likewise the same cement would penetrate 90 degrees at 90° F.

This method of control enables one to know at all times and to record the character of the cement in use. The consistency is, of course, varied for different conditions somewhat, but a mean for surface mixtures on such machines as have been mentioned would be 77 degrees, or a penetration equal to the temperature of the air at the time of penetrating, the cement itself always being at 77° F. On heavily-traveled streets and warmer climates the penetration is generally much lower than on residence streets and in the North.

For binder it is the practice in Washington to make a softer cement, penetrating from 150 degrees to 200 degrees, but in New York City and elsewhere the surface cement is used for the same purpose. Before the penetration machine was introduced and when chewing and judgment alone were used in determining the proper consistency, cements have been found which, while used and supposed to be all right, varied from 40 degrees to 130 degrees in penetration.

At present, with a good superintendent of works, asphalt cement may be kept within 5° for an entire season.

SHEET ASPHALT PAVEMENT.

Washington has had more experience with sheet asphalt pavements and more time and attention have been devoted to both the scientific and practical sides of the industry there than in any other city in this country.

Careful consideration of the specifications under which such pavements are now laid there will therefore form the best basis for understanding the technology of the subject. In the earlier years from 1876 to 1880 the specifications were very meager, but with the establishment of the office of Inspector of Asphalt and Cements, scientific principles began to be introduced into the industry, with the result that the present specifications are a vast improvement over those of ten years ago and represent fairly exact requirements as can be seen from those for 1893.

SPECIFICATIONS FOR SHEET ASPHALT PAVEMENTS.

STANDARD ASPHALT PAVEMENT ON CONCRETE BASE.

Trimming.—The space over which the pavement is to be laid having been excavated to the proper depth of seven or nine inches below the surface of the pavement when completed, any objectionable or unsuitable matter below the bed will be removed and the space filled with clean gravel or sand well rammed. The bed will then be trimmed so as to be parallel to the surface of the pavement when completed, and the entire road-bed will be thoroughly rolled with a roller weighing at least five tons. No extra allowance will be made for trimming and rolling.

Upon the foundation thus prepared the pavement will be laid as follows:

Hydraulic cement concrete base.—This will be four or six inches in depth and will be laid as follows, and with material conforming to the following specifications:

Hydraulic cement.—The cement in use shall be a natural hydraulic cement, and shall conform to the current specifications for supplying such hydraulic cement to the Engineer Department of the District of Columbia. No hydraulic cement shall be used upon the work until it has been tested in the office of the Engineer Commissioner and accepted by him, the tests to extend over such a length of time not exceeding twenty-eight days, as the Engineer Commissioner may think necessary. The cement while in storage or upon the work or while being hauled upon the work shall be properly protected, and no cement shall be used which in the opinion of the Engineer Commissioner has been injured by age or exposure. The cement shall be kept by the contractor in store, under proper cover, in the city of Washington and subject to inspection for at least ten days before it is used on the streets, and, if deemed advisable by the Engineer Commissioner, twenty-eight days.

Sand.—The sand used shall be clean, coarse, sharp river sand, free from mud, clay, mica, and foreign matter, and not showing, on shaking with water and subsidence, more than five (5) per cent. by volume of loam.

Stone.—The stone in use shall be the best Potomac granite or its equivalent. It shall be broken to pass a two and one-half inch screen, and, as used in the work, at least eighty-five (85) per cent. of it must pass by its largest dimension a two and one-half inch ring, and of the remaining fifteen (15) per cent. no pieces shall have a larger dimension than three and one-half ($3\frac{1}{2}$) inches.

In hauling stone, sand, and cement upon the work, the soil foundation shall be properly planked and protected from injury, and no materials will be dumped except on a proper planking.

Concrete.—The concrete shall be composed of the above materials manipulated as follows: The mortar shall be composed of cement and sand in the proportion of three hundred pounds of cement and two barrels of loose sand, thoroughly mixed dry, and a sufficient quantity of water added afterward to form as stiff a paste as it is practicable to work, the proportions given being intended to form a mortar in which every particle of sand shall be enveloped by cement, and this result must be obtained to the satisfaction of the Engineer Commissioner and under his direction.

Facilities shall be given the Engineer Commissioner and his representatives for weighing and measuring the cement and sand, and they shall also be allowed to take such samples of materials as they may think necessary.

To the mortar made as above, the specified broken stone shall be added in such proportions that the resulting concrete shall contain, for every three hundred (300) pounds of cement and two barrels of loose dry sand, such a proportion of broken stone as to give a slight surplus of mortar when rammed. This proportion shall be regulated by the Engineer Commissioner or his representatives. The stone shall be thoroughly cleaned from dust and foreign substances and sprinkled before it is added to the mortar. Any material which would pass a number 10 screen will be regarded as a foreign substance. Each batch of concrete shall be thoroughly mixed upon a water-tight board, in a manner satisfactory to the Engineer Commissioner or his representatives, until each piece of stone is coated with mortar. It will then be spread upon the foundation so that the mortar shall remain evenly incorporated with the stone, which can best be accomplished by a turning of the shovel in the act of dumping, and then thoroughly compacted by ramming, until free mortar appears on the surface.

Any evidence of lack of compaction shall be regarded as sufficient reason for requiring removal and replacement of base. If required, the surface of the concrete shall be gone over by the contractor after ramming and any inequalities or voids filled with mortar.

If, at any time, for any violation of the preceding specifications, any hydraulic concrete should in the opinion of the Engineer Commissioner prove in any portion or entirely inferior, it shall be removed by the contractor and replaced in a suitable manner; and if, after twenty-four (24) hours' notice he shall have failed to do so, it shall be removed and the cost charged to any money which may be due him or may become due him by the District.

The contractor shall not enter upon a hydraulic concrete base in order to lay the binder course until in the opinion of the Engineer Commissioner it has obtained sufficient strength for such a purpose, and during the period between laying base and binder he shall properly protect it, and when ordered by the Engineer Commissioner shall sprinkle it in warm weather between the hours of sunset and sunrise as often as may be deemed necessary, or in cold weather cover it with a material suitable for its protection.

Binder.—The binder course shall be composed of suitable clean broken stone passing an inch and one-quarter screen. Eighty-five per cent. of this shall pass in its longest dimension, and of the remaining fifteen no piece shall have a larger dimension than two (2) inches, and the stone after passing the heating drums shall not contain more than five (5) per cent. of material passing a number ten (10) screen.

The stone will be heated in suitable appliances not higher than 300° F. It is then to be thoroughly mixed, by machinery, with asphalt cement made with petroleum residuum, such as is acceptable for surface cement, at 300° to 325° F.; penetration, 150 degrees to 230 degrees, in proportion of about 6 to 7 pints of cement to one cubic foot of stone.

The mixture will be so made that the resulting binder has life and gloss without an excess of cement. Should it appear dull from overheating or lack of cement, it will be rejected.

No cements composed of mixtures of asphalt and tar will be allowed. While hot it will be hauled upon the work, spread upon the base to a thickness of two inches, so that when compacted it will be at least one and a half (1½) inches in thickness, and immediately rammed and rolled until it is cold.

Should the resulting course not show a proper bond it shall be immediately removed and replaced by the contractor, or should he fail to do so in twenty-four (24) hours after written notice from the Engineer Commissioner, it shall be removed and the cost charged against any moneys which may be or may become due him from the District.

Wearing surface.—The wearing surface shall be at least 1½ inches in thickness, when compacted, and shall be made in the following manner and with materials, complying with the following specifications:

The materials which shall be employed are as follows:

1. Asphaltum.
2. Heavy petroleum.
3. Sharp, clean river sand.
4. Fine powder of limestone.

Asphaltum.—The asphalt shall be from the pitch lake of the island of Trinidad, or any other deposits which may be proved to be equally suitable, to the satisfaction of the Engineer Commissioner.

When Trinidad asphalt is used the crude pitch shall be subject to the inspection of the Engineer Commissioner. It shall be a bright, live, porous pitch, corresponding in chemical composition and physical properties with the best Trinidad pitch, as determined by comparison with data on file in the office of the Inspector of Asphalt and Cements, and shall be equal in quality to the pitch in use in pavements in the District during the fiscal year 1892 and 1893, and shall be in every respect satisfactory to the Engineer Commissioner.

Refined asphalt.—The crude pitch shall be refined under the direction and to the satisfaction of the Engineer Commissioner, and the resulting product shall be smooth and free from lumps of unmelted pitch or organic matter not bituminous. It shall not at any time reach a temperature over 375° F. The asphaltic cement shall be prepared from such refined asphalt as may meet the approval of the Engineer Commissioner, and suitable heavy petroleum oil.

Heavy petroleum oil.—The oil in use in the manufacture of asphalt cement shall be a petroleum from which the lighter oils have been removed by distillation, without cracking, preferably, especially for paving purposes, until the oil has the following characteristics:

Specific gravity Beaumé, 17° to 21°.

Flash point, not less than 300° F.

Distillate at 400° for 10 hours, less than 10 per cent.

Shall not cease to flow above 60° F.

Shall not require more than 21 pounds of oil for each 100 pounds of refined asphalt to produce the specified quality of cement.

The flash point shall be taken in a New York State closed oil tester.

The distillate shall be made with about 90 grammes of oil in a small glass retort provided with a thermometer and packed entirely in asbestos.

The flowing point shall be determined by cooling 100 cubic centimeters of oil in a small bottle and noting the temperature at which it flows readily from one end of the bottle to the other.

Asphaltic cement.—Shall be prepared from refined asphalt and heavy petroleum oil, complying with the above specifications.

To the melted asphalt at a temperature of not over 325° F. the oil, after having been heated to at least 150° F., is to be added in suitable proportions to produce an asphalt cement penetrating from 75 degrees to 95 degrees, as may be directed by the Engineer Commissioner, on the penetration machine now in the office of the Inspector of Asphalt and Cements. To accomplish this from 15 to 21 pounds of oil per 100 of refined asphalt will be required. As soon as the oil has begun to be added suitable agitation by means of an air blast or other acceptable appliances will commence and be continued till a homogeneous cement is produced. The appliances for agitation shall be such as to accomplish this in at least ten (10) hours, during which the temperature shall be kept at from 290° to 325° F. and no higher. If the cement then appear homogeneous and free from lumps and inequalities, as shown by penetration of samples from different parts of the still, it may be used. Should it not prove homogeneous and of the proper penetration, such deficiencies as may exist shall be corrected by the addition of hot oil or melted asphalt in the necessary proportion.

Where asphalt cement is kept in storage it must be thoroughly agitated when used, as must also all dipping kettles while in use.

Samples of the asphaltic cement and of the petroleum oil shall be supplied to the Inspector of Asphalt and Cements when required and in suitable tin boxes and cans, and he shall have access to all branches of the works at any time.

Sand.—The sand in use shall be the best sharp, clean river sand obtainable, equal to that described for use in hydraulic concrete for base, and none shall be used which is collected in the river above the Long bridge. When deemed advisable by the Engineer Commissioner, stone dust, which shall be the fine screenings produced by the crushers, may be substituted for a portion of the sand.

Limestone dust.—This shall be an impalpable powder of carbonate of lime, the whole of which shall pass a 30-mesh screen, and at least seventy-five per cent. pass a 100-mesh screen.

Asphalt surface.—The materials complying with the above specifications shall be mixed in the following proportions by weight:

Asphalt cement, from 13 to 16 parts.

Sand, 79 to 84 parts.

Limestone dust, 3 to 5 parts.

The proportion of materials used will depend upon their character and the traffic on the street, and will be determined by the Engineer Commissioner, but the percentage of bitumen in any mixture soluble in carbon bisulphide shall not exceed the limits, 9 to 11 per cent. If the proportions of the mixture are varied in any manner from those specified the mixture will be condemned; its use will not be permitted; and, if already placed on the street, it will be removed and replaced by proper materials at the expense of the contractor.

The sand or the mixture of sand and stone dust and the asphaltic cement will be heated separately to about 300° Fahrenheit. The pulverized carbonate of lime, while cold, will be mixed with the hot sand in the required proportions and then mixed with the asphalt cement at the required temperature and in the proper proportion, in a suitable apparatus, so as to effect a thoroughly homogeneous mixture. Sand boxes and asphalt gauges will be weighed in presence of inspectors as often as may be desired.

The pavement mixture prepared in a manner thus indicated will be brought to the ground in carts at a temperature of not less than 250° Fahrenheit, and if the temperature of the air is less than 50° Fahrenheit the contractor must provide canvas covers for use in transit. It will then be thoroughly spread to a thickness of two and one-half inches by means of hot iron rakes in such manner as to give uniform and regular grade, so that, after having received its ultimate compression of about two-fifths, it will have a net thickness of at least one and one-half inches.

This depth will be constantly tested by means of gauges furnished by the Engineer Commissioner. The surface will then be compressed by hand-rollers, after which a small amount of hydraulic cement will be swept over it, and it will then be thoroughly compressed by a steam-roller weighing not less than 250 pounds to the inch run, the rolling being continued for not less than five hours for every 1,000 yards of surface.

BASE.

In the preceding specifications it is provided that the base shall consist of 6 inches of hydraulic concrete. Where economy must be practiced and on streets with firm subsoil base the depth is sometimes reduced to 4 inches or the hydraulic is entirely replaced by bituminous concrete, for which the specifications read as follows:

The base shall be composed of clean broken stone, free from spalls, that will pass through a 3-inch ring, well-rammed and rolled with a steam roller weighing not less than 5 tons, to a depth of 4 inches. The rolling will be continued until the stone ceases to creep before the roller and until it is evident that the final compression has been reached. It will then be thoroughly coated with No. 4 coal-tar paving cement in the proportion of about 1 gallon to the square yard of base.

The binder and surface on this form of pavement are the same as specified for hydraulic base.

A pavement of this description is a monolithic mass, base, binder, and surface being inseparably cemented together. This may be an advantage, but any attempt to remove the surface for repairs or resurfacing results in the destruction of the entire pavement. A bituminous base, moreover, is not a rigid mass, but yields with any defect or subsidence of the subsoil base. Experience with its use has led to its universal abandonment. Hydraulic base, once properly constructed and in place, will last practically forever. The binder and surface coats can be removed and readily replaced, so that it is eventually the cheapest form. The shape of the street is not lost, as is the case where it is necessary to superimpose one surface upon another with a bituminous base, and its rigidity and strength enable it to withstand considerable failure in the subsoil base, to which the bituminous concrete quickly yields.

While the hydraulic base is usually made 6 inches thick a greater depth is now and then specified for certain conditions, and Portland substituted for natural cement. In regard to the actual construction of base for sheet asphalt pavements it may be said that the ordinary forms of procedure are employed with the hydraulic concrete. For bituminous base coal tar alone can be used as the bituminous cementing material, as experiment has shown that melted asphalt will not adhere to stone at ordinary atmospheric temperatures.

BINDER.

The binder course in sheet asphalt pavements was first introduced in Washington in 1888. It was an inheritance from the old coal-tar pavements, and as such was originally made with coal-tar cement. Its object is, by replacing a certain amount of the thicker surface found in the original standard asphalt pavement, to prevent the movement of the surface upon the base by pushing, and to bind the base and surface more closely together.

This is accomplished by a binder, owing to the fact that the surfaces of the individual pieces of stone, of which it is composed, prevent, by their size, any rolling motion or movement upon the hydraulic base, where the more doughy or viscous nature of the surface mixture permits it. The interstices in the top surface of the binder also form a good anchorage for the surface mixture, and prevent it from getting out of shape.

In addition, where, as in Washington, broken stone can be economically obtained, the use of a binder course is a matter of economy.

The methods of production are plainly shown in the preceding specifications. The broken stone from the crushers, of suitable dimensions, is shoveled into ordinary iron bucket carriers upon an endless link-belt, which dumps it into a hopper just above the upper end of the rotary drum in which it is heated. These elevators are placed at an angle of about 70 degrees.

The heating apparatus consists of a cylinder of iron or steel about 32 inches in diameter and 14½ feet long, inclined with a drop of a half inch to the foot.

It is provided with a shaft running through its center, to which it is firmly clamped, and with which it revolves, being geared to the source of power at the lower end.

The interior has angle irons along its sides to properly distribute the broken stone in its course through the drum.

The rotary is heated by means of either wood or fuel oil, preferably the latter, as it can be more closely regulated. The temperature of the stone as delivered from the rotary is then controlled, not only by the fire, but by the rate at which it is fed.

The stone, which, as shown in the specification, should have a temperature of about 300° F., is then fed into a mixer from 10 to 14 feet long, provided with pairs of blades set at an angle upon a shaft making twelve to fifteen revolutions per minute in such a manner that some of them act as propellers to push the material forward and others to mix it with the cement, which is poured upon the stone as it falls into the mixer at the end farthest from the delivery. The mixer is about 2½ to 3 feet in diameter, and thoroughly coats the hot stone with asphalt before it drops from it into the cart to be hauled upon the street.

Considerable skill is required in regulating the temperature of the stone, and in pouring the proper amount of cement upon it by means of a bucket, the supply of cement coming from a dipping tank near by. Where the mixing is well regulated the hot stone is fed smoothly into one end of the mixer, the cement poured over it in proper proportions, and the binder drops continuously into a cart beneath the mixer at the other end, with a uniform temperature, glossy, but not covered with excess of asphalt and never having a dull surface, which is due generally to too hot stone. In Washington, District of Columbia, it will be seen from the specifications that the stone in use is rather large, and that any considerable amount of fine material or dust is excluded from it. A certain amount of the latter must be allowed for, as it originates in the rotaries. The cement, too, it will be observed, is quite different in consistency from that used in surface mixtures, having a penetration of from 150 degrees to 230 degrees where surface cement penetrates but 75 degrees, and consequently being much softer.

In some other cities a different practice has prevailed. The stone has been made very fine, even to one-half and one-quarter of an inch in size, and the cement has been made of the same penetration as that in use in surface. The resulting binder in consequence becomes a mere dense bituminous concrete, lacking the essential features which have been described as giving binder its real value. The softer cement is preferable as being much more elastic, and therefore permitting a safer haul over it in hauling surface mixture as well as by its advantage as a cushion to the surface itself. It has never been found to push or change, and, in fact, when made with as large stone as is customary, would not be as apt to do so as a finer binder with harder cement. Coal-tar binder was rejected because of the great variability of the cementing material, the great difficulty in handling it, the fact that it must be worked at a much lower temperature, 220° F., thus chilling rapidly in cold weather, and because it will not withstand the necessary hauling in the laying of surface mixtures. Binder is not used at all in many cities where the expense of the production of binder stone and of the additional plant required for its preparation exclude it from consideration. It will, probably, even with its advantages, be employed only in the larger cities where quantities of work are done.

ASPHALT SHEET SURFACE.

In the standard form of specification for the District of Columbia, the thickness of the surface, after compression, which is laid upon the binder course, is 1½ inches or, on extraordinary occasions, 2 inches. In other cities, where binder is not in use, the thickness is 2½ inches, either laid all at once, as a homogeneous course, or in two courses, called cushion and top, the former about one-half an inch thick.

Asphalt surface mixture is composed of asphalt cement, 13 to 16 parts; sand, 79 to 84; and limestone dust, 3 to 5; and it is provided that, when deemed advisable, stone dust from the crushers may be substituted for a portion of the sand. As a matter of fact, this is always desirable, as 5 per cent. of limestone dust is not sufficient for the purpose for which it is used.

The proportions given vary within limits in order that the resulting mixture may be made suitable for the conditions under which it is to be used. In a northern climate a softer cement can be used than in the South. With heavy traffic, less cement is needed than on suburban streets, and with certain sand the amount and kind of cement used is different from that with other sand. The proportion of limestone dust and ordinary stone dust to the sand must also be varied according to the uniformity of the particular sand in use and the voids which it contains. Sands, in different localities, vary a great deal, and this variation, aside from purity (that is to say, admixture of clay, loam, or any foreign matter), is dependent on two factors—size and uniformity. There may be recognized sands where all the grains are about the same size, that is to say, very uniform sand, and the sizes of the grains in these sands may be either large, medium, or small. Of course, such sands are not often met with. Usually the grains are of various sizes, and it is from the relative proportion of each that any sand derives its character.

As a sand becomes graded in size the smaller grains fill a certain proportion of the spaces between the larger ones and the voids are diminished, so that in practice sands are found with voids ranging from 40 to 30 per cent. and averaging about 33 per cent.

The best sand for use as an aggregate for paving purposes is naturally one that is most graded, and therefore forms the most compact surface, for where the voids are too large, the viscous nature of the asphalt cement has a greater opportunity for coming into play, and where all the particles are too small the mixture becomes too doughy and, lacking grit and surface to its particles, is too readily moved out of place and form.

In practice, therefore, a sand of as varied size as possible is used and the voids partially filled with stone dust to diminish the amount of asphaltic cement necessary and to give it the necessary body and resistance to viscous flow. The impalpable mineral matter in the original Trinidad pitch is also of very material assistance in this direction and, being so very thoroughly incorporated with it, is even more desirable than any artificial addition can possibly be.

The impalpable mineral matter which is added to the sand is the ground limestone and stone dust from the crushers, given in the specifications. Both are equally good, probably; but, as ground limestone was originally used, it has never been entirely discarded, and in some localities stone dust is not available, so that limestone dust is used entirely.

The stone dust is or should be added in such proportion as to fill the voids as much as possible without making the resulting mixture too doughy and bally. With different sand this, of course, will vary. With the coarser sand in use in Washington, D. C., about 10 to 15 per cent. of fine mineral matter, passing a sieve of one hundred meshes to the inch, will be found in the mixture. In this case the voids are so reduced that the percentage of cement added nearly fills them, as shown by calculation. It is not well that it should entirely do so as the mixture would then be too liable to viscous flow, and thus get out of shape; nor should it be too little, for water may then penetrate it and destroy the mass. In Washington the mixture is so regulated that it contains about 10 per cent. of pure bitumen, corresponding to about 15 per cent. of asphaltic cement.

The materials for the surface mixture being assembled, its preparation is as follows:

The asphalt cement, its consistency and penetration having been proved correct, is melted in rectangular tanks with cylindrical bottoms (flat bottoms rapidly burn out), and is held at a temperature of about 300° F. by means of a small wood fire. The tanks are 4 by 8 feet and 2 feet 6 inches deep. Into it is conducted a pipe delivering a blast of air, which keeps the material in constant agitation and so of uniform quality.

The sand is heated in rotary drums of quite the same description as those used for binder, with the exception that at the delivery end there is a screen, of 10 meshes to the inch, which separates and throws out any pebbles and coarse matter.

Dropping from the rotaries, at a temperature of from 275° to 325° F., into a boot or apron, an endless chain bucket elevator carries it up to a platform or hopper above the floor, where the mixing of the material is to take place. Delivery pipes from different parts of this floor carry an average of the heap to the measuring box, thus insuring an even temperature, and, should the sand be too hot, it is tempered with cooler sand from the floor of the mixing platform. The measure for the hot sand is a rectangular box of sheet iron, 39 inches long, 19 inches wide, and 19 inches deep. It holds about 720 pounds of hot material, and is swung upon trunnions so that its contents can be dumped into the mixer. If the sand hopper or heap is any distance from the mixer, the sand box is run upon a track by means of an overhead hanger from one point to the other.

The sand, at the proper temperature and containing the proper amount of stone dust, where that is used, and which is added before the sand goes to the heating drums, is run into the measuring box, the limestone dust being thrown in from a measure at the same time. The surface is then struck off with a straightedge and the temperature of the material taken with a thermometer. If this is correct, it is dumped into the mixer, where the limestone dust becomes in a few turns well mixed with the sand. In the meantime, the measure for the asphaltic cement, which is much like the sand box, only on a smaller scale, and of a little different shape, so that it may pour and drain well, is being filled. This runs upon an overhead track to the dipping tanks. It is provided with an adjustable gauge, which shows to what height the cement should be poured in, and as a check the box and contents hang upon a portion of the track which is a part of a Fairbanks scale, and thus by means of an electric indicator and bell the workman can determine the exact amount of asphalt in the measure.

The sand and limestone having been given a few turns, the hot cement is poured into the mixer. This is a double pug mill, each shaft being provided with a set of double blades, with their pitch and position so arranged that the material while being mixed is continually thrown toward the center of the mixer.

The pug mill is about 3 feet 9 inches by 3 feet 7 inches in size at the top, and there are twenty-four pairs of blades. It makes forty-five revolutions per minute, and the mixing is allowed to go on for one and one-fourth to one and one-half minutes. All the particles of sand, if it is of good quality and free from loam, are in this time thoroughly coated with cement. By means of a lever the bottom of the mixer is opened and the material is dropped into a wagon or cart beneath, which has been oiled slightly with petroleum oil to prevent sticking when the load is dumped. It then is ready to be hauled upon the street. The temperature of each load is usually taken and a canvas cover thrown over it. Three mixings constitute a cartload and six a wagonload, and they weigh, respectively, about 2,535 and 5,070 pounds.

The successful production of the mixture requires skill on the part of the foremen and laborers in firing the heaters or sand drums, in feeding the mixture of sand and stone dust regularly, and thus maintaining a uniform temperature, and in regulating the consistency, temperature, and accuracy of measurement of the asphaltic cement.

The labor involved is that of about twenty men, most of whom may be of the ordinary class of day laborers. Negroes are found to learn the work more quickly and are preferable to white men, both at the works and on the street.

ON THE STREET.

Work upon the street with the binder and surface mixture is begun as soon as the bituminous base has had its coating of tar or when the hydraulic base has set for a sufficiently long time, generally from seven to ten days, not to be injured by hauling over its surface. In the care of both forms of base it is preferable that planks should be spread upon the surface and the hauling done over them.

Binder.—The laying of binder is a very simple operation. It is spread with shovels, raked to an even grade, and compressed at once by a steam roller and with hot tamping irons along the curb or car tracks. With asphalt binder there is but one thing to guard against, and that is where some of the cement, during a long haul may have run down and collected on the bottom of the cart or wagon, making it necessary to reject the scrapings. Asphalt binder, from the safety to which it can be heated to high temperatures, rarely chills, but with coal-tar binder and high winds this often happens, and the material after rolling will be found to have no bond at all.

Surface.—The binder or, where a cushion coat of surface material has been laid the cushion, is ready as soon as it is cold for the application of the final surface coat.

It is found that the temperature of the surface mixture falls but very little in transit from the work to the street, even after a haul of several miles, a loss of 10°, from 290° to 280°, being quite as large as is common. Excluding accidents, therefore, the material arrives upon the street in as good condition as when sent from the mixer.

The necessary chalk lines having been made along the curb and in the center of the street as guides for gutters and crown, the laying of surface may begin.

It is usual to start in the middle of a block in order to divide the haul, and where there is any grade to speak of to work uphill, as the tendency to push the surface in rolling is less under such condition.

A straightedge of plank having been placed across the streets, the surface mixture is dumped and raked up to it to such a depth that when its final compression is reached the desired depth of the pavement is obtained. This compression is somewhat less than two-fifths, but varies with the richness of the mixture, the poorer ones compacting more than the richer.

The depth is regulated by gauges, but the eye of a skilled foreman seems to be quite as good. Great care must be exercised in this part of the work that an even distribution of the loose material is made; otherwise there will be depressions or elevations in the finished surfaces. With a skilled foreman and good laborers this is accomplished in a remarkably successful manner and the material is ready for compression.

Compression is accomplished by means of rollers and tamping irons, the latter being heated in a fire upon an iron basket moved from place to place on wheels. The original method of first compression was to run an iron roller weighing about 800 pounds (whose surface was prevented from taking up any of the sticky mixture by being oiled with kerosene) rapidly over the surface, four men being employed for this work. This method is still employed to a certain extent, but it has been improved upon and superseded in part by a form of roller which is attached to the front of the heavy steam roller and is heated by steam. It is guided by a parallel motion from the steering gear of the latter and does away with the necessity of anyone walking on the newly laid surface.

The primary compression having been given by either form of roller, some natural hydraulic cement or any impalpable mineral matter is dusted over the surface to prevent adhesion of the steam roller and to give it a more pleasing color. The necessary amount of rolling and cross rolling is then given with the steam rollers, of which it is desirable to have two, one of rather narrow tread and light, about 6 tons, which can be readily handled and gives the first hard compression, and the second of broader tread and which is more suitable for shaping up the street.

In the meantime, after the first preliminary rolling, men with the hot tamping and smoothing irons are finishing the gutters, joints, and all angles and edges where the heavier rollers would fail to reach. The gutters are tested with straight edges to detect depressions and any inequalities on the surface removed.

The rolling by the steam rollers, which are of the Lindeloff patterns, should be kept up at least five hours for each thousand yards of surface.

When cold the pavement is ready to be thrown open to traffic as soon as the gutters have been painted, which is customary, with a coating of hot asphalt cement or tar.

The chief points where skill is required in the working of asphalt surface is in avoiding inequalities, especially depressions which prevent the rapid removal of storm water, in securing a very thorough compaction of the gutters, which otherwise rot rapidly, and in thorough rolling, which is dependent on the skillful use of the steam roller.

Traffic, if not of too heavy vehicles, is an advantage to a newly laid surface. It aids decidedly in compacting it and keeps the surface well closed against the action of the elements. Asphalt pavements in suburban streets, where there is little or no traffic, do not appear as well after a few years as a good surface under considerable traffic.

On streets with flat grades it is often the custom to provide gutters of hydraulic cement, stone, or vitrified brick, to avoid their rotting, as has happened when the asphalt surface is continuous, but if the proper care is used this seems unnecessary. Along car tracks and at crossings where there are vibrations and pounding of the wheels of vehicles, a line of headers and stretchers of granite blocks or vitrified brick is desirable.

The laying of asphalt surface can go on at almost any time of year, when the base is clean and dry, except when it is windy; and streets which have been laid in light rain, or when snow has been swept from the base for the purpose, have worn as well as others laid in summer. The heavy thunderstorms of summer also have failed to do the injury that might be expected.

The form of pavement which has been described involves the construction of a base, either hydraulic or bituminous. In the older cities, however, there are many streets which have been paved for years with cobble or blocks, which have become so much out of place as to be unfit for use. Instead of removing these when an asphalt pavement is desired it has been found quite practicable to use the old pavement as a base, since the travel of years has pounded it firmly into place, and to lay the asphalt surface upon this, evening off the inequalities, and bringing it to a proper grade with a binder course. Such a pavement is durable and has been successful in the East.

LIFE OF ASPHALT PAVEMENTS.

The life of an asphalt pavement depends upon three things:

The materials of which it is constructed.

The skill with which it is laid.

The amount of traffic it sustains.

With the best materials, combined and laid with the greatest skill, where traffic is of ordinary character and the street not too narrow, so as to confine wheels to ruts, the life of the pavement should be fifteen years. There are surfaces in existence to-day which are of that age, which have had scarcely any repairs and seem to be good for many years to come. Such a pavement can be seen in front of the Arlington Hotel on Vermont avenue in Washington, District of Columbia. Where, through lack of judgment, too much or too soft cement has been used, the surface is liable to soon push out of shape. Where too little or too hard cement has been employed, the surface cracks after a few years, and scales and disintegrates in the colder months of the year, and other mistakes make themselves known in similar ways.

The best pavements, in addition, have enemies which will destroy them if not prevented.

Water penetrating into the base and surface from the seepage of ground higher than the pavement has an injurious effect, while the escape of illuminating gas from the mains produces a peculiar and characteristic disintegration which is readily recognized. The success with which asphalt surfaces has been maintained on some of the narrow streets of the lower part of the city of New York, with the very heavy traffic there met with, shows that with skill in laying they may be made suitable for even very trying conditions; and as they have been maintained at such geographical extremes as New England and Louisiana, it would seem that climatic conditions do not qualify their use.

TECHNOLOGY OF BERMUDEZ ASPHALT.

Bermudez asphalt, which is obtained near Maturin in the Venezuelan State of that name, differs in its treatment for the preparation of street pavements from Trinidad asphalt in that it contains less water than Trinidad pitch, very little mineral matter, and more of the oils volatile at low temperatures.

The small amount of water and mineral matter makes the refining process somewhat more rapid, and the larger amount of light oil renders it necessary to add a much smaller amount of petroleum oil to the refined material for the production of cement.

The absence of the impalpable mineral matter found in the Trinidad material is no advantage, and the defect must be made up by the addition of a corresponding amount of the impalpable limestone dust. The cement, too, must be made of softer consistency. It melts at a lower temperature than Trinidad asphalt cement, but otherwise is handled both at the works and on the street in quite the same way.

But a small amount has hitherto been laid. In Detroit in 1892 and 1893 32,456 yards, and in Washington in 1893 about 16,000 yards were laid. Utica also laid 32,000 square yards. Judgment in regard to its qualities as a paving material must be suspended until further experience has been had with it and it has been upon the street under traffic for some years.

OTHER ASPHALTUM DEPOSITS IN SOUTH AMERICA. (*a*)

Asphaltum is said to exist in great abundance near the Pedernales river, an estuary of the Orinoco, opening into the Gulf of Paria, where petroleum wells have been sunk with good results, and a company has been organized in Caracas to work the property. The machinery is on the spot and in the process of erection. Inexhaustible mines of mineral pitch also exist near Maracaibo, Merida, and Coro. Petroleum wells are abundant in Cumana and Trujillo. On the island of Pedernales, which is formed by the two delta streams, the Cucirina and the Pedernales, its northern shore being that of the Gulf of Paria, is found a vast supply of asphaltum. The land is low, intersected by small streams, and containing many ponds of salt and brackish water. In such ponds on the northern shore is found the asphaltum known as Pedernales asphalt. This differs in the main from that found at La Brea in Trinidad, in being generally more liquid and freer from earthy matter, and in containing a greater percentage of light oils. As found it is a thick, black, viscous mass, without odor and strongly adherent. The process of refining consists in merely boiling it, thus depriving it of a large proportion of the lighter volatile oils and all contained moisture. The deposits at Pedernales may be said to be the same, geographically considered, as that of La Brea, notwithstanding that the Trinidad contains a quantity of earthy matter well nigh inseparable, although mechanically mixed. These earths are mainly very finely divided quartz grains, held in suspension by the viscous asphaltum. The presence of these impurities adds largely to the weight, and, while proving of little or no detriment to the many uses of the material, debars it from many other purposes. The Pedernales deposit can be used for any purpose known in the art, and is as desirable for varnishes and chemical compounds as it is useful in increasing the elasticity of the asphalt, which contains too small a percentage of volatile oils.

GERMAN ASPHALT.

Asphaltum is found in the province of Alsace and in Brunswick in connection with petroleum of a heavy nature, which is used chiefly for lubricating purposes. The following table shows the production of asphaltum in Alsace from 1881 to 1891:

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a From the *American Manufacturer and Iron World.*

Product of asphaltum in the province of Alsace, Germany, 1881 to 1891.

Years.	Metric tons.
1881	42,330
1882	37,120
1883	42,930
1884	41,139
1885	45,412
1886	42,894
1887	34,483
1888	41,534
1889	43,496
1890	51,144
1891	49,150

ASPHALT MINES IN SYRIA. (*a*)

Four asphalt mines are known to exist in Syria. One is situated in the vicinity of Hasbaya, about 40 miles southeast of Beyroot; the second in Sohmor, about 30 miles to the south of this city; the third is near Ain-Ettineh village, 70 miles to the east of Beyroot, and the fourth is found in the valley of the Dead Sea. Of these mines, the one at Hasbaya is the most important, and the asphalt obtained from it is considered the best, with the exception of that of the Dead Sea, which floats in small quantities on the surface of the water and drifts ashore, where it is picked up by the Bedouin Arabs.

Until 1860 these asphalt mines were almost entirely neglected, and the Fellahs used to dig, free of tax, small quantities, which they applied to the stems of their vines to destroy worms that ravage the vineyards.

In 1864 the asphalt mine as Hasbaya was leased by the Turkish Government to two native merchants—Messrs. Freige & Misk—for a term of four years at a rental of 80,000 piasters ($3,520) per annum. The operations of this company did not prove very successful, lack of an adequate system of engineering greatly reducing its profits.

In 1878 the mine was leased by the firm of Messrs. Tabet & Co. for four years, at an annual rental of 250,000 piasters ($11,000). During these four years about 4,000,000 kilograms (4,400 tons) of asphalt were extracted.

At the expiration of the lease the mine was leased to another company—Absy & Co.—for a term of ten years, commencing in 1888. The condition was that 65½ per cent. of all the asphalt extracted should go to the agents of the imperial private treasury, the mine being the private property of the Sultan.

During the last five years the amount of asphalt obtained by Messrs. Absy & Co. from the Hasbaya mine is estimated to be 5,400 tons. The company's success has been mainly due to their skillful engineering and methods of excavation.

No asphalt is at present extracted from the other mines in Syria, as the local Turkish authorities strictly prohibit their being worked.

a From report by Vice-Consul Khouhri.

When Messrs. Freige & Misk first worked the Hasbaya mine the asphalt was sold in Europe at an average rate of $19.30 per 100 kilograms (220 pounds). Its present price in the foreign markets is between $8.69 and $9.65 per 100 kilograms.

The Syrian asphalt is subject to no tax except an export duty of 1 per cent. It is rumored, however, that a new rescript issued by the Sultan enjoins that no export dues shall be hereafter imposed on that article.

The exact quantity of asphalt now in stock can not be ascertained, as the parties who monopolize it decline to give the figures. It is probable, however, that not less than 3,000 tons are stored for sale by the agents of the imperial treasury and the mining company.

The asphalt obtained from the Syrian mines is invariably exported to Europe and America in its natural state, without undergoing any process of preparation.

The following table shows the value of that exported from Beyroot to the United States since 1882, when the first important shipments were made:

Exports of asphalt from Beyroot to the United States since 1882.

Years.	Value.
1882	$12,239.00
1883	11,576.99
1884	6,095.00
1885	3,176.30
1889	1,958.17
1890	6,983.00
1891	7,303.03
1892	21,207.44
Total	70,538.93

During the years 1886, 1887, and 1888 none was exported from this consular district to the United States, owing to low prices in America and a scarcity in the supply for home consumption.

From statements made by a number of reliable persons it seems very probable that asphalt exists in large quantities in all the mines which have been discovered, and that thousands of tons might be extracted every year if the local authorities would allow the mines to be worked. The following is a detailed analysis of the asphalt taken from the Hasbaya mine:

The weight of the specimen was 575 grams. This asphalt is black in color, of a bright, jet-like luster, making a blackish-brown streak on unsized paper. Its brittleness is extreme; splinters may be easily chipped off with the fingers. Its specific gravity is 1.104.

It is very combustible. It readily burns with a heavy, yellow flame, yielding much soot and a "bituminous" though not very disagreeable odor. A splinter held in a flame melts and drops off before igniting. On burning it swells up, and bubbles of gas escape. Six grams ignited and incinerated for an hour over an alcohol flame lost 4.5 grams in weight, or 75 per cent.

Pulverized it is brown in color and slightly gummy. Two and a half grams of the powder destructively distilled for an hour readily melted, then gave off gases which quickly ignited and burned for about fifteen minutes with a clear, white flame of about 1-candle power and for a somewhat longer period with a feebler flame. The loss of the volatile hydrocarbon gases distilled from 2.5 grams was 1.7 grams, or, in other words, the bitumen contains 68 per cent. of volatile hydrocarbons, and would therefore furnish valuable material to enrich illuminating gas.

ABRASIVE MATERIALS.

By E. W. Parker.

BUHRSTONES.

Buhrstones, or millstones, are made from a quartz conglomerate rock occurring along the eastern slope of the Allegheny mountains in New York, Pennsylvania, Virginia, and North Carolina. A similar rock is also found near Fair Haven, Vermont. It is known locally by various names. In Ulster county, New York, it is called Esopus stone; in Lancaster county, Pennsylvania, it is known as cocalico-stone; in Montgomery county, Virginia, it is quarried as Brush mountain stone, and in Moore county, North Carolina, it goes by the name of North Carolina grit. During 1893 no millstones were made in North Carolina or Vermont. In fact production ceased in the former State about five years ago, and as the industry has shown a declining tendency elsewhere it has not been resumed there. In 1892 a small number of millstones were made in Vermont from stone quarried locally. No product was reported from that State in previous years, and there was no production there in 1893. The total product of the United States in 1893 was valued at $16,639, a decrease, as compared with 1892, of $6,778, and was less than at any time since 1880, with the exception of 1891, when the output was valued at $16,587—$52 less than in 1893.

The introduction of emery rock millstones will probably cause a still further decline in those made from quartz conglomerate.

The following table shows the value of buhrstones produced in the United States since 1880:

Value of buhrstones produced in the United States since 1880.

Years.	Value.	Years.	Value.
1880	$200,000	1887	$100,000
1881	150,000	1888	81,000
1882	200,000	1889	35,155
1883	150,000	1890	23,720
1884	150,000	1891	16,587
1885	100,000	1892	23,417
1886	140,000	1893	16,639

Imports.—The decline in the buhrstone industry has not been confined to stones of domestic production, as the following table of imports will show. These show an almost steady decline from $125,072 in 1880 to $24,007 in 1887. There was then a moderate increase in 1888 and 1889, but the business again decreased in 1890 and 1891, reaching in the latter year within $32 of the low-water mark of 1887. As in the case of domestic production the imports showed an increase in 1892:

Value of buhrstones and millstones imported into the United States from 1868 to 1893.

Years ended—	Rough.	Made into millstones.	Total.	Years ended—	Rough.	Made into millstones.	Total.
June 30, 1868..	$74,224	....	$74,224	June 30, 1881..	$100,417	$3,495	$103,912
1869..	57,942	$2,419	60,361	1882..	103,287	747	104,034
1870..	58,601	2,297	60,898	1883..	73,413	272	73,685
1871..	35,406	3,698	39,104	1884..	45,837	263	46,100
1872..	69,062	5,967	75,029	1885..	35,022	455	35,477
1873..	60,463	8,115	68,578	Dec. 31, 1886..	29,273	662	29,935
1874..	36,540	43,170	79,710	1887..	23,816	191	24,007
1875..	48,068	66,991	115,059	1888..	36,523	705	37,228
1876..	37,759	46,328	84,087	1889..	40,432	452	40,884
1877..	60,857	23,068	83,925	1890..	32,892	1,103	33,995
1878..	87,679	1,928	89,607	1891..	23,997	42	24,039
1879..	101,484	5,088	106,572	1892..	33,657	529	34,186
1880..	120,441	4,631	125,072	1893..	29,532	729	30,261

GRINDSTONES.

In 1893 the total value of grindstones produced in the United States was $338,787, against $272,244 the preceding year. The figures for 1893 include a small amount of whetstones made from sandstone in Ohio. The entire value is included in that of the sandstone product of Ohio and Michigan. During 1892 prices for this class of goods were very much demoralized, and while production itself decreased the value fell off much more, showing a total loss of over $200,000 as compared with 1891.

The annual production since 1880 has been as follows:

Value of grindstones produced in the United States, 1880 to 1893.

Years.	Value.	Years.	Value.
1880	$500,000	1887	$224,400
1881	500,000	1888	281,800
1882	700,000	1889	439,587
1883	600,000	1890	450,000
1884	570,000	1891	476,113
1885	500,000	1892	272,244
1886	250,000	1893	338,787

Grindstones imported and entered for consumption in the United States, 1868 to 1893, inclusive.

Years ended—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
June 30, 1868		$25,640		$35,215	$60,855
1869		15,878		99,715	115,593
1870		29,161		96,444	125,605
1871	385	43,781	3,957.15	60,935	104,716
1872	1,202	13,453	10,774.80	100,494	113,947
1873	1,437	17,033	8,376.84	94,900	111,933
1874	1,443	18,485	7,721.44	87,525	106,010
1875	1,373	17,642	7,656.17	90,172	107,814
1876	1,681	20,262	6,079.34	69,927	90,189
1877	1,245	18,546	4,979.75	58,575	77,121
1878	1,463	21,688	3,669.41	46,441	68,129
1879	1,603	24,904	4,584.16	52,343	77,247
1880	1,573	24,375	4,578.59	51,899	76,274
1881	2,064	30,288	5,044.71	56,840	87,128
1882	1,705	30,286	5,945.61	66,939	97,225
1883	1,755	28,055	6,945.63	77,797	105,852
1884					*a* 86,286
1885					50,579
Dec. 31, 1886					39,149
1887					50,312
1888					51,755
1889					57,720
1890					45,115
1891					21,028
1892					61,052
1893					59,569

a Since 1884 classed as finished or unfinished.

OILSTONES AND WHETSTONES.

The production of oilstones, whetstones, etc., in 1893, was slightly less than in 1892, being valued at $135,173, against $141,050, a decrease of $5,877. Included in this production are the two grades of novaculite from Arkansas, known as Arkansas and Washita stone; the fine-grained sandstone of Orange county, Indiana, known as Hindostan or Orange county stone; a gray sandstone, known as Lake Superior stone, from Cuyahoga county, Ohio; a similar stone, known as Labrador stone, from Cortland county, New York; chocolate stone from Lisbon, New Hampshire, and scythestones made from Indian Pond and Lamoille sandstones, quarried in Grafton county, New Hampshire, and Orleans county, Vermont, and from Berea, Ohio, "grit."

For several years prior to 1893 the output of finished stones has been practically controlled by the Pike Manufacturing Company, of Pike Station, New Hampshire, but during the past year the contracts with this company and some of the factories working for it were dissolved, and the factories resumed production on their own account. The factory of Mr. Geo. Chase renewed operations during the year, but the output was limited to Lake Superior whetstones, of which about 75,000 pounds, valued at $9,275, were turned out. In the spring of 1894 Mr. Chase received several carloads of Washita and Arkansas stone, and his factory is at present running to practically full capacity. No stones were finished in Arkansas, the quarries sending the rough stones to the Eastern factories for manufacture. The Deer Lick Oilstone Company, of

Chagrin Falls, Ohio, made and sold whetstones and scythestones, as did Mr. J. A. Chaillaux, of Georgia, Indiana; and Mr. John J. Kirk, of Huron, and Mr. H. E. Welles, of French Lick, in the same State, manufactured whetstones.

The Pike Manufacturing Company has kindly furnished this office with a detailed statement of its product in 1893, which is given below, together with its statement for 1892, for comparison. Mr. E. B. Pike, president of the company, states that during the first six months of 1893 the domestic business increased about 33⅓ per cent. over that of 1892, but decreased about 60 per cent. during the latter half. A slight increase is noted in the export trade of the company, while the import trade decreased materially.

Production of whetstones, etc., by the Pike Manufacturing Company in 1892 and 1893.

Kinds.	1892.		1893.	
	Output.	Value.	Output.	Value.
Washita stone ....pounds..	400,000	$60,000	300,000	$45,000
Arkansas stone ....do....	20,000	12,000	12,000	12,000
Labrador stone ....do....	500	50	200	20
Hindostan stone ....do....	300,000	15,000	250,000	13,000
Sandstone ....do....	100,000	2,000	100,000	2,000
Chocolate stone ....do....	20,000	2,000	20,000	2,000
Scythestones ....gross....	16,000	50,000	13,000	40,000
Total ....{pounds.. {gross....	856,500 16,000	141,050	682,000 13,000	114,020

Estimated exports of whetstones, etc., in 1892 and 1893.

Kinds.	1892.		1893.	
	Amount.	Value.	Amount.	Value.
Scythestones ....gross..	8,000	$20,000	8,000	$19,000
Washita stone ....pounds..	150,000	20,000	180,000	21,000
Arkansas stone ....do....	9,000	12,250	8,000	10,500
Hindostan stone ....do....	75,000	2,250	100,000	3,500
Sandstone	....	....	50,000	1,000
Total value	....	54,500	....	55,000

Estimated imports of whetstones, etc., in 1892 and 1893.

Kinds.	1892.		1893.	
	Amount.	Value.	Amount.	Value.
Turkey stone ....pounds..	1,000	$200	1,000	$200
Scotch stones (all kinds) ....do....	8,000	800	4,000	400
Razor hones ....dozen..	1,000	2,000	1,000	1,500
English scythestones ....gross..	50	300	25	150
Norway Ragg scythestones	....	None.	....	None.
German emery scythestones	50,000	1,000	30,000	500
Total value	....	4,300	....	2,750

The following table shows the total value of all kinds of hones and whetstones imported since 1880:

Imports of hones and whetstones since 1880.

Years ended—	Value.	Years ended—	Value.
June 30, 1880	$14,185	Dec. 31, 1887	$24,093
1881	16,631	1888	30,676
1882	27,882	1889	27,400
1883	30,178	1890	37,454
1884	26,513	1891	35,344
1885	21,434	1892	33,420
Dec. 31, 1886	21,141	1893	25,301

EMERY AND CORUNDUM.

The production of these allied abrasives in 1893 was slightly less than in 1892, being 1,713 short tons, against 1,771 short tons, a decrease of 58 tons. The value, however, declined considerably more, or from $181,300 to $142,325, a decrease of $38,975, or over 20 per cent. The production in 1893 was from Rabun county, Georgia; Macon and Jackson counties, North Carolina; West Chester county, New York, and Hampden county, Massachusetts. No corundum was mined in Chester county, Pennsylvania, during the year, the company formerly operating there having assigned. The output of emery and corundum is combined in these reports in order that individual statistics may be held confidential.

The following table shows the annual product of corundum and emery since 1881:

Annual product of corundum and emery since 1881.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			Short tons.	
1881	500	$80,000	1888	589	$91,620
1882	500	80,000	1889	2,245	105,567
1883	550	100,000	1890	1,970	89,395
1884	600	108,000	1891	2,247	90,230
1885	600	108,000	1892	1,771	181,300
1886	645	116,190	1893	1,713	142,325
1887	600	108,000			

THE OCCURRENCE OF CORUNDUM AND EMERY IN NORTH CAROLINA.

The corundum is found in "pockets" and veins usually 4 to 12 feet wide, chiefly in gneiss, talc, chlorite, and mica-schists, in massive anthophyllite, and in olivine or serpentinized rocks. Its occurrence at Corundum hill and Laurel creek has been ably described by Dr. T. M. Chatard in Mineral Resources for 1883 and 1884. North Carolina corundum is white, gray, pink, red, blue, green, brown, and brownish black in color, of various shades of depth, often banded. It sometimes possesses a chatoyant luster but is rarely sufficiently transparent for use as a fine gem.

Crystals have been found weighing as much as 375 pounds. The alteration products of corundum present a very interesting study. Frequently we find corundum wrapped in a layer of various minerals containing alumina and magnesia, and again we find these minerals surrounded by a layer of corundum. The above facts have led to an assumption, which may not always be well founded, that the corundum in these cases has undergone an internal, zonal, or external alteration. The minerals found thus associated are as follows: Margarite, prochlorite, ripidolite, vermiculite, damourite, lepidomelane, pleonaste, hercynite, diaspore, cyanite, zoisite, fibrolite, tourmaline, actinolite, smaragdite, albite, steatite, and kaolin. Within the last six months emery has been discovered on Skeena creek, 5 miles from Franklin, Macon county, North Carolina. This discovery has greatly stimulated prospecting in this region. The Fairview and Smoky mines are the best developed prospects. In both the ore is found to be more or less "pockety." It consists at the surface chiefly of hard emery rock, which continues 8 or 10 feet down and then pinches out or "runs into a flint seam," which may, however, lead to another vein-like pocket. The walls are decomposed chloritic, hornblendic, and talc schist or "soapstone." In the emery veins are found masses of red clay carrying manganese-stained sand-corundum, into which the hard emery rock seems to merge in shallow depth. An indication of the proximity of the emery or corundum veins is float rock from them, often near granite with coarse plated mica, and decomposed schistose rocks, carrying much magnetite. The emery seems to consist of a mixture of rather fine grained to medium coarse corundum and magnetite, often associated with chlorite, hematite, quartz, mica, garnet, and pyrite. About one ton of emery has been shipped from Fairview to be tested, it is said, at Chester, Massachusetts. Emery has also been reported as occurring at Cartoogaja Mountain.

The corundum mines of the Sapphire Valley Company are located in Jackson and Transylvania counties, North Carolina, on the southeast slope of the Blue Ridge mountains. In the Socrates mine, situated about 1 mile from the town of Sapphire, the vein is 2 to 6 feet wide, dips 45 degrees, and has been explored by means of shafts, tunnels, and crosscuts for a distance of about 1,000 feet. The deepest shaft is down 75 feet, and at its bottom shows rich corundum ore. This ore is known as "sand-corundum," and generally consists of white or gray corundum crystals about one-fourth inch in diameter, embedded in a matrix of decomposed chlorite and red clay. The walls of green chloritic schist often show slickensides and gradually become merged into a rock composed of radiately structured tremolite and anthophyllite. This last-named rock extends from 50 to 100 yards to each side of the corundum vein and is bounded by a fine grained granite or gneiss, which forms the usual country rock in this section. The vein material averages 15 per cent. corundum by a mill run. About 800 tons of ore ready for the mill are now on the dumps of this mine and the one next to be described.

The Bad creek mine is located 2 miles from Sapphire. The vein is a bedded one, 4 to 15 feet wide, and is exploited by means of tunnels, shafts, drifts, and open cuts. The ore shows white, pink, or blue corundum one-third inch to 1 inch in diameter, embedded in a gneiss consisting chiefly of black biotite or lepidomelane, chlorite, feldspar, hornblende, tourmaline, quartz, and garnet, sometimes associated with pyrite, margarite, autunite, molybdenite, kaolin, talc and asbestos. The vein averages probably 10 to 15 per cent. corundum. Surrounding the vein is frequently found a "walling" of chlorite 1 to 2 feet thick and then about 4 feet of hornblende schist, and beyond this anthophyllite rock extending 40 to 60 yards from either side of the vein to the country gneiss or granite. Another property, the Sapphire mine, is only partially developed, but shows very rich masses of corundum rock. The vein is about 7 feet wide, and contains a gangue of yellow decomposed mica and a fine-grained tourmaline gneiss, in which pink or blue-stained corundum crystals lie embedded. The Whitewater mine, 8 miles southwest of Sapphire, carries some highly crystallized and brilliantly colored corundum, of a decidedly resinous luster, besides much sand corundum. The mica here is decomposed and yellow, and occurs with white feldspar in various stages of alteration to kaolin. The Brockton mine, situated about 3 miles northeast of Sapphire, apparently consists of a series of pockets, in which are found very large dark brown crystals of corundum. From a single pocket about 75 tons of clean corundum were taken. The occurrence is peculiar in that the corundum crystals are wrapped in decomposed feldspar and margarite, mixed with a small quantity of tourmaline.

The Burnt Rock mine is located about 8 miles northeast of Sapphire. The corundum here is found embedded in dark green chlorite and decomposed yellow mica, and frequently occurs in large masses weighing from 25 to 50 pounds. The color of the corundum is mostly pure white, streaked with bands of deep blue. Rarely bronze colored masses are found with a chatoyant luster. Closely associated with corundum veins are deposits of large plated mica and long-fibered asbestos. The property of the Sapphire Valley Company embraces 15,000 acres, and extends about 21 miles along what is thought to be the three principal corundum leads found in Jackson and Transylvania counties.

Beside the above property, the company owns the Edison mine at Acworth, Paulding county, Georgia, 35 miles north of Atlanta. This mine is characterized by its beautiful blue and pink banded and striated corundum, occurring in large cleavable masses together with a much decomposed variety of quartz, feldspar, and chlorite. Although this mine is, as yet, only developed by a few shafts 25 feet deep, it has produced several tons of corundum, among which is, undoubtedly, the largest specimen of pure corundum ever mined, a specimen weighing nearly 100 pounds, which was exhibited in the Tiffany collection at the World's Fair. It is supposed that this variety of corundum contains a little water, as it is somewhat less hard and more easily cleavable than the common variety known as sand corundum, and turns white upon heating with the blowpipe.

The company's concentrating mill at Sapphire is well adapted to the purpose of crushing and separating the corundum from the gangue, and has a capacity of about 10 tons of clean corundum per twenty-four hours. This clean corundum was shipped as unfinished material in 100-pound sacks by team 46 miles to Hendersonville, and thence north by rail to be finished ("refined") and put on the market. The first quality or coarse corundum was sold for 10 cents per pound, and the second or finer sized material for 7 cents. The production for 1892 was about 150 tons, and for 1893 about 400 tons, the mill only having been run during four months.

THE LUCAS MILL AT CULLASAJA.

At Cullasaja, the Hampden Emery and Corundum Company has a mill for the treatment of its corundum and emery ores. It is commonly known as the Lucas mill, from Dr. H. S. Lucas, president of the company.

Power for its operation is obtained from a turbine developing 40-horse power. The ore consists both of so-called rock corundum and sand corundum. The rock or lump corundum is carried to the mill by team, crushed in rock breakers, and ground down to size No. 12. The principal ore, sand corundum, is sent down from the mines upon Corundum hill in plank sluice troughs, a foot or two wide, a distance of 1½ miles to the mill. There are 3 sets of washing troughs at the mill, the ore and water being turned upon any one or all three at once by means of sluice gates with variable water feed. The pulp is fed to punched iron screens 3 feet wide and 8 long, with 7 or 8 holes to the linear inch. The "coarse" remaining on top of the sieve is reground in either vertical or horizontal steel rolls, and in the screw mill (the object here being to break off the chlorite from the corundum) and rewashed. All that part going through the washing sieves is separated into three sizes from No. 8 to No. 100 (the finest), dried in a furnace of 20 tons capacity in twenty-four hours, and shipped as unfinished corundum in sacks of 100 or 120 pounds to Chester, Massachusetts. Here it is sized more closely for the market. The maximum capacity of the above mill is 60 tons of ore, making not more than 20 tons of shipping corundum, as at least two-thirds of the ore is waste rock, such as chlorite and hornblende. Eight hands are employed in the mill when running full capacity, and 30 hands at the mines on Corundum hill. Generally a load of 8 sacks per wagon is sent to Dillsboro or Sylva and shipped from these towns by rail to Chester, where 8 or 10 grades of corundum are made, and the finished or "refined" product is put on the market. Dr. S. H. Lucas gives the production of the mill in 1893 as 304 tons and the average price as 5 cents per pound. When the corundum is below the sizes Nos. 60 or 70, it is sold for about 1 cent less per pound.

Emery imported into the United States from 1867 to 1893, inclusive.

Years ended—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
June 30, 1867	....	....	428	$14,373	924,431	$38,131	....	$52,504
1868	....	....	85	4,531	834,286	33,549	....	38,080
1869	....	....	964	35,205	924,161	42,711	....	77,916
1870	....	....	742	25,335	644,080	29,531	....	54,866
1871	....	....	615	15,870	613,624	28,941	....	44,811
1872	....	....	1,641	41,321	804,977	36,103	....	77,424
1873	610,117	$29,706	755	26,065	343,828	15,041	$107	70,919
1874	331,580	16,216	1,281	43,886	69,890	2,167	97	62,366
1875	487,725	23,345	961	31,972	85,853	2,990	20	58,327
1876	385,246	18,999	1,395	40,027	77,382	2,533	94	61,653
1877	343,697	16,615	852	21,964	96,351	3,603	....	42,182
1878	334,291	16,359	1,475	38,454	65,068	1,754	34	56,601
1879	496,633	24,456	2,478	58,065	133,556	4,985	....	87,506
1880	411,340	20,066	3,400	76,481	223,855	9,202	145	105,894
1881	454,790	22,101	2,884	67,781	177,174	7,497	53	97,432
1882	520,214	25,314	2,765	69,432	117,008	3,708	241	98,695
1883	474,105	22,767	2,447	59,282	93,010	3,172	269	85,490
1884	143,267	5,802	4,145	121,719	513,161	21,181	188	148,890
1885	228,329	9,886	2,445	55,368	194,314	8,789	757	74,800
Dec. 31, 1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,638
1887	367,239	14,290	2,078	45,033	a144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287	....	....	8,743	118,246
1889	503,347	18,937	5,234	88,727	....	....	111,302	218,966
1890	534,968	20,382	3,867	97,939	....	....	5,046	123,367
1891	90,658	3,729	2,530	67,573	....	....	....	71,302
1892	566,448	22,586	5,280	95,625	....	....	2,412	120,623
1893	516,953	20,073	5,066	103,875	....	....	3,819	127,767

a To June 30, only; since classed with grains.

INFUSORIAL EARTH.

The value of infusorial earth produced in 1893 was $22,582, but little more than half that of 1892, when the value was $43,655. The product in 1893 consisted of 850 tons of earth from Maryland and Connecticut sold crude, or without any further preparation than drying and pulverizing, valued at $10,902; 755 barrels (of 50 pounds) of refined material from New Hampshire, worth $9,680, and $2,000 worth of cleansing articles, made from earth mined in California in previous years, but not marketed until 1893. There were also some manufactured articles sold from earth previously mined in Nevada, but this has been included in the crude earth production of 1892, the year in which it was mined, and is not counted in the output of 1893.

The following table shows the annual production of infusorial earth since 1880:

Production of infusorial earth from 1880 to 1893.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1880	1,833	$45,660	1887	3,000	$15,000
1881	1,000	10,000	1888	1,500	7,500
1882	1,000	8,000	1889	3,466	23,372
1883	1,000	5,000	1890	2,532	50,240
1884	1,000	5,000	1891	....	21,988
1885	1,000	5,000	1892	....	43,655
1886	1,200	6,000	1893	....	22,582

TRIPOLI.

Mention was made in the report for 1892 of the development of a deposit of a siliceous earth in Newton county, Missouri. To this product the term of "tripoli" has been applied, though it is in reality a distinct mineral, being a siliceous lime-stone from which the carbonate of lime has been leached out, leaving the silica in a very porous state. Work was continued on the property in 1893, and the output increased over that of 1892 about 25 per cent. The product is used for water filters in the form of discs, cylinders, tubes, etc.; for ink blotters, either in the shape of rollers or in rectangular blocks about 5½ inches long, 2¾ inches wide, and three-fourths inch thick. It is very porous, absorbs fluids readily, and makes a very convenient as well as enduring desk blotter. When the surface becomes clogged by drying it is easily cleaned by rubbing gently over it a piece of ordinary sandpaper. The material is also ground into a fine powder for polishing metal surfaces and for manufacturing various cleansing preparations.

CARBORUNDUM.

This interesting artificial material continues to attract the attention of scientists, mechanicians and others interested in abrasives. Intelligent study has been given to it during the past year, and its properties and useful fields are becoming more clearly understood. Improvements have been made in the matter of binding, in the manufacture of wheels and discs, and there is no doubt of its continued usefulness in the arts. In glass-cutting and dental work it is particularly useful.

The present capacity of the Carborundum Company is 200 pounds per day, the power consisting of 225 horse power and a battery of 210 horse power, and 112,000 Watt & Westinghouse alternating dynamos. During 1893, 15,200 pounds of carborundum was produced, varying from No. 30, determined by the number of threads in the sieve, down to the finest powder. This is principally made in the form of wheels, which are distributed through the dental, glass, and other trades, 200,000 wheels being used by the dental trade during 1893. The glass trade uses it for the purpose for which Scott stone was formerly used.

The Carborundum Company of Monongahela, Pennsylvania, reports that it has sold in the form of machine wheels, dental wheels, discs and points, powder and hones, $35,933.21; goods manufactured and held in stock, $24,280.75, making a total for the year's business of $60,213.96.

PRECIOUS STONES.

By George F. Kunz.

INTRODUCTORY.

The value of the rough gems produced in the United States during 1893 decreased, as will be seen by the table on the following page, from $312,050 in 1892, to $264,041. This decrease is principally due to the financial depression. A considerable proportion of the total sales of rough gems found in the United States is to tourists who purchase these as souvenirs of some locality visited, and but for the increase in sales to tourists at the World's Columbian Exposition, it is probable that the decrease in value would have been very much more considerable.

In spite of the decline in production above noted, the year 1893 was characterized by a number of interesting gem discoveries, including a diamond weighing $3\frac{14}{16}$ carats, found in a new district, Oregon, Dane county, Wisconsin. An interesting fact was proved, that the supposed diamonds in the Canyon Diablo meteorites are really diamonds, and the first instances are recorded of the polishing of a diamond by means of the diamond dust obtained from meteoric iron. The finding of small rubies of fairly good color in Macon county, North Carolina, gives ground for the belief that larger and better stones may be found there by more extended development.

It is interesting to note further that, in spite of the financial depression, $143,136 worth of American turquoise was sold—a greater amount probably than has ever been sold from the Persian mines in a single year. The finding of a remarkable 66-carat green tourmaline at Paris, Maine, and the discovery of a new tourmaline locality in the San Jacinto mountains, in California; the development of the opal industry in Idaho, where the gems are quite equal to those of Hungary, and in sufficient quantity to make the United States prominent even compared with Hungary, Queensland and the more recent remarkable find in Wilcannia, New South Wales, and some new moss agate from Hartville, Wyoming, with interesting possibilities for inlaid and ornamental work, are among the notable developments of the year.

PRODUCTION.

The following table shows the value of the precious stones produced in the United States from 1883 to 1893, inclusive:

Estimated production of precious stones in the United States from 1883 to 1893.

Species.	1883.	1884.	1885.	1886.	1887.	1888.
	Value.	Value.	Value.	Value.	Value.	Value.
Diamond	....	$800	....	$60	....	....
Sapphire	$2,200	1,750	$500	750	$500	$500
Chrysoberyl	100	25	....	....	....	....
Topaz	1,000	500	1,250	1,000	2,000	600
Beryl (aquamarine, etc.)	500	700	750	5,500	3,500	800
Phenacite	....	....	....	....	....	650
Emerald	500	....	3,200	3,200	....	100
Hiddenite (Lithia emerald)	600	....	2,500	4,500	....	....
Tourmaline	....	2,000	600	5,500	500	....
Smoky quartz	10,000	12,000	7,000	7,000	4,500	4,000
Quartz	11,500	11,500	11,500	11,500	11,500	11,150
Silicified wood	5,000	10,500	6,500	1,500	36,000	16,000
Garnet	6,000	4,000	2,700	3,250	3,500	3,500
Anthracite	2,500	2,500	2,500	2,500	2,000	1,500
Pyrite	2,000	3,000	2,000	2,000	2,500	2,500
Amazon stone	3,750	2,750	2,750	2,250	1,700	1,700
Catlinite (pipestone)	10,000	10,000	10,000	10,000	5,000	5,000
Arrow points	1,000	1,000	2,500	2,500	1,500	1,500
Trilobites	500	500	1,000	1,000	500	500
Hornblende in quartz	600	600	300	200	100	....
Thomsonite	750	750	750	400	750	500
Diopside	300	....	100	....	50	....
Agate	1,500	4,500	2,000	2,000	4,000	4,000
Chlorastrolite	1,500	1,500	....	1,009	800	800
Turquoise	2,000	2,000	3,500	3,000	2,500	3,000
Moss agate	21,000	3,000	2,500	2,000	950	950
Amethyst	2,250	2,250	2,100	2,100	2,100	2,500
Jasper	2,500	2,500	....	....	....	100
Sunstone	450	450	350	300	150	....
Fossil coral	750	750	....	1,000	2,000	3,000
Rutile	....	....	750	750	....	....
Gold quartz	115,000	140,000	140,000	40,000	75,000	75,000
Rutilated quartz	....	....	250	1,750	....	....
Peridot	300	150	....	....	....	....
Total	206,050	221,975	209,850	118,519	163,600	139,850

Estimated production of precious stones in the United States from 1883 to 1893—Cont'd.

Species.	1889.	1890.	1891.	1892.	1893.
	Value.	Value.	Value.	Value.	Value.
Diamond					$125
Sapphire	$6,725	$6,725	$10,000	$20,000	10,000
Ruby					150
Topaz	400		100	1,000	100
Beryl (aquamarine, etc.)	747		1,000	1,000	500
Phenacite	200				
Emerald	450		1,000		
Tourmaline	2,250	2,250	3,000	3,000	5,000
Opal			5,000	10,000	5,000
Peridot			1,000	1,000	500
Smoky quartz	4,232	2,225	5,000	5,000	5,000
Quartz, rock crystal	14,000	14,000	10,000	10,000	10,000
Silicified wood				1,000	1,250
Garnet (pyrope, almandite and essonite)	2,308	2,308	3,000	5,250	2,000
Anthracite				3,000	3,000
Pyrite	2,000	2,000	1,500	1,500	1,500
Amazon stone	500	500		1,000	1,000
Catlinite (pipestone)	5,000	5,000	5,000	5,000	5,000
Arrow points				1,000	
Thomsonite	400	400	200	500	500
Diopside				500	105
Agate				2,000	1,000
Chlorastrolite	500	400	500	500	500
Turquoise	23,675	28,675	150,000	175,000	143,136
Moss agate				1,500	2,000
Amethyst	98			200	75
Fossil coral	700	700	1,000	1,000	1,000
Rose quartz	600	200		200	100
Gold quartz	9,000	9,000	6,000	15,000	10,000
Rutilated quartz	30				
Dumortierite in quartz	250	250			
Quartz coating chrysocolla	4,000	2,000		500	
Chrysoprase	200	200		100	
Agatized and jasperized wood	53,175	6,000	2,000	10,000	20,000
Banded and moss jasper	630				
Obsidian				100	
Fluorite	500	500			
Azurite and malachite	2,037			1,000	
Prehnite				200	
Zircon (*a*)	16,000				
Gadolinite, fergusonite, etc. (*a*)	1,500				
Monazite (*a*)	1,000				
Spodumene (*a*)	200				
Wooden ornaments decorated with minerals (*b*)	15,500	15,500	15,000	15,000	15,000
Staurolite crystals					500
Miscellaneous minerals (*c*)	20,000	20,000	15,000	20,000	20,000
Total	188,807	118,833	235,300	312,050	264,041

a Used to extract the rarer elements for chemical purposes.
b Such as clocks, horseshoes, boxes, etc.
c Collection and souvenir minerals.

DIAMONDS.

During the year 1893 several interesting discoveries of diamonds were made in the United States, although this is not a regular diamond-producing country. In December my attention was called by Prof. William H. Hobbs, professor of mineralogy and metallurgy in the University of Wisconsin, at Madison, to a diamond that had been found in Oregon township, 2½ miles southwest of Oregon Village, in Dane county, Wisconsin. Through his courtesy the stone was sent to the writer by the finder, Mr. Charles Devine, of the place just named. The diamond was found by him while husking corn, in October, 1893, in a rough, stony field which had been under the plow for forty years. The bank of clayey earth in which it was found contained a large number of rounded pebbles of quartz, but no other of the associated minerals of the diamond; and as the entire district consists of glacial drift coming from the north, a diamond bed is not likely to exist in the immediate vicinity, but is rather to be looked for in the direction from which the drift came.

The diamond is a rhombic dodecahedron, deeply pitted with circular, elongated, reniform markings. In color it is slightly grayish-green. But it is one of those diamonds in which the color is likely to be superficial, and it would probably cut into a white gem. Its weight is $3\frac{14}{16}$ carats. This is the second authentic occurrence of diamond in Wisconsin, the other occurrence being at Plum Creek, Pearce county, of three small stones, the largest of which weighed $\frac{25}{32}$ carat, see the last report (p. 759). A 16-carat diamond was reported to have been found, also in glacial drift, at Waukesha, Wisconsin, in 1884. Some litigation resulted from its finding, and considerable doubt was expressed at the time as to the genuineness of the discovery.

A small elongated crystal 7 mm. long and 4 mm. in diameter, weighing three-fourths of a carat and of a bright, light canary color, with polished surfaces, was found in the vicinity of Kings Mountain, North Carolina, during the summer of 1893. Mr. H. S. Durden, of the California State Mining Bureau, reports that two small diamonds were obtained in 1892 and 1893; at Cherokee, Butte county, California. One weighed 2 carats.

The London Mining Journal of May 6, 1893, states that important discoveries of diamonds have been made in the Landak district of Borneo. Landak is about three days by steamer from Singapore, and the district has been declared by experts to be not only gem-bearing but auriferous. A large number of diamonds have been taken from the beds of streams. Under ordinary circumstance this would require dredging or diving, but at an interval of every five or six years the streams become so abnormally dry and shallow that the beds can be reached without difficulty.

Diamonds in meteorites.—The discovery of diamonds in the Canyon Diablo meteoric iron was first announced by Dr. A. E. Foote in the American Journal of Science for July, 1891 (Vol. XLII, pp. 413–417). Diamonds have previously been noted in the Novy Urej Russian meteoric stone by Latchinoff and Jerofeieff, and in the Arva, Hungary, meteoric iron by E. Weinschenck. On cutting the Canyon Diablo meteorite it showed extraordinary hardness, a day and a half being consumed and chisels destroyed in the process of removing a section. In the cutting, the chisels had fortunately gone through a group of small cavities, which on examination were found to contain hard particles that cut through polished corundum easily, while the emery wheel used to polish the surface was ruined. The grains exposed were small and black, and Prof. Geo. A. Koenig pronounced them diamonds because of their hardness and their indifference to chemical reagents. The extreme hardness was subsequently verified by the writer, who carefully examined the type specimen.

Dr. Oliver W. Huntington has contributed much valuable information in regard to this meteoric iron. The results were first announced in *Science*, on April 8, 1892, and were read in detail before the American Academy of Arts and Sciences on May 11, 1892, and afterwards published in the Proceedings, new series, Vol. XXII, p. 252, and in *Science* of July 8, 1892.

He placed 100 grams of iron in a perforated platinum cone suspended in a platinum bowl filled with acid, the cone being made the positive pole and the dish the negative pole of a Bunsen cell. The iron slowly dissolved, leaving on the cone a large amount of black slime. This was carefully collected and digested over a steam bath for many hours first with aqua regia, and afterwards with strong hydrofluoric acid. Most of the residue disappeared, but there remained a small amount of white grains which resisted the acids, and, when carefully separated by hand, resembled fine beach sand. Under the microscope they were found to be transparent and of brilliant luster. One of the grains was then mounted upon a point of metallic lead and drawn across a watch crystal, when it gave the familiar singing noise characteristic of a glass-cutter's tool and with the same result, namely, cutting the glass completely through. It deeply cut glass, topaz, and a polished sapphire.

Subsequently M. C. Friedel says, in the Bulletin de la Sociètè Francaise de Mineralogie (No. 9, p. 258, December, 1892), that he took a fragment of the Canyon Diablo meteorite, weighing 34 grams, with the characteristic Widmannstattian figures, and treated it with hydrochloric acid. He digested the residue in aqua regia and obtained a black powder. After various treatments he thus separated about 0·35 gram of a powder, which he presented to the Academy. No grains were found measuring more than 0·5 mm., the powder being fine and impalpable, capable of scratching corundum, and sinking in a solution of iodide of methyl having a density of 3·3. He also burned some of the black residue, and as a product obtained CO_2.

At the meeting above referred to of the Academy of Arts and Sciences Dr. Huntington showed to the members, under a microscope, the slightly yellow transparent grains he had obtained, and called attention to their adamantine luster. Not enough of the clear material was obtained at the time for a chemical test, and, on account of the association of the diamond grains with amorphous carbon, such a test would not have been conclusive without a perfect mechanical separation. The writer suggested that if enough of the clear grains could be obtained to polish a diamond it would be a conclusive test.

For this purpose about 200 pounds of the meteoric iron was carefully examined, and specimens which appeared to contain diamonds were dissolved. The method used will be published by Dr. Huntington later.

After enough material had been separated by him, on September 11, 1893, Dr. Huntington and the writer were enabled, through the courtesy of Messrs. Tiffany & Company, to try the desired experiment in their diamond-cutting pavilion in the Mining Building of the World's Columbian Exposition. (*a*) They had prepared a new skaif or wheel, 10½ inches in diameter, which was placed in position after having been specially planed down and prepared with the radiating scratches so as to be easily charged with diamond powder. A diamond was then soldered in a metal dop and placed on the clean wheel, which made 2,500 revolutions per minute. This diamond was tried for more than five minutes by itself without the slightest polish resulting, and no markings other than such as would be produced by the minute shattering of the diamond at extreme edges, due to the friction, as when a diamond is placed on an uncharged wheel. A cleavage weighing five thirty-seconds of a carat was set with solder in the metal dop, ready to be placed on the wheel, the diameter of which where the stone was to be placed was 4 inches. The wheel was then charged with the residue from the meteorite (the powder mixed, as usual, with oil).

The moment that the diamond was placed on the wheel a hissing noise was apparent, showing to an expert that the material was really cutting the diamond. In three minutes a flat surface measuring 3 mm. by 1 mm. had been ground down and polished. A small crystal with a natural face up was then set in the metal dop, the crystal being a complex twin, weighing four thirty-seconds of a carat. It was first tried on a projecting angle. The cutting was very slow for about seven minutes as the natural face of a diamond is always exceedingly hard. The position of the stone was then slightly changed, and a face measuring 2 mm. by 1 mm. was ground on the stone and cut. Three minutes later the surface had been cut down somewhat and a decided polish was produced on the triangular face, which was 3 mm. by 1.25 mm. The fragment used was one of the octahedral faces of a crystal. The face ground down was at the angle of 45 degrees with the octahedral face. The entire time of this experiment was fifteen minutes. The two experiments having been made with great care with both of us present, we can not hesitate to pronounce the material diamond, or a substance with the same hardness, color, luster, and brilliancy. (*b*)

The diamond industry.—The great interest manifested in the diamond-cutting industry at the present time makes a statement of the condition of this, and the allied industries abroad, opportune.

At Amsterdam, which is the chief diamond-cutting center at present, there are 52 large factories and about 20 small ones, using steam as a motive power, where the rough diamonds are cut into brilliants and roses. The largest of these is the establishment of Messrs. Boas

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a This was announced in the American Journal of Science, Vol. XLVI, December, 1893, pp. 469-472.

b Paper read by G. F. Kunz before Chicago Academy of Science, September 15, 1893.

Brothers, which counts 600 mills, turning as many cylinders or "skaifs." Every one of these is occupied by one polisher; and these, with the number of "setters" (verstellers) and apprentices, bring the total up to at least a thousand persons for this single factory. If we estimate that the 52 large establishments have an average of but 60 mills each, or a total of 3,120 mills, and that the 20 small ones average 20 mills each, making 400 mills, we have in all 3,520 wheels or skaifs. Then counting for each mill or wheel, including polishers, setters, apprentices, scaive-scrapers, and machinists, at least two persons, we have 7,040 employés. To these must be added the diamond cleavers and cutters, about 460 persons, of whom one-quarter are women, giving a total of 7,500 persons for Amsterdam. Now, the large diamond-trading club, composed of diamond merchants and brokers, numbers about 900, and the two smaller ones about 400, with perhaps 100 additional dealers who transact their diamond business in the cafés in the vicinity of the clubs. Adding to these the merchants and brokers who do not frequent any of these places, and the employés of the one steam diamond-cutting shop at Rotterdam, we have about 10,000 persons in all engaged in the diamond industry in Holland.

Antwerp has been rapidly becoming one of the greatest diamond-cutting centers. Whereas in 1870 there were 4 mills and 200 diamond workers, in 1893 there were 78 mills and 4,000 workers, and diamonds are annually cut to the value of 12,000,000 francs. London comes third in importance, where the diamond polishers, brokers, importers, and dealers in rough diamonds must number about 1,000 persons. St. Claude and adjoining cities in the Jura mountains, in France, have several diamond-cutting establishments that employ in various capacities about 1,000 people. Paris comes next with several diamond works, as also a great number of diamond merchants and brokers; these will reach above 500 individuals. Geneva and Berlin each possess a diamond-cutting shop, at each of which perhaps 100 people are employed; and, finally, Hanau, the jewelry center in Hesse, Germany, where much goldsmiths' work is done, and where a few years ago were established two large diamond mills and four or five small ones, all operated by steam power, which on an average employ 500 persons.

In Idar and Oberstein about 1,000 more are similarly engaged, giving a total of above 16,500 persons occupied in the diamond business in Europe; but this does not include the merchants, dealers, and work people who set diamonds in jewelry, or any of the white and colored population engaged in diamond mining at the Cape and in Brazil. If we estimate, therefore, the number of dealers in Europe at about 4,000, and about 200 in the United States and elsewhere, and the workers at the mines, which at present are not carried on with great activity, at between 7,000 and 8,000 persons, we reach a total approximating 28,000 people at the principal diamond centers of the world. When we read, therefore, that in past centuries 60,000 persons were working at some of the Indian diamond mines at one time, this statement is perhaps not exaggerated, since with the aid of modern machinery more is accomplished by 1,000 persons than formerly by twenty times that number.

Roughly speaking, there probably are in the entire world some 6,500 cutters and about 8,000 dealers in diamonds, who carry in their stock $350,000,000 worth of stones, which is probably one-third of the world's entire possession at the present time; as the total value of all the diamonds known is over $1,000,000,000.

To compare present conditions with those of the past, it is instructive to note the enormous increase in the production of diamonds, and the important industrial changes wrought thereby, which have resulted from the discovery and working of the great South African mines. During the past quarter century, 10 tons of diamonds, selling for more than $300,000,000 uncut and $600,000,000 after cutting, have been added to the world's wealth—an amount more than twice as great as was known to exist before. This vast value is in the most concentrated, portable, and ornamental form, and more convertible than anything except gold and silver. Its accumulation has built up cities like Kimberley, and maintained important industries in Amsterdam and other centers. The De Beers Company, Limited, a single corporation, with stock having a market value quoted at over $90,000,000, controls more than nine-tenths of the entire output, and regulates and maintains the price. As a result, diamond-cutting industries have been established such as were not thought of before, employing thousands of people in immense mills, where the cutters hire only the benches at which they do their work.

Mr. Gardiner F. Williams, superintendent of the De Beers Diamond Mining Company shows that diamonds were mined and sold worth £3,239,389 during the past year. The expenditures amounted to £1,695,293 and the profits to £1,544,096. Through improved mining facilities they have been able to mine the blue stuff for 3 shillings 6 pence per load, formerly 5 shillings and 6 pence, and that they have increased the amount on the floors by 981,557 loads, equaling £2,500,000 on the floors.

In this country diamond cutting has been carried on with some success, and the following statistics and historical notes may properly be appended here. The official census of 1890 reports as follows regarding the diamond-cutting industry in the United States: In New York in 1889 there were sixteen firms engaged in cutting and recutting diamonds, and in Massachusetts three. Cutting has also been carried on at times in Pennsylvania and Illinois, but this has been discontinued.

In 1889 seven of the New York firms ran on full time, but the others were unemployed, respectively, for 14, 50, 61, 120, 125, and 240 days, owing to inability to obtain rough material at a price at which it could be advantageously cut. The firms fully employed were generally the larger ones, whose business consisted chiefly in repairing chipped or imperfectly cut stones or in recutting stones previously cut abroad, which, owing to the superior workmanship in command here, could be recut at a profit, or else in recutting very valuable diamonds when it was desired, with the certainty that the work could be done under their own supervision, thus guarding against any possible loss or exchange for inferior stones.

It will be seen from the following table that the industry employed 236 persons (69 under age), who received $148,114 in wages. Of the 19 establishments, 16 used steam power, which was usually rented. Foot power was used in but one establishment. Three of the firms were engaged in shaping black diamonds for mechanical purposes, for glass cutters and engravers, or for use in the manufacture of watch jewels. The average weight of the material before and after cutting is also given in the table. The marked difference in the prices of diamonds, as shown, is due to variations in their weight and quality.

Beginning in the latter part of 1888, and lasting through 1889, there was a marked increase in the price of rough diamonds, resulting in rapid advances of from 20 to 25 per cent. at a time, amounting in all to an increase of from 80 to 100 per cent. above the prices of the previous years.

Census of the diamond-cutting industry, 1889.

	Massachusetts.	New York.	Total.
Number of works	3	16	19
Weight of material before cutting...carats..	4,100	50,244	54,344
Weight after cutting into gems, watch jewels, and for mechanical uses ....carats..	1,580	23,425	25,005
Value after cutting into gems	$41,000	$965,716	$1,006,716
Number of men employed	11	156	167
Average wages per day	$4.10	$3.49	$3.53
Average number of days employed	300	229	234
Number of boys employed	4	65	69
Average wages per day	$1.17	$0.62	$0.65
Average number of days employed	300	211	216
Total wages	$14,932	$133,180	$148,114
Value of machinery used in cutting	$3,000	$74,050	$77,050

IMPORTS.

The diamonds used in this industry are all imported, for, as already mentioned, they are but rarely found in the United States. The following table gives the imports of rough diamonds for a series of twenty-one years:

Imports of rough or uncut diamonds since 1873.

Years ending June 30—	Value.	Years ending June 30—	Value.
1873	$176,426	1885	$371,679
1874	144,629	1886	302,822
1875	211,920	1887	262,357
1876	186,404	1888	322,356
1877	78,033	1889	250,187
1878	63,270	1890	513,611
1879	104,153	1891	804,626
1880	129,207	1892	1,032,869
1881	233,596	1893	802,075
1882	449,513		
1883	443,996	Total for 21 years	6,251,550
1884	367,816		

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Diamonds.			Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.			
June 30, 1867	$906			$1,317,420	$291	$1,318,617
1868	484			1,060,544	1,465	1,062,493
1869	445	$140		1,997,282	23	1,997,890
1870	9,372	71		1,768,324	1,504	1,779,271
1871	976	17		2,349,482	256	2,350,731
1872	2,386	89,707		2,939,155	2,400	3,033,648
1873		40,424	$176,426	2,917,216	326	3,134,392
1874		68,621	144,629	2,158,172	114	2,371,536
1875		32,518	211,920	3,234,319		3,478,757
1876		20,678	186,404	2,409,516	45	2,616,643
1877		45,264	78,033	2,110,215	1,734	2,235,246
1878		36,409	63,270	2,970,469	1,025	3,071,173
1879		18,889	104,158	3,841,335	538	3,964,920
1880		49,360	129,207	6,690,912	765	6,870,244
1881		51,409	233,596	8,320,315	1,307	8,606,627
1882		92,853	449,513	8,377,200	3,205	8,922,571
1883		82,628	443,996	7,598,176	*a* 2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315		9,139,460
1885	11,526	30,426	371,679	5,628,916		6,042,547
Dec. 31, 1886	8,949	32,316	302,822	7,915,660		8,259,747
1887	9,027	33,498	262,357	10,526,998		10,831,880
1888	10,025	29,127	244,876	10,223,630		10,557,658
1889	8,156	68,746	196,294	11,704,808		11,978,004
1890	147,227	179,154	349,915	*b* 12,429,395		13,105,691
1891	565,623	125,688	408,198	11,657,079		12,757,079
1892	532,246	144,487	516,153	13,328,965		14,521,851
1893	357,939	74,255	444,137	9,321,174		10,197,505

a Not specified since 1883.
b Includes stones set and not specially provided for since 1890.

The importation of rough or uncut diamonds in 1880 amounted to $129,207; in 1889 to $250,187, and the total for the decade was $3,133,529; while in 1883 there was imported $443,996 worth, showing that there was 94 per cent. more cutting done in 1889 than in 1880, but markedly more in the years 1882 and 1883. The large increase in importation is due to the fact that in the years 1882 to 1885 a number of American jewelers opened diamond-cutting establishments, but the cutting has not been profitably carried on in this country on a scale large enough to justify branch houses in London, the great market for rough diamonds, where advantage can be taken of every fluctuation in the market and large parcels purchased which can be cut immediately and converted into cash, for nothing is bought and sold on a closer margin than rough diamonds.

The average wages paid in the United States are $2 per carat less bench expenses. In Boston $3 per carat and higher is paid. In one New York shop, where mathematical accuracy is demanded, $4 per carat is paid. During 1893 diamond cutting was carried on in the United States by 15 firms, employing each from 1 to 20 men, the total number amounting from 130 to 150, consisting of diamond cleavers, cutters, polishers, etc.

The American public demands a much higher quality of cutting than the dealers of the European markets. The result is that more time is consumed, and hence a higher rate of remuneration is demanded. But at present less is often paid for cutting here than in Amsterdam.

Good European workmen receive an equivalent of about $2 per carat in the shops there, while their bench expenses are less than they are in this country. When one considers also the fact that better work is required here for the same wages, it will be seen that there is small inducement for Amsterdam cutters to emigrate.

This subject of diamond-cutting in the United States is worthy of consideration when we remember that there have been imported into the United States since 1868 more than $175,000,000 worth of diamonds, and about $15,000,000 worth in the year between June, 1892, and June, 1893. Of these, the original rough stones could not have cost more than one-half. The difficulty with the diamond-cutting industry in this country is due, as above noted, to the inability of the dealers to obtain the rough stones at first hand, and the fact that diamond-cutting is an old-established industry, and in many ways waste is prevented by a more economic system of working.

The pioneer diamond-cutter in the United States was Mr. Henry D. Morse, of Boston, Massachusetts, who in early life learned the engraver's art and later became a jeweler. In 1869, Mr. Morse had delivered to him the Dewey diamond, weighing $25\frac{1}{3}\frac{1}{2}$ carats, which was found near Richmond, Virginia, and by adroit manipulation and due regard to lights and geometric relations, produced from the rough stone a gem weighing $11\frac{1}{3}\frac{1}{2}$ carats, which permanently established his reputation as a cutter and polisher.

Shortly after the great yields of the South African diamond fields began to attract the attention of the trade in 1871, Mr. B. S. Pray, of Boston, at that time engaged in the African diamond trade, brought to this country a parcel of rough diamonds with the intention of seeing what Mr. Morse could do in the way of cutting. The two men associated themselves in business, and in a short time the industry of diamond cutting was an established fact in this country. The Morse Diamond Cutting Company was the style of the firm, and American dealers watched the result of the undertaking with much interest. Dutch workmen were employed at first, working under Mr. Morse's supervision. Conformably with their long-established custom, the workers maintained secrecy with respect to their art; but Mr. Morse, already familiar with the work, took pains to acquaint himself with all details, which he communicated to apprentices in a shop established in the suburbs of Boston. When the former finally struck, Mr. Morse was ready for them, and his American hands, men and women, took the places of the Amsterdam cutters at once.

The firm of Crosby, Morse & Foss, which succeeded the Morse Diamond Cutting Company, was dissolved in 1875, Mr. Morse going into business on his own account as a cutter and dealer in diamonds. In 1887 he again associated himself with one of his old partners, under the style of Henry D. Morse & Charles D. Foss. Mr. Morse died on January 2, 1888, after having lived to see the art introduced by him extended to about a dozen cutting shops in this country at the time of his death.

In 1870 Mr. Herrmann started the New York Diamond Cutting Company, in New York city. In his attempt to establish this industry in the United States he has sunk three fortunes, but he still has faith in this ultimately becoming a diamond-cutting center.

Both Mr. Morse and Mr. Herrmann taught the art of diamond cutting to girls, which led to the taking up of this industry by women, not only on this side of the Atlantic but to a large extent in France, Switzerland, and other European countries. It was really these pioneer diamond cutters that increased the taste and proficiency of the workers abroad; for cutting diamonds as they did, with mathematical precision, they created a demand for such work here, which the foreign cutters had to acquire the skill to meet; and the result was a style of diamond cutting never before equalled.

Changes in cutting machinery.—In Mr. Morse's shop, in 1872, Mr. C. M. Field invented the first diamond-cutting machine, which has made it possible to do the work faster and with more precision than by the old hand process. It has been adopted in some of the larger establishments in the United States, although abroad its true value has not yet been fully recognized.

Sir Henry Bessemer has devised for the London cutters an endless rope that furnishes the power for as many as ten diamond mills at the same time, thus doing away with the long belt for each machine. Now, an individual dynamo for each mill is suggested, thus dispensing with the belts entirely, saving power and making it possible to cut diamonds with more cleanliness than with a moving belt. This is also of interest when one realizes that small dynamos could be attached directly to precious-stone polishing wheels, to the gem-cutting lathe, or, better still, to the revolving drill, such as is used for the dentist's work and gem engraving, thus producing, as in the days of ancient Greece and Rome, more artistic finish than would be possible by the horizontal lathe method. This method of gem engraving was fully described by the writer in a paper read before the New York Academy of Sciences, May 25, 1884.

SAPPHIRE.

About $20,000 worth of sapphire was sent abroad in 1892, but during 1893 more Montana sapphires were actually sold than in any previous year, probably on account of the company's endeavor to introduce them into the London market, and also because of the large influx of people into this country and particularly to the World's Columbian Exposi tion, where a lapidary cut and sold these stones in one of the main aisles of the Mining Building.

At a meeting of the Montana Sapphire and Ruby Company, held in London, December 18, 1893, a deficit of £6,000 was shown, £158 only having been realized from the sale of the gems during the past year. It was also shown that in this company, which was supposed to have been incorporated with a capital of £450,000, apparently not more than one-tenth of that amount had been subscribed; as the underwriters, among whom were the Marquis of Lorne, the Duke of Portland, and the Duke of Leinster, representing £370,000, had withdrawn, so that in reality only £45,000 had been actually paid in.

Among other sapphire deposits in Montana is one of 1,500 acres on the west fork of Rock creek, 25 miles west of Phillipsburg, in Granite county, on the east slope of the Bitter Root range. The specimens obtained here are red, pink, yellow, blue, and amethyst of various shades. The matrix is an argillaceous slate. Another deposit of about 2,500 acres is situated on Dry Cottonwood creek, about 5 miles east of the mining camp of Champion and on the western slope of the main ridge. Within the few days that this was worked, about 25 pounds of sapphires were found. On Rock creek the yield is about 60 stones to the pan of gravel, and about 30 stones to the pan at Bed Rock; on Cottonwood creek. Mr. F. B. Walker mentions a locality for sapphires as occurring about 125 miles northwest of Helena, Montana. The earliest mention of the finding of sapphires in Montana goes back to May 5, 1865, when they were found by Mr. Ed. R. Collins, an earnest and reliable prospector, on claim No. 4, before the discovery of Eldorado Bar. A stone was cut by Messrs. Tiffany & Co., and another by Messrs. M. Fox & Co., New York City. Mr. Collins also sent stones to an Amsterdam diamond cutter and other parties abroad, endeavoring to find a market for them.

RUBY.

On the Reeves farm, near Franklin, Macon County, North Carolina, in an alluvial deposit, some very interesting crystals of ruby have been round in flat, hexagonal, tabular forms, occasionally 10 to 12 millimeters in diameter and from 2 to 5 millimeters in thickness. Some of these crystals were of fairly good ruby color. One gem weighed when cut three-fourths of a carat; a number of others weighed from one-sixteenth to one-half of a carat, all of good color and quite equal to the medium rubies from Burmah, one gem selling for $50. Some investigation has been made, but as yet they not been found in sufficient quantities to warrant working the ground. Associated with these rubies are some irregular fragments of almandite garnet, very light in color, which, when cut, produced stones of unusually brilliant, rare, and beautiful tints, many of which have found ready sale at from $2 to $10 each. In many respects this was one of the most beautiful varieties of almandite garnet ever found.

It is to be hoped that the Burmah Ruby Mining Company will be more prosperous under its new lease, for which it will now pay the sum of 300,000 rupees instead of 400,000, as formerly, the Government, however, receiving a royalty of 30 per cent. on all rubies found, and the company relinquishing its right to mine for rubies in the whole of Upper Burmah, but securing the exclusive right to mine for rubies in the Mogok district, where the mine is situated and to which rubies have hitherto been confined. Up to 1893 the company has not been fortunate enough to declare a dividend.

TURQUOISE.

In 1893 turquoise has been more actively and more successfully mined than any other gem. The Azure Mining Company reports that material enough was mined to cut about 20,000 carats of turquoise during the year. Half of these were very good material, many of them small stones cut in Europe; and as the average selling price was $5 per carat, the production for the year amounted to $50,000. This company has adopted the system of offering to replace any stones that may change color; and every stone is marked with a small circle engraved on the back, showing it to be from this company's mines. Of the thousands sold, they claim that none have as yet been returned. Many of the stones found are of a paler blue than those formerly mined, and have met with ready sale.

The American Turquoise Company obtained and sold from its various mines $90,136.39 worth of fine blue turquoise during 1893.

The "Persian," situated near the old Castilian, 18 miles from Los Cerrillos, New Mexico, is another turquoise claim recently taken up by ex-Governor Bradford L. Prince, of New Mexico. It is contemplated to work the claim under the name of the New Mexico Turquoise Company, but since October 6, no developments have been made.

Mr. M. W. Porterfield, of Silver City, New Mexico, has found traces of turquoise on the surface half a mile from the Azure mine, in the Burro mountains, 15 miles south of Silver City, and has made excavations to the depth of about 18 feet. The turquoise has the characteristic green color of that in the Burro mountains. Whether any fine material will be found by further digging is a question.

Two other groups of turquoise mines are described by Mr. William E. Hidden as occurring in New Mexico. (*See* American Journal of Science, November, 1893, vol. 46, pp. 400–402, and the Jewelers' Circular, November 1 and November 8, 1893.) The first group is 15 miles southeast of the Azure Company's mines, in what is known as the Cow Spring district. Some prospecting had been done for turquoise, and 60 miles in a southerly direction the locality showed evidences of prehistoric workings; the matrix containing the trachyte is very similar to that in the Burro mountains. The nearest railroad station, 22 miles north of this locality, was abandoned because of the scarcity of the blue—the only valuable—shades of turquoise, the scarcity of water, and the arid condition of the surroundings.

The most important locality observed by Mr. Hidden is in Doña Ana county, in the Jarilla mountains, 150 miles east of the Burro range The mines are situated here in an arid and desolate region, Las Cruces being 50 miles west, and El Paso 50 miles south. The turquoise is described as occurring in trachyte containing minute crystals of quartz implanted in fine crystals of pyrite, granular jarosite and gypsum coating some of the same. A shaft 70 feet deep has been sunk on the contact with the porphyry, and turquoise was traced all the way down. This is the light green material called "*Shoo-ar-me.*" The writer believes that the phosphoric acid of the turquoise may have been derived from the limestone beds, adjacent to the trachyte, that may have covered this trachyte at no very distant date, and suggests that the oxidation of the pyrite evidently resulted in the decomposition of the kaolin, limonite, gypsum, and jarosite, and that this is a product of a subsequent kaolin, the kaolin being earlier, and the turquoise a secondary formation, basing his opinion upon the fact that the majority of turquoise deposits are semiglobular or reniform in outline, although compact masses are found wholly occupying small cavities.

The tendency of the turquoise is said to be toward the blue, more so than at the two other localities, although green varieties were observed which were attributed to alteration. The turquoise found at a depth of 25 feet or taken from rock was of a rich blue, but it rapidly faded after being detached from the matrix and becoming dry. At all three of the localities described by Mr. Hidden the discoveries were due to the investigation of old turquoise workings which had been considered merely copper stains. Ancient pottery which was unearthed made it probable that the place had been abandoned for several hundred years.

Messrs. Bell & Barber have opened what they term the Blue Gem mine and Manitou mine, at Village Grove Post-Office, Colorado, 25 miles south of Salida. All the turquoise found there up to the present time has been of a fair blue color, but mostly fissured and veined with small dark streaks. Few have been sold up to 1894.

George M. Bowers, of Los Angeles, California, reports the discovery of turquoise on the side of Turquoise mountain, near Clingman, Arizona, 40 miles from the Colorado river.

Turquoise is reported as occurring twelve miles from Hedi, King River District, Victoria, Australia, where it is found in veins in a gray slaty rock. The color is pale blue shading to dark green. Up to the present no fine gems have reached the gem marts, but it is believed by the miners that they will be obtained by deeper mining.

TOURMALINE.

At the historic Mount Mica locality at Paris, Oxford county, Maine, some work was carried on during the summer of 1893, resulting in the discovery of a number of large green crystals, one of which furnished one of the finest tourmaline gems ever found on this continent, being of a clear grass-green color and weighing 63½ carats. The total find of minerals and gems at Mount Mica for the year 1893 amounted to the value of $3,000. Among the crystals of tourmaline were some fine ones tipped with red, while the shafts were green with a transverse band of indigo blue at the middle portion.

Mr. Charles Russell Orcutt announced a new and remarkable occurrence of pink tourmaline in lepidolite, similar to that of Rumford, Maine, 12 miles south of Temecula, near San Luis Rey river, in San Diego county, the southern county of California, and it has already become celebrated from the abundance and beauty of the specimens yielded, as much as 20 tons having been sent East for sale. Through San Diego county runs the Peninsula range, rising several thousand feet between the coast and the Colorado desert. In these granite mountains are dioritic intrusions and some metamorphic schists, etc. West of the summit lies a parallel belt of granitic rock characterized by dikes of pegmatite, in one of the largest of which occurs this great deposit of lepidolite with tourmaline. In Pala, a little west of Smith's mountain, in the Peninsula range, San Diego county, California, a ledge of lepidolite containing rubellite has been traced for over half a mile. It consists of a coarse granite, penetrating a norite rock, and including masses of pegmatite. Small garnets occur in the granite, and black tourmaline, with a little green tourmaline.

The lepidolite appears in the southern portion, finally forming a definite vein which at one point is 20 yards wide. The rubellite is chiefly in clusters and radiations, several inches in diameter, also occasionally as single crystals, and the specimens of deep pink tourmaline in the pale lilac mica are remarkably elegant. About 18 tons were mined during 1892. No work has been done since then.

Tourmalines are mined at the California gem mine, the San Jacinto gem mine, and the Columbian gem mine, near Riverside, California. These three mining claims cover the ground on which the tourmaline is found, and are situated in the San Jacinto range of mountains in Riverside township, California, at an altitude of 6,500 feet, overlooking Hemet valley and the Cohuilla valley, and are 27 miles from the railroad. The formation in which the crystals are found is a vein from 40 to 50 feet wide running almost north and south through the old crystalline rocks which make up the mountain range.

The vein in some places consists of pure feldspar, or else feldspar with quartz, in others all mica, and in others rose quartz and smoky quartz. The tourmalines vary in size from almost micrograins to crystals 4 inches in diameter. They are most plentiful in feldspar, but are found in other portions of the vein, sometimes in pockets and sometimes isolated. The larger crystals generally have a green exterior and are red or pink in the center. Some of the crystals contain green, red, pink, black, and intermediate colors: others again are all of uniform tint—red, pink, colorless, or blue.

Associated with the tourmalnies are rose quartz, smoky quartz, asteriated quartz, and fluorite, and some of the quartz was penetrated with fine, hair-like crystals of tourmaline, strikingly like a similar occurrence of rutile. One of the finest specimens found is now in the Harvard College collection at Cambridge, Massachusetts. Another is in the American Museum of Natural History, New York City.

A fuller description is contained in "The Bullion," El Paso, Texas, pp. 3–4, February 13, 1894.

BERYL, EMERALD, AQUAMARINE.

No work was done at the emerald and hiddenite mine in Alexander county, North Carolina, during 1893.

According to the last report of the British minister at Bogota, the celebrated emerald mines of Muzo are situated about 80 miles to the north and northwest of Bogota, on the banks of the river Minero. They are Government property, but are farmed out to a Columbian-French syndicate at a yearly rental of $11,250 (£2,250). The working expenses can be roughly estimated at $50,000 (£10,000) per annum, and the mines yield a fair profit, the production of emeralds being of the value of about $100,000 (£20,000) annually. The rough stones are mostly sent to Paris to be cut, as native work is inferior to foreign. These mines are situated in a very rough, wild country, with nearly impassable roads; at the present time there are about 300 natives employed there. The mode of working is by open cuts, the debris being washed down the river by water collected in a reservoir built above the level of the mine.

The Emerald Mining Company of Colombia was reorganized during the year 1891 in London, and it was believed by the company that emeralds quite as fine as those from the famous Muzo mine would be found. The property was purchased for $1,100,000, all of which, except $10,000, was paid for by the shares of the company, in the expectation that emeralds would be obtained much sooner than they have been.

Mr. A. M. Field, of Asheville, North Carolina, reports that he has sold 89 beryls from Mitchell and Yancey counties, value $311.40. The prices vary from $1 to $20 per carat.

GARNET.

Mr. Field also found 118 garnets, worth $117, in Burke and Macon counties, North Carolina. The value per carat was from $1 to $10.

The essonite locality in Phippsburg, Maine, was worked by Mr. T. P. Lamb in 1893, and specimens valued at $250 were obtained.

MOSS AGATE.

At Hartville, Wyoming, large masses of moss agate, weighing from 40 to 50 pounds each, and covered on the outside with a white calcareous incrustation, have been found in a limestone rock on a 100-acre claim. When they are cut into translucent slabs, they show the magnificent black dendritic or moss-like markings in a most striking manner. Some table tops of this elegant material were exhibited in the Wyoming section of the Mining building at the World's Columbian Exposition. About 4,000 pounds have been found.

HYDROLITE.

Some remarkable specimens of hydrolite from the Cowlitz district, Washington State, were shown the writer by Mr. J. P. H. Morris, consisting of agate replacing fossil marine shells. Some of these silicified shells were nearly 2 inches across and of a beautiful white color, and were replaced by quartz and chalcedony, and filled with water and moving bubbles of air. They were valued from $1 to $15 each.

DUMORTIERITE.

Mr. John Stewart, of Los Angeles, California, informs me that he has found dumortierite in quartz on the land of Mr. Carey, 50 miles north of Yuma, and 11 miles west of the Colorado river on the Colorado desert, and about 25 miles from the Southern Pacific Railroad track. Here it occurs in blocks weighing several hundred pounds and upwards, and varies from dark blue to light blue and a mixture of blue and white, the occurrence being similar to that at Clipp, Yuma county, Arizona.

Mr. Stewart believes that this material can be delivered for $200 per ton on cars, and as the dumortierite thoroughly impregnates the quartz rock, this ought to find a market as a high-class ornamental stone. It is mistaken here for lapis lazuli. The locality where this dumortierite occurs can be worked only in the winter or in the rainy season, as the water has to be hauled from the Colorado river, and the climate is too hot from June until December for horses or white men in that locality.

OPAL.

Opals were discovered in Idaho during the summer of 1892 by Mr. George Shirley, Mr. F. B. Schermerhorn, and Mr. H. C. Anchor, who kindly furnished me with the following information.

The Owyhee opal mines of Idaho are situated on section 13, township 1 north, range 4 west, Boise meridian, about 3 miles from Snake river in Owyhee county. The work done on the mine amounted to about eight months' work for two men. The opal taken out amounted to about 7,000 carats in the rough, varying from transparent fire opal to the finest white noble opal; but nearly all that they found was given away or poorly marketed. They are found in a dike or vein of dark blue or black andesite rock, 25 feet in thickness, running in a northwest and southeast direction with a nearly perpendicular pitch. This crops out on the surface for a distance of about 750 feet in length by 25 feet wide. In the center of this dike is a stratum of jasper, very hard, 4 to 5 feet wide, on each side of which the opals are found in seams and flat pockets. Opals have been traced for a distance of 250 feet along the surface. The greatest depth reached is about 20 feet, all open cuts.

North of and parallel with this dike is a smaller dike traced for about 50 feet in length, by 8 feet in width. It has produced about 1,000 carats of good stones.

The North America Gem and Opal Mining Company, which works the mines at Moscow, Idaho, did no work during the year 1893, owing to a litigation with a former owner; but it is believed that in 1894 active operations will be carried on.

Opals were announced as having been discovered on a school section in Lincoln county, Washington, and a committee was appointed to investigate and report upon the discovery. It proved not to be a genuine find.

During the past two years opals have been found at Wilcannia, New South Wales, which in quality are quite equal to those from the famous Hungarian mines. It is reported that about 500 men are already on the fields and an immense amount of work and prospecting is going on. The opals found here are generally free from the yellow tint which the Queensland stones show by transmitted light. They are found in a fossiliferous sandstone rock. Many of the fossil univalve and bivalve shells are entirely changed to a beautiful noble opal, as is also the case with wood and branches of trees found in the same district. Some fine stones weighing nearly 50 carats each have been obtained at this place.

STAUROLITE.

During 1893 a large quantity of small crystals of twinned cruciform crystals of staurolite have been found in Patrick county near the Henry county line, Virginia, and they have been drilled at one end, a small eye inserted, and sold as lucky charms. About $500 worth were sold during the past year.

JADEITE.

There are at present two groups of jadeite quarries in Upper Burmah, which the French vice-consul says are situated respectively at the summit of the mountain near the village of Jawmaw and in the valley of the river Uru, the latter commencing near Sanka and extending for some miles below the mountain. The geographical position of Jawmaw is in latitude 25 degrees and 44 minutes north latitude, and 96 degrees and 14 minutes east longitude, while Sanka is about 6 miles from the east coast. According to all accounts, the river mines are the oldest, those on the mountaintop having only been discovered some fifteen years ago. In the valley of the Uru the jade is found in blocks in the alluvial sediment of the river. Where it is imbedded or is found in heavy masses, a primitive method for obtaining the material is adopted, namely, heating by fire on the surface, the reduction of the temperature during the night sufficing to crack the rock, and then by pure force the blocks are broken into transportable pieces. The mines are claimed by a native, who collects a royalty on all the jade produced at a variable revenue. The jadeite, Feitsui or imperial jade, harder than jade (nephrite) but not so tough, is a striking example of the favor that certain persons bestow upon a particular article, whereas others look upon the same article with indifference, and would not give centimes for that which the others have paid gold. The Burmese, but principally the Chinese, appreciate a fine piece of jadeite as much as—if not more than—gold. For example, a piece of jadeite, only sufficient for a bracelet, will fetch 400 to 500 rupees, whereas in Europe it would not fetch a small part of that amount. While China and Burmah are the only markets for the sale of jadeite, it should not be forgotten that the population of these two countries is at least 450,000,000, ready to buy all available jade. However this may be, and whatever the price of jadeite as an article of commerce, the fact is certain that it exists in inexhaustible quantities. If methodical processes of extraction were put in operation, if dynamite replaced the savage methods now employed, if one head in place of a hundred directed the work, the production of jadeite could be made enormous. But will a European company methodically work the deposits, in place of the Kachin savages who exploit them now?" The vice-consul replies: "It is improbable, because the difficulties of the undertaking would be too great."

The revenue for 1892–'93 was 35,000 rupees and for the year 1893–'4, 52,000 rupees.

LAPIS LAZULI.

One of the many remarkable objects in the Montez collection, Anthropological Building, at the World's Fair, was an immense mass of lapis lazuli measuring 26 inches by 14 by 8, and weighing 360 pounds, found in a stone grave in the vicinity of Chankas, Peru. The lapis lazuli was of a fine blue color and this is one of the largest masses known. In the Montez collection there was also a number of small idols and figurines of light green and dark green turquoise, the blue color having been destroyed by burial, if it had ever existed. These were obtained in the same region of Chankas, in a stone grave. With them were some small animals made of sodalite mistaken for lapis lazuli, also found in the vicinity of Chankas, near Cuzco, Peru. The entire collection has been acquired by the Field Columbian Museum at Chicago.

LABRADORITE.

The original locality on the coast of Labrador has been prospected for the past two years, and Lloyd & Taber, of New York, have obtained an extensive Government grant of the only available deposits, from which they have already obtained four tons of good material.

GEM EXPLORATION IN CEYLON.

Mr. Barrington Brown in January, 1893, presented a report on gem-mining to the Ceylon Gem and Mining Syndicate, limited. In this report he says that the rock formations of the island are chiefly gneiss, permeated occasionally by graphite, garnet, and occasional beds of limestone, and suggests that the latter may be the source of the spinels which are occasionally found with the rubies and sapphires.

In the districts visited the gems are generally found in beds of gravel called *illan* by the natives. Usually a number of beds of this *illan* occur, one over the other, separated by strata of alluvial matter in the form of mold or clay. The problem which presents itself to those in the syndicate is to find inexpensive methods of working the lower beds of gravel; as the upper strata have undoubtedly been frequently worked in the search for gems during the many centuries in which gem mining has been carried on by the Singalese, as well as by the natives of India, who have visited the island for this purpose. There is only one instance mentioned of valuable gems being found in the main mass of gneissoid rock. They are always found in the gravel, and hence the rocks have never been searched. Mining is entirely carried on in the beds of streams and rivers, both ancient and modern, where the gems must have either fallen from the overhanging rocks, or come from the wearing down of rocks at some distance from the river by tributary streams.

Rubies, sapphires, cat's-eyes, alexandrites, etc., are the gems sought for, but with these zircon, chrysoberyl, tourmalines, spinels, garnets, and other gems are also obtained. It is proposed to work the streams by means of dredges and other improved mining machinery. The properties mentioned are in Ratnapura, Rakwanne, and Doloswella. In the district acquired by the syndicate are several localities in the province of Sabaragamuwa. The gems occurring here are true sapphires, rubies, and cat's-eyes. Many valuable ones have been found, and the localities have been worked from time immemorial.

ARTIFICIAL PRECIOUS STONES.

Frequent references have been made in the public press during the year 1893 to Mr. Thomas A. Edison's experiments in producing artificial rubies and sapphires. As so much stress is laid commercially on the success of such attempts, inquiry was made of him by the writer as to whether his results had been satisfactory or not. He responded as follows: "The experiments to which you refer were given up because it was found impossible to produce stones free from bubbles, which rendered them useless for cutting edges." This referred to their use as points for the phonograph, but the same objection would render them valueless as gems.

In reference to a statement that the Cowles Electric Smelting and Aluminum Company is suffering an infringement on its patent for making artificial diamonds by means of an electric furnace, Mr. Cowles, the inventor, informs me that the statement is incorrect in so far as it relates to the subject of artificial diamonds, they never having produced any diamonds. Therefore another reputed artificial diamond discovery has been withdrawn. The Cowles brothers claim that they were the first to put on record the direct reduction of silicon from silica in the presence of carbon and in the absence of a base metal to alloy with the product, and they claim that the product they secured is the same as the substance "carborundum" (*a*) lately introduced as a polishing material. In this substance the Carborundum Company has discovered that there is carbon in combination with the silicon, forming a carbide. They now hold a patent secured on the composition of the carbides.

The new composition known as carborundum is essentially a carbide of silicon, containing silicon 69·10 per cent. and carbon 30·20 per cent. Dr. Mulhauser gives the specific gravity of green crystals as 3·22; Mr. J. W. Richards, 3·0123. In form the crystals are hexagonal, either in flat plates or in short, stout rhombohedral plates, varying from one-half to 2½ millimeters in diameter. This material has been used as a high-class abrasive for wheels, dental tools, glass grinders, etc.

In August, 1893, the writer, while examining the hardness of carborundum, found that it readily scratched red, blue, white, pink, and yellow

a "Carborundum" by Acheson. *See* Journal of the Franklin Institute, June 1, 1893; and William P. Blake, Engineering and Mining Journal, September 9, 1893, pp. 270–330, September 23, 1893.

corundum in the form of fine gems. It having been suggested that this material would cut and polish a diamond, an experiment was made on a new wheel in the mining building at the World's Columbian Exposition. After several trials it was found that the carborundum used would not scratch or polish the diamond, but on the other hand it was easily scratched by diamond cleavages and crystal faces.

This experiment is only mentioned as it precludes any possibility of the material which has been found in the Canyon Diablo meteorite being any compound of carbon and silicon, such as the new interesting and valuable abrasive material just mentioned. But it establishes the fact that we have here an artificial substance that exceeds all natural substances except the diamond in hardness, *i. e.*, being harder than 9, but still far distant from 10.

FERTILIZERS.

PHOSPHATE ROCK.

Production.—Although the total product from all sources increased from 681,571 long tons in 1892 to 941,368 long tons in 1893, the apparent increase loses part of its significance because of stocks of 1892 being included in the 1893 output. As shown by the tables below, both Florida and South Carolina shared in the increase, which was more marked however in Florida. South Carolina was crippled by the storm of August 27, by far the most disastrous of many years, and practically stopping work in the region of Beaufort. The royalty question between the producers of river rock and the State authorities also lessened the South Carolina product.

In spite of the depressed prices during the first part of 1893, the total value ($4,136,070) for the product of the year shows only a slight reduction in the average price. The increase in Florida towards the end of the year was chiefly due to the devastation of the works at Beaufort, South Carolina, but also to more accurate knowledge of the extent of the Florida deposits.

Product of phosphate rock in 1891, 1892, and 1893.

States.	1891.		1892.		1893.	
	Quantity	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	57,982	....	*a* 155,908	$859,276	215,685	$1,117,732
Soft rock			6,710	32,418	13,675	64,626
Land pebble			21,905	111,271	86,624	359,127
River pebble	54,500	....	*b* 102,820	415,453	122,820	437,571
Total	112,482	$703,013	287,343	1,418,418	438,804	1,979,056
South Carolina:						
Land rock	344,978	2,187,150	243,653	1,236,447	308,435	1,408,785
River rock	130,528	760,978	150,575	641,262	194,129	748,229
Total	475,506	2,948,138	394,228	1,877,709	502,564	2,157,014
Grand total	587,988	3,651,151	681,571	3,296,227	941,368	4,136,070

a Includes 52,708 tons of land rock carried over in stock from 1891.
b Includes 12,120 tons of river pebble carried over in stock from 1891.

SOUTH CAROLINA.

The increased production noted, from 394,228 long tons, worth \$1,877,709 in 1892, to 502,564 long tons, worth \$2,157,014 in 1893, would have been much greater but for the cyclone of August 27, which wrecked many buildings, tore up railroad sidings, and did other heavy damage in the neighborhood of Charleston, and was especially disastrous to the river mining at Beaufort.

The royalty dispute between the State and the river miners has also had important bearing on the progress of that branch of phosphate-mining during the year. It is thus told by Maj. Edward Willis:

By an act dated March 1, 1870, the State granted to certain persons the right to dig phosphate rock in the beds of the navigable streams of the State for twenty-one years. By a subsequent act approved March 28, 1876, the exclusive right was granted to the Coosaw Mining Company to mine phosphate rock in the Coosaw river, so long as and no longer than they should make returns and pay royalty as prescribed by the act. Under this grant the Coosaw company claimed an indefinite exclusive right to mine in the territory named, so long as they made the stated returns and paid the said royalty. The State, on the other side, claimed that this act must be limited by the act of 1870, and that the period in which said right inured to the Coosaw company was only for the balance of the period of twenty-one years fixed by the act of 1870.

By an act dated December 23, 1890, the legislature created a Board of Phosphate Commissioners, and among other things ordered them, on and after March 1, 1891, when the original period of twenty-one years expired, to 'take possession and control of the Coosaw river phosphate territory theretofore occupied by the Coosaw Mining Company, and to issue licenses to other parties to mine therein.' The act was very drastic in its terms, and provided the severest kind of penalties, with confiscation of plant, and fine and imprisonment for all parties digging without a license.

On March 1, 1891, the Board of Phosphate Commissioners took possession of the Coosaw river, issued licenses to other companies which started mining therein, whereupon the Coosaw company filed its bill for injunction in the United States court. The court after full argument on the merits, decided in favor of the State, holding that the period for the exclusive right to the Coosaw company expired on March 1, 1891. This judgment was affirmed on appeal by the Supreme Court of the United States. Thereupon, licenses to mine were issued to all the companies in the Coosaw river, and they all mined there until the cyclone on August 27, 1893.

Under the acts in force up to that time, the companies so mining paid royalty at the rate of \$1 per ton for crude rock, to which was added about 5 per cent. as a difference between crude and dried rock, so that they paid about \$1.05 on the rock as shipped.

The cyclone worked great havoc and disaster with all of the mining plants. The dredge of the Brotherhood Company, which is by far the largest dredge at work, was turned bottom upwards in the river, all the dredges of the other companies were driven ashore, and many of them were wrecked. The total damage to the plants ashore and afloat was estimated at about $300,000. The Board of Phosphate Commissioners then met and offered the phosphate companies, if they would restore their plants and resume operation, a reduction of the royalty to 50 cents for the balance of the year 1893, and a relief of all royalty during the year 1894, after they had paid in $75,000 to the State. This offer the companies refused. Their damage was so great that it would take them months to get to work again, and the offer was not a sufficient inducement for the outlay of new capital necessary.

There was some correspondence between the companies and the Board of Commissioners. The matter remained in *statu quo* until the meeting of the legislature in December, 1893. Then the legislature took it up through the appropriate committee and, after due consideration, reported a bill, which passed, allowing the companies to pay a royalty of 50 cents a ton on all rock, the value of which to the companies free on board at the wharf did not exceed $4 a ton. For all excess between $4 and $4.50 the companies were to pay one-third of such excess, and for all excess over $4.50 the companies were to pay one half of such excess. This act to remain in force for the period of five years.

The companies accepted the terms of this offer and went actively to work to repair the damages. The Farmers' Mining Company have both their dredges at work; the Beaufort Mining Company has its one dredge also at work. Out of five dredges at work at the time of the cyclone the Coosaw company has three in operation and two very nearly ready to go to work. Brotherhood's dredge is being repaired, but it will take several months to put it into operating condition.

The damage done by the cyclone was done both to the shore and to the water plants. The latter were scattered in every direction. Much of it was sunk and the balance was driven up on the marshes and shores of the rivers adjacent, and more or less seriously damaged. The shore plant at some of the works suffered terribly. The long line of expensive wharves fronting the river, consisting of the regular wharves with the overhead system of railways for the purpose of receiving and discharging rock, was all swept away; drying sheds and other buildings were terribly damaged, and great loss was caused thereby. Much of this damage has been restored since the first of last January. Much yet remains to be done, and the companies are at work doing it.

The following tables continue the statement of the total amount of land and river rock mined in South Carolina and the disposition made of the product:

Phosphate rock (washed product) mined by the land and river mining Companies of South Carolina.

Years ending—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
May, 1867	6	....	6
1868	12,262	....	12,262
1869	31,958	....	31,958
1870	63,252	1,989	65,241
1871	56,533	17,655	74,188
1872	36,258	22,502	58,760
1873	33,426	45,777	79,203
1874	51,624	57,716	109,340
1875	54,821	67,969	122,790
1876	50,566	81,912	132,478
1877	36,431	126,569	163,000
1878	112,622	97,700	210,322
1879	100,779	98,586	199,365
1880	125,601	65,162	190,763
1881	142,193	124,541	266,734
1882	191,305	140,772	332,077
1883	219,202	159,178	378,380
1884	250,297	181,482	431,779
1885	225,913	169,490	395,403
Dec. 31, 1885, (from June 1)	149,400	128,389	277,789
1886 (Calendar year)	253,484	177,065	430,549
1887	261,658	218,900	480,558
1888	290,689	157,878	448,567
1889	329,543	212,102	541,645
1890	353,757	110,241	463,998
1891	344,978	130,528	475,506
1892	243,652	150,575	394,228
1893	308,425	194,129	502,564

Detailed statement of total foreign and coastwise shipments and local consumption since July 1, 1874.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Total.	Total for each year.
		Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
June 1, 1874, to May 31, 1875	Foreign ports	44, 617	25, 929	70, 546	122, 790
	Domestic ports	7, 000	25, 560	32, 560	
	Consumed	....	19, 684	19, 684	
June 1, 1875, to May 31, 1876	Foreign ports	50, 384	25, 431	75, 815	132, 896
	Domestic ports	9, 400	28, 831	38, 231	
	Consumed	....	18, 850	18, 850	
June 1, 1876, to May 31, 1877	Foreign ports	73, 923	28, 844	102, 767	163, 220
	Domestic ports	6, 285	40, 768	47, 053	
	Consumed	....	13, 400	13, 400	
June 1, 1877, to May 31, 1878	Foreign ports	100, 619	21, 123	121, 742	208, 323
	Domestic ports	8, 217	60, 729	68, 946	
	Consumed	....	17, 635	17, 635	
June 1, 1878, to May 31, 1879	Foreign ports	97, 799	21, 767	119, 566	199, 365
	Domestic ports	8, 618	52, 281	60, 899	
	Consumed	....	18, 900	18, 900	
June 1, 1879, to May 31, 1880	Foreign ports	47, 157	14, 218	61, 375	190, 763
	Domestic ports	13, 346	94, 002	107, 348	
	Consumed	....	22, 040	22, 040	
June 1, 1880, to May 31, 1881	Foreign ports	62, 200	8, 568	70, 768	266, 734
	Domestic ports	65, 895	91, 929	157, 824	
	Consumed	....	38, 142	38, 142	
June 1, 1881, to May 31, 1882	Foreign ports	89, 581	22, 905	112, 486	332, 077
	Domestic ports	65, 340	111, 314	176, 654	
	Consumed	....	42, 937	42, 937	
June 1, 1882, to May 31, 1883	Foreign ports	94, 789	28, 251	123, 040	378, 380
	Domestic ports	62, 175	150, 545	212, 720	
	Consumed	....	42, 620	42, 620	
June 1, 1883, to May 31, 1884	Foreign ports	132, 114	20, 539	152, 653	431, 779
	Domestic ports	41, 040	181, 363	222, 403	
	Consumed	5, 800	50, 923	56, 723	
June 1, 1884, to May 31, 1885	Foreign ports	111, 075	11, 495	122, 570	395, 403
	Domestic ports	44, 130	161, 700	205, 833	
	Consumed	12, 000	55, 000	67, 000	
June 1, 1885, to Dec. 31, 1885	Foreign ports	105, 761	8, 581	114, 342	277, 789
	Domestic ports	16, 321	112, 126	128, 447	
	Consumed	5, 000	30, 000	35, 000	
Jan. 1, 1886, to Dec. 31, 1886	Foreign ports	153, 443	5, 926	159, 369	430, 549
	Domestic ports	14, 622	187, 558	202, 180	
	Consumed	9, 000	60, 000	69, 000	
Jan. 1, 1887, to Dec. 31, 1887	Foreign ports	189, 995	9, 740	199, 735	480, 558
	Domestic ports	15, 905	181, 918	197, 823	
	Consumed	13. 000	70, 000	83, 000	
Jan. 1, 1888, to Dec. 31, 1888	Foreign ports	124, 474	3, 611	128, 085	448, 567
	Domestic ports	20, 404	212, 078	232, 482	
	Consumed	13, 000	75, 000	88, 000	
Jan. 1, 1889, to Dec. 31, 1889	Foreign ports	137, 102	5, 900	143, 002	541, 645
	Domestic ports	60, 000	248, 643	308, 643	
	Consumed	15, 000	75, 000	90, 000	
Jan. 1, 1890, to Dec. 31, 1890	Foreign ports	72, 241	55, 000	127, 241	463, 998
	Domestic ports	15, 000	213, 757	228, 757	
	Consumed	13, 000	85, 000	98, 000	
Jan. 1, 1891, to Dec. 31, 1891	Foreign ports	94, 528	4, 655	99, 183	475, 506
	Domestic ports	22, 000	252, 083	274, 083	
	Consumed	14, 000	88, 250	102, 250	
Jan. 1, 1892, to Dec. 31, 1892	Foreign ports	105, 150	5, 052	110, 202	394, 228
	Domestic ports	30, 425	148, 600	179, 025	
	Consumed	15, 000	90, 000	105, 000	
Jan. 1, 1893, to Dec. 31, 1893	Foreign ports	156, 257	175	156, 432	502, 564
	Domestic ports	22, 872	160, 942	183, 814	
	Consumed	15, 000	147, 318	162, 318	

FLORIDA.

The product increased to a total of 438,804 long tons, worth at the mines $1,979,056. The condition of the industry at the close of the year improved, notwithstanding this increased product. The most immediate factor in the increased price which showed itself in the latter part of the year was the crippling of the competing industry in South Carolina by the great storm; but more permanent improvement was effected in the foreign market, first, by investigations of the reported Algerian phosphates which, as usual, had a quieting effect on the rumors of large and cheap supplies from this source. The most important effect on the Florida business was due to the fact that the sensational reports which have gone abroad have about spent their force, and the actual mining conditions are better understood. As is well known, reports have made the foreign consumers think of western Florida as a smooth tract of phosphate, of which it was possible to state the available tonnage by the cubic contents of that part of the State obtained from the acreage multiplied by a theoretical depth. The utter recklessness of such a method is realized when it is understood that the floor of the phosphate section is limestone rock, with an extremely irregular surface. At places this limestone outcrops; at others it is covered with still more irregular deposits of phosphate rock, clay, and sand. In one place the phosphate rock will be visible at the surface, and a few feet away it is likely to be found covered with many feet of barren sand or clay, or both. The rock must be sought, therefore, above the pitted, often jagged, surface of the limestone, and below the equally irregular piles of sand and clay. And even then the phosphate boulders and pebbles must be separated from the sand and clay with much labor and mechanical ingenuity, which has developed a system of mining that is somewhat novel, and, therefore, requiring comparatively costly supervision to adapt it to the constantly changing details of occurrence, even after expert and costly prospecting has defined the deposit. With the uncertainty as to the persistency of a given deposit, the phosphate is not, as a rule, followed below water level. It will be understood that the writer is endeavoring to represent the condition of things in what is generally thought of as the Florida phosphate field, i. e., the "hard-rock" region. The pebble region, which, by the way, is developing more satisfactorily than the rock phosphate, is susceptible of more systematic treatment; but even here the necessity is recognized for the greatest skill in selecting only here and there a property which may be profitably worked.

Great improvement is noticable in the methods of saving the small pebbles occurring with the larger boulders of phosphate in the hard rock region, and also the sand phosphate occurring with the land and river pebble, most of which has been screened to waste. Indeed it may be said in general that the mining features have been studied more carefully, or more successfully, than the financiering part of the problem.

After the usual primitive and careless methods of effecting sales, characteristic of a new mining region, have had time for teaching their costly lessons, it might be expected that the financial results would be as good as the condition of demand and supply could possibly warrant. But there is general doubt as to whether this condition has been realized. It is confidently asserted by producers in the best position to judge that the price should be nearly double that which is now realized, and further, that the foreign manufacturers, who are the best customers for high grade phosphate rock, are perfectly willing to pay this high price provided they can be assured that all must pay it, and there is to be no great deviation in the price. The most evident policy which suggests itself, that of combination, still seems difficult to effect. For this reason there are many devices, one of which is the offer of phosphate on the market which has not even been mined, employed in order to secure an advance to aid in producing it. The market is thus depressed by phosphate which will not be used for one or more years. It is to be regretted that while these experiments are bearing their results, some of the best phosphate is leaving the country, for when this Florida rock is once found, then exploited, mined, washed, dried, and finally marketed it is without question the most satisfactory material for the manufacture of fertilizers known in the world.

TENNESSEE.

Near the close of 1893 attention was called to the occurrences of phosphatic nodules which have long been known in several counties in Tennessee southwest of Nashville, especially in Lewis and Hickman counties. Hohenwald in Lewis county at once became a center for phosphate prospectors, and their developments have been recorded with especial promptness in the Manufacturers' Record. Analyses by Dr. J. C. Wharton and others of many specimens have shown that material containing as high as 65 per cent. of ordinary calcium phosphate, $Ca_3(PO_4)_2$, can be obtained. It was then shown by Prof. J. M. Safford, State geologist of Tennessee, in an article in the American Geologist, that in addition to the phosphatic nodules occurring above the Devonian ("Harpeth") shales, there is a layer of stratified phosphate rock occurring immediately under the shale. This stratified rock frequently yields 50 to 70 per cent. of phosphate of lime. At certain points the rock contains fish teeth and fragments of bones, having the appearance of a bone bed. It also shows, occasionally, indications of coprolitic origin.

Mr. C. G. Memminger, who has just examined the region, makes the following report to the Survey: The phosphate deposits cover a territory about 80 miles long by 25 wide. Phosphate rock is found at different points all through this territory, but it appears that the workable deposits cover an area not exceeding 20 miles long by 8 wide on the waters of Swan Creek, covering the Tottys Bend and Fall Branch deposits.

The surface of this section is hilly and undulating, cut at frequent intervals by numerous streams; the valley proper, however, Swan Creek, being comparatively level, with foothills rising on either side to a height of 800 feet. In the natural sections along these foothills the phosphate outcrops appear.

The phosphate deposit occurs in a regular vein between the Chattanooga shale and the Devonian limestone. The veins lie almost horizontally, occasionally folding slightly with the general formation of the country. The limestone for several inches immediately under the phosphate veins carries a considerable percentage of phosphoric acid. A vertical section of the formation would be as follows:

Section of Tennessee phosphate formation.

1. Harpeth shale 20 to 25 feet.
2. Nodular phosphate 6 inches to 1 foot.
3. Chattanooga shale 2 to 25 feet.
4. Vein of phosphate rock 6 to 40 inches.
5. Finally, underlying limestone.

The phosphate nodules which cover the black shales, although of good quality, can not be profitably mined, unless the shale thins out, bringing them in immediate contact with the phosphate vein. At one or two points nodules were found in the shale; usually they occur in the bluish clay matrix, and immediately overlie the shale. The geological position of these deposits is a definite one, marked and easily defined; they have a wide range and distinctive stratigraphical position; there is no great difficulty in tracing the outcroppings of the veins.

Physical characteristics.—The phosphate is (1) a dull bluish, fine-grained rock, or (2) a grayish rock showing a conglomerate structure under the microscope. Where the rock has been lying exposed to the air, oxidation of the iron has taken place, turning the rock to a brownish color. The specific gravity of the rock is 2.8; hardness, 3.5; weight per cubic foot, 175 pounds. The rock can be ground easily. The general average thickness of the veins at the most promising territory examined was 30 inches. The thickest vein measured was 40 inches. It is not possible at the present state of development, for lack of accurate surveys, etc., to give tonnage estimates, especially as none of the veins have been opened up under cover, but from the general conditions, apparent uniformity of the veins, and the area over which they extend, it is safe to state that these deposits are capable of producing an immense amount of phosphate.

Quality.—The following analyses represent average samples taken from different localities on the vein, extending over a distance of 10 to 12 miles. The presence of pyrite, or, more strictly speaking, marcasite, was noted at each locality from which samples were drawn, and appears to be characteristic of these deposits.

Analyses of phosphate from western Tennessee.

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	2.10	2	1.35
Insoluble siliceous matter	2.32	1.69	4.67
Alumina	1.60	1.92	1.06
Iron oxide	1.04	86	74
Iron sulphide FeS_2 pyrite	1.75	1.88	1.80
Carbonic oxide	4.06	2.72	2.53
Sulphur	2.34	2.55	2.63
Phosphoric acid	34.68	32.91	33.81
Lime fluorine and organic matter	50.11	53.47	51.41
Total	100	100	100

The percentage of iron oxide and alumina is low, the bulk of the iron being combined with sulphur to form the pyrite. This phosphate from its chemical composition, is undoubtedly well adapted to the manufacture of superphosphate, and will unquestionably command a market both in Europe and in the United States.

Method of mining.—The rock should be mined by the ordinary coal-mining method, probably with some local modifications.

The nearest railroad at present is a road running to Etna Furnaces, average distance four miles, but already surveys are in progress for the construction of a line through the phosphate territory. One of the most notable features of these deposits is, that the rock will not have to be washed and dried, as is the case with Carolina and Florida phosphates. The mining outfit, therefore, will be much less expensive. It is yet too early in the history of the development of these deposits to make estimate as to the exact cost of production, but there seems to be no doubt that where the vein exceeds 20 inches in thickness they can be worked at a profit, and if suitable freight rates can be obtained, will become an important source of supply for both Europe and in this country.

NORTH CAROLINA.

The North Carolina Phosphate Company, at Castle Hayne, continued mining and washing the conglomerate found in that region. About 7,000 tons were sold at $3 per ton, on cars at Castle Hayne. The rock contains about 50 per cent of bone phosphate. The plant has lately been enlarged to double its capacity, with the expectation of shipping 15,000 tons in 1894. Other owners of similar land have engaged experts from the land-pebble region in Florida to explore their property.

Fertilizers imported and entered for consumption in the United States, 1868 to 1893.

Years ending—	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
June 30, 1868	99.668	$1,336,701	....	$88,864	$1,425,625
1869	13,480	217,004	....	61,529	278,533
1870	47,747	1,414,872	....	90,817	1,505,689
1871	94,344	3,313,914	....	105,703	3,479,617
1872	15,279	423,322	....	83,342	506,664
1873	6,755	167,711	....	218,110	385,821
1874	10,767	261,085	....	243,467	504,552
1875	23,925	539,808	....	212,118	751,926
1876	19,384	710,135	....	164,849	874,984
1877	25,580	873,459	....	195,875	1,069,334
1878	23,122	849,607	....	285,089	1,134,696
1879	17,704	634,546	....	223,283	857,829
1880	8,619	108,733	....	317,068	425,801
1881	23,452	399,552	....	918,835	1,318,387
1882	46,699	854,463	133,956	1,437,442	2,291,905
1883	25,187	537,080	96,586	798,116	1,335,196
1884	28,090	588,033	35,119	406,233	994,266
1885	20,934	393,039	40,068	611,284	1,004,323
Dec. 31, 1886	13,520	306,584	82,608	1,179,724	1,486,308
1887	10,195	252,265	53,100	644,301	896,566
1888	7,381	125,112	36,405	329,013	454,125
1889	15,991	313,956	35,661	403,205	717,161
1890	4,642	59,580	31,191	252,787	312,367
1891	11,937	199,044	29,743	214,671	413,715
1892	3,073	46,014	92,476	666,061	712,075
1893	5,856	97,889	106,549	718,871	816,760

GYPSUM.

The product of gypsum in the United States during 1893 did not differ materially from that of the preceding year either in amount or value. The amount was a little less, being 253,615 short tons against 256,259 short tons; a decrease of 2,644 tons; the value increased slightly—from $695,492 to $696,615, a gain of $1,123. This increase in value is accounted for, not by an improvement in prices, but by the calcining of a larger amount into plaster of Paris. The amount of gypsum calcined in 1892 was 150,511 short tons, yielding 106,141 short tons of calcined plaster, worth $508,448, an average of $4.79 per ton. In 1893 the amount calcined was 160,399 short tons, producing 122,927 tons of plaster, worth $518,390, an average of $4.22 per ton, a loss of 57 cents per ton, as compared with the previous year, though the total value shows a gain of nearly $10,000. In the amount ground and sold for land plaster there was an increase from 47,668 short tons in 1892 to 50,408 short tons in 1893, while the value remained practically unchanged, being $106,247 in 1892 and $106,365, a difference of only $118. In the amount sold crude there was a comparative increase in the value, though the total amount was less. The product in 1892 was 58,080 short tons, valued at $80,797, and in 1893, 43,108 short tons, worth $72,010. The following table shows the production in 1893 by States. In order not to disclose confidential statements furnished by producers, the products of Ohio and Texas have been consolidated, there being only one operator in each of those States. No product was reported from Colorado, Utah, and Wyoming, and the mines in California were not worked, the manufacturers of plaster of Paris obtaining their supplies of crude gypsum from Mexico. Regarding the conditions of the industry during 1893 there is little to be said. Some operators report an improvement as compared with the preceding year; some report much poorer business; but the majority of correspondents state that while during the first half of the year trade was in a satisfactory condition, that of the latter half was depressed so as to more than balance the former good condition.

Product of gypsum in the United States in 1893, by States.

States.	Sold crude.		Ground into plaster.		Calcined into plaster of Paris.			Total product.	
	Quantity.	Value.	Quantity.	Value.	Before calcining.	After calcining.	Value of calcined plaster.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	*Short tons.*		*Short tons.*	
Iowa	109	$82	2,853	$2,296	18,485	14,273	$53,160	21,447	$55,538
Kansas	196	510	57	114	43,378	29,975	180,975	43,631	181,599
Michigan	31,000	62,000	16,263	28,562	77,327	62,031	213,359	124,590	303,921
New York	10,979	8,198	22,802	49,221	2,345	1,813	7,973	36,126	65,392
South Dakota	....	....	50	150	5,100	4,080	12,400	5,150	12,550
Virginia	22	66	5,579	19,181	1,413	1,131	5,112	7,014	24,359
Other States (*a*)	502	1,004	2,804	6,841	12,351	9,624	45,411	15,657	53,256
Total	43,108	72,010	50,408	106,365	160,399	122,937	518,390	253,615	696,615

a Includes Ohio, and Texas. In each of these States the output is reported from only one company.

For the purposes of comparison the following tables, showing the statistics of production during 1891 and 1892 and the total product and value for the past five years, are given:

Product of gypsum in the United States in 1892, by States.

States.	Sold crude.		Ground into land plaster.		Calcined into plaster of Paris.			Total product.	
	Quantity.	Value.	Quantity.	Value.	Before calcining.	After calcining.	Value of calcined plaster.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	*Short tons.*		*Short tons.*	
Kansas	420	$840	....	....	45,596	31,961	$194,357	46,016	$195,197
Michigan	47,500	71,250	14,458	$22,026	77,599	53,105	213,251	139,557	306,527
New York	7,887	5,661	24,407	55,039	100	75	400	32,394	61,100
Virginia	400	800	5,028	20,357	1,563	1,250	7,050	6,991	28,207
Other States (*a*)	1,873	2,246	3,775	8,825	25,653	19,750	93,390	31,301	104,461
Total	58,080	80,797	47,668	106,247	150,511	106,141	508,448	256,259	695,492

a Includes Colorado, Iowa, Ohio, Texas, and Utah. In each of these States the output is reported from only one company.

Product of gypsum in the United States in 1891, by States.

States.	Total amount sold crude.	Value of crude.	Ground into land plaster.	Value of land plaster.	Calcined into plaster of Paris.			Total product.	Total value.
					Before calcining.	After calcining.	Value of calcined plaster.		
	Short tons.		*Short tons.*		*Short tons.*	*Short tons.*		*Short tons.*	
California, Ohio, Utah, and Wyoming	....	....	988	$3,336	16,127	14,085	$90,810	17,115	$94,146
Iowa	....	....	4,822	4,845	26,563	21,049	53,250	31,385	58,095
Kansas	640	$1,280	70	210	39,497	28,468	159,832	40,217	161,322
Michigan	11,000	22,000	15,100	28,550	53,600	44,860	173,175	79,700	223,725
New York	6,730	5,058	23,405	53,513	....	....	....	30,135	58,571
South Dakota	....	....	1,560	4,680	2,055	1,544	4,938	3,615	9,618
Virginia	204	352	5,755	22,222	....	....	....	5,959	22,574
Total	18,574	28,690	51,700	117,356	136,727	110,006	482,005	208,126	628,051

Comparative statistics of gypsum production for five years.

States.	1889.		1890.		1891.		1892.		1893.	
	Product.	Value.	Product.	Value.	Product.	Value.	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Colorado	7,700	$28,940	4,580	$22,050	....	....	....	....	....	....
Iowa	21,789	55,250	20,900	47,350	31,385	$58,095	(a)	(a)	21,447	$55,538
Kansas	17,332	94,235	20,250	72,457	40,217	161,322	41,016	$195,197	43,631	181,599
Michigan	131,767	373,740	74,877	192,099	79,700	223,725	139,557	306,527	124,590	303,921
New York	52,608	79,476	32,903	73,093	30,135	58,571	32,394	61,100	36,126	65,392
South Dakota	320	2,650	2,900	7,750	3,615	9,618	....	....	5,150	12,550
Virginia	6,838	20,336	6,350	20,782	5,959	22,574	6,991	28,207	7,014	24,359
Other States	29,420	109,491	20,235	138,942	17,115	94,146	31,301	104,461	15,657	53,256
Total	267,769	764,118	182,995	574,523	208,126	628,051	256,259	695,492	253,615	696,615

a Included in other States.

Imports.—The imports of gypsum are chiefly from Canada, the product from the Dominion being very pure and well adapted for the manufacture of plaster of Paris. The following table exhibits the total amount and value of gypsum imported into the United States since 1867:

Gypsum imported into the United States from 1867 to 1893.

Years ended—	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total.
	Quantity.	Value.	Quantity.	Value.		
	Long tons.		*Long tons.*			
June 30, 1867	....	$29,895	97,951	$95,386	....	$125,182
1868	....	33,988	87,694	80,362	....	114,350
1869	....	52,238	137,039	133.430	$844	186,512
1870	....	46,872	107,237	100,416	1,432	148,720
1871	....	64,465	100,400	88,256	1,292	154,013
1872	....	66,418	95,339	99,902	2,553	168,873
1873	....	35,628	118,926	122,495	7,336	165,459
1874	....	36,410	123,717	130,172	4,319	170,901
1875	....	52,155	93,772	115,664	3,277	171,096
1876	....	47,588	139,713	127,084	4,398	179,070
1877	....	49,445	97,656	105,629	7,843	162,917
1878	....	33,496	89,239	100,102	6,989	140,587
1879	....	18,339	96,963	99,027	8,176	125,542
1880	....	17,074	120,327	120,642	12,693	150,409
1881	....	24,915	128,607	128,107	18,702	171,724
1882	5,737	53,478	128,382	127,067	20,377	200,922
1883	4,291	44,118	157,851	152,982	*a*21,869	218,969
1884	4,996	42,904	166,310	168,000	....	210,904
1885	6,418	54,208	117,161	119,544	....	173,752
1886	5,911	37,642	122,270	115,696	....	153,338
1887	4,814	37,736	146,708	162,154	....	195,890
Dec. 31, 1888	3,340	20,764	156,697	170,023	....	190,787
1889	5,466	40,291	170,965	179,849	....	220,140
1890	7,568	55,250	171,289	174,609	....	229,859
1891	9,560	97,316	110,257	129,003	....	226,319
1892	6,882	75,608	181,104	232,403	....	308,011
1893	3,363	31,670	164,300	180,254	....	211,924

a Not specified since 1883.

Canadian production.—According to the Statistical Year Book the production of gypsum in the Dominion is steadily increasing. It is at present worked only in Ontario, New Brunswick, and Nova Scotia, though deposits have been found in Manitoba and the Northwest Territories. The following table shows the production and exports since 1886:

Production and exports of Canadian gypsum from 1886 to 1892.

Years.	Production.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
1886	162,000	$178,742	142,833	$155,213
1887	154,008	157,277	132,724	146,542
1888	175,887	179,393	125,508	121,389
1889	213,273	205,108	178,182	194,404
1890	226,509	194,033	175,691	192,254
1891	203,545	192,096	172,496	184,977
1892	226,568	225,260	178,518	194,304
1893	192,568	196,150	....	....

The production of gypsum in Great Britain during 1892 was 165,244 short tons, valued at $283,362, against 169,913 short tons, worth $292,175, in 1891. The product in 1893 aggregated 117,854 short tons.

SALT.

By E. W. Parker.

The salt product of the United States in 1893 was 11,816,772 barrels of 280 pounds, against 11,698,890 barrels in 1892. The difference is comparatively small, the product in 1893 being 117,882 barrels, or about 1 per cent. more than that of 1892. The value, however, shows a seemingly enormous decrease from $5,654,915 in 1892 to $4,054,668 in 1893, a difference of $1,600,247, or a little more than 28 per cent. But this decrease must not be taken as showing so great a decline in the price of salt during 1893. In fact the prices ruling for 1892 were about as low as they could reach; so low, indeed, that a number of manufacturers ceased producing, finding the business unprofitable. The large apparent decrease in value in 1893 is due to the fact that all cost of packages has been excluded and the net value taken for the product. In 1892 and former years the value of the packages has been included by producers in making their reports, which resulted in a fictitious total. It is not possible to correct former statements in this regard, so the tables are carried forward as published in former volumes of this series. In collecting the statistics of production in 1893 care has been taken to obtain the cost of barrels, sacks, or other packages, and this has been uniformly deducted from the value when the value as reported included the item. The results obtained show the average net value of the salt produced in 1893 to have been about 34½ cents per barrel of 280 pounds. The price per barrel in 1892, according to the statements published, was a little less than 50 cents, the difference being about 15 cents. The majority of producers pack their product in barrels, whose cost ranges from 19 cents to 25 cents. Some ship in bulk, particularly in the Western States, and allowing for this product, the net value of which was given in 1892, it will be readily seen that prices did not vary greatly.

Notwithstanding the low prices which have prevailed, and which have been due to keen competition among producers, there has been a laudable endeavor on the part of a number of manufacturers to improve the quality of their product. In this, signal success has been attained, and salt of American production has been so improved by new processes, which each producer holds secret, that importations of refined salt have almost ceased to be a factor in the industry. The competition in the production of fine grades of salt has become as sharp in its way as the competition in prices. Table and dairy salts are now prepared for commerce practically chemically pure—free from gypsum, calcium chloride, and magnesium salts. The thorough elimination of gypsum and other salts of calcium from salt produced from brine has been attempted for years, but it is only recently that it has been accomplished at a cost which makes it practical for ordinary commercial purposes. Salt containing calcium or magnesium salts in appreciable quantities is extremely objectionable, and the processes for eradicating these impurities mark a noteworthy step in the preparation of pure-food products. The presence of these compounds in table and dairy salts causes them to deliquesce (i. e., absorb moisture) if the atmosphere be at all damp; they then become lumpy and will not flow freely from an ordinary "shaker" salt cellar. The tendency to deliquesce is much lessened in pure salt, and when in a very moist climate some water is absorbed and the salt "cakes," it disintegrates easily after drying and will flow readily from the shaker.

Gypsum and other calcium salts are best detected by dissolving the salt in water until a saturated solution is obtained; a few drops of amonium oxalate are then added, which will give to the solution a milky appearance, and if left to stand for awhile a white precipitate will be found at the bottom.

The presence of magnesium may be detected by treating a similar saturated solution with sodium phosphate and ammonium chloride, producing a similar white precipitate due to insoluble magnesium ammonium phosphate.

It is to be anticipated that most of the competition for trade in the future, particularly on the finer grades of salt, will be made more on the quality of the product than on its cheapness, though the latter recommendation is necessarily a factor in all transactions. The greater purity must be established in order to justify a higher price.

In determining the quality of the salt, for dairy purposes, especially, particular attention is paid to obtaining a grain of uniform size. This has no relation to the purity, but is of importance to dairymen who desire to have the salt distributed evenly and thoroughly through their butter or cheese. The preparation of dairy salts has thus become an art of itself, in so far as the grain alone is considered, and the purest salt with a "pretty" and uniform grain is the one to obtain favor with that branch of trade.

Production in 1893.—In collecting the statistics of salt production in 1893, an effort has been made to ascertain the amount of each grade of salt produced. This has been only partially successful, as the methods of grading differ in the several States, and frequently in different sections of the same State. In addition to this a number of producers do not keep any record of the different grades made and sold and have not attempted to distribute them. The statement in the following table is the best that could be obtained. It will be observed that no distribution by grades has been made of the rock salt product of Kansas, Louisiana, and New York. This is intentional. The rock salt industry in these States is of such importance as to warrant distinction from the product obtained from brine.

With the exceptions mentioned above and in the footnote to the table, the production in 1893, by grades, was as follows:

Production of salt in 1893, by States and grades.

States.	Table.	Dairy.	Common fine.	Common coarse.	Packers'.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
California	14, 286	3, 571	3, 571	32, 143	21, 487
Illinois			59, 161		
Kansas			*b* 959, 466		
Louisiana					
Michigan	157, 148	21, 483	2, 619, 244	206, 384	20, 017
Nevada	381	181	52	13	
New York:					
Onandaga district			105, 372		
Warsaw district	782, 031	479, 139	922, 960	103, 126	30, 672
Rock salt					
Ohio	65, 000	130, 000	304, 839	30, 000	14, 124
Pennsylvania		33, 000	217, 343	20, 000	10, 000
Texas			*c* 126, 000		
Utah	5, 357	100, 000	1, 071	1, 071	357
West Virginia			158, 975	51, 761	
Total	1, 024, 203	767, 374	5, 478, 054	444, 498	96, 657

States.	Solar.	Rock.	Milling.	Agricultural.	Total product.	Total value.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	
California	*a* 214, 229	3, 571			292, 858	$137, 962
Illinois					59, 161	30, 168
Kansas		317, 714			1, 277, 180	471, 543
Louisiana		191, 430			191, 430	97, 200
Michigan	30, 000			3, 622	3, 057, 898	888, 837
Nevada			5, 141	791	6, 559	4, 481
New York:						
Onandaga district	*a* 1, 865, 344				1, 970, 716	582, 893
Warsaw district				2, 000	2, 319, 928	909, 191
Rock salt		1, 371, 430			1, 371, 430	378, 000
Ohio					543, 963	209, 393
Pennsylvania					280, 343	136, 436
Texas					126, 000	110, 267
Utah	714				108, 570	30, 075
West Virginia					210, 736	68, 222
Total	2, 110, 287	1, 884, 145	5, 141	6, 413	11, 816, 772	4, 054, 668

a The salt classed as "solar" in California and New York includes all not otherwise classified by producers.

b Includes all grades, except the rock salt product.

c Includes table, dairy, and common coarse.

In reporting production some operators use the bushel as a unit of measurement, some the short ton, and some the barrel. For the sake of convenience the product of each State in the preceding and following tables has been reduced to one unit, the barrel, containing 280 pounds, or 5 bushels of 56 pounds, and a ton being equal to $7\frac{1}{7}$ barrels.

Comparative table of production of salt in States and Territories from 1883 to 1893

States and Territories.	1883.		1884.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	2, 894, 672	$2, 344, 684	3, 161, 806	$2, 392, 536
New York	1, 619, 486	680, 638	1, 788, 454	705, 978
Ohio	350, 000	231, 000	320, 000	201, 600
West Virginia	320, 000	211, 000	310, 000	195, 000
Louisiana	265, 215	141, 125	223, 964	125, 677
California	214, 286	150, 000	178, 571	120, 000
Utah	107, 143	100, 000	114, 285	80, 000
Nevada	21, 429	15, 000	17, 857	12, 500
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (*a*)	400, 000	377, 595	400, 000	364, 443
Total	6, 192, 231	4, 251, 042	6, 514, 937	4, 197, 734

States and Territories.	1885.		1886.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	3, 297, 403	$2, 967, 663	3, 677, 257	$2, 426, 989
New York	2, 304, 787	874, 258	2, 431, 563	1, 243, 721
Ohio	306, 847	199, 450	400, 000	260, 000
West Virginia	223, 184	145, 070	250, 000	162, 500
Louisiana	299, 271	139, 911	299, 691	108, 372
California	221, 428	160, 000	214, 285	150, 000
Utah	107, 140	75, 000	164, 285	100, 000
Nevada	28, 593	20, 000	30, 000	21, 000
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (*a*)	250, 000	243, 993	240, 000	352, 763
Total	7, 038, 653	4, 825, 345	7, 707, 081	4, 825, 345

a Estimated.

States and Territories.	1887.		1888.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	3, 944, 309	$2, 291, 842	3, 866, 228	$2, 261, 743
New York	2, 353, 560	936, 894	2, 318, 483	1, 130, 409
Ohio	365, 000	219, 000	380, 000	247, 000
West Virginia	225, 000	135, 000	220, 000	143, 000
Lousiana	341, 093	118, 735	394, 385	134, 652
California	200, 000	140, 000	220, 000	92, 400
Utah	325, 000	102, 375	151, 785	32, 000
Kansas			155, 000	189, 000
Other States and Territories (*a*)	250, 000	150, 000	350, 000	143, 399
Total	8, 003, 962	4, 093, 846	8, 055, 881	4, 374, 203

States and Territories.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	3, 856, 929	$2, 088, 909	3, 837, 632	$2, 302, 579
New York	2, 273, 007	1, 136, 503	2, 532, 036	1, 266, 018
Ohio	250, 000	162, 500	231, 303	136, 617
West Virginia	200, 000	130, 000	229, 938	134, 688
Louisiana	325, 629	152, 000	273, 553	132, 000
California	150, 000	63, 000	62, 363	57, 085
Utah	200, 000	60, 000	427, 500	126, 100
Kansas	450, 000	202, 500	882, 666	397, 199
Other States and Territories (*a*)	300, 000	200, 000	300, 000	200, 000
Total	8, 005, 565	4, 195, 412	8, 776, 991	4, 752, 286

a Estimated.

Comparative table of production of salt in States and Territories, etc.—Continued.

States and Territories.	1891.		1892.		1893.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.	*Dollars.*	*Barrels.*	*Dollars.*	*Barrels.*	*Dollars.*
Michigan	3,966,784	2,037,289	3,829,478	2,046,963	3,057,898	888,837
New York	2,839,544	1,340,036	3,472,073	1,662,816	5,662,074	1,870,084
Ohio	(*a*)	(*a*)	} 899,244	} 394,720	543,963	209,393
West Virginia	(*a*)	(*a*)			210,736	68,222
Louisiana	173,714	102,375	200,000	100,000	191,430	97,200
California	200,949	90,303	235,774	104,938	292,858	137,962
Utah	969,000	265,350	1,292,471	340,442	108,570	30,075
Nevada	60,799	39,898	22,929	22,806	6,559	4,481
Kansas	855,536	304,775	1,480,100	773,989	1,277,180	471,543
Illinois	39,670	34,909	60,000	48,000	59,161	30,168
Virginia	70,442	70,425	60,000	50,000	....	....
Pennsylvania	....	....	25,571	10,741	280,343	136,436
Texas	....	....	121,250	99.500	126,000	110,267
Other States and Territories (*b*)	811,507	430,761	....	....	....	....
Total	9,987,945	4,571,121	11,698,890	5,654,915	11,816,772	4,054,668

a Included in "Other States." *b* Estimated.

CALIFORNIA.

The total amount of salt produced in California in 1893 was 292,858 barrels, or 41,000 short tons, valued at $137,962, against 235,703 barrels in 1892, worth $104,788. With the exception of 500 tons (3,571 barrels) of rock salt mined in San Bernardino county, the entire product is obtained from sea water by solar evaporation. The sea water is run into ponds at high tide by means of water gates, the ponds covering from 50 to 150 acres. The water remains in these ponds until a brine of proper strength is obtained, when it is drawn off into settling ponds, and from the settling ponds into the crystallizing ponds, the length of time required for each operation depending, of course, upon the weather.

Salt product of California since 1883.

Years.	Barrels.	Value.	Years.	Barrels.	Value.
1883	214,286	$150,000	1889	150,000	$63,000
1884	178,571	120,000	1890	62,363	57,085
1885	221,428	160,000	1891	200,949	90,303
1886	214,285	150,000	1892	235,703	104,788
1887	200,000	140,000	1893	292,858	137,962
1888	220,000	92,400			

ILLINOIS.

The output of salt in Illinois during 1893 was 59,161 barrels, valued at $30,168, being 839 barrels less than in 1892. The value, including cost of packages, was $42,000 in 1893, a decrease of $6,000 from 1892. The deduction of value of the packages accounts for the further decrease in the value of the product:

Salt product of Illinois since 1891.

Years.	Barrels.	Value.
1891	39,670	$34,909
1892	60,000	48,000
1893	59,161	30,168

KANSAS.

During 1893, Kansas produced 1,277,180 barrels of salt, valued at $471,543, net, against 1,480,100 barrels in 1892, worth $773,989, the greater value during 1892 being due to the inclusion of the cost of barrels, etc. Of the total product in 1893, 317,714 barrels were of rock salt and 959,466 barrels were produced from brine. The following table shows the annual product of the State since 1888, when the first statistics of production were obtained:

Salt product of Kansas since 1888.

Years.	Barrels.	Value.	Years.	Barrels.	Value.
1888	155,000	$189,000	1891	855,536	304,775
1889	450,000	202,500	1892	1,480,100	773,989
1890	822,666	397,199	1893	1,277,180	471,543

LOUISIANA.

The entire salt product of Louisiana is rock salt from the Petite Anse mine, a full description of which, geologically and historically, was published in "Mineral Resources" for 1882. The product in 1893 was 191,430 barrels, or 26,800 short tons, valued at $97,200, against 200,000 barrels or 28,000 tons, valued at, $100,000 in 1892. The difference in both quantity and value is insignificant, the value of the product in both years being exclusive of cost of packages. The following table shows the annual production, in tons, at the Petite Anse mine since 1882:

Production of the Petite Anse salt mine since 1882.

Years.	Short tons.	Years.	Short tons.
1882	25,550	1888	25,214
1883	37,130	1889	45,588
1884	31,355	1890	39,979
1885	41,898	1891	24,320
1886	41,957	1892	28,000
1887	47,750	1893	26,800

MICHIGAN.

Michigan, for the first time in the history of salt production, takes second place in importance, being supplanted at the head of the list by New York. The production in Michigan in 1893 shows a notable decrease as compared with 1892, declining from 3,829,478 barrels to 3,057,898 barrels. The value of the product, for the reasons previously stated, shows a comparatively greater decline, and indicates the average net value per barrel in 1893 to have been about 29 cents. The total value for the salt produced in 1893 was $888,837, and in 1892, $2,046,963.

The report of Mr. George W. Hill, State Salt Inspector, gives the total amount of salt inspected during the fiscal year ended November 30, 1893, as 3,514,485 barrels. The amount of salt in bins November 30, 1893, was 506,402 barrels, making a total of 4,020,887 barrels. To obtain the amount of salt manufactured in 1893, there should be deducted from this the 1,001,780 barrels in bins November 30, 1892. This shows the product in 1893 to have been, according to Mr. Hill, 3,019,107 barrels. The returns for the calendar year to the Survey show the total production to have been 3,057,898 barrels, a difference so slight that it need not be considered. The following table shows the grades of salt produced in Michigan, as reported by the inspector. This grading differs slightly from that adopted by the Survey, but here, too, the differences are immaterial:

Grades of salt produced in Michigan, as reported by the inspectors, from 1869 to 1893, inclusive.

Years.	Fine.	Packers.	Solar.	Second quality.	Common coarse.	Total for each year.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1869	513,989	12,918	15,264	19,117	....	561,288
1870	568,326	17,869	15,507	19,650	....	621,352
1871	655,923	14,677	37,645	19,930	....	728,175
1872	672,034	11,110	21,461	19,876	....	724,481
1873	746,762	23,671	32,267	20,706	....	823,346
1874	960,757	20,090	29,391	16,741	....	1,026,979
1875	1,027,886	10,233	24,336	19,410	....	1,081,865
1876	1,402,410	14,233	24,418	21,668	....	1,462,729
1877	1,590,841	20,389	22,949	26,818	....	1,660,997
1878	1,770,361	19,367	33,541	32,615	....	1,855,884
1879	1,997,350	15,641	18,020	27,029	....	2,058,040
1880	2,598,037	16,691	22,237	48,623	....	2,685,588
1881	2,673,910	13,885	9,683	52,821	....	2,750,299
1882	2,928,542	17,208	31,335	60,222	....	3,037,307
1883	2,828,987	15,424	16,735	33,526	....	2,894,672
1884	3,087,033	19,308	16,957	38,508	....	3,161,806
1885	3,230,646	15,480	19,849	31,428	....	3,297,403
1886	3,548,731	22,221	31,177	71,235	3,893	3,677,257
1887	3,819,738	19,385	13,903	73,905	17,378	3,944,309
1888	3,720,319	18,126	26,174	87,694	13,915	3,866,228
1889	3,721,099	19,780	17,617	93,455	4,978	3,856,929
1890	3,655,331	20,337	18,896	143,068	....	3,837,632
1891	3,764,108	11,400	17,335	121,269	13,559	3,927,671
1892	....	....	....	....	....	3,812,054
1893	3,421,607	16,550	11,893	64,435	....	3,514,485

The amount of each grade of salt produced in Michigan in 1893, as reported to the Survey, will be found in the table on page 719.

NEVADA.

Owing to the shutting down of silver smelters, which consume the greater part of the salt produced in Nevada, the product in 1893 was very limited, being 6,559 barrels, against 22,929 barrels in 1892 and 60,799 barrels in 1891. Of the amount produced in 1893, 5,141 barrels were used at smelters.

NEW YORK.

New York takes first place in the production of salt, superseding Michigan, which State until 1893 was the most important salt producer. It is probable that the production of salt in New York in previous years has been understated. The returns from producers in 1893 are very complete, and show a total output of 5,662,074 barrels, with a net value of $1,870,084. In 1892 the product was reported at 3,472,073 barrels, indicating an increase in quantity of 2,190,001 barrels, or 63 per cent. The value, owing to a large number of producers having included the cost of packages with the selling value of their product in 1892, shows only a small increase in 1893, from $1,662,816 to $1,870,084, a difference of $207,268, or about 12½ per cent. Of the product in 1893, 4,290,644 barrels, valued at $1,492,084 were from brine, and 1,371,430 barrels, worth $378,000, represented the rock-salt product.

The following table exhibits the total salt production of New York since 1883:

Production of salt in New York since 1883.

Years.	Barrels.	Value.	Years.	Barrels.	Value.
1883	1,619,486	$680,638	1889	2,273,007	1,136,503
1884	1,788,454	705,978	1890	2,532,036	1,266,018
1885	2,304,787	874,258	1891	2,839,544	1,340,036
1886	2,431,563	1,243,721	1892	3,472,073	1,662,818
1887	2,353,560	936,894	1893	5,662,074	1,870,084
1888	2,318,483	1,130,409			

New York brine salt.—Salt is made from brine in two localities in New York, the Onondaga reservation, in the vicinity of Syracuse, Onondaga county, and the Warsaw district, in Warsaw county. The wells in the Onondaga reservation are controlled by the State, the brine being sold to the manufacturers. It will be noted in the following table that there was a remarkable increase in the yield of the Onondaga wells, which was considerably more than double that of 1892, while in the Warsaw district there was a decrease of about 10 per cent. The usual unit of measurement employed in New York is the bushel of 56 pounds, and in the following statement the quantities have been reduced to that unit:

Product of salt from brine in New York since 1883.

Districts.	1883.	1884.	1885.	1886.	1887.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	7,497,431	6,942,270	6,934,299	6,101,757	5,695,797
Warsaw district	600,000	2,000,000	4,589,635	6,056,060	6,072,000
Total	8,097,431	8,942,270	11,523,934	12,157,817	11,767,797

Districts.	1888.	1889.	1890.	1891.	1892.	1893.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	5,657,367	5,365,039	4,928,122	3,948,914	4,405,674	9,853,580
Warsaw district	5,935,000	6,000,000	7,732,060	10,248,505	12,954,705	11,599,640
Total	11,592,367	11,365,039	12,660,182	14,197,419	17,360,379	21,453,220

In the following table the figures for years prior to 1893 are taken from the annual reports of the State superintendent of the Onondaga salt springs. The figures for 1893 are from direct returns by operators to the Geological Survey. It will be observed that there has been a steady decline in the production of fine salt since 1882, the output in 1893 being the smallest in seventy years. The production of solar salt, on the other hand, was the largest on record. It includes salt used in the manufacture of chemical preparations, and which, not entering the market as salt, may not be included in the superintendent's returns.

Production of the Onondaga district, 1797 to 1893.

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797		25,474	25,474	1846	331,705	3,507,146	3,838,851
1798		59,928	59,928	1847	262,879	3,688,476	3,951,355
1799		42,704	42,704	1848	342,497	4,394,629	4,737,126
1800		50,000	50,000	1849	377,735	4,705,834	5,083,569
1801		62,000	62,000	1850	374,732	3,894,187	4,268,919
1802		75,000	75,000	1851	378,967	4,235,150	4,614,117
1803		90,000	90,000	1852	633,595	4,288,938	4,922,533
1804		100,000	100,000	1853	577,947	4,826,577	5,404,524
1805		154,071	154,071	1854	734,474	5,068,873	5,803,347
1806		122,577	122,577	1855	498,124	5,584,761	6,082,885
1807		175,448	175,448	1856	709,391	5,257,419	5,966,810
1808		319,618	319,618	1857	481,280	3,830,846	4,312,126
1809		128,282	128,282	1858	1,514,554	5,518,665	7,033,219
1810		450,000	450,000	1859	1,345,022	5,549,250	6,894,272
1811		200,000	200,000	1860	1,462,565	4,130,682	5,593,247
1812		221,011	221,011	1861	1,884,697	5,315,694	7,200,391
1813		226,000	226,000	1862	1,983,022	7,070,852	9,053,874
1814		295,000	295,000	1863	1,437,656	6,504,727	7,942,383
1815		322,058	322,058	1864	1,971.122	5,407,712	7,378,834
1816		348,665	348,665	1865	1,886,760	4,499,170	6,385,930
1817		408,665	408,665	1866	1,978,183	5,180,320	7,158,503
1818		406,540	406,540	1867	2,271,892	5,323,673	7,595,565
1819		548,374	548,374	1868	2,027,490	6,639,126	8,666,616
1820		458,329	458,329	1869	1,857,942	6,804,295	8,662,237
1821		526,049	526,049	1870	2,487,691	6,260,422	8,748,113
1822		481,562	481,562	1871	2,464,464	5,910,492	8,374,956
1823		726,988	726,988	1872	1,882,604	6,048,321	7,930,925
1824		816,634	816,634	1873	1,691,359	5,768,998	7,460,357
1825		757,203	757,203	1874	1,667,368	4,361,932	6,029,300
1826		811,023	811,023	1875	2,655,955	4 522,491	7,179,446
1827		983,410	983,410	1876	2,308,679	3,083,998	5,392,677
1828		1,160,888	1,160,888	1877	2,525,335	3,902,648	6,427,983
1829		1,129,280	1,129,280	1878	2,788,754	4,387,443	7,176,197
1830		1,435,446	1,435,446	1879	2,957,744	5,364,418	8,322,162
1831		1,514,037	1,514,037	1880	2,516,485	5.482,265	7,998.750
1832		1,652,985	1,652,985	1881	3,011,461	4,905,775	7,917,236
1833		1,838,646	1,838,646	1882	3,032,447	5,307,733	8,340,180
1834		1,943,252	1,943,252	1883	2,444,374	5,053,057	7,497,431
1835		1,209,867	1,209,867	1884	2,353,860	4,588,410	6,942,270
1836		1,912,858	1,912,858	1885	2,439,332	4,494,967	6,934,299
1837		2,167,287	2,167,287	1886	2,772,348	3,329,409	6,101,757
1838		2,575,033	2,575,033	1887	3,118,974	2,576,823	5,695,797
1839		2,864,718	2,864,718	1888	3,115,314	2,542,053	5,657,367
1840		2,622,305	2,622,305	1889	2,916,922	2,448,117	5,365,039
1841	220,247	3,120,520	3,340,767	1890	2,726,471	2,201,651	4,928,122
1842	163,021	3,128,882	2,291,903	1891	2,113,727	1,735,186	3,948,914
1843	318,105	2,809,395	3,127,500	1892	3,122,789	1,282,885	4,405,674
1844	332,418	3,671,134	4,003,552	1893	9,326,720	526,860	9,853,580
1845	353,455	3,408,903	3,762,358				

Warsaw district.—Salt production in the Warsaw district began in 1883, with an output of 600,000 bushels, equivalent to 120,000 barrels. In the following year it more than trebled its initial production with an output of 2,000,000 bushels. In 1887 it exceeded the production of the

Onondaga reservation with a yield of 6,072,000 bushels. In 1892, five years later, the product had more than doubled, reaching 12,954,705 bushels. The product in 1893 was 1,355,065 bushels less than in 1892. Since 1887 the Warsaw has been the principal salt-producing district in the State. The annual production in bushels since 1883 has been as follows:

Production of salt in the Warsaw district, New York, since 1883.

Years.	Bushels.	Years.	Bushels.
1883	600,000	1889	6,000,000
1884	2,000,000	1890	7,732,060
1885	4,589,635	1891	10,248,505
1886	6,056,060	1892	12,954,705
1887	6,072,000	1893	11,599,640
1888	5,935,000		

OHIO.

The amount of salt produced in Ohio in 1893 was 543,963 barrels, worth $209,393. No separate statement of the production of salt in Ohio has been published prior to 1893.

PENNSYLVANIA, TEXAS, AND WEST VIRGINIA.

During 1893 Pennsylvania produced 280,343 barrels, valued at $136,436. In 1892 a product of 25,571 barrels, worth $10,741, was reported. This was probably less than the actual product. The product of Texas in 1893 was 126,000 barrels, worth $110,267, against 121,250 barrels, valued at $99,500, in 1892. The output of West Virginia in 1893 was 210,736 barrels, worth $68,222. The product of this State in 1891 and 1892 has been included with that of other States.

UTAH.

The production of Utah in 1893 shows a remarkable decrease, due to the shutting down of silver-smelting works in the vicinity. The output during the year was only 15,200 tons, or 108,571 barrels. In 1892 it was 180,946 tons, or 1,292,471 barrels. During 1893, 10,000 tons of salt were refined from the harvest of the previous year. This was included in the product of 1892, although marketed in 1893.

Production of salt in Utah since 1883.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Barrels.			*Barrels.*	
1883	107,143	$100,000	1889	200,000	$60,000
1884	114,285	80,000	1890	427,500	126,100
1885	107,140	75,000	1891	969,000	265,350
1886	164,285	100,000	1892	1,292,471	340,442
1887	325,000	102,375	1893	108,570	30,075
1888	151,785	32,000			

IMPORTS AND EXPORTS.

Salt imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ended—	In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
June 30, 1867...	254, 470, 862	$696, 570	229, 304, 323	$336, 302	....	....	$1, 032, 872
1868...	308, 446, 080	915, 546	219, 975, 096	365, 458	....	....	1, 281, 004
1869...	297, 382, 750	895, 272	256, 765, 240	351, 168	....	....	1, 246, 440
1870...	288, 479, 187	797, 194	349, 776, 433	507, 874	68, 597, 023	$87, 048	1, 392, 116
1871...	283, 993, 799	800, 454	274, 730, 573	355, 318	64, 671, 139	66, 008	1, 221, 780
1872...	258, 232, 807	788, 893	257, 637, 230	312, 569	57, 830, 929	60, 155	1, 161, 617
1873...	239, 494, 117	1, 254, 818	388, 012, 132	525, 585	86, 756, 628	86, 193	1, 866, 596
1874...	358, 375, 496	1, 452, 161	427, 294, 209	649, 838	105, 613, 913	126, 896	2, 228, 895
1875...	318, 673, 091	1, 200, 541	401, 270, 315	549, 111	110, 294, 440	119, 607	1, 869, 259
1876...	331, 266, 140	1, 153, 480	379, 478, 218	462, 106	118, 760, 638	126, 276	1, 741, 862
1877...	359, 005, 742	1, 059, 941	444, 044, 370	532, 831	132, 433, 972	140, 787	1, 733, 559
1878...	352, 109, 963	1, 062, 995	414, 813, 516	483, 909	100, 794, 611	96, 898	1, 643, 802
1879...	375, 286, 472	1, 150, 018	434, 760, 132	532, 706	94, 060, 114	95, 841	1, 778, 565
1880...	400, 970, 531	1, 180, 082	449, 743, 872	548, 425	109, 024, 446	119, 667	1, 848, 174
1881...	412, 442, 291	1, 242, 543	529, 361, 041	658, 068	133, 395, 065	144, 347	2, 044, 958
1882...	329, 969, 500	1, 086, 932	399, 100, 228	474, 200	134, 777, 569	147, 058	1, 708, 190
1883...	312, 911, 360	1, 035, 946	412, 938, 686	451, 001	142, 065, 557	154, 671	1, 641, 618
1884...	340, 759, 010	1, 093, 628	441, 613, 517	433, 827	126, 605, 276	122, 463	1, 649, 918
1885...	351, 276, 969	1, 030, 029	412, 322, 341	386, 858	140, 067, 018	121, 429	1, 538, 316
Dec. 31, 1886...	319, 232, 750	966, 993	366, 621, 223	371, 000	103, 360, 362	94, 721	1, 432, 714
1887...	275, 774, 571	850, 069	343, 216, 331	328, 201	105, 577, 947	107, 089	1, 285, 359
1888...	238, 921, 421	620, 425	272, 650, 231	246, 022	113, 459, 083	111, 120	977, 577
1889...	180, 906, 293	627, 134	234, 499, 635	249, 232	97, 960, 624	100, 123	976, 489
1890...	172, 611, 041	575, 260	243, 756, 044	252, 848	98, 279, 719	96, 648	924, 756
1891...	150, 033, 182	492, 144	220, 309, 985	224, 569	103, 990, 324	89, 196	805, 909
1892...	150, 799, 014	488, 108	201, 366, 103	196, 371	105, 192, 086	90, 327	774, 806
1893...	98, 037, 648	358, 575	146, 945, 390	63, 404	103, 536, 135	87, 749	509, 728

Salt of domestic production exported from the United States from 1790 to 1893, inclusive.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Bushels.			*Bushels.*	
Sept. 30, 1790........	31, 935	$8, 236	June 30, 1861........	537, 401	$144, 046
1791........	4, 208	1, 052	1862........	397, 506	228, 109
1830........	47, 488	22, 978	1863........	584, 901	277, 838
1831........	45, 847	26, 848	1864........	635, 519	296, 088
1832........	45, 072	27, 914	1865........	589, 537	358, 109
1833........	25, 069	18, 211	1866........	670, 644	300, 980
1834........	89, 064	54, 007	1867........	605, 825	304, 030
1835........	126, 230	46, 483	1868........	624, 970	289, 936
1836........	49, 917	31, 943	1869........	442, 947	190, 076
1837........	99, 133	58, 472	1870........	298, 142	119, 582
1838........	114, 155	67, 707	1871........	120, 156	47, 115
1839........	264, 337	64, 272	1872........	42, 603	19, 978
1840........	92, 145	42, 246	1873........	73, 323	43, 777
1841........	215, 084	62, 765	1874........	31, 657	15, 701
1842........	110, 400	39, 064	1875........	47, 094	16, 273
June 30, 1843 (*a*).....	40, 678	10, 262	1876........	51, 014	18, 378
1844........	157, 529	47, 755	1877........	65, 771	20, 133
1845........	131, 500	45, 151	1878........	72, 427	24, 968
1846........	117, 627	30, 520	1879........	43, 710	13, 612
1847........	202, 244	42, 333	1880........	22, 179	6, 613
1848........	219, 145	73, 274	1881........	45, 455	14, 752
1849........	312, 063	82, 972	1882........	42, 085	18, 265
1850........	319, 175	75, 103	1883........	54, 147	17, 321
1851........	344, 061	61, 424	1884........	70, 014	26, 007
1852........	1, 467, 676	89, 316	1885........	*b* 4, 101, 587	26, 488
1853........	515, 857	119, 729	Dec. 31, 1886........	4, 828, 863	29, 580
1854........	548, 185	159, 026	1887........	4, 685, 080	27, 177
1855........	536, 073	156, 879	1888........	5, 359, 237	32, 986
1856........	698, 458	311, 495	1889........	5, 378, 450	31, 405
1857........	576, 151	190, 699	1890........	4, 927, 022	30, 079
1858........	533, 100	162, 650	1891........	4, 448, 846	23, 771
1859........	717, 257	212, 710	1892........	5, 208, 935	28, 399
1860........	475, 445	129, 717	1893........	5, 792, 207	38, 375

a Nine months. *b* Pounds from 1885.

NATURAL SODIUM SALTS.

By R. L. Packard.

NATURAL SODA.

The geographical occurrence of natural soda in the United States is principally confined to the arid regions of the Great Basin, especially to the soda lakes at Ragtown, Nevada; Mono lake, Mono county; Owens lake, Inyo county, California, and Albert lake, Oregon, and to the many dry deposits and incrustations in the same region (*a*). A full chemical discussion of the nature of the natural sodas and their technology, together with numerous analyses of the waters of the soda lakes and the dry deposits, are given by Dr. T. M. Chatard, in Bulletin No. 60 of the U. S. Geological Survey. The lakes, as shown by Messrs. King, Hague, (Fortieth Parallel, II), and Russell (Eighth Annual Report, and Monograph XI, U. S. Geological Survey), are, for the most part, the residues left by the evaporation of larger bodies of water, the shore lines of which can be traced at considerable distances, sometimes several hundred feet, above the present beaches, showing that the old lakes covered wide expanses of the present desert. The concentration by evaporation of the waters of the former lakes has increased the proportion of their mineral salts, and sometimes this concentration reaches the crystallizing point, when the sodium carbonate appears as a white incrustation on the surface and shores of the lake. The origin of this salt is explained by the geology of the region where it occurs, which is given in the reports above referred to, and by certain chemical reactions which will be described later on.

The Ragtown, Nevada, soda lakes are two adjoining, but not visibly communicating, small bodies of water, the larger being about 268 acres in extent, and the smaller only about one-fifth of a mile in diameter. They have the peculiarity that they are enclosed by rims which are higher than the surface of the desert while the lakes themselves are below the level of the plain. They are regarded as craters. They have no visible water supply or outlet, and Professor Russell concludes (*a*) that their water comes from the Carson river, which is at no great distance, by seepage or percolation. While, therefore, these lakes or ponds are in the hydrographic basin of the great Quaternary lake which Mr. Clarence King called Lake Lahontan, they are not evaporation residues of a portion of that body of water, but their high saline contents are due to the grad-

a Monograph XI, U. S. Geological Survey.

ual concentration of their own water supply. The density of the water of these lakes is very high. A specimen analyzed by Dr. Chatard had a specific gravity of 1.0995 and contained 129.011 grammes of mineral salts per liter. The salts of soda which crystallize from this water form a crust sufficiently strong at some seasons to support a man's weight. The solid contents of the water of the larger lake, as analyzed by Dr. Chatard, gave the following results:

Composition of the solid contents of the soda lake at Ragtown, Nevada.

Constituents.	Per cent.	Constituents.	Per cent.
SiO_2	0.24	$Na_2B_4O_7$	0.31
$MgCO_3$	.73	Na_2CO_3	13.08
KCl	3.73	$NaHCO_3$	11.61
$NaCl$	55.44		
Na_2SO_4	14.86	Total	100.00

The salts which had crystallized from the water of this lake, and which formed "large fields of dazzling white carbonate of soda" on the shore, were analyzed by Prof. O. D. Allen, of Yale College, whose results, rearranged by Dr. Chatard, show the following composition:

Composition of salts crystallized from the soda lake at Ragtown, Nevada.

Constituents.	Per cent.	Constituents.	Per cent.
Insoluble matter	0.80	$NaHCO_3$	34.66
Na_2SO_4	1.29	H_2O	16.19
$NaCl$	1.61		
Na_2CO_3	45.05	Total	99.60

The large proportion of sodium chloride and sulphate which the lake water contains has therefore been eliminated by this natural process of crystallization, a process which has been imitated in the manufacture of "summer soda" at the Ragtown soda works. The other soda lakes are residual bodies of water left by former large lakes. Mono and Owens lakes, California, are of this character, although they are outside of the great hydrographic basin of Lake Lahontan. Professor Russell describes the geography and geology of Mono lake in the Eighth Annual Report of the U. S. Geological Survey. Its hydrographic basin has no outlet, but streams and springs feed the lake, and the only escape for the water is by evaporation. The ancient shore lines can be traced far up on the sides of the Sierra Nevada, which formed the western shore of the ancient lake. There are springs in the bottom of the lake and near its shores. They are especially abundant near the base of the mountains—the seat of former orographic movements—and a belt of hot springs extends along the range for hundreds of miles. Just south of the lake is a series of volcanic cones known as the Mono craters, so that the locality is one of former volcanic activity. Professor Russell says:

"The Mono craters and other modern volcanoes have contributed vast quantities of lapilli and pumiceous dust to the filling of the [Mono] basin. The products of volcanic activity are more soluble than the granites and metamorphosed sediments in which streams rising in the Sierra Nevada have excavated their channels, and probably exert a controlling influence on the chemistry of the lake waters." A fuller way of stating this would be that the soda-lime feldspars of the lavas have afforded the soda which abounds in the water of the lake. It is not necessary to imagine that an abnormal quantity of mineral salts is supplied to the lake, for Professor Russell says that its water supply does not differ from that of many other basins of the West. The density of the water must therefore be due to evaporation, and a long continued supply of soda-lime salts in small quantities would suffice to produce the present condition. In the absence of analyses of the supply waters it is impossible to say whether chlorides and sulphates are still entering the lake in more than ordinary proportion.

The density of the water of Mono lake is far less than that of the Ragtown ponds. At the time in 1882 when the specimen analyzed by Dr. Chatard was collected it was 1.045, and the evaporation residue amounted to 53.473 grams per liter, with the following composition:

Composition of residue from water of Mono lake, California.

Constituents.	Per cent.	Constituents.	Per cent.
SiO_2	0.13	KCl	3.44
Al_2O_3, Fe_2O_3	.005	$NaCl$	34.60
$CaCO_3$	.09	Na_2SO_4	18.45
$MgCO_3$	.36	Na_2CO_3	34.33
$Na_2B_4O_7$	.39	$NaHCO_3$	8.20
		Total	99.995

A little lime still remains in this water, but most of it is precipitated as carbonate in a striking form, which has been described by Messrs. King and Russell. Above the surface of the lake and on its shores are pinnacles and domes of calcareous tufa which often assume fantastic shapes. These domes are formed under water, often at the mouths of springs carrying lime in solution, which is precipitated at their mouths. The proportion of lime in the spring water is small, but long-continued action is sufficient to build up these domes. The lake formerly covered the tufa now projecting above the water. Sometimes the deposit is formed around springs in the open air, when simple evaporation would account for it, as in the case of travertine and siliceous sinter. But when the precipitation occurs under water, as Professor Russell describes, it would seem that the alkaline carbonates of the lake water must be the precipitating cause. The springs themselves, he says, are fresh water. He adds: "The sandy and pumiceous lapilli forming the immediate border of Lake Mono are often cemented by calcium carbonate into a semi-compact sandstone or breccia, but beyond this no chemical precipitation is known to be in progress. The comparatively small percentage of lime in the waters of the lake shows that this element must be deposited as fast as it is delivered by the inflowing streams and springs." It does not therefore coat the rocks now washed by the waves or form a sheet of tufa on the bottom of the lake. These tufa domes are still forming both in Pyramid and Walker lakes, the water supply of which contains less than one-half of one per cent. of saline matters.

Professor Russell states that one of the Mono craters is composed of hornblende andesite; the others are of rhyolite, and there is much basalt, both older and more recent than the lake. "Not less than ten and probably fifteen craters have been formed in and about the lake since its last great expansion" (*a*).

An analysis of this rhyolite by Dr. Chatard gave the results shown below.

Analysis of rhyolite from Mono county, California.

Constituents.	Per cent.	Constituents.	Per cent.
Ignition	2.20	K_2O	4.31
SiO_2	74.05	Na_2O	4.60
Al_2O_3	13.85		
CaO	.90	Total	99.98
MgO	.07		

This rock, like volcanic rocks in general, contains both soda and potash; yet very little potash, compared with the soda, is found in the waters of the soda lakes. Andesites contain on the average 4.26 per cent. soda, 2.68 per cent. potash, 5.03 per cent. lime; trachytes 5.25 per cent. soda, 6.37 per cent. potash, and 1.61 per cent. lime; liparite 4.49 per cent. soda, 3.49 per cent. potash, 1.21 per cent. lime; basalts, 3.12 per cent. soda, 1.23 per cent. potash, and 10 per cent. lime; while granites average 2.93 per cent. soda, 3.95 per cent. potash, and 2.54 per cent. lime (*b*). The relatively small proportion of potash in the waters analyzed is therefore, noteworthy, as they are so near the source of supply of the alkaline salts. The chlorides and sulphates are to be accounted for by the proximity of the volcanoes, the volcanic activity in this region having evidently been accompanied by the evolution of quantities of hydrochloric and sulphurous acid gases as in volcanic areas near the sea. Sulphuric acid is also derived from the oxidation of pyrite, which is often found in abundance in volcanic rocks, and may have contributed to form the sulphates.

The geology of the other soda lakes is like that of Lake Mono. Thus Owens lake is in a basin which receives the drainage from a volcanic country, the rocks of which are much decomposed, and the ground in many places is covered with incrustations and efflorescences. There

a Eighth Annual Report U. S. Geol. Survey, pt. I, p. 377.

b Averages calculated from tables of analyses in Kalkowsky's Lithologie.

are many warm springs, the waters of which flow into several soda lakes that drain in the wet season into Owens river which feeds Owens lake. King (Fortieth Parallel, Vol. II) describes the Carson desert as rimmed north and south by low volcanic hills connecting the parallel ranges which inclose the basin. The present Carson lake is fed by two streams, one saline (Humboldt river) and the other (Carson river) fresh. The lake having no outlet, its salinity is due to concentration by evaporation. Similarly Lake Tahoe overflows into Pyramid and Winnemucca lakes which become charged with soda salts by evaporation.

Like Lake Lahontan on the west, another great Quaternary lake occupied a part of the eastern side of the Great Basin. It is known as Lake Bonneville and its residual water is the Great Salt lake. King (Fortieth Parallel, Vol. II), after showing that the predominating salts of the water of this lake are chloride of sodium with some magnesium chloride and small quantities of sulphates, says: "It would seem that the carbonate of lime which is brought in by the present drainage either goes down as a crystalline precipitate of carbonate or decomposes some of the sulphate and remains in solution as sulphate." The rivers bring the carbonate of lime and the springs which abound in the neighborhood of the lake supply the alkalies.

He adds: "All the spring waters of central Nevada, with the few exceptions of those having their origin in granite, are strongly impregnated either with salts of lime or with those of the alkalies. Humboldt and Reese rivers, like almost all modern rivers, carry carbonate of lime in excess over all other salts, but all the Nevada rivers have also a variable amount of free alkaline carbonates. On entering the brackish lakes at the sinks of these rivers the carbonate of lime mainly goes down, and the alkaline carbonates, chlorides, and sulphates remain to enrich the saline solution."

The neighborhood of the Great Salt lake is volcanic. Mr. G. K. Gilbert (Monograph I) describes the various volcanoes and concludes that the flows of rhyolite preceded the formation of Lake Bonneville, while basalt both preceded it and was ejected during and after the lake came into existence. Some eruptions took place under water, and the old lake shores are found on some of the volcanic cones. The same material is, therefore, present in this region for supplying chlorides and sulphates and carbonates of the alkalies and lime as in the western part of the Great Basin, yet the sodium carbonates are wanting. The cause of this difference is not obvious, and the few analyses of the rivers and springs supplying the Great Salt lake and of those in Nevada do not help us, as the slight amount of carbonate of soda reported in Humboldt, Truckee, and Carson rivers compared with the chlorides and sulphates would not explain the high proportion found in the soda lake waters if concentration alone is to be considered.

As sodium carbonate is found, therefore, in isolated occurrences associated with the chloride and sulphate and frequently gypsum, while the chloride and sulphate are often found without it, its origin is a matter of curiosity. It is obvious that atmospheric carbonic acid is insufficient to account for it, or sodium carbonate would occur in the Great Salt lake region as well as in the Lake Lahontan basin, for chlorides and sulphates are abundant there, while the carbonate is absent. Mr. King mentions an incrustation from near Great Salt lake which had the following composition:

Composition of an incrustation from near Great Salt lake.

	Per cent.
$Na\,Cl$	38.25
$Na_2\,SO_4$	17.54
$K_2\,SO_4$	4.71
$Na_2\,CO_3$	37.09

This is, he says, a solitary instance of a carbonate from this region. Its composition is characteristic.

The following chemical reaction may supply an explanation of the origin of natural carbonate of soda: It appears that the acid carbonate of sodium is formed in a dilute solution of the chloride or sulphate of sodium in the presence of calcium carbonate in suspension, by passing carbonic acid gas into the solution. The laboratory experiment on this point is said to have been mentioned by Brandes in 1826, and was more exactly described by Alexander Müller, of Stockholm, in 1859, who used the sulphate of sodium and found that gypsum was formed by the reaction. Dr. T. Sterry Hunt also describes the same reaction between carbonate of lime, sulphate of soda (and sulphate of magnesia), and carbonic acid. *a* The experiments of Brandes and Müller are quoted by Hilgard and Weber, who repeated them in 1889 and showed that the reaction holds good for the chloride of sodium as well as the sulphate. More recently (Ber. der d. Chem. Gesellsch., xxv, 3624) Prof. Hilgard has continued this line of investigation with some quantitative particulars. He applies the reaction to the arid region of California (San Joaquin valley), where the scanty rainfall dissolves the surface chlorides and sulphates, and carries them a short distance into the ground, and there, he suggests, in the presence of the abundant carbonate of lime contained in the soil, the carbonic acid of the soil air and that dissolved in the rainwater, sodium carbonate is formed which, on evaporation of the moisture, effloresces on the surface of the ground. *b*

a Am. Jour. Sci. [2] vol. xxviii, p. 175.

b Daubrée (Les eaux souterraines à l'époque actuelle, Tome 2d., 1887, p. 119) dismisses the origin of carbonate of soda in a few words. He says "as to the carbonate of soda which is characteristic of numerous springs, several contemporary phenomena should be mentioned. We know that the salt is now produced in the waters of various lakes in Egypt, in California, and elsewhere by the double decomposition of chloride of sodium and carbonate of lime. This process of formation would seem to be more frequent than is usually supposed, according to M. Schlösing, who has pointed out its general occurrence at various places on the French coast." But M. Daubrée makes no mention of carbonic acid, the intervention of which is essential to the reaction.

The analyses above quoted show that in the Great Basin also chlorides and sulphates of soda are present, together with carbonate of lime, in the waters entering the soda lakes and in the lakes themselves. Professor Russell (Monograph XI) is of the opinion that the carbonate of lime was held in solution by carbonic acid in the springs and the dilute lake waters, and was precipitated on the escape of the gas. The streams feeding the lake contain about the normal amount, viz., 0.09 per cent. of carbonate of lime. He also says that "sublacustral springs charged with carbonic acid and carbonate of lime may part with their dissolved gases and deposit calcareous tufa," meanwhile furnishing the precise condition for the production of sodium carbonate. Some of the numerous springs of this region formerly deposited carbonate of lime quite abundantly by the escape of carbonic acid gas, and it is probable that at the close of the volcanic period the springs were highly charged with that gas. As sulphate of lime is formed when sodium sulphate is involved in this reaction, and no gypsum is found in Mono lake water or the tufa deposited from it or in the mud of the lake, the solution must have been dilute enough to retain this salt in solution to be subsequently converted into carbonate.

While the hypothesis requires that sodium chloride or sulphate should be present in dilute solution together with carbonate of lime and carbonic acid, and all these conditions have been shown to be and to have been present in the Lake Lahontan region except the abundant or excessive presence of carbonic acid (which is a justified inference), the origin of the sodium carbonate in the springs and lakes of that region may be regarded as provisionally accounted for. The composition of the waters of Great Salt Lake and its tributaries shows that they contain the same salts, although in different proportions, as those of the Lahontan basin, except the carbonate. The geological reports show volcanic regions in both cases, but we cannot conclude from them whether or not there was a deficiency of carbonic acid gas in the waters of the Lake Bonneville region at the time the saline solutions were in a proper condition to fulfill the reaction, although it is probable that such was the case.

Production:—The production of natural carbonate of soda in 1893 amounted to about 3,100 tons, of which one-fifth was soda ash and crystal carbonate.

The Wyoming sulphate has received new attention in the last two years. In 1892, 1,670 tons of salt cake were shipped from the Laramie works. Improvements were being made in the works in 1893, and new plants for producing the carbonate were erected in other places in Wyoming during the year. These causes interfered with the production of both salts.

Natural borax.—The waters of the soda lakes, as Dr. Chatard's analyses show, contain small quantities of sodium borate, which the volcanic neighborhood easily accounts for. In various places in the arid regions of California, Nevada, and farther north, even into eastern Washington, which is in the volcanic belt, there are deposits of borax and borate of lime, which have been worked more or less successfully. The origin of the soda and lime is to be ascribed to the feldspars of the volcanic rocks which furnished those bases for the boracic acid which was supplied by the volcanic emanations, as in the well-known cases in Tuscany. Some springs in the volcanic belt still contain traces of boracic acid. The borates formed in this way were concentrated in lakes or ponds in the same way as the carbonates until crystallization took place. The present beds are former lake or pond deposits of this kind. An interesting occurrence is the lime borate at Calico, San Bernardino county, California, where the borate bed has been tilted up with the inclosing sedimentaries until its edge forms a "vein," which is mined by shafts, drifts, and stopes, as any ore deposit would be. (*a*)

A full list of the borax occurrences, together with the technology of the manufacture, was given by Mr. Charles G. Yale in the Mineral Resources for 1889 and 1890.

Production.—The following table gives the production of borax in California and Nevada from the beginning of the industry:

Product of borax in the United States.

Years.	Pounds.	Years.	Pounds.
Before 1873	1, 750, 000	1883	6, 500, 000
1873	2, 000, 000	1884	7, 000. 000
1874	4, 000, 000	1885	8, 000, 000
1875	5, 433, 658	1886	9, 778, 290
1876	5, 180, 810	1887	11, 000, 000
1877	3, 727, 280	1888	7, 830, 000
1878	2, 802, 800	1889	8, 800, 000
1879	1, 584, 966	1890	9, 500, 000
1880	3, 860, 748	1891	13, 380, 000
1881	4, 045, 405	1892	12, 538, 196
1882	4, 236, 291	1893	8, 699, 000

The average value for 1892 and 1893 was 7½ cents per pound.

The falling off in production in 1893 was due to the general dullness of trade. The prices averaged 9¾ cents in 1884; in 1885, 8¼ cents; 1886, 6¾ cents; 1887, 5¾ cents. Then the Pacific Borax Company took hold of the industry, and in 1888 the price went to 7 cents, and from 1889 to 1894 it has been 7½ cents.

a Report of State Mineralogist of California for 1892.

The imports of borax have been as follows:

Borax, boracic acid, and borate of lime imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Refined borax.		Crude borax.		Boracic acid.		Borate of lime.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		
June 30, 1867.	49,652	$6,601	5,672	$711	770,756	$73,396	....	....	$80,708
1868.	79,183	10,127	22,293	2,985	243,993	22,845	....	....	35,957
1869.	89,695	12,799	54,822	8,011	988,033	109,974	....	....	130,784
1870.	97,078	14,511	2,616	322	1,166,145	173,806	33,529	$1,666	190,305
1871.	134,927	20,705	5	1	1,204,049	185,477	45,600	2,248	208,431
1872.	35,542	6,288	....	....	1,103,974	191,575	22,500	800	198,663
1873.	9,284	2,152	....	....	1,222,006	255,186	....	....	257,338
1874.	3,860	1,253	588	78	233,955	52,752	....	....	54,083
1875.	5,153	1,224	....	....	41,742	6,280	....	....	7,504
1876.	3,145	691	....	....	137,518	15,711	....	....	16,402
1877.	3,500	676	55	12	107,468	11,231	....	....	11,919
1878.	3,492	514	286	61	178,798	14,925	....	....	15,500
1879.	3,472	490	....	....	306,462	21,888	....	....	22,378
1880.	15,278	2,011	....	....	243,733	18,473	22,122	742	21,226
1881.	4,136	865	....	....	187,053	15,771	....	....	16,636
1882.	15,710	3,774	....	....	536,334	71,343	....	....	75,117
1883.	5,611	1,359	....	....	4,334,432	580,171	....	....	581,530
1884.	7,332	1,691	142	34	44,512	4,494	....	....	6,219
1885.	240	41	....	....	48,517	4,035	....	....	4,076
1886.	4,625	770	4	1	*a*430,655	26,237	....	....	27,008
1887.	3,731	439	33	4	376,184	19,885	....	....	20,328
1888.	4,705	600	455	39	487,777	26,394	....	....	27,033
1889.	5,642	685	....	....	676,736	36,814	....	....	37,499
1890.	2,302	275	....	....	8,667,802	43,967	....	....	44,242
1891.	10,725	1,062	82,642	9,050	666,865	41,019	....	....	51,131
1892.	3,970	426	40	6	701,625	39,418	....	....	39,850
Dec. 31, 1893.	7,261	855	756,584	18,931	572,794	31,938	(*b*)	....	51,724

a 393,832 pounds were commercial, the remainder pure.
b Included in crude borax.

Chile saltpeter.—The desert of Atacama, in northern Chile, is the seat of the large deposits of nitrate of soda which have been so extensively worked in the last ten or fifteen years. An official report of the geology of this region was made to the Chilean Government by Señor A. Pissis, which gives a sufficiently clear general idea of the structure of the country.*a*

The desert is bounded by the Andes on the east and by the Coast Range on the west, and from these ranges and the larger mountain chains which divide the desert into four great basins extend smaller spurs which often inclose plains which are the beds of ancient lakes. The Coast Range abounds in igneous rocks, while modern eruptive rocks upheaving Jurassic sediments form the eastern border. The plains of the desert itself are covered with the angular débris of volcanic rocks, and weathered masses of eruptives covered with their own ruins rise from the plain. The feldspathic decay of the volcanic rocks has left the chalcedony of the amygdaloidal rocks lying everywhere on the surface of the ground. Möricke*b* calls the igneous rocks of the coast granitites and quartz diorites, and the eruptives of the eastern border and the interior, andesites. The volcanic character of the region is, therefore, sufficiently indicated.

a "Nitrate and guano deposits in the desert of Atacama." Published by authority of the Chilean Government. London, 1878.

b Tschermak's Mittheil. 1891, pp. 186–198.

Señor Pissis states that the nitrate is associated with salt, sulphate of sodium, and gypsum, and is generally found on the hillsides rather than in the center of the lake beds and marshes. Samples of the native saltpeter analyzed by Domeyko gave:

Analyses of native saltpeter from Chile.

	Per cent.	Per cent.		Per cent.	Per cent.
Nitrate of sodium	24.30	27.98	Magnesia	Trace.	Trace.
Chloride of sodium	53.65	23.00	Water	7.30	22.45
Sulphate of soda	4.95	8.46			
Insoluble	9.80	14.70		100.00	100.00
Sulphate of lime	....	3.41			

Señor Pissis shows that the deposit could not be of marine origin, because it is not found in stratified rocks or associated with marine shells. It is found on the hillsides and often at great altitudes, and he concludes that its origin is due to the decomposition of the feldspathic sands which form the slopes of the nitrate plains. The feldspars of the neo-volcanic rocks, everywhere present in the district, he identifies as labradorite, albite, and oligoclase, containing up to 12 per cent. of lime and 10 per cent. of soda, and therefore capable of furnishing all the bases found in the deposits. Sulphuric acid for the formation of the sulphates is probably furnished by the oxidation of the pyrites, an invariable constituent of the rocks, and chlorine is constantly present in volcanic emanations, "the water derived from trachytic areas containing large quantities of soluble chlorides." He attributes the formation of the nitric acid to the "property possessed by alkaline carbonates of transforming atmospheric nitrogen into nitric acid in the presence of other oxidizable matters." More recent views would account for it by the speedier way of nitrification. Señor Pissis refers to the extensive guano beds which accompany the niter deposits, but gives no details of their occurrence, as there was no particular inducement to make discoveries of them at the time of his reconnaissance. He says, however, that the guano deposits are almost always found near the niter beds, and are so near the surface that they are often laid bare by the horses' hoofs. An analysis of guano from Atacama by Domeyko gave 12 per cent. of nitrogen. This guano would, by nitrification, produce the nitric acid necessary to form nitrates with the accompanying alkalies. Indeed, the conditions seem to have been those of the old artificial niter beds, which were prepared by mixing decomposing nitrogenous animal matter and alkaline salts, and were leached after the nitrates had been produced (*a*).

(*a*) Carl Ochsenius, in the Zeitschrift für praktische Geologie, Heft 2, 1893, discusses the subject of nitrification by micro-organisms and shows that in the European and East Indian occurrences the potash saltpeter was formed from decomposing nitrogenous animal matter in the presence of alkaline chlorides, sulphates, and carbonates, the latter having been previously formed from the chlorides and sulphates, in his opinion, by the action of carbonic acid. The Chilean association is similar. There the chlorides and sulphates abound together with the nitrate, and the nitrogenous organic matter adjoins the deposit.

The process of obtaining the niter is simple. As it occurs at slight depth, small pits are sunk into it and explosives are introduced into small chambers at their bottoms, so as to throw down as much ground as possible when fired. The crude material is transported to the extensive works at the coast to be lixiviated, in order to extract the niter which is recovered by evaporation.

The nitrate beds of southern California and Nevada have been frequently noticed, but have not as yet been systematically worked or adequately described.

Imports of nitrate of soda into the United States from 1867 to 1893.

Years ended—	Quantity.	Value.
	Pounds.	
June 30, 1867	29, 429, 469	$563, 624. 20
1868	18, 433, 173	282, 785. 00
1869	28, 866, 364	600, 691. 00
1870	31, 122, 795	752, 604. 00
1871	12, 001, 329	318, 914. 00
	38, 289, 048	936, 051. 00
1872	35, 817, 597	934, 118. 00
1873	59, 757, 241	1, 469, 243. 00
1874	61, 978, 316	1, 338, 141. 00
1875	52, 105, 826	968, 855. 00
1876	51, 887, 218	1, 055, 357. 00
1877	54, 246, 531	1, 324, 299. 00
1878	42, 258, 855	973, 223. 00
1879	76, 285, 858	1, 348, 580. 00
1880	68, 043, 426	1, 830, 396. 00
1881	98, 341, 161	2, 356, 167. 00
1882	184, 598, 857	3, 911, 610. 00
1883	127, 892, 324	2, 336, 681. 00
1884	121, 202, 296	1, 983, 378. 00
1885	109, 361, 808	1, 696, 055. 68
1886	101, 216, 225	1, 681, 824. 14
1887	172, 291, 911	2, 614, 162. 00
1888	178, 954, 024	2, 449, 639. 40
1889	151, 149, 985	2, 275, 093. 00
1890	204, 763, 849	2, 709, 130. 72
1891	*a* 98, 091. 57	2, 929, 759. 78
1892	105, 341. 47	2, 976, 818. 00
Dec. 31, 1893	113, 899. 00	3, 673, 838. 00

a Tons from 1891.

SULPHUR AND PYRITES.

By E. W. Parker.

SULPHUR.

The total product of sulphur in 1893 was 1,200 short tons, valued at $42,000. It was all mined by the Utah Sulphur Company at Black Rock, Utah, formerly operated by the Dickert & Myer Sulphur Company.

The product in 1892 was 2,688 short tons, worth $80,640, showing a decrease in 1893 of 1,488 short tons in amount and of $38,640 in value.

The following table shows the production of sulphur in the United States since 1880. During 1888, 1889, and 1890 the Dickert and Myer mines were in litigation and nonproductive. The product in 1889 was from the Barnes sulphur mine, near Frisco, Utah, and the Wise mine, at Winnemucca, Navada. The output in that year was 1,150 short tons of sulphur ore, yielding 450 tons of refined sulphur.

Sulphur product of the United States since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	600	$21,000	1887	3,000	$100,000
1881	600	21,000	1888		
1882	600	21,000	1889	450	7,850
1883	1,000	27,000	1890		
1884	500	12,000	1891	1,200	39,600
1885	715	17,875	1892	2,688	80,640
1886	2,500	75,000	1893	1,200	42,000

Imports.—The following tables show the total amount of sulphur imported into the United States from 1867 to 1893, the countries from which it was received and customs districts through which it was imported.

Sulphur imported and entered for consumption in the United States, 1867 to 1893.

Years ended —	Crude.		Flowers of sulphur.		Refined.		Ore.(*a*)	Total value.
	Quantity.	Value.	Quantity.	Valne.	Quantity.	Value.	Value.	
	Long tons.		*Long tons.*		*Long tons.*			
June 30, 1867...	24, 544. 10	$620, 373	110. 05	$5, 509	250. 55	$10, 915	....	$636, 797
1868...	18, 150. 55	446, 547	16. 48	948	64. 75	2, 721	....	450, 216
1869...	23, 589. 69	678, 642	96. 59	4, 576	645. 04	27, 149	....	710, 367
1870...	27, 379. 60	819, 408	76. 34	3, 927	15[illegible] 24	6, 528	$1, 269	831, 132
1871...	36. 131. 46	1, 212, 448	65. 54	3, 514	92. 26	4, 328	754	1, 221, 044
1872...	25, 379. 55	764. 798	35. 97	1, 822	56. 94	2, 492	....	769, 112
1873...	45, 533. 27	1, 301, 000	55. 29	2, 924	35. 97	1, 497	....	1, 305, 421
1874...	40, 989. 55	1, 260, 491	51. 08	2, 694	56. 68	2, 403	....	1, 265, 588
1875...	39, 683. 10	1, 259, 472	17. 83	891	....	....	....	1, 260, 363
1876...	46, 434. 72	1, 475, 250	41. 07	2, 114	43. 87	1, 927	....	1, 479. 291
1877...	42, 962. 69	1, 242, 888	116. 34	5, 873	1, 170. 80	36, 962	....	1, 285, 723
1878...	48, 102. 46	1, 179, 769	158. 71	7, 628	149. 51	5, 935	....	1, 193, 332
1879...	70, 370. 28	1, 575, 533	137. 60	6, 509	68. 94	2, 392	....	1, 584, 434
1880...	87, 837. 25	2, 024, 121	123. 70	5, 516	158. 36	5, 262	....	2, 034, 899
1881...	105, 096. 54	2, 713, 485	97. 66	4, 226	70. 96	2, 555	....	2. 720, 266
1882...	97, 504. 15	2, 627, 402	158. 91	6, 926	58. 58	2, 196	....	2, 636, 524
1883...	94, 539. 75	2, 288, 946	79. 13	3, 262	115. 33	4, 487	....	2, 296, 695
1884...	105, 112. 19	2, 242, 697	178. 00	7, 869	126. 00	4, 765	....	2, 255, 331
1885...	96, 839. 44	1, 941, 943	120. 56	5, 351	114. 08	4, 060	....	1, 951, 354
1886...	117, 538. 35	2, 237, 989	212. 61	8, 739	116. 05	3, 877	....	2, 250, 605
1887...	96, 881. 55	1, 688, 360	278. 56	9, 980	83. 54	2, 383	....	1, 700, 723
Dec. 31, 1888...	98, 252. 15	1, 581, 583	127. 67	4, 202	27. 02	734	....	1, 586, 519
1889...	135, 933. 00	2, 068, 208	15. 34	1, 954	10. 00	299	....	2, 070, 461
1890...	162, 674. 00	2, 762. 953	12. 06	1, 718	103. 00	3, 060	....	2, 767, 731
1891...	116, 971. 00	2, 675. 192	206. 00	6, 782	10. 00	1, 997	133, 250	2, 817, 221
1892...	100, 938. 00	2, 189, 481	158. 00	5, 439	26. 00	4, 106	587, 981	2, 787, 007
1893...	105, 539. 00	1, 903, 198	241. 00	5, 746	43. 00	1, 017	721, 699	2, 631, 660

a Latterly classed under head of pyrites.

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1893.

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Dutch West Indies and Guiana	1, 515	$15, 427	......	....	......	....	......	....
England	30	1, 211	425	$14, 631	(?)	$16	2	$335
Scotland	24	910	472	13, 231	160	3, 961	806	19, 287
Gibraltar	......	....	290	7, 789	......	....	......	....
Quebec, Ontario, Manitoba, etc	......	....	......	....	12	264	......	....
Italy	46, 941	1, 439, 839	41, 819	1, 194, 000	47, 494	1, 161, 367	64, 420	1, 453, 138
Japan	456	16, 291	437	13, 137	256	7, 548	224	4, 528
Portugal	......	....	......	....	......	....	467	10, 410
Total	48, 966	1, 473, 678	43, 443	1, 242, 788	47, 922	1, 173, 156	65, 919	1, 487, 698
DISTRICTS.								
Baltimore, Md	5, 157	$157, 828	3, 882	$105, 175	5, 455	$138, 202	6, 969	$157, 243
Barnstable, Mass	......	....	......	....	......	....	600	13, 780
Boston and Charlestown, Mass	5, 031	154, 883	3, 931	101, 215	5, 795	131, 945	7, 841	173, 506
Charleston, S. C	......	....	......	....	526	12, 267	605	13, 812
Delaware, Del	450	13, 500	......	....	......	....	890	21, 907
Huron, Mich	......	....	......	....	12	264	......	....
Newark, N. J	......	....	1. 071	31, 802	462	13, 240	443	10, 175
New Orleans, La	172	5; 705	150	4, 750	......	....	100	2, 087
New York, N. Y	24, 524	721, 092	21, 867	654, 997	28, 240	690, 989	36, 543	827, 193
Philadelphia, Pa	12, 549	385, 671	9, 216	256, 224	6, 657	167, 222	11, 704	263, 467
Providence, R. I	600	18, 232	1, 739	45, 487	519	11. 479	......	....
San Francisco. Cal	483	17, 367	862	27, 768	256	7, 548	224	4, 528
Savannah, Ga	......	....	725	15, 370	......	....	......	....
Total	48, 966	1, 473, 678	43, 443	1, 242, 788	47, 922	1, 173, 156	65, 919	1, 487, 698

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1893—Continued.

Countries whence exported and customs districts through which imported.	1880.		1881.		1882.		1883.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
England	1	$22					13	$379
Scotland	1,664	36,444	1,668	$43,311	755	$20,294	3	88
France	988	23,580			526	13,770	34	858
French West Indies					2	8		
Greece					500	13,927		
Italy	80,301	1,862,712	102,771	2,645,293	92,944	2,504,862	92,861	2,248,870
Japan	282	4,744	691	16,253	2,980	66,356	1,038	23,714
San Domingo					240	7,875		
Spain			308	8,637			500	12,856
Spanish possessions in Africa and adjacent islands					9	310	87	2,030
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795
DISTRICTS.								
Baltimore, Md	13,827	$313,342	16,477	$430,917	13,781	$364,384	11,977	$286,438
Beaufort, S. C					540	13,889		
Boston and Charlestown, Mass	8,207	183,486	8,860	226,801	7,467	194,317	7,756	173,569
Charleston, S. C	1,061	25,398	3,065	78,741	6,025	161,281	4,051	106,235
Middletown, Conn					9	310		
New Orleans, La	280	7,121	100	2,646	220	6,516	428	10,378
New York, N. Y	46,657	1,083,784	57,608	1,463,082	46,531	1,260,222	45,385	1,110,313
Philadelphia, Pa	10,679	254,892	17,987	477,547	14,839	408,611	22,772	549,095
Providence, R. I	1,255	31,155	650	17,507	1,244	33,036	535	13,830
Richmond, Va					660	17,760		
San Francisco, Cal	1,270	28,324	691	16,253	6,054	151,234	1,072	24,572
Savannah, Ga					586	15,842	560	14,365
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795

Countries whence exported and customs districts through which imported.	1884. (a)		1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Belgium			190	$4,766	60	$1,718		
Danish West Indies							861	$5,250
England			606	15,084	81	2,535	162	4,437
France							290	6,951
Quebec, Ontario, Manitoba, and the Northwest Territory						9		
Italy			94,370	1,894,858	112,283	2,166,565	89,924	1,588,146
Japan			1,541	25,683	4,972	66,505	6,146	83,576
Spain			134	1,552				
Total	105,143	$2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360
DISTRICTS.								
Baltimore, Md	15,037	303,226	14,505	285,006	19,307	364,958	12,547	225,669
Barnstable, Mass	650	16,163	480	11,040	1,617	35,385	1,152	22,816
Beaufort, S. C	600	13,259	610	12,847				
Boston and Charlestown, Mass	5,294	112,152	5,125	99,712	3,681	69,898	4,850	85,575
Champlain, N. Y						9		
Charleston, S. C	6,125	132,570	8,525	169,564	13,350	265,265	12,420	220,598
New Orleans, La			102	2,282	250	5,102		
New York, N. Y	52,478	1,135,725	45,537	909,123	58,758	1,115,519	46,711	792,114
Philadelphia, Pa	18,786	401,568	18,696	381,010	15,568	300,749	15,267	269,216
Providence, R. I	651	15,517	1,840	37,422	1,265	25,930	600	11,291
San Francisco, Cal	5,522	112,598	1,421	33,937	3,600	54,517	3,176	50,521
All other customs districts							660	10,560
Total	105,143	2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360

a Sources not reported.

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1893—Concluded.

Countries whence exported and customs districts through which imported.	1888.		1889.		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Long tons.*		*Long tons.*		*Long tons.*	
Belgium	83	$1,993	180	$4,086	182	$3,995
Danish West Indies	....	....	....	....	550	9,076
England	310	7,200	305	8,337	4,898	101,100
Scotland	....	....	....	....	20	487
Italy	92,528	1,499,720	123,260	1,935,368	115,240	1,800,585
Japan	6,332	72,729	6,441	77,853	21,031	221,316
Total	99,253	1,581,582	130,191	2,025,644	141,921	2,136,559
DISTRICTS.						
Baltimore, Md	11,989	182,769	15,791	234,693	21,198	322,018
Beaufort, S. C	500	9,000	600	9,213	....	....
Boston and Charlestown, Mass	3,760	62,298	6,446	101,257	7,410	135,044
Charleston, S. C	12,005	199,048	23,377	364,859	15,752	255,106
New Orleans, La	200	3,845	....	....	200	3,397
New York, N. Y	50,486	816,286	60,922	959,872	66,359	983,754
Philadelphia, Pa	10,519	173,699	13,288	202,357	13,919	210,576
Providence, R. I	1,310	21,012	570	8,581	1,240	19,160
San Francisco, Cal	6,352	78,732	4,539	57,925	8,223	87,391
Savannah, Ga	....	....	2,345	44,244	5,560	86,826
Wilmington, N. C	1,532	25,893	1,753	28,443	2,040	32,800
All other customs districts	600	9,000	560	11,200	20	287
Total	99,253	1,581,582	130,191	2,025,644	141,921	2,136,559

Countries whence exported and customs districts through which imported.	1891.		1892.		1893.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Long tons.*		*Long tons.*		*Long tons.*	
Belgium	267	$6,576	....	....	....	....
England	5,613	127,976	6,522	$162,616	8,777	$186,914
Scotland	....	....	....	....	1,452	27,288
France	....	....	1	23	....	....
Quebec, Ontario, etc	....	....	1	49	8	269
Italy	101,660	2,140,516	90,668	2,147,942	103,146	958,303
Japan	12,763	168,073	12,227	213,776	8,307	133,455
Other countries	501	8,372	....	....	....	....
Total	120,804	2,451,513	109,419	2,524,406	121,690	2,305,464
DISTRICTS.						
Baltimore, Md	9,339	247,324	9,981	263,293	13,759	271,949
Beaufort, S. C	1,300	26,951	....	....	....	....
Boston and Charlestown, Mass	6,381	136,402	9,086	221,033	11,001	224,624
Charleston, S. C	28,281	557,384	14,651	304,593	10,885	209,246
Mobile, Ala	750	14,863	....	....	....	....
New Orleans, La	1,300	30,474	2,118	47,165	2,441	43,970
New York, N. Y	44,027	910,075	52,047	1,191,169	57,474	1,085,289
Pensacola, Fla	1,399	23,206	....	....	....	....
Philadelphia, Pa	10,842	216,763	9,380	211,570	12,625	241,293
Portland, Me	....	....	2,000	42,460	....	....
San Francisco, Cal	8,819	115,637	7,256	127,797	7,766	125,507
Savannah, Ga	5,245	99,717	....	....	4,650	86,562
Willamette, Oregon	288	11,852	398	6,866	541	7,948
Wilmington, N. C	2,832	60,843	1,900	48,388	540	8,807
Vermont	....	....	....	....	8	269
All other customs districts	1	22	2	72	....	....
Total	120,804	2,451,513	109,419	2,524,406	121,690	2,305,464

PYRITES.

The production of pyrites for acid making in 1893 was less than in any year since 1888, being 75,777 long tons or 84,870 short tons, valued at $256,552. In 1892 the product amounted to 122,963 short tons, worth $305,191, indicating a decrease of 38,093 short tons or over 30 per cent. The product, as heretofore, was entirely from Massachusetts and Virginia. In this statement an account is taken only of the amount marketed. The actual amount mined was 83,776 long tons or 93,829 short tons, thus leaving 7,999 long tons or 8,959 short tons (in addition to the stocks carried January 1, 1893) unsold at the beginning of 1894.

Production of pyrites in the United States from 1882 to 1893.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	13,440	$72,000	1888	60,851	$167,658
1883	28,000	137,500	1889	104,950	202,119
1884	39,200	175,000	1890	111,836	273,745
1885	54,880	220,500	1891	119,320	338,880
1886	61,600	220,000	1892	122,963	305,191
1887	58,240	210,000	1893	84,870	256,552

Imports of pyrites containing not more than $3\frac{1}{2}$ per cent. of copper. (*a*)

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Long tons.			*Long tons.*	
1884	16,710	$50,632	1891	100,648	$392,141
1885	6,078	18,577	1892	152,359	587,980
1886	1,605	9,771	1893	194,934	721,699
1887	16,578	49,661			

a Previous to 1884 classed among sulphur ores; 1887 to 1891 classed among other iron ores; since 1891 includes iron pyrites containing 25 per cent. and more of sulphur.

The relative merits of sulphur and pyrites as raw materials for the manufacture of sulphuric acid have been considerably discussed by various writers whose familiarity with the subject entitle them to consideration as reliable authorities. In Mineral Resources for 1886, Mr. R. P. Rothwell contributed a very interesting chapter on the subject of pyrites, with tables of comparative cost of acid made from brimstone and pyrites. His estimates showed the cost of a ton of acid 50 degrees Beaumé made from brimstone to be $6.80, and from pyrites $5.50. In arriving at this result one ton of brimstone "thirds" is taken at a value of $19, and $2\frac{1}{4}$ tons of pyrites worth $11.50, and the estimates made for New York or Philadelphia. For acid made at the pyrites mines the cost was estimated at $4.20 per ton for 50-degree acid. Mr. William H. Adams and Mr. J. H. Kelley have also contributed some valuable literature on the subject, particularly in articles published in the Engineering and Mining Journal.

American writers have attributed the larger use of brimstone in this country principally to the outlay necessary to make the changes in furnaces, which manufacturers hesitated to incur. Mr. Karl F. Stahl, in a paper published in the Journal of Analytical and Applied Chemistry, takes issue with these writers. He claims that "besides the somewhat more complicated and more costly construction of furnaces and the constant higher cost of labor in burning pyrites, there are other factors in favor of brimstone: (1) It requires less chamber space to produce the same amount of acid; (2) lead chambers are said to last longer with brimstone than with pyrites; (3) the acid produced is of different quality."

The first proposition is doubtless true. In regard to the second, Mr. Stahl admits that it is difficult to get exact data, and states that while the higher temperature of the gases (and not the arsenic in the pyrites, as is claimed by some) is detrimental to the lead, this could be avoided by proper construction, so as to cool the gases before entering the first chamber.

There is no doubt that acid from brimstone is purer than that made of pyrites which contain copper, zinc, and some arsenic. The last mentioned is the most harmful. Mr. Stahl states that the amount of arsenic in American pyrites is small and is all precipitated in the Glover tower and first chamber. The presence of arsenic does not injure the acid for the usual commercial purposes, that is, the manufacture of fertilizers and the refining of petroleum. But for medicinal purposes the acid must be entirely free from arsenic.

Mr. Stahl then gives an estimate of his own for the relative cost of acid from brimstone and pyrites, which is as follows:

Cost of chamber acid from brimstone.

2½ tons brimstone (5,600 pounds), $21 per ton	$52.50
225 pounds niter (=4 per cent. of the brimstone), 2 cents per pound	4.50
220 pounds sulphuric acid, 60° Baumé, 40 cents per 100 pounds	.88
4 men, at $1.50 (2 firemen for boilers included)	6.00
Wear and tear on buildings, furnace, chambers, etc., 40 cents per ton chamber acid produced	5.40
Repairs on buildings, furnace, chambers, etc., 20 cents per ton chamber acid produced	2.70
Fuel, light, etc	2.00
Office expenses	5.00
Interest on capital invested	5.00
Product: 13½ tons (2,000 pounds each) = 27,000 pounds	83.98

One ton chamber acid, 50° Baumé, costs $6.22.

Cost of chamber acid from pyrites.

5½ tons pyrites (=12,320 pounds), 37 per cent. available sulphur, $6	33.00
180 pounds niter (=4 per cent. of the available sulphur), 2 cents per pound.	3.60
250 pounds sulphuric acid, 60° Baumé, 40 cents per 100 pounds	1.00
Breaking of the pyrites and removing the cinders	1.40
6 men, at $1.50 (2 firemen for boilers included)	9.00
Wear and tear on buildings, furnaces, chambers, etc., 50 cents per ton chamber acid produced	5.50
Repairs on buildings, furnaces, chambers, etc., 25 cents per ton chamber acid produced	2.75
Fuel, light, etc	2.00
Office expenses	5.00
Interest on capital invested	5.50
Product: 11 tons (2,000 pounds each) = 22,000 pounds, cost	68.75

One ton chamber acid, 50° Baumé, costs $6.25.

From the above it will be seen that Mr. Stahl assumes the cost of pyrites to be $6 per long ton, and the cost of acid made from it 3 cents more per ton than that made from brimstone. This valuation for pyrites is, however, excessive. The average price realized for it by producers in 1893 was less than $3.50 per long ton, and a fair average for the past three years would not be more than $3 per ton. But taking the price at $3.50 per ton, the above total cost for 11 tons of acid would be reduced $13.75, or to $55, making the cost of one ton of acid $5 instead of $6.25. With the United States almost entirely dependent upon Sicily for her supply of brimstone, there seems to be little reason why our own pyrites deposits should not be made the source of supply for commercial acid.

FLUORSPAR.

This mineral is produced in only one locality in the United States, near Rosiclare, Illinois. The product in 1893 was 12,400 short tons, valued at $84,000, against 12,250 short tons, worth $89,000, in 1892, and 10,044 tons, valued at $78,330 in 1891. This shows a slight increase in amount (150 short tons) during 1893, but a decrease in value of $5,000.

In addition to its use for metallurgical purposes, fluorspar is consumed in the manufacture of glass and of hydrofluoric acid. When intended for glass or acid making the fluorspar is crushed and put through a buhr mill at the mines before selling. For other purposes it is sold in lumps as mined. The reader is referred to "Mineral Resources of the United States, 1889 and 1890," for a more extended discussion of the use of fluorspar for metallurgical purposes.

The following table shows the yearly production of fluorspar since 1882:

Production of fluorspar in the United States from 1882 to 1893.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	4,000	$20,000	1888	6,000	$30,000
1883	4,000	20,000	1889	9,500	45,835
1884	4,000	20,000	1890	8,250	55,328
1885	5,000	22,500	1891	10,044	78,330
1886	5,000	22,000	1892	12,250	89,000
1887	5,000	20,000	1893	12,400	84,000

Cryolite.—This mineral is used to a considerable extent in the manufacture of alum and sodium salts, for making white, porcelain-like glass, and other technical purposes. In the preparation of alum and sodium salts from cryolite, alumina is left as a residue; and from this, metallic aluminum is extracted by electrolytic process. The only source of supply for the mineral is Greenland, although traces of this mineral were long ago shown by Cross and Hillebrand to occur in the neighborhood of Pikes Peak, Colorado. The imports of cryolite for a series of years is shown in the following table:

Imports of cryolite from 1871 to 1893.

Years ended—	Amount.	Value.	Years ended—	Amount.	Value.
	Long tons.			*Long tons.*	
June 30, 1871		$71,058	June 30, 1883	6,508	$97,400
1872		75,195	1884	7,390	106,029
1873		84,226	Dec. 31, 1885	8,275	110,750
1874		28,118	1886	8,230	110,152
1875		70,472	1887	10,328	138,068
1876		103,530	1888	7,388	98,830
1877		126,692	1889	8,603	115,158
1878		105,884	1890	7,129	95,405
1879		66,042	1891	8,298	76,350
1880		91,366	1892	7,241	96,932
1881		103,529	1893	9,574	126,688
1882	3,758	51,589			

MICA.

By E. W. Parker.

The mica-mining industry in the United States has been in an unsatisfactory condition for a number of years. In 1884 the production amounted to 147,410 pounds, valued at $368,525. In the following year it fell off to 92,000 pounds, valued at $161,000, and in 1886 the product was only 40,000 pounds, valued at $70,000. In 1887 the production increased somewhat, but again declined, and from then until 1891 the value of the product did not exceed $75,000 in any year. During 1891 and 1892 the product was estimated at 75,000 pounds, valued at $100,000. It must be remembered that with the exception of the census year (1889), when 49,500 pounds, worth $50,000, were produced, the output has been shown by estimates. Owing to the very irregular methods pursued by a large number of producers, particularly in North Carolina, it was almost impossible to secure accurate returns. In collecting the statistics of 1893, however, valuable assistance has been given by the dealers who handle practically all the mica mined in North Carolina, and all the known producers in other States have reported their production. From these the product during the year is found to have been 51,111 pounds of cut mica, worth $80,629, and 156 short tons of scrap or waste mica, worth $8,300, making the total value of the output $88,929. The greater part of the output, as in former years, was from New Hampshire and North Carolina, with small amounts from Alabama, Connecticut, and Nevada. The following table shows the annual production of mica in the United States since 1880:

Production of mica since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	81,669	$127,825	1888	48,000	$70,000
1881	100,000	250,000	1889	49,500	50,000
1882	100,000	250,000	1890	60,000	75,000
1883	114,000	285,000	1891	75,000	100,000
1884	147,410	368,525	1892	75,000	100,000
1885	92,000	161,000	1893	51,111	88,929
1886	40,000	70,000	1893 tons scrap.	156	
1887	70,000	142,250			

Mica mining in North Carolina.—During the latter part of November, 1893, the writer visited the mica regions of North Carolina for the purpose of studying the methods employed in mining the mica in that locality and the facilities afforded for placing it upon the market. The time selected for the trip was unfortunate, for the region had just been visited by heavy rains, and the mountain roads, bad at the best seasons, were in many places almost impassable. With a good pair of horses, capable of making 10 miles an hour on a good road, and in a light buckboard, with no other burden than the writer and driver, two full days were occupied in traveling from Asheville to Bakersville, a distance barely exceeding 50 miles. A number of places which it was desirable to visit could not be reached on account of the condition of the road, it being necessary to keep to the county roads. Notwithstanding these disappointments, considerable information was obtained, and the writer is indebted to Mr. G. D. Ray, of Burnsville, and Mr. J. L. Rorison, of Bakersville, for valuable assistance and various courtesies extended. Mr. Ray owns one of the largest mines in the vicinity of Burnsville, besides doing considerable business in buying and shipping mica, when business justifies it, but owing to low prices prevailing during 1893 his mine remained idle and he did no other trading in mica. Mr. Rorison handles most of the mica shipped from Bakersville. He attributes the unsatisfactory condition of the mica-mining industry in that locality principally to the crude methods employed. There has been an entire absence of enterprise in the way of adopting modern mining appliances, and this, he claims, accounts for the limited product. In addition to this, there is the lack of transportation facilities. The region is very mountainous and without railroads, while the wagon roads for many months of the year are all but impassable. The streams are without bridges and the larger ones much of the time past fording. The beds of the smaller streams frequently form a part of the county road, especially in ascending and descending the heavy mountain grades. These portions of the "road" are naturally rough and very hard both on the horses and vehicles. The nearest railroad point from Bakersville is at Marion, distant about 40 miles. For a heavy team the time necessary for this journey is nearly four days, in fairly good seasons. With these disadvantages it is not surprising that more capital has not been invested in modern machinery, and that the crude methods of mining with which the industry started still obtain. There is, however, some prospect of the extension of the Charleston, Cincinnati and Chicago railroad from Marion to Johnson City, Tennessee, following the grade of the North Toe river. This road, if constructed as at present contemplated, will pass within about 2 miles of Bakersville and within 5 or 6 miles of Burnsville. The lack of railroad transportation will then be supplied, and it would be an easy matter to induce capital to invest in the necessary machinery to properly develop the mica properties.

The mica industry of New Hampshire.—Mr. D. L. Stran, of Grafton Center, reports the following in regard to the mica industry of New Hampshire:

"Mica deposits exist and mica has been mined in the towns of Acworth, Alstead, and Springfield, in Sullivan county; Wilmot and Danbury, Merrimack county; and in Alexandria, Grafton, Orange, Dorchester, Groton, and Wentworth, Grafton county. These towns are located on a belt that runs in a northeast and southwest direction. On this belt at various places, for a distance of 50 miles, are found veins of quartz, feldspar, and mica, interspersed with beryl, tourmaline, garnets, quartz, crystals, and many other minerals. In the above-named towns no mica was produced in 1893 except in the towns of Alexandria and Groton. In Alexandria work was commenced in April and continued until September at the deposit formerly owned by the Alexandria Mica Company.

"This work was under the management of the American Mica Company, of Boston, Massachusetts. Large quantities of mica are here found, but a large percentage is of a poor quality. In the town of Groton the several companies were in operation and producing mica during the year 1893. The largest producer has been the Old Ruggles deposit, located in the town of Grafton. It was at this place that the first mica was mined for commercial purposes in the United States, as far back as the commencement of the present century.

"At first and for many years the work was carried on in a desultory way. About the period of 1840 there was an increased demand for this mineral, and more extensive operations were carried on. About the year of 1860 there was a greatly increased demand, and from that time down to 1885 this deposit was in the full tide of prosperity. This property being owned by private parties, with their headquarters in Boston, and they for many years having a monopoly of the mica business, but little could be ascertained of the output or its value. The large piles of waste mica that can be seen at this deposit show the production to have been immense. Other openings have been made at various places in this town by different parties, and some have been very productive.

"The discovery of mica in North Carolina about the year 1867 and the large production that followed caused a decline in prices, more especially for small and medium sizes, and this finally closed most of the deposits for several years. When the deposits of North Carolina began to decrease in their production, the mica business of the United States found its level, and the industry gradually revived in New Hampshire, and for several years good deposits carried on a remunerative business. About 1885 mica began to be imported from India, duty free, and later from the Dominion of Canada. This tended to reduce prices, and production was again curtailed. The large importation of 1892, before the McKinley tariff took effect (which placed an ad valorem duty of 35 per cent. on mica), probably furnished this country with that article for quite a period in advance of the consumption. During the early part of 1893 quite extensive plans were under consideration for mining mica in this State, but the widespread business demoralization that followed paralyzed the industry, and the present outlook is not very encouraging for mining mica in this vicinity.

"The hills of this mica belt are fast being cleared of their forests, and in many instances these denuded tracts are burned over, thus bringing into view new deposits, some of which look very promising. When the business of the country assumes a brighter aspect, with the increasing demand for mica it is expected that this section will again come to the front with large productions."

Mr. S. A. Mitchell, of Alstead, New Hampshire, states that the first mica mining in that State was carried on by a Mr. Ruggles at Grafton, in Grafton county, but the date of his operations is uncertain. Later (about 1830 to 1835), Mr. James Bowers commenced working mica deposits at Acworth, Sullivan county, and Alstead, Cheshire county. These parties supplied the trade of the United States for a number of years. Mr. Bowers was succeeded by his son, who continued the business until his death, working deposits in Alstead, Acworth, and Orange, New Hampshire, and in North Carolina. He was in his turn succeeded by his son, who worked the North Carolina mines, and by Mr. Mitchell, who worked the New Hampshire properties. Meanwhile other parties were working other mines in New Hampshire at different periods and with varying success. Mr. Mitchell states that the mica-bearing belt extends from Cheshire county in a northeasterly direction through Sullivan and Grafton counties. The deposits are overlain with micaceous slate or schist, sometimes approaching hornblende slate. This has been ruptured, and seams of granite, sometimes rich in mica, occur in the overlying rock. Tourmalines, beryl, and other crystals are associated with the mica. According to Mr. Mitchell, the sheets of mica are more numerous in the New Hampshire veins than in the North Carolina deposits, but are not as perfect. He attributes this difference in quality to more violent disturbances, which not only affected the crystals directly by pressure and distortion, but opened seams in the rock which exposed the deposits to the action of water and changes of temperature.

Alabama.—Mr. J. B. Merrill, of Edwardsville, Alabama, reports a production of $1,000 worth of rough mica in that State during 1893. Mr. Merrill states that it is only very recently that the mica deposits of Alabama have been receiving proper attention, or that efforts made to develop them given promise of successful results. He claims that the mica is of excellent quality, and that the lands are being taken up by parties interested in obtaining good merchantable mica. A writer in the Chattanooga Tradesman gives the following account of the mica deposits in Alabama:

"The occurrence of mica in Alabama in crystals large enough to make merchantable sheets was discovered and considerable prospect work done several years since. Attention was first attracted to the occurrence of mica by some prehistoric workings considerable in extent, and very ancient, large oak trees from 15 to 18 inches through having grown on the dumps and in the pits since they were abandoned.

"The location of these granite veins bearing mica is in the extreme southern portion of Cleburne county, east of the Tallapoosa river, and also in the extreme northern portion of Randolph county. The district from which merchantable mica can be mined covers about 15 or 16 square miles, being about 5 miles in length from northeast to southwest and 3 in width. On one property there appear as many as 11 distinct veins carrying mica, which outcrop parallel with each other at irregular intervals for half a mile, and a shaft sunk 80 feet crosscut 4 of these, the narrowest of which was 4 feet. The strike of the veins is in a course slightly east of north to south of west, and the outcrop can be easily traced across 600 acres, showing great continuity in length. The dip is irregular, at an angle of about 20° to 25° towards the southeast. Each vein is distinct and separated from the next in rotation by strata of decomposed feldspar and kaolin clay.

"A few years ago considerable activity was manifested in the mica mines, and the prospect work previously mentioned was then performed; but the imported Indian mica was placed on the Eastern market at so low a price for the better grade used in stoves and furnaces that, although slightly inferior in transparency to the North Carolina and the best of the Alabama mica, the miners in both of those States became discouraged, and all the Alabama mines, as well as some in North Carolina, were shut down, and remained idle until quite recently. In North Carolina as well as Alabama, the mica mines are remote from railroad transportation, and the work has been crudely done, but the transparency of the mica and the sizes in which it can be cut promises to bring it into demand in the future, and with an increased demand and steady market the one great drawback of distance will, it is believed, be overcome.

The production of North Carolina in 1884, from only a few mines, reached $180,000 in value, and demonstrates what the possibilities are in the future for the Southern mines with an increased demand and steady market for the product. The work in Alabama has only been shallow, up to the present time, but crystals which produced 7 per cent. of first grade sheets of cut mica have been mined. As depth is attained the rust, stains, and flaws in the sheets become scarcer and the transparency consequently improves, so that in the near future it is possible that Alabama mica will be in as great demand as any on the market. The superficial area of the district being limited to the size before mentioned is an incentive to the owners of property to develop it in a systematic and thorough manner, instead of following the crude system of a few years since. When this is done the value of the Alabama mines will be demonstrated more fully than to-day, and it will be possible to estimate with some degree of accuracy the quantity of mica in sight and the probable yield of the district. But this will always be somewhat speculative, because all the mines are pockety; in other words, although the veins are regular in their occurrence and dip, yet the mica crystals are found in irregular bunches in the veins, especially where a vein swells and in offshoots.

"On all the mica properties there is a large quantity of refuse on the dumps which would be of value for electrical purposes, but which because of the lack of railroad transportation is not at present utilized, although pronounced by experts superior to the Canadian mica.

"There is a good prospect, though, as soon as the present panicky conditions pass away, that a railroad, and maybe two, will be built into this section of Alabama. One of these is projected and partially graded from Tallapoosa, Georgia, southward to connect at Roanoke, in the southern portion of Randolph county, with the East Alabama railroad, and the other is projected from Anniston, Alabama, southeastward to Brunswick, Georgia, or, rather, to be more particular, from Sheffield, at deep water on the Tennessee river, to Lagrange, Georgia, and thence to Brunswick."

Connecticut.—Mr. S. L. Wilson, of New Milford, Connecticut, was the only producer of mica in that State during 1893. His production amounted to 2 tons of rough mica, which was sold to an electrical company, by whom it was cut and split for market. The mine is not worked for mica alone, but also for feldspar, golden beryl, aquamarine, and garnets.

Nevada.—During 1893, 300 pounds of uncut mica were shipped from the Czarina mine, near Rioville, Nevada. All of this was sent to Hamburg, Germany, to be cut. In February, 1894, 200 pounds were shipped to Hamburg and 300 pounds to Syracuse, New York. In April, 1894, 1,000 pounds were shipped to Syracuse. All of this was cleaned of waste, so far as practicable, and was supposed to cut from 2 by 3 inches to 8 by 10 inches, a good portion of it being estimated to cut about 3 by 5 inches. No returns had been received by the shipper, Mr. Daniel Bouelli, up to the time of making his report. In addition to the Czarina mine, Mr. Bouelli has other claims, chief among which are the "Pioneer" and "Princess" mines. In his report to the Survey Mr. Bouelli says:

"The mica mines of which the Pioneer and Princess are among the best (there being some other smaller deposits) were discovered by me about twenty years ago. They are situated in the Virgin range in the St. Thomas mining district, Lincoln county, Nevada. The Pioneer is about 15 miles slightly north of east from Rioville, which is at the head of steam navigation on the Colorado river, at its confluence with the Rio Virgin. The Princess is about 1 mile northeast from the Pioneer. The Pioneer group is at an altitude of 5,000 feet, near springs and accessible to wagons. About $600 has been expended in development work, and the probability is that $1,000 worth of work is needed to strike the mica below the influence of surface dislocations. The mica occurs in hard, glassy quartz rock, of which there is an outcrop 200 feet wide and 600 feet long. The surrounding rocks are systematic gneiss and granular schists.

"The Princess is a smaller reef of white quartz, with solid mica, better laminated, surrounded by dark-colored tourmaline bearing rocks, gneissoid graduating into syenite. Hornblende and biotite abound and pyrite and other associations of tin are at hand. These claims have been worked very little of late years.

"The Czarina was discovered and located in May, 1891. On this claim there is now a shaft on an incline following the dip of the mica 27 feet. This was found unsafe and another shaft of 35 feet is now directly over the point towards which the dip of the mica seam leads, and will be sunk vertically until the surface crush of the inclosing rocks is penetrated and the crystals show no breaks. Here also the mica occurs in and along the side of a heavy outcrop of white quartz in a country rock of gneiss, carrying various characteristic minerals. The muscovite or white mica seems to follow the division plane of the stratification, along the line or axis of the uplift or rock fold. This line runs north and south, slightly east of north of the main trend of the range, thus running into Arizona a few miles north of Rioville. In fact, the mica belt forms the boundary line between Nevada and Arizona for about 50 miles. The mica, mostly small, is abundant, but marketable sizes are rare and not to be had without a good deal of hard work."

Imports.—In October, 1890, mica was placed on the dutiable list by the new tariff, with a duty of 35 per cent. ad valorem. It had previously been imported free. The imports for the year, especially before the law went into effect, were exceptionally heavy—more than double the value of the imports in any previous year. This undoubtedly provided for an accumulation of stock beyond immediate needs.

Unmanufactured mica imported and entered for consumption in the United States, 1869 to 1893, inclusive.

Years ending—	Value.	Years ending—	Value.
June 30, 1869	$1,165	June 30, 1882	$5,175
1870	226	1883	9,884
1871	1,460	1884	28,284
1872	1,002	1885	28,685
1873	498	Dec. 31, 1886	*a* 56,354
1874	1,204	1887	*a* 49,085
1875	....	1888	*a* 57,541
1876	569	1889	*a* 97,351
1877	13,085	1890	*a* 207,375
1878	7,930	1891	95,242
1879	9,274	1892	218,938
1880	12,562	1893	147,927
1881	5,839		

a Including mica waste.

Uses.—The various uses for mica have been described so frequently that it is not deemed advisable to discuss them at length in this chapter. Its employment by stove manufacturers is well understood, and of late years the larger sheets have been found to be very valuable in the manufacture of electrical armatures. It is also used in the manufacture of spectacles or stonecutters and other workmen. For this purpose the scraps and fragments from waste mica are usually employed. Mica is also used in the manufacture of paints, wall papers, and for other ornamental purposes. Ground mica is used extensively in making lubricators, and is mixed with cement in the manufacture of micanite for insulating purposes.

Mica is made into reflectors, sea compasses, and inlaying for wood instead of enamel. It is also employed for roofing purposes, and in several patented processes forms a water and fire proof covering for strata of rubber, tar, canvas, felt, and similar materials.

ASBESTOS.

Asbestos was produced commercially in only one State during 1893, the output being limited to California, and amounted to 50 short tons, valued at $2,500 crude at the mines. The actual amount received by the producers, however, would be largely in excess of this valuation, as the product is not marketed as mined, but is manufactured into fire-proof paints, cements, boiler coverings, etc. It has been the custom to give the value for crude asbestos, and this practice is adhered to.

Owing to the general depression which prevailed throughout the year, the Wyoming properties were not operated except for the necessary assessment work. Some of the mineral found in Wyoming shows characterictics similar to those of Canadian chrysotile, and is to all appearance, from specimens recently submitted to the Survey, the most valuable and interesting discovery of this mineral made in the United States. The specimens shown are evidently from near the surface and show signs of weathering. The fibers are from an inch to an inch and a half long, but are not as tough nor as elastic as the Canadian chrysotile. Should these defects disappear with greater depth, and conditions prevail to make its mining economical, it will not be necessary for the United States to depend entirely upon Canadian mines for its supply.

The production of asbestos in the United States since 1880 has been as follows:

Annual product of asbestos since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	150	$4,312	1887	150	$4,500
1881	200	7,000	1888	100	3,000
1882	1,200	36,000	1889	30	1,800
1883	1,000	30,000	1890	71	4,560
1884	1,000	30,000	1891	66	3,960
1885	300	9,000	1892	104	6,416
1886	200	6,000	1893	50	2,500

As indicated above, the amount of asbestos produced in 1893 was less than at any time since 1880 with the exception of 1889, when the product was only 30 short tons, and in which year, as in 1893, the output was entirely from California. The value of imported asbestos also shows a remarkable decrease, being more than 30 per cent. less than that of 1892, more than 50 per cent less than that of 1891, and was the smallest value reported since 1887. The following table shows the value of asbestos imported since 1869:

Value of asbestos imported from 1869 to 1893.

Years ended—	Unmanufactured.	Manufactured.	Total.
June 30, 1869	....	$310	$310
1870	....	7	7
1871	....	12	12
1872	....	....	....
1873	$18	....	18
1874	152	....	152
1875	4,706	1,077	5,783
1876	5,485	396	5,881
1877	1,671	1,550	3,221
1878	3,536	372	3,908
1879	3,204	4,624	7,828
1880	9,736	....	9,736
1881	27,717	69	27,786
1882	15,235	504	15,739
1883	24,369	243	24,612
1884	48,755	1,185	49,940
Dec. 31, 1885	73,026	617	73,643
1886	134,193	932	135,125
1887	140,264	581	140,845
1888	168,584	8,126	176,710
1889	254,239	9,154	263,393
1890	252,557	5,342	257,879
1891	353,589	4,872	358,461
1892	262,433	7,209	269,642
1893	175,602	9,403	185,005

The Statistical Year Book gives the following statement showing the amount and value of shipments from the mines since 1879:

Annual product of asbestos in Canada since 1879.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Tons.			*Tons.*	
1879	300	$19,500	1887	4,619	$226,976
1880	380	24,700	1888	4,404	255,007
1881	540	35,100	1889	6,113	426,554
1882	810	52,650	1890	9,860	1,260,240
1883	955	68,750	1891	9,000	1,000,000
1884	1,141	75,079	1892	6,042	388,462
1885	2,440	142,441	1893	6,473	313,806
1886	3,458	206,251			
			Total	56,535	4,495,534

The exports of asbestos from Canada amounted in 1891 to 7,022 tons, valued at $513,909, and in 1892 to 7,316 tons, valued at $514,412, some of the exports in the latter year being from material won the year before, the production in 1892 being 1,274 less than the exports.

MINERAL PAINTS.

By E. W. Parker.

In the statistics of mineral paint production are included primarily ochers, umbers, siennas, metallic paint, Venetian reds, mineral black and soapstone and slate ground for pigment. The total production of these in 1893 amounted to 37,724 short tons, worth $530,284, against 50,013 short tons, valued at $699,263 in 1892. In addition to the pigments noted above, paints made from graphite and asphaltum, the product of white lead corroders (white lead, red lead, litharge, and orange mineral), and zinc white might properly be included under the head of "mineral paints" and they are discussed in this connection, but the bases of these, with the exception of zinc white, are included in the production of graphite, asphaltum, pig lead, etc., and they are therefore not included as paints in the table of mineral production on page 10, nor in the statement above. The production of zinc white is stated separately.

The following table shows the total production of mineral paints in 1892 and 1893:

Production of mineral paints in 1892 and 1893.

Kinds.	1892.		1893.	
	Short tons.	Value.	Short tons.	Value.
Ocher	13,390	$176,624	10,517	$129,393
Umber	475	7,100	480	7,560
Sienna	500	9,350	150	4,875
Metallic paint	25,711	362,966	19,960	297,289
Venetian reds	4,900	106,800	3,214	64,400
Mineral black	200	2,500	70	840
Soapstone	1,050	10,400	100	700
Slate	3,787	23,523	3,183	24,727
Other colors	....	....	50	600
Total	50,013	699,263	37,724	530,384

As will be seen, the decreased output in 1893 is almost general, there being but one item in which an increase occurs. The production of umber increased 5 tons in amount and $460 in value. The largest decrease in amount was in the production of metallic paint, which fell off 5,751 short tons, or a little more than 20 per cent. The greatest percentage of loss was in the production of soapstone for pigment, which declined from 1,050 to 100 short tons, or about 90 per cent. The total decrease amounted to 12,289 short tons in amount and $168,879 in value.

The production of white lead, red lead, litharge, orange mineral, zinc white, and ultramarine for the past three years is shown in the following table:

Production of white lead, etc., for three years.

	1891.		1892.		1893.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
White lead	78,018	$10,454,029	74,485	$8,733,620	72,172	$7,695,130
Read lead	4,607	591,730	6,122	757,787	6,122	707,363
Litharge	5,759	720,925	5,764	611,726	11,077	1,091,293
Orange mineral	330	43,300	395	60,170	217	32,893
Zinc white	23,700	1,600,000	27,500	2,200,000	24,059	1,804,420
Ultramarine	112,414	13,409,984	114,266	12,363,303	113,647	11,331,099
Total	224,828	26,819,968	228,532	24,726,606	227,294	22,662,198

A study of the foregoing table shows a decrease in the production of each item in 1893, except red lead and litharge. The production of white lead was 2,213 tons less than in 1892, the value declining a little more than $1,000,000. The total product of red lead was the same in both years, but the value declined something over $50,000. Litharge shows an increase of 5,313 short tons in amount and $480,567 in value. The total decrease in value was over $2,000,000.

Ocher, umber, and sienna.—Ocher was produced in 9 States in 1893, namely, Alabama, Georgia, Kentucky, Maryland, Massachusetts, Missouri, Pennsylvania, Vermont, and Virginia. The production was 10,517 short tons, valued at $129,393, against 14,365 short tons, worth $193,074 in 1892. All of the umber and sienna produced in 1893 was from Pennsylvania. The following table shows the production in 1893 by States:

Production of ocher, umber, and sienna in 1893, by States.

States.	Short tons.	Value.
Alabama	350	$3,000
Georgia	2,600	39,000
Missouri	555	5,413
Pennsylvania	5,375	71,575
Vermont	523	5,280
Other States (*a*)	1,744	17,560
Total	11,147	141,828

a Includes Kentucky, Maryland, Massachusetts, and Virginia.

For the purposes of comparison the production for the preceding four years is shown in the following table. Prior to 1889, when the statistics were compiled for the Eleventh Census, the product for each State was not published.

Production of ocher, umber, and sienna from 1889 to 1892, by States.

States.	1889.		1890.		1891.		1892.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Alabama	336	$3,500	350	$4,100	524	$5,840	375	$4,050
Colorado	50	150	1,000	15,000				
Georgia	2,512	29,720	800	12,800	600	9,000	1,748	26,800
Maryland	616	12,000					1,000	10,000
Massachusetts	80	750	300	2,700	300	2,700	46	418
Missouri			2,200	30,000	1,850	27,500	1,922	28,220
New Jersey					600	7,200	175	3,600
New York			365	4,493				
Pennsylvania	7,922	103,797	4,173	61,458	4,535	56,588	7,055	90,755
Vermont	1,884	7,800			935	11,095	544	5,731
Virginia	1,658	18,755	1,367	22,972	1,950	29,900	1,500	23,500
Wisconsin	100	1,000						
Other States (*a*)			7,000	84,000	7,000	84,000		
Total	15,158	177,472	17,555	237,523	18,294	233,823	14,365	193,074

a Includes all of Maryland, and estimated products of some firms in other States not reporting.

Annual production of ocher, etc., since 1884.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1884	7,000	$84,000	1889	15,158	$177,472
1885	3,950	43,575	1890	17,555	237,523
1886	6,300	91,850	1891	18,294	233,823
1887	8,000	75,000	1892	14,365	193,074
1888	10,000	120,000	1893	11,147	141,828

Imports.—The following tables show the amount and value of ochers, etc., from 1867 to 1893:

Ocher, etc., imported from 1867 to 1883.

Fiscal years ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral, French and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,373	$385		$35,374		$2,083	1,430,118	$9,923
1868	6,949	333		11,165		500	3,670,093	32,102
1869	65,344	2,496	2,582,335	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,465	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,763	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,352	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	2,524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	25,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42,563
1880	91,293	4,233	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	3,201,880	30,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883 (*a*)	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,593

a Since 1883 classified as "dry" and "ground in oil."

Imports of ocher of all kinds from 1884 to 1893.

Years ended—	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
June 30, 1884	6,164.359	$63,973	108,966	$4,717	6,273,325	$68,690
1885	4,983,701	51,499	79,666	3,616	5,063,363	55,115
Dec. 31, 1886	4,939,183	53,593	112,784	6,574	5,051,967	60,167
1887	5,957,200	58,162	54,104	7,337	6,011,304	65,499
1888	6,574,608	64,123	43,142	9,690	6,617,750	73,813
1889	5,540,267	52,502	51,063	9,072	5,591,330	61,574
1890	....	....	....	....	6,471,863	71,953
1891	6,246,890	63,040	52,206	5,272	6,299,096	68,312
1892	8,044,836	97,946	49,714	5,120	8,094,550	103,066
1893	6,225,789	55,074	52,468	3,354	6,278,257	58,428

Imports of umber from 1867 to 1893.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	2,147,342	$15,946	June 30, 1881	1,475,835	$11,126
1868	345,173	2,750	1882	1,923,648	20,494
1869	570,771	6,159	1883	785,794	8,419
1870	708,825	6,313	1884	2,946,675	20,654
1871	470,392	7,064	1885	1,198,060	8,504
1872	1,409,822	18,203	Dec. 31, 1886	1,262,930	9,187
1873	845,601	8,414	1887	2,385,281	16,536
1874	729,864	6,200	1888	1,423,800	14,684
1875	513,811	5,596	1889	1,555,070	20,887
1876	681,199	7,527	1890	1,556,823	19,329
1877	1,101,422	10,213	1891	633,291	6,498
1878	1,038,880	8,302	1892	1,028,038	6,256
1879	986,105	6,959	1893	1,488,849	16,636
1880	1,877,645	17,271			

Metallic paint.—The production of metallic paint in 1893 amounted to 19,960 short tons, valued at $297,289, against 25,711 short tons, valued at $362,966, in 1892, showing a decrease of 5,751 short tons in quantity and of $65,677 in value. Previous to 1889 the statistics of metallic paint production were not reported by States. Since then the production has been as follows:

Production of metallic paint since 1889, by States.

States.	1889.		1890.		1891.		1892.		1893.	
	Product.	Value.	Prod. uct.	Value.	Product.	Value.	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Colorado	90	$2,500	1,300	$22,100	....	....	....	....	....	....
New York	3,658	63,698	5,224	72,952	7,352	$99,487	5,200	$76,500	3,885	$57,500
Ohio	540	11,123	637	16,341	800	14,500	879	17,090	710	5,750
Pennsylvania	8,849	128,036	8,955	145,243	9,175	134,138	10,289	176,785	8,300	143,875
Tennessee	3,057	24,237	5,386	46,088	4,000	30,000	5,000	32,000	3,006	27,500
Vermont	....	....	500	6,000	400	5,000	400	5,000	338	4,600
Wisconsin	1,832	26,700	2,125	31,035	2,343	34,375	2,448	33,826	2,246	29,500
Other States (*a*)	3,000	30,000	50	610	1,072	16,955	1,495	20,765	1,481	28,564
Total	21,026	286,294	24,177	340.369	25,142	334,455	25,711	362,966	19,960	297,289

a Includes Alabama, California, Delaware, Kentucky, Maryland, Missouri, New Jersey, and Virginia.

Venetian reds.—The product in 1893 was 3,214 short tons, valued at $64,400, against 4,900 short tons, valued at $106,800, in 1892, a decrease of 1,686 short tons in amount and $42,400 in value. The statistics of production since 1890 have been as follows:

Production of Venetian reds since 1890.

Years.	Short tons.	Value.
1890	4,000	$84,100
1891	4,191	90,000
1892	4,900	106,800
1893	3,214	64,400

Soapstone.—The use of soapstone as a base for paint began in this country in 1891, when 25 tons were used for that purpose. In 1892 the amount used was 1,050 tons, but during 1893 comparatively little soapstone paint was made, the product being only 100 tons, valued at $700.

Mineral black.—This pigment was reported separately for the first time in 1892, when 200 short tons were produced. In 1893 the product decreased to 70 short tons, valued at $840.

Slate as a pigment.—The amount of slate ground for paint in 1893 was 3,183 short tons, valued at $24,727, a decrease from 1892 of 604 short tons in quantity, but an increase in value of $1,304. The product since 1880 has been as follows:

Amount and value of slate ground for pigment since 1880.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1880	1,120	$10,000	1887	2,240	$20,000
1881	1,120	10,000	1888	2,800	25,100
1882	2,240	24,000	1889	2,240	20,000
1883	2,240	24,000	1890	2,240	20,000
1884	2,240	20,000	1891	2,240	20,000
1885	2,212	24,687	1892	3,787	23,523
1886	3,360	30,000	1893	3,183	24,727

White lead.—The product of white lead in 1893 was 72,172 short tons, worth $7,695,130, a decrease from 1892 of 2,313 short tons and in value of $1,038,490. The production both in amount and value was less in 1893 than in any year since 1887. The following table shows the annual production since 1884:

Product of white lead in the United States since 1884.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1884	65,000	$6,500,000	1889	80,000	9,600,000
1885	60,000	6,300,000	1890	77,636	9,382,967
1886	60,000	7,200,000	1891	78,018	10,454,029
1887	70,000	7,560,000	1892	74,485	8,733,620
1888	84,000	10,080,000	1893	72,172	7,695,130

White lead during 1893.—In reviewing the white lead trade in 1893 the Oil, Paint and Drug Reporter of January 15, 1894, contains the following:

"The past year was an eventful one, as regards the white lead industry. Up to the close of the first six months there was an unusually good trade; large sales were made at remunerative prices and the outlook appeared fair for a prosperous year. Meanwhile the low prices for pig lead and the full values obtained for the manufactured product attracted the attention of capital, and new works, which were either under process of construction or in contemplation, were soon put in position to become competitors for the yearly increasing consumption of this pigment.

"The financial depression which prevailed during the summer and early fall, and which affected all branches of trade, was particularly depressing on the lead industry, and the new works which had been erected found their stocks of corroded lead increasing by reason of the falling off in the demand or the inability of the purchasers to make prompt payments, owing to the unsettled condition of the money market. Up to this time there had been very few fluctuations in the price of dry lead and lead in oil.

"The year opened with the card price at $6\frac{1}{4}$ cents quoted for dry and $6\frac{3}{4}$ cents for lead in oil. These figures were fairly maintained until late in June, when a disturbing element appeared. The Government had advertised for bids to supply its various departments. Corroders who had been accumulating stocks saw at once that here was a good opportunity to unload, and by so doing relieve the market of so much extra stock. The scheme was a good one—at least for those who were the successful bidders. When the bids were opened it was found that the low price of $5\frac{3}{4}$ cents for lead in oil had been named. Following closely came other Government contracts calling for lead in oil in tins and kegs for delivery, not only at Omaha, but also at points on the Atlantic Coast. The former contract was accepted at $5\frac{8}{10}$ cents, and the latter at $5\frac{47}{100}$ cents and $5\frac{48}{100}$ cents respectively. When these prices became public it was only natural that the market should become more or less demoralized. Card prices were no longer respected except for certain brands in a jobbing way. Corroders began an aggressive warfare for orders and the price, from $5\frac{1}{2}$ cents for dry lead, gradually began to drop until near the close of the year, when sales were made at $4\frac{3}{4}$ cents per pound, less the usual discounts for freight, cartage, and cash payments. Meanwhile the price of pig lead was on the decline, having reached about the lowest price known in years, it being quoted at 3.1 to $3\frac{1}{4}$ cents per pound for round lots.

A new price list was issued at the close of the year giving the card rate at $5\frac{1}{4}$ cents for dry and $5\frac{3}{4}$ cents and upwards for lead in oil, less 2 per cent for cash. These prices, except for small lots, are nominal, as outside corroders secure trade here by giving additional rebates, and these prices are being met by the National Company."

The following table is of interest, as it shows the average yearly prices of pig lead and white lead in oil (both at New York) and the difference between the two since 1874:

Average yearly net prices, at New York, of pig lead and white lead in oil since 1874.

Years.	Pig lead in New York, per 100 pounds.	White lead in oil in New York, per 100 pounds.	Difference, per 100 pounds.
1874	$6.00	$11.25	$5.25
1875	5.95	10.50	4.55
1876	6.05	10.00	3.95
1877	5.43	9.00	3.57
1878	3.58	7.25	3.67
1879	4.18	7.00	2.82
1880	5.05	7.60	2.55
1881	4.80	7.25	2.45
1882	4.90	7.00	2.10
1883	4.32	6.88	2.56
1884	3.73	5.90	2.17
1885	3.95	6.00	2.05
1886	4.63	6.25	1.62
1887	4.47	5.75	1.28
1888	4.41	5.75	1.34
1889	3.80	6.00	2.20
1890	4.33	6.25	1.92
1891	4.33	6.37	2.05
1892	4.05	6.39	2.34
1893	3.73	6.03	2.30

Messrs. Wetherill & Bro., of Philadelphia, have recently issued a circular, containing statements published in the Congressional Record, relative to the production and imports of pig lead and the prices of white lead, red lead, etc., since 1783, so far as could be ascertained, from which the following is abstracted:

Prices of white lead, etc., since 1783.

[Per 112 pounds.]

Years.	White lead.		Red lead for potters.	Litharge.	Pig lead.
	Dry.	Ground in oil.			
1783	$10.64	$14.00			
1784	11.00	13.33			
1785	13.33	13.07			
1786	11.11	12.80			
1787	11.00	12.80			
1788	11.00	12.44			
1789	11.50	12.44			
1790	11.00	12.00			
1791	11.00	12.00			
1792	11.00	12.27			
1793	11.00	12.50			
1794	12.00	12.50			
1795	13.33	15.00			
1796	12.50	14.40	$7.50		
1797	12.66	14.92			
1798	13.33	13.08			
1799	14.00	16.00			
1800	14.00	16.00			
1801	16.00	16.00			
1802	14.00	15.00			
1803	14.00	16.00			
1804	15.66	16.66			
1805	15.66	16.80	12.00		
1806	16.50	18.22	12.50		
1807	18.75	18.94	12.60		
1808	19.00	19.40	13.00		
1809	18.25	19.35	14.00		
1810	16.00	19.00	13.00		

Prices of white lead, etc., since 1783—Continued.

[Per 112 pounds.]

Years.	White lead. Dry.	White lead. Ground in oil.	Red lead for potters.	Litharge.	Pig lead.
1811	$16.00	$19.00	$10.50	$14.00	....
1812	20.00	24.00	10.50	16.00	$12.50
1813	24.00	27.00	....	....	....
1814	23.00	24.50	23.00	....	....
1815	$24.00–40.00	$24.00–40.00	16.00	16.00	20.00
1816	12.00	16.00	9.50	11.00	....
1817	12.00	15.00	9.00	10.00	....
1818	12.00	14.00	8.50	11.00	....
1819	13.00	14.00	8.00	10.00	7.50
1820	13.00	14.00	8.50	....	7.12½
1821	12.00	14.00	9.50	10.00	7.43
1822	12.00	14.00	9.00	10.00	7.11
1823	12.00	14.00	8.50	8.50	6.00
1824	12.00	13.00	8.50	....	7.16
1825	12.00	13.00	8.50	8.50	8.50
1826	12.00	13.00	9.00	9.00	7.56
1827	11.50	13.00	8.00	....	6.88
1828	11.00	13.00	8.00	....	6.03
1829	8.50	10.63	6.50	7.00	4.20
1830	8.25	9.63	6.25	7.00	4.20
1831	9.23– 9.78	10.32	7.60	7.60	$5.11–6.72

[Per 100 pounds.]

Years.	White lead. Dry.	White lead. Ground in oil.	Red lead for potters.	Litharge.	Pig lead.
1832	$9.50	$10.66	$8.12	$8.50	$5.94
1833	9.50	10.66	8.35	8.75	5.91
1834	9.35	10.16	8.37	8.50	5.12½
1835	9.86	10.84	8.50	8.50	6.50
1836	10.00	11.50	8.50	8.50	6.37½
1837	11.12	12.00	8.75	8.75	5.96
1838	10.75	11.50	8.00	8.00	5.29
1839	10.25	11.00	8.00	8.00	5.83
1840	9.75	10.25	7.25	7.00	4.89
1841	9.00	9.25	7.25	7.25	4.50
1842	8.00	8.25	6.50	6.75	3.81
1843	7.75	8.25	6.00	6.00	3.58
1844	7.25	8.25	6.25	6.50	3.90
1845	7.50	8.00	5.87	6.25	4.03
1846	7.00	8.00	6.12	6.12	4.73
1847	6.90	7.20	5.60	5.25	4.37
1848	6.18	6.83	5.62	5.62	4.26
1849	7.31	7.45	6.12	6.25	4.78
1850	7.00	7.22	6.25	6.25	4.80
1851	6.75	7.28	6.00	6.50	4.85
1852	6.31	7.06	6.00	6.25	4.80
1853	8.75	9.50	8.00	8.00	6.45
1854	8.50	9.25	8.25	8.25	6.57
1855	8.75	.02	8.00	8.00	6.87
1856	8.37	9.09	8.37	8.50	6.59
1857	8.25	9.00	8.00	8.25	6.18
1858	8.50	8.77	7.25	7.25	5.94
1859	7.25	8.00	6.91⅔	6.91⅔	5.50
1860	7.25	8.00	6.79⅙	6.79⅙	5.65
1861	7.26⅞	8.06⅔	6.93¾	6.93¾	5.25
1862	8.19¾	8.46⅞	8.21½	7.72½	6.10
1863	10.43¾	12.16⅔	10.87½	10.35½	6.25
1864	16.71⅞	16.81¼	16.18¾	16.18¾	7.10
1865	15.58¼	15.87½	14.91⅔	14.75	6.60
1866	13.40⅝	16.12½	12.30½	12.30½	6.90
1867	12.73	14.31¼	11.49	11.50	6.50
1868	12.18¾	13.60	10.85	10.85	6.50
1869	13.27	12.00	10.66¼	10.66¼	6.45
1870	9.63½	10.85	9.61½	9.61½	6.25
1871	9.67½	11.30	9.00	9.00	6.10
1872	9.40⅝	11.33½	8.81¼	9.21⅞	6.35
1873	10.61½	11.83½	8.86½	9.00	6.30
1874	10.50	11.25	8.29⅙	8.32¼	6.00
1875	10.00	10.83½	8.78⅛	8.75	5.95
1876	10.00	10.50	7.84½	8.75	6.05
1877	9.30	9.81¼	7.77¾	7.18¾	5.45
1878	7.50	8.08⅓	6.43¾	6.43¾	3.60
1879	7.00	7.46	5.34⅜	5.34⅛	4.18
1880	8.00	8.54¼	6.37	6.30	5.06

Prices of white lead, etc., since 1793—Continued.

[Per 100 pounds.]

Years.	White lead.		Red lead for potters.	Litharge.	Pig lead.
	Dry.	Ground in oil.			
1881	6.58⅓	7.03⅓	6.24	6.00	4.89
1882	6.17	6.67	6.42	6.42	4.91
1883	6.18	6.68	6.33	6.33	4.32
1884	5.50	6.00	5.75	5.75	3.74
1885	4.98	5.48	5.23	5.25	3.95
1886	4.88	5.38	5.13	5.13	4.63
1887	5.87	6.37	6.12	6.12	4.50
1888	5.16	5.66	5.41	5.41	4.42
1889	4.89	5.39	5.14	5.14	3.93
1890	5.43	5.93	5.43	5.43	4.48
1891	5.80	6.30	6.05	6.05	4.35
1892	6.50	6.75	6.75	6.75	4.05
1893	5.75	6.38	6.38	6.38	3.69

Red lead, litharge, and orange mineral.—The product of red lead in 1893 was 6,122 short tons, valued at $707,363, the amount being exactly the same as in 1892, but showing a decrease in value of $50,424. The product in 1891 was 4,607 short tons, worth $591,730. The amount of litharge produced was exceptionally large, being 11,077 short tons, valued at $1,091,293, against 5,764 short tons, valued at $611,726, in 1892, and 5,759 short tons, worth $720,925, in 1891. Of orange mineral, the output in 1893 was 217 short tons, worth $32,893, against 395 short tons, valued at $60,170, the preceding year, and 330 short tons, worth $43,300, in 1891.

The following table shows the imports of white lead, red lead, and litharge since 1867:

Red lead, white lead, and litharge imported from 1867 to 1893.

Years ended.	Red lead.		White lead.		Litharge.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Jun 0, 1867	926,843	$53,087	6,636,508	$430,805	230,382	$8,941
1868	1,201,144	76,773	7,533,225	455,698	250,615	12,225
1869	808,686	46,481	8,948,642	515,783	187,333	7,767
1870	1,042,813	54,626	6,228,285	365,706	97,398	4,442
1871	1,295,616	78,410	8,337,842	483,392	70,889	3,870
1872	1,513,794	85,644	7,153,978	431,477	66,544	3,396
1873	1,583,039	99,891	6,331,373	408,986	40,799	2,379
1874	756,644	56,305	4,771,509	323,926	25,687	1,440
1875	1,048,713	73,131	4,354,131	295,642	15,767	950
1876	749,918	54,884	2,546,766	175,776	47,054	2,562
1877	387,260	28,747	2,644,184	174,884	40,331	2,347
1878	170,608	9,364	1,759,608	113,638	28,190	1,499
1879	143,237	7,237	1,274,196	76,061	38,495	1,667
1880	217,033	10,397	1,906,931	107,104	27,380	1,222
1881	212,423	10,009	1,068,030	60,132	63,058	2,568
1882	288,946	12,207	1,161,889	64,493	54,592	2,191
1883	249,145	10,503	1,044,478	58,588	34,850	1,312
1884	265,693	10,589	902,281	67,918	54,183	1,797
1885	216,449	7,641	705,535	40,437	35,283	1,091
Dec. 31, 1886	597,247	23,038	785,554	57,340	51,409	1,831
1887	371,299	16,056	804,320	58,602	35,908	1,302
1888	529,665	23,684	627,900	49,903	62,211	2,248
1889	522,026	24,400	661,694	56,875	41,230	1,412
1890	450,402	20,718	742,196	57,659	48,283	2,146
1891	651,577	23,807	718,228	40,773	94,586	3,108
1892	812,703	28,443	744,838	40,032	56,737	1,811
1893	854,982	27,349	686,490	34,145	42,582	1,310

GRAPHITE.

Ticonderoga, New York, continues to furnish the entire commercial product, which in 1893 amounted to 843,103 pounds, against 1,398,363 pounds in 1892, showing a decrease of 555,260 pounds or about 40 per cent. No cause is assigned for this decrease except the prevalent business depression, which lessened the demand.

The following table shows the annual production since 1880:

Production of graphite since 1880.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	....	$49,800	1887	416,000	$34,000
1881	400,000	30,000	1888	400,000	33,000
1882	425,000	34,000	1889	....	72,662
1883	575,000	46,000	1890	....	77,500
1884	....	....	1891	1,559,674	110,000
1885	327,883	26,231	1892	1,398,365	87,902
1886	415,525	33,242	1893	843,103	63,232

Uses.—The higher grades of graphite are used in the manufacture of lead pencils and lubricants. The poorer qualities are used for crucibles, stove polish, foundry facing, and in the manufacture of paint for metallic surfaces.

The Joseph Dixon Crucible Company, the owners of the Ticonderoga mines and the largest consumers of graphite in the United States, have issued the following instructions in regard to the use of graphite for foundry facings:

"In considering the subject of foundry facings, the art of molding may be divided into three classes, viz., first, green sand; second, dry sand or loam, and third, flat or print-back molding. Such a division answers to the three general methods in which facings are applied. But in different shops different conditions exist and different methods are followed, and because of these differences we are often unable, through ignorance of them, to fill orders correctly.

"For better information a short description is given of the three methods of mold making and using of facings:

"First, in green sand molding, the sand (slightly damp—just enough so to pack and retain the form of the pattern) is rammed around the pattern, the pattern is removed, and the facing is applied. This is done either by shaking the facing through a bag or by being put on with a brush, to insure its even distribution over the surface of the mold. It is then rubbed by the hand or by the use of a sleeking tool; this insures the adherence of the facing to the moist sand so that it will not run or become loosened as the molten iron runs across it. This method of making molds is used more than any of the others, and is used in all general machine-shop work, except where the castings are very heavy.

"Second, the dry sand or loam molding is employed. In this branch of work dry sand, that is, sand that has previously been used in the same kind of work, is mixed with fresh loam, and after the molds are made they are baked by placing them in an oven, if small, or by building a fire inside the mold, if they are large. Such a mold is hard and firm, and the surfaces are porous in texture and afford a fine support for the facing, which is applied in the form of a wash or paste. The usual sleeking follows to insure perfectly smooth surfaces on the casting. This method is followed where the work is heavy, such as engine and planer beds, engine cylinders, large gear wheels, etc.

"Third, flat or print-back molding is the method employed where the articles to be cast are light and ornamental in character, such as stove plate, grate fronts, castings, and iron fences, etc. In this case the molds are made the same as in green-sand molding, and the facing is applied through a shake bag; but instead of smoothing the facing by the hand or tool, the pattern itself is pressed back into the mold, and in this way the facing is made to stick to the sand and also to correspond exactly to the surface of the pattern. Whatever loose facing may be left in the mold is blown out by the bellows and the mold is finished."

Its uses as a lubricant.—In regard to the uses of graphite for lubricating purposes, the Dixon company says in a circular on the subject:

"For all engine cylinders it can be used dry or mixed with a little oil or water. All three ways have been tried with satisfactory results. For heavy bearings it may be mixed with oil or grease, and with oil for light bearings. The quantity to be used depends upon the tightness of the bearings. It is better to use too little rather than too much, as graphite is a solid substance. The graphite coats the bearing surfaces with a shiny, unctuous veneer.

"It is equally useful for wood or metal surfaces, if the bearings are loose enough for the introduction of this thin flake graphite.

"Its proper selection, sizing, and perfecting for lubricating purposes is a matter requiring large skill, much machinery, and great experience. The difference between a perfectly pure graphite and one almost pure, but still totally unfit for lubricating, can not be detected by either sight or touch."

Graphite imported into the United States from 1867 to 1893.

Years ended—	Unmanufactured.		Manufactured.	Total.
	Quantity.	Value.		
	Cwt.			
June 30, 1867	27, 113	$54, 131		$54, 131
1868	68, 620	149, 083		149, 083
1869	74, 846	351, 004		351, 004
1870	80, 795	269, 291	$833	270, 124
1871	51, 628	136, 200	3, 754	139, 954
1872	96, 381	329, 030		329, 030
1873	157, 539	548, 613		548, 613
1874	111, 992	382, 591		382, 591
1875	46, 492	122, 050		122, 050
1876	50, 589	150, 709	17, 605	168, 314
1877	75, 361	204, 630	18, 091	222, 721
1878	60, 244	154, 757	16, 909	171, 666
1879	65, 662	164, 013	24, 637	188, 650
1880	109, 908	278, 022	22, 941	300, 963
1881	150, 927	381, 966	31, 674	413, 640
1882	150, 421	363, 835	25, 536	389, 371
1883	154, 893	361, 949	21, 721	383, 670
1884	144, 086	286, 393	1, 863	288, 256
1885	110, 462	207, 228		207, 228
1886	83, 368	164, 111		164, 111
1887	168, 841	331, 621		331, 621
Dec. 31, 1888	184, 013	353, 990		353, 990
1889	177, 381	378, 057		378, 057
1890	255, 955	594, 746		594, 746
1891	212, 360	555, 080		555, 080
1892	233, 540	667, 775		667, 775
1893	288, 740	795, 379		865, 379

BARYTES.

Barytes, barium sulphate, or heavy spar, as it is commonly called, occurs in a number of localities in the United States, chiefly in Missouri, New Jersey, North Carolina, and Virginia. The better grades are used principally in the manufacture of pigments as a cheaper substitute for white lead. Usually it is mixed with white lead, thus lessening the cost to the consumer, and, it is claimed, not materially affecting the weight, quality, or covering properties. It is also used as a makeweight in paper manufactures, and the lower grades find a market with pork-packers in the preparation of canvas covers for their products.

Sympathizing with the general falling off in trade during 1893, the production of barytes decreased about 10 per cent., being 28,970 short tons, against 32,108 tons in 1892. The value declined still more, being $88,506 in 1893, against $130,025 the previous year, a decrease of about 32 per cent.

The product was entirely from Missouri and Virginia, in nearly equal proportions, no output from New Jersey or North Carolina being reported. The value quoted is uniformly for crude barytes, which is, of course, much less than that of the material after it has been ground, floated, or otherwise prepared for commerce. The amount of refined or floated barytes reported by Saint Louis manufacturers in 1893 was 13,400 short tons, valued at $231,000. Since 1882 the production of barytes has been as follows:

Production of crude barytes from 1882 to 1893.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	22,400	$80,000	1888	22,400	$110,000
1883	30,240	108,000	1889	21,460	106,313
1884	28,000	100,000	1890	21,911	86,505
1885	16,800	75,000	1891	31,069	118,363
1886	11,200	50,000	1892	32,108	130,025
1887	16,800	75,000	1893	28,970	88,506

Imports of barium sulphate from 1867 to 1893.

Years ended—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
June 30, 1867	14, 968, 181	$141, 273		
1868	2, 755, 547	26, 739		
1869	1, 117, 335	8, 565		
1870	1, 684, 916	12, 917		
1871	1, 385, 004	9, 769		
1872	5, 804, 098	43, 521		
1873	6, 939, 425	53, 759		
1874	4, 788, 966	42, 235		
1875	2, 117, 854	17, 995		
1876	2, 655, 349	25, 325		
1877	2, 388,373	19, 273		
1878	1, 366, 857	10, 340		
1879	453, 333	3, 496		
1880	4, 924, 423	37, 374		
1881	1, 518, 322	11, 471		
1882	562, 300	3, 856		
1883	411, 666	2, 489		
Dec. 31, 1884	3, 884, 516	24, 671	5, 800, 816	$8, 044
1885	4, 095, 287	20, 606	7, 841, 715	13, 567
1886	3, 476, 691	18, 338	6, 588, 872	8, 862
1887	4, 057, 831	19, 769	10. 190, 848	13, 290
1888	3, 821, 842	17, 135	6, 504, 975	9, 037
1889	3, 601, 506	22, 458	13, 571, 206	7. 660
1890	*a*1, 563	16, 453	*a*4, 815	13, 133
1891	2, 149	22, 041	2, 900	8, 816
1892	1, 389	15, 419	2. 789	7, 418
1893	1, 032	11, 457	2, 983	7, 612

a Tons since 1890.

MINERAL WATERS.

By A. C. Peale.

For the year 1893 the list of springs from which mineral water was sold is the largest since these reports were begun, the total number being 330, which is 47 more than were included in the list for 1892. Of these springs 270 report, which is 26 more than the total reporting last year. Of the 60 springs not reporting many are springs whose sales in the past have been very large.

The total production for 1893, including the delinquent springs at one-half the figures last reported by them, is 23,544,495 gallons, at a valuation of $4,246,734. This would be an increase of 1,667,891 gallons, but a decrease of $659,236 in the value as compared with the value of the total product in 1892. The average price per gallon for 1892 was 22½ cents, whereas for 1893 it is 18 cents. When the springs actually reporting in each year are compared we find that the 270 report in 1893 20,092,733 gallons, which is a loss of 1,345,371 gallons as compared with the product of the 242 springs reporting in 1892. The difference in the valuation is $1,172,182 in favor of 1892.

The list of waters used commercially in the North Atlantic States shows a net gain of 27 springs. Five springs have been taken off the list and 32 new ones added. These new springs are as follows: Granite Springs, Oxford Mineral Spring, and Windsor Mineral Spring, in Maine; Pack Monadnock Lithia Spring, New Hampshire; Equinox Spring, Vermont; Gladstone Spring, Rhode Island; Althea Spring, Connecticut; Table Rock Mineral Spring, New York; Cloverdale Lithia Springs, Gettysburg Katalysine Spring, Gray's Spring, and Magnesia Fountains, in Pennsylvania, and the following in Massachusetts: Ballardvale Lithia Spring, Blue Hill Silver Spring, Burnham Spring, Columbia Lithia Spring, Crystal Spring of Stoughton, Crystal Mineral Spring of Methuen, Crystal Mineral Spring of Stoneham, Diamond Spring, Electric Spring, Fulton Natural Spring, Goulding Spring, Harvard Crystal Spring, Indian Spring, Leland Mineral Spring, Massasoit Spring, Middlesex Mountain Spring, Moose Hill Spring, Mount Washington Cold Spring, Nobscot Mountain Spring, and Robbins Spring. Of the 98 springs credited to this section, 79 report, and the figures show an increase in the production of 1,497,470 gallons. Notwithstanding this increase in the product, the value is $88,571 less than the value of the product of 1892.

The South Atlantic States gain 4 springs and lose 1. The new springs are: Mardela Springs, Maryland; Lake Como Lithia Springs and Nye Lithia Springs, in Virginia. Of the 60 springs now on the list 49 report for 1893, showing an increase of 29,884 gallons. There is, however, a decrease of $48,457 in the value of the product, as compared with 1892.

In the North Central States 14 springs have been added to the list and 5 taken from it, leaving the total number for the section at 92, a gain of 9 over the list of 1892. The new springs are: Crum Mineral Spring, Crystal Rock Spring, Magnetic and Saline Spring, Mustcash Spring, and Oak Ridge Spring, in Ohio; Barnard's Spring and Spencer Mineral Spring, in Indiana; American Carlsbad Spring, Sailor Springs, and Piasaqua Spring, in Illinois; Blue Rock Spring, in Michigan; Wautoma Spring, in Wisconsin; Siloam Spring, in Iowa, and Excelsior Springs, in Missouri. Seventy-eight springs report, with a decreased production of 2,732,728 gallons and a decrease of $761,305 in value.

Three springs increase the list for the South Central States from 38 for 1892 to 41 for 1893. The springs new on the list are Jackson White Sulphur Springs, Alabama; Robinson Mineral Spring, Mississippi, and Rockdale Mineral Wells, Texas. The production of the 35 reporting for 1893 is 446,415 gallons more than that of 1892, and the increase in value $12,997.

The list for the Western States and Territories shows a net gain of 5 springs, the total being 39, as against 34 in 1892. The springs new to the list are, Hiawatha Spring, Manitou, Colorado; Wasatka Spring, Utah; Alhambra Mineral Spring, El Moro Mineral Spring, Shasta Mineral Spring, and Humboldt Artesian Mineral Spring, in California. The production of this section has decreased 586,412 gallons, and the decrease in value is $286,846.

Production of mineral waters for 1893, by States and Territories.

States and Territories.	Springs reporting.	Product.	Value.
		Gallons.	
Alabama	4	17,900	13,637
Arkansas	4	76,989	11,160
California	13	383,179	190,667
Colorado	4	125,922	48,003
Connecticut	5	50,100	7,602
Georgia	3	86,000	14,600
Illinois	8	118,800	8,440
Indiana	8	140,000	12,650
Iowa	6	69,100	10,770
Kansas	8	49,600	5,549
Kentucky	4	57,100	7,925
Maine	10	869,917	138,930
Maryland	5	86,100	11,650
Massachusetts	27	2,764,400	118,436
Michigan	7	610,900	174,232
Mississippi	5	166,400	47,355
Missouri	8	399,500	143,075
Montana	2	16,840	6,078
New Hampshire	2	1,409,125	702,281
New Mexico	3	6,000	750
New York	16	1,942,850	595,376
North Carolina	7	317,200	79,926
Ohio	10	1,072,200	48,640
Oregon	2	29,200	8,800
Pennsylvania	11	1,065,800	247,420
Rhode Island	3	145,000	9,000
Tennessee	4	44,500	7,757
Texas	13	359,070	21,957
Vermont	4	97,000	24,400
Virginia	26	544,799	187,045
Washington	3	37,100	33,375
West Virginia	7	28,730	8,515
Wisconsin	21	5,705,212	652,703
Other States (*a*)	7	1,200,200	54,258
Total	270	20,092,733	3,652,962

a Idaho, Louisiana, Minnesota, New Jersey, South Carolina, South Dakota, and Utah are included here, as only one spring in each of these States reports.

Production of natural mineral waters from 1883 to 1893.

Geographical division.	Springs reporting.	Gallons sold.	Value.
1883.			
North Atlantic....	38	2, 470, 670	$282, 270
South Atlantic....	27	312, 090	64, 973
North Central.....	37	1, 435, 809	323, 600
South Central.....	21	1, 441, 042	139, 973
Western	6	169, 812	52, 787
	129	5, 829, 423	863, 603
Estimated..........	60	1, 700, 000	256, 000
Total........	189	7, 529, 423	1, 119, 603
1884.			
North Atlantic....	38	3, 345, 760	328, 125
South Atlantic....	27	464, 718	103, 191
North Central.....	37	2, 070, 533	420, 515
South Central.....	21	1, 526, 817	147, 112
Western	6	307, 500	85, 200
	129	7, 715, 328	1, 084, 143
Estimated..........	60	2, 500, 000	375, 000
Total........	189	10, 215, 328	1, 459, 143
1885.			
North Atlantic....	51	2, 527, 310	192, 605
South Atlantic....	32	908, 692	237, 153
North Central.....	45	2, 925, 288	446, 211
South Central.....	31	540, 436	74, 100
Western	10	509, 675	86, 776
	169	7, 411, 401	1, 036, 845
Estimated..........	55	1, 737, 000	276, 000
Total........	224	9, 148, 401	1, 312, 845
1886.			
North Atlantic....	49	2, 715, 050	177, 969
South Atlantic....	38	720, 397	123, 517
North Central.....	40	2, 048, 914	401. 861
South Central.....	31	822, 016	58, 222
Western	14	781, 540	137, 796
	172	7, 087, 917	899, 365
Estimated..........	53	1, 862, 400	384, 705
Total........	225	8, 950, 317	1, 284, 070
1887.			
North Atlantic....	40	2, 571, 004	213, 210
South Atlantic....	34	614, 041	147, 149
North Central.....	38	1, 480, 820	208, 217
South Central.....	29	741, 080	87, 946
Western	12	1, 236, 324	288, 737
	153	6, 643, 269	945, 259
Estimated..........	62	1. 616, 340	316, 204
Total........	215	8, 259, 609	1, 261, 463
1888.			
North Atlantic....	42	2, 856, 799	247, 108
South Atlantic....	32	1, 689, 387	493, 489
North Central.....	38	2, 002, 373	325, 839
South Central.....	19	426, 410	71, 215
Western	15	1, 853, 679	421, 651
	146	8, 828, 648	1, 559, 302
Estimated..........	52	750, 000	120, 000
Total........	198	9, 578, 648	1, 679, 302
1889.			
North Atlantic....	60	4, 106, 464	471, 575
South Atlantic....	47	646, 239	198, 032
North Central.....	86	6, 137, 776	604, 238
South Central.....	33	500, 000	43, 356
Western	32	1, 389, 992	431, 257
Total........	258	12, 780, 471	1, 748, 458
1890.			
North Atlantic....	55	5, 043, 074	1, 175, 512
South Atlantic....	39	647, 625	245, 760
North Central.....	71	5, 050, 413	737, 672
South Central.....	30	604, 571	81, 426
Western	25	869, 504	253, 578
	220	12, 215, 187	2, 493, 948
Estimated..........	53	1, 692, 231	106, 802
Total........	273	13, 907, 418	2, 600, 750
1891.			
North Atlantic....	62	5, 724, 752	1, 591, 746
South Atlantic....	41	796, 439	313, 443
North Central.....	68	8, 010, 556	482, 082
South Central.....	29	629, 015	106, 022
Western	27	1, 123, 640	414, 564
	227	16, 284, 402	2, 907, 857
Estimated..........	61	2, 108, 330	88, 402
Total........	288	18, 392, 732	2, 996, 259
1892.			
North Atlantic....	65	6, 853, 722	1, 933, 416
South Atlantic....	47	1, 062, 945	353, 193
North Central.....	74	11, 566, 440	1, 834, 732
South Central.....	32	693, 544	109, 334
Western	24	1, 261, 453	594, 469
	242	21, 438, 104	4, 825, 144
Estimated..........	41	438, 500	80, 826
Total........	283	21, 876, 604	4, 905, 970
1893.			
North Atlantic....	79	8, 357, 192	1, 844, 845
South Atlantic....	49	1, 092, 829	304, 736
North Central.....	78	8, 833, 712	1, 073, 427
South Central.....	35	1, 139, 959	122, 331
Western	29	675, 041	307, 623
	270	20, 092, 733	3, 652, 962
Estimated..........	60	3, 451, 762	593, 772
Total........	330	23, 544, 495	4, 246, 734

Alabama.—One new spring is added to the list and one reporting last year is delinquent for 1893. The following springs report:

Bailey Springs, Bailey Springs, Lauderdale county.
Healing Springs, Healing Springs, Washington county.
Jackson White Sulphur, Jackson, Jackson county.
Wilkinson's Matchless Mineral Water, Greenville, Butler county.

Arkansas.—Four of the five springs credited to Arkansas report; they are:

Arkansas Lithia Springs, Hope, Hempstead county.
Dovepark Springs, Dovepark, Hot Spring county.
Eureka Springs, Eureka Springs, Carroll county.
Potash Sulphur Spring, Hot Springs, Garland county.

California.—Three new springs are added to California's list, which makes the total for 1893 eighteen; of these, thirteen report, as follows:

Alhambra Mineral Spring, Martinez, Contra Costa county.
Azule Natural Seltzer Water, San José, Santa Clara county.
Bartlett Springs, Bartlett Springs, Lake county.
Castalian Mineral Water, Inyo county.
El Moro Mineral Spring, Elmoro, San Luis Obispo county.
El Toro Spring, Novata, Marin county.
Humboldt Artesian Mineral Spring, Eureka, Humboldt county.
Napa Soda Springs, Napa Soda Springs, Napa county.
Ojai Hot Springs, Matilija, Ventura county.
Pacific Congress Springs, Saratoga, Santa Clara county.
Shasta Mineral Spring, Shasta Springs, Siskiyou county.
Tolenas Soda Spring, Fairfield, Solano county.
Tuscan Springs, Red Bluff, Tehama county.

Colorado.—One new spring is added to the list and two are dropped, as the water is no longer sold; the total for the State is therefore eight instead of nine as for the previous year. Of these, however, only four report for 1893, viz:

Boulder Springs, Boulder, Boulder county.
Colorado Carlsbad, Barr, Arapahoe county.
Canyon City Vichy, Canyon City, Fremont county.
Hiawatha Spring, Manitou, El Paso county.

Connecticut.—One new spring is added to the list, making the total for the State 6. Of these 5 report as follows:

Althea Spring, Waterbury, New Haven county.
Aspinock Spring, Putnam heights, Windham county.
Highland Rock and Tonica Springs, Highland Park, Hartford county.
Oxford Chalybeate Spring, Oxford, New Haven county.

Florida.—No reports have been received from the Florida Springs.

Georgia.—All of the Georgia Springs, 3 in number, report as follows:

Bowden Lithia Springs, Lithia Springs, Douglas county.
Hughes Mineral Spring, Rome, Floyd county.
Ponce de Leon Springs, Atlanta, Fulton county.

Idaho.—The State of Idaho is still represented by 1 spring, viz:

Idanha Springs, Soda Springs, Bannock county.

Illinois.—Three new springs are added to the list for Illinois for 1893, and 1 taken off, leaving the total number at 10, a net gain of 2 over 1892. Of these the following 8 reported, viz:

American Carlsbad, Nashville, Washington county.
Black Hawk Springs, Rock Island, Rock Island county.
Cumberland Mineral Spring, Greenup, Cumberland county.
Kirkwood Mineral Spring, Kirkwood, Warren county.
Perry springs, Perry Springs, Pike county.
Piasaqua Spring, Jersey county.
Sailor Springs, Sailor Springs, Clay county.
Sanicula Springs, Ottawa, La Salle county.

Indiana.—Two new springs are added to the list, making the total number for the State 10, of which 8 report as follows:

Barnard's Spring, Martinsville, Morgan county.
French Lick Springs Company, French Lick, Orange county.
Indiana Mineral Springs, Indiana Mineral Springs, Warren county.
Kickapoo Magnetic Spring s, Kickapoo, Warren county.
King's Mineral Springs, Muddy Fork, Clark county.
Magnetic Mineral Spring, Terre Haute, Vigo county.
Spencer Mineral Water, Spencer, Owen county.
West Baden Springs, West Baden, Orange county.

Iowa.—One new spring is added to the list for Iowa, making the total 6, all of which report. They are:

Black Hawk Springs, Davis county, near Eldon, Wapello county.
Colfax Mineral Water Company, Colfax, Jasper county.
Lake View Medical Spring, Lake View, Sac county.
Ottumwa Mineral Spring, Ottumwa, Wapello county.
Siloam Springs, Iowa Falls, Hardin county.
White Sulphur Spring, White Sulphur, Scott county.

Kansas.—The list for Kansas remains the same as for 1892, except that the name of the Great Spirit Spring is changed to Waconda. All the springs, 8 in number, report. They are:

Blazing's Natural Medical Spring, Manhattan, Riley county.
Geuda Mineral Springs, Geuda Springs, Cowley county.
Iola Mineral Well, Iola, Allen county.
Lithium Spring, Montrose, Jewell county.
Providence Mineral Wells, Providence, Butler county.
Topeka Mineral Wells, Topeka, Shawnee county.
Waconda Springs, Cawker City, Mitchell county.
Wichita Mineral Water, Wichita, Sedgwick county.

Kentucky.—There is no change in the list for Kentucky, the total remaining at 5. Only 1 of the springs is delinquent for 1893. The springs reporting are:

Bedford Springs, Bedford, Trimble county.

Blue Lick Springs, Blue Lick Springs, Nicholas county.
Crab Orchard Springs, Crab Orchard, Lincoln county.
St. Patrick's Well, Louisville, Jefferson county.

Louisiana.—The 1 spring credited to Louisiana reports, viz:
Abita Springs, Abita Springs, St. Tammany parish.

Maine.—Three new springs are added to the list. Of the 12 springs now credited to the State 10 report, viz:
Barker Mill Spring, Auburn, Androscoggin county.
Cold Bowling Spring, Steep Falls, Sinington, York county.
Crystal Springs, Auburn, Androscoggin county.
Granite Spring, Lewiston, Androscoggin county.
Keystone Spring, East Poland, Androscoggin county.
Oxford Mineral Spring, Oxford county.
Poland Spring, South Poland, Androscoggin county.
Seal Rock Spring, Saco, York county.
Underwood Springs, Falmouth Foreside, Cumberland county.
Windsor Mineral Spring, Lewiston, Androscoggin county.

Maryland.—The total number of springs for the State of Maryland is 6, 1 new spring being added to the list. Only 1 is delinquent for 1893. The following reported, viz:
Carroll Spring, Forest Glen, Montgomery county.
Chattolanee Springs, Baltimore county.
Mardela Springs, Wicomico county.
Strontia Mineral Spring, Brooklandville, Baltimore county.
Tacoma Springs, Tacoma Park, Montgomery county.

Massachusetts.—Twenty springs are added to the list for Massachusetts, and 1 deducted, leaving the total for the State, 29. Of these, 27 report. They are the following:
Allendale Mineral Spring, West Roxbury, Suffolk county.
Ballardvale Lithia Spring, Lowell, Middlesex county.
Belmont Hill Spring, Everett, Middlesex county.
Blue Hill Silver Spring, Milton, Norfolk county.
Burnham Spring, Methuen, Essex county.
Columbia Lithia Spring, Revere, Suffolk county.
Commonwealth Mineral Spring, Waltham, Middlesex county.
Crystal Spring, Stoughton, Norfolk county.
Crystal Mineral Spring, Metheun, Essex county.
Crystal Mineral Spring, Stoneham, Middlesex county.
Diamond Spring, Lawrence, Essex county.
Electric Spring, Lynn, Essex county.
Everett Crystal Spring, Everett, Middlesex county.
Fulton Natural Spring, Medford, Middlesex county.
Goulding Spring, Whitman, Plymouth county.
Harvard Crystal Spring, Allston, Suffolk county.
Indian Spring, Brighton, Suffolk county.
Leland Mineral Spring, Lowell, Middlesex county.

Massasoit Spring, Springfield, Hampden county.
Middlesex Mountain Spring, Malden, Middlesex county.
Moose Hill Spring, Swampscott, Essex county.
Mount Washington Cold Spring, Chelsea, Suffolk county.
Nobscot Mountain Spring, Framingham, Middlesex county.
Robbins Spring, Arlington, Middlesex county.
Sheep Rock Spring, Lowell, Middlesex county.
The Belmont Natural Spring, Belmont, Middlesex county.
Undine Spring, Brighton, Suffolk county.

Michigan.—One new spring is added, making the total 10, of which 7 report as follows:

Americanus Water, Lansing, Ingham county.
Blue Rock, Grand Rapids, Kent county.
Eastman Springs, Benton Harbor, Berrien county.
Moorman Well, Ypsilanti, Washtenaw county.
Mount Clemens Sprudel Water, Mount Clemens, Macomb county.
Salutaris Spring, St. Clair Springs, St. Clair county.
Zauber Wasser, Hudson, Lenawee county.

Minnesota.—The only representation on the list for Minnesota is still the—

Inglewood Spring, Minneapolis, Hennepin county.

Mississippi.—One new spring is added to the list, making 5 springs for the State, all of which report as follows:

Brown's Wells, Brown's Wells, Copiah county.
Castalian Springs, Durant, Holmes county.
Godbold Mineral Well, Summit, Pike county.
Robinson Mineral Spring, Madison county.
Stafford Mineral Springs, near Vosburg, Jasper county.

Missouri.—The list for Missouri remains the same in number as for 1892, 1 new spring being added and 1 dropped. The name of Reiger Springs has been changed to Lineville Mineral Springs. Eight of the 10 springs report as follows:

B. B. Mineral Springs, Bowling Green, Pike county.
Blue Lick Springs, Blue Lick, Saline county.
Eldorado Springs, Cedar county.
Excelsior Springs, Excelsior Springs, Clay county.
Lebanon Springs, Lebanon, Laclede county.
Lineville Mineral Springs, Mercer county, near Lineville, Iowa.
Randolph Springs, Randolph Springs, Randolph county.
Sweet Springs, Sweet Springs, Saline county.

Montana.—One spring is gained by Montana, and both springs on the list report as follows:

Lissner's Mineral Springs, Helena, Lewis and Clarke county.
Pipestone Springs, Pipestone Springs, Jefferson county.

New Hampshire.—Although 1 new spring has been added to the list, 1 has also been dropped, leaving the total at 3; of these, 2 report as follows:

Londonderry Lithia Spring, Londonderry, Rockingham county.
Pack Monadnock Lithia Spring, Temple, Hillsboro county.

New Jersey.—No change is noted in New Jersey. It is still represented on the list by—

Kalium Springs, Collingswood, Camden county.

New Mexico.—Three of the 4 springs credited to New Mexico report. They are the following:

Aztec Spring, Santa Fe, Santa Fe county.
Coyote Soda Springs, Coyote Canyon, Bernalillo county.
Ojo Caliente Spring, Ojo Caliente, Taos county.

New York.—Three springs have been dropped from the list for New York and 1 new one added. The list, therefore, shows 24 springs, as compared with 26 springs in 1892. Sixteen report their sales for 1893. They are as follows:

Artesian Lithia Spring, Ballston Spa, Saratoga county.
Avon Sulphur Spring, Avon, Livingston county.
Cayuga Water, Cayuga, Cayuga county.
Deep Rock Springs, Oswego, Oswego county.
Geneva Mineral Spring, Geneva, Ontario county.
Massena Springs, Massena, St. Lawrence county.
Sulphur Springs, Richfield Springs, Otsego county.
Table Rock Mineral Spring, Honeoye Falls, Monroe county.
Verona Springs, Verona, Oneida county.
White Sulphur Spring, Sharon Springs, Schoharie county.
Saratoga Springs, Saratoga county:
    Empire Spring.
    Excelsior Spring.
    Union Spring.
    Hathorn Spring.
    Saratoga Imperial Spring.
    Saratoga Vichy Spring.
    Saratoga Victoria Spring.

North Carolina.—Seven of the 10 springs credited to North Carolina report. They are:

Ashley Bromine and Arsenic Spring, Ashe county.
Barium Springs, Barium Springs, Iredell county.
Black Mountain Iron and Alum Springs, Buncombe county.
Panacea Springs, Warren county.
Seven Springs, Seven Springs, Wayne county.
Shaw's Healing Springs, Littleton, Halifax county.
Thompson's Bromine Arsenic Springs, Crumpler, Ashe county.

Ohio.—Although 3 springs are dropped from Ohio's list, 5 new springs are added, the total being increased from 9 in 1892, to 11 in 1893. Ten springs report as follows:

Adams County Mineral Spring, Mineral Springs, Adams county.

Bromo Lithia Natural Spring, Ripley, Brown county.
Crum Mineral Springs, Austintown, Mahoning county.
Crystal Mineral Spring, Urbana, Champaign county.
Crystal Rock Spring, Erie county.
Electro-Magnetic Spring, Fountain Park, Champaign county.
Magnetic and Saline Spring, Marysville, Union county.
Mustcash Spring, Erie county.
Oak Ridge Spring, Green Spring, Seneca county.
Sulphur Lick Springs, Anderson, Ross county.

Oregon.—Both of Oregon's springs report for 1893. They are:
Siskkiyou Spring, Soda Springs, Jackson county.
Wilhoit Springs, Wilhoit, Clackamas county.

Pennsylvania.—Four new springs for Pennsylvania bring the total for the State up to 15. Of these, 11 report as follows:
Bedford Mineral Spring, Bedford, Bedford county.
Black Barren Mineral Spring, Pleasant Grove, Lancaster county.
Cloverdale Lithia Spring, Newville, Cumberland county.
Eureka Springs, Saegertown, Crawford county.
Gettysburg Katalysine Spring, Gettysburg, Adams county.
Gray Spring, Cambridgeboro, Crawford county.
Magnesia Fountains, Cambridgeboro, Crawford county.
Parker Mineral Spring, Gardeau, McKean county.
Pavilion Spring, Wernersville, Berks county.
Sizerville Magnetic Mineral Spring, Sizerville, Cameron county.
Susquehanna Spring, Rush, Susquehanna county.

Rhode Island.—One new spring brings the list for Rhode Island up to 3, all of which report. They are:
Gladstone Spring, Narragansett Pier, Washington county.
Holly Spring, Woonsocket, Providence county.
Ochee Mineral and Medical Springs, Johnson, Providence county.

South Carolina.—Only 1 of 3 springs credited to South Carolina reports its sale for 1893. It is:
Garrett Mineral Spring, Spartanburg, Spartanburg county.

South Dakota.—There is no change in the list for South Dakota. The 1 spring credited to the State is:
Hot Springs of South Dakota, Hot Springs, Fall River county.

Tennessee.—Four of Tennessee's 6 springs report as follows:
Hurricane Springs, Tullahoma, Coffee county.(*a*)
Idaho Springs, St. Bethlehem, Montgomery county.
Red Boiling Springs, Red Boiling Springs, Macon county.
Tate Epsom Springs, Tate Spring, Grainger county.

Texas.—One new spring appears on the list credited to the State. Thirteen report sales in 1893. They are:
Capp's Well, Longview, Gregg county.
Dalby Springs, Dalby Springs, Bowie county.
Elkhart Mineral Wells, Elkhart, Anderson county.

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a The spring is in Franklin county.

Georgetown Mineral Water, Georgetown, Williamson county.
Hynson's Iron Mountain Spring, Marshall, Harrison county.
Mineral Wells, Mineral Wells, Palo Pinto county.
Montvale Springs, Marshall, Harrison county.
Overall Mineral Wells, Franklin, Robertson county.
Rockdale Mineral Wells, Rockdale, Milam county.
Slack's Wells, Waelder, Gonzales county. (*a*).
Texas Sour Springs, Luling, Caldwell county.
Tioga Mineral Wells, Grayson county.
Wooten Wells, Wooten Wells, Robertson county.

Utah.—For the first time Utah appears on our list represented by the—

Wasatka Spring, Salt Lake City, Salt Lake county.

Vermont.—The total for Vermont is increased by 1 new spring. Of the 5 springs, only 1 is delinquent for 1893. The following are the springs that reported:

Brunswick White Sulphur, Brunswick Springs, Essex county.
Clarendon Springs, Clarendon Springs, Rutland county.
Equinox Spring, Manchester, Bennington county.
Missisquoi Mineral Springs, Sheldon, Franklin county.

Virginia.—One spring is dropped from Virginia's list and 2 new ones are added, making the total for the State 29. Of these 26 report the sales of 1893.

Anti-Dyspeptic and Tonic, Burkeville, Nottoway county.
Blue Ridge Springs, Botetourt county.
Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg county.
Chase City Mineral Springs, Chase City, Mecklenburg county.
Cove Lithia Springs, near Wytheville, Wythe county.
Farmville Lithia Springs, near Farmville, Prince Edward county. (*b*)
Healing Springs, Healing Springs, Bath county.
Hunter's Pulaski Alum Springs, Sassin, Pulaski county.
Jordan White Sulphur Spring, Stephenson, Frederick county.
Lake Como Lithia Spring, Henrico county.
Massanetta Springs, Harrisonburg, Rockingham county.
Nye Lithia Springs, Wytheville, Wythe county.
Osceola Springs, near Pleasant Valley, Rockingham county.
Otterburn Lithia and Magnesia Springs, Amelia Court-House, Amelia county.
Pæonian Springs, Loudoun county.
Rawley Springs, Rawley Springs, Rockingham county.
Roanoke Red Sulphur Spring, Catawba, Roanoke county.
Rockbridge Alum Springs, Goshen Bridge, Rockbridge county.
Rockingham Springs, McGaheysville, Rockingham county.
Shenandoah Alum Springs, Mount Jackson, Shenandoah county.
Stribling Springs, Stribling Springs, Augusta county.

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a The spring is in Fayette county.

b The spring is in Cumberland county.

The Seven Springs, near Glade Spring, Washington county.

The Steephill Ferro-phospho-magnesium Spring, North Staunton, Augusta county.

Virginia Waukesha Lithia Springs, Staunton, Augusta county.

Wallawhatoola Alum Springs, near Millboro Spring, Bath county.

Wolf Trap Lithia Springs, Wolf Trap, Halifax county.

Washington.—The 3 springs of the State of Washington report their sales for 1893. They are:

Cascade Springs, near Cascades, Skamania county.

Medical Lake, Medical Lake, Spokane county.

Yakima Soda Spring, near North Yakima, Yakima county.

West Virginia.—One new spring increases the total for West Virginia to 7 springs, all of which report. They are:

Borland Springs, Bull Creek, Wood county.

Capon Springs, Capon Springs, Hampshire county.

Irondale Springs, Independence, Preston county.

Red Sulphur Springs, Monroe county.

Salt Sulphur Springs, Salt Sulphur Springs, Monroe county.

Triplet Well, Calf Creek, Grant District, Pleasants county.

White Sulphur Springs, White Sulphur Springs, Greenbrier county.

Wisconsin.—One new spring is added to Wisconsin's list, and the name of the Darlington Mineral Spring is changed to the Badger State Spring, while the Palmyra is changed to Great Geyser Spring. Of the 24 springs credited to the State, 21 report the sales of 1893. The springs reporting are:

Allouez Mineral Springs, Green Bay, Brown county.

Badger State Spring, Darlington, Lafayette county.

Bethania Mineral Spring, Osceola, Polk county.

Fort Crawford Springs, Prairie du Chien, Crawford county.

Great Geyser Spring, Palmyra, Jefferson county.

Lebens Wasser, Green Bay, Brown county.

Nee-Ska-Ra Mineral Spring, Wannatosa, Milwaukee county.

Salvator Springs, Green Bay, Brown county.

Shealliel Springs, Waupaca, Waupaca county.

Sheboygan Spring, Sheboygan, Sheboygan county.

Silver Sand Spring, Milwaukee, Milwaukee county.

Sparkling Spring, Milwaukee, Milwaukee county.

Wautoma Mineral Spring, Waushara county.

Waukesha Springs, Waukesha county:

Almanaris Springs.

Arcadian Spring.

Bethesda Mineral Spring.

Henk Mineral Spring.

Horeb Spring.

Siloam Spring.

Waukesha Hygeia Mineral Spring.

White Rock Mineral Spring.

Summary of reports of mineral springs for 1893.

States and Territories.	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	10	2	12
New Hampshire	2	1	3
Vermont	4	1	5
Massachusetts	27	2	29
Rhode Island	3	0	3
Connecticut	5	1	6
New York	16	8	24
New Jersey	1	0	1
Pennsylvania	11	4	15
SOUTH ATLANTIC STATES.			
Delaware	0	0	0
Maryland	5	1	6
District of Columbia	0	0	0
Virginia	26	3	29
West Virginia	7	0	7
North Carolina	7	3	10
South Carolina	1	2	3
Georgia	3	0	3
Florida	0	2	2
SOUTH CENTRAL STATES.			
Kentucky	4	1	5
Tennessee	4	2	6
Alabama	4	1	5
Mississippi	5	0	5
Louisiana	1	0	1
Texas	13	1	14
Indian Territory	0	0	0
Arkansas	4	1	5
Oklahoma	0	0	0

States and Territories.	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH CENTRAL STATES.			
Ohio	10	1	11
Indiana	8	2	10
Illinois	8	2	10
Michigan	7	3	10
Wisconsin	21	3	24
Minnesota	1	0	1
Iowa	6	0	6
Missouri	8	2	10
North Dakota	0	0	0
South Dakota	1	0	1
Nebraska	0	1	1
Kansas	8	0	8
WESTERN STATES AND TERRITORIES.			
Alaska	0	0	0
Wyoming	0	0	0
Montana	2	0	2
Colorado	4	4	8
New Mexico	3	1	4
Arizona	0	0	0
Utah	1	0	1
Nevada	0	0	0
Idaho	1	0	1
Washington	3	0	3
Oregon	2	0	2
California	13	5	18
Total	270	60	330

IMPORTS AND EXPORTS.

Imports.—Prior to 1884 the Treasury Department did not distinguish natural mineral waters from those that were artificial; since 1883 the distinction has been made, but the artificial waters have not been classified according to the receptacles in which they have been imported. The importation is shown in the two tables following, with a table of exports appended.

Mineral waters imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All, not artificial.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370,610	$24,913	3,792	$360		$137			$25,410
1868	241,702	18,438	22,819	2,052	554	104			20,594
1869	344,691	25,635	9,739	802	1,042	245			26,682
1870	433,212	30,680	18,025	1,743	2,063	508			32,931
1871	470,947	34,604	2,320	174	1,336	141			34,919
1872	892,913	67,951			639	116			68,067
1873	35,508	2,326			355	75	394,423	$98,151	100,552
1874	7,238	691			95	16	199,035	79,789	80,496
1875	4,174	471			5	2	395,956	101,640	102,113
1876	25,758	1,899					447,646	134,889	136,788
1877	12,965	1,328				22	520,751	167,458	168,808
1878	8,229	815					883,674	350,912	351,727
1879	28,440	2,352			3	4	798,107	282,153	284,509
1880	207,554	19,731					927,759	285,798	305,529
1881	150,326	11,850			55	26	1,225,462	383,616	395,492
1882	152,277	17,010					1,542,905	410,105	427,115
1883	88,497	7,054					1,714,085	441,439	448,493

Imports for years 1884 to 1893.

Years ended—	Artificial mineral waters.		Natural mineral waters.	
	Gallons.	Value.	Gallons.	Value.
June 30, 1884	29,366	$4,591	1,505,298	$362,651
1885	7,972	2,157	1,660,072	397,875
Dec. 31, 1886	62,464	16,815	1,618,960	354,242
1887	13,885	4,851	1,915,511	385,906
1888	12,752	4,411	1,716,461	341,695
1889	36,494	8,771	1,558,968	368,661
1890	22,328	7,133	2,322,008	433,281
1891	26,700	8,700	2,019,833	392,894
1892	16,052	9,089	2,266,123	497,660
1893	6,086	2,992	2,321,081	506,866

Exports of natural mineral waters, of domestic production, from the United States.

Fiscal year ending June 30—	Value.	Fiscal year ending June 30—	Value.
1875	$162	1881	$1,029
1876	80	1882	421
1879	1,529	1883	*a* 459
1880	1,486		

a None reported since 1883.

MINERAL-SPRING RESORTS.

Many of the mineral springs of the United States are utilized both for commercial purposes and as places of resort. The waters of many, however, are not suitable for bottling, on account of ingredients which undergo chemical changes when taken from the springs and allowed to stand. At others, the facilities for bottling or for transportation are not present, and therefore many springs are utilized only as sanitaria or places of resort. Some are of widespread reputation, while others are only locally known. The mineral-spring resorts have never been very thoroughly studied from a statistical point of view, and yet there is scarcely a State in the country which is without its mineral-spring resorts of recognized medicinal value, which are sources of profit to the owners of the springs and, therefore, indirectly, an addition to the wealth of their localities. These remarks are made in view of the therapeutic application of the waters, which is, of course, the principal use to which mineral waters are put, as is well shown by the advertising circulars issued by their owners. Mineral waters are also largely utilized in the production of borax, bromine, carbonate of magnesia, soda, and as one of the principal sources of common salt, and thus largely add to the economic wealth of many States.

They are considered from these points of view, however, in another place. As utilized at mineral-spring resorts, the waters are used for drinking purposes, and for bathing, especially at the hot springs, and many, as already noted, are also bottled, and sold at a distance from the springs, to be used either medicinally or as table waters. The following list has been prepared as carefully as possible, but is subject to future revision:

LIST OF AMERICAN MINERAL-SPRING RESORTS.

ALABAMA.

Bailey Springs.
Bladen Springs.
Blount Mineral Springs,
Butler Springs.
Chandler's Springs.
Cullom's Springs.
Healing Springs.
Lays Mineral Spring.
Livingston Artesian Well.
Shelby Springs.
Sulphur Springs.
Talladega Springs.
White Sulphur Springs.
Wilkinson's Matchless Mineral Well.

ARIZONA.

Castle Creek Springs.
Hooker's Hot Springs.

ARKANSAS.

Arkansas Lithia Springs.
Armstrong Spring.
Blanchard Springs.
Britt's Spring.
Buttermilk Springs.
Clear Spring.
Cluster Springs.
Dove Park Springs.
Eagle Springs.
Electric Springs.
Elixir Springs.
Eureka Springs.
Hot Springs
Howard County Mineral Spring.
Magnetic Gas Well.
Manitou Springs.
Mountain Valley Springs.
National Springs.
Pinnacle Springs.
Potash Sulphur Springs.
Ravenden Springs.
Searcy Springs.
Shover's Springs.
Sugarloaf Springs.
Sulphur Springs.
Sumter's Springs.
Twin Springs.
Watalulu Springs.
White Sulphur Springs.

CALIFORNIA.

Adams Springs.
Ætna Springs.
Alhambra Mineral Springs.
Allen's Springs.
Alum Rock Springs.
Anderson Mineral Springs.
Arrowhead Hot Springs.
Aqua de Vida Springs.
Bartlett Springs.
Blodgett's Springs.
Byron Hot Springs.
California Geysers.
California Seltzer Springs.
Campbell's Hot Springs.
Carnelian Hot Springs.
Coronado Mineral Springs.
El Paso de Robles Springs.
Elsinore Springs.
Eureka Springs.
Felt's Mineral Spring.
Fulton Wells.
Geyser Spa Spring.
Gilmore Glenn Spring.
Gilroy Hot Springs.
Glen Alpine Springs.
Gordon's Mineral Springs.
Harbin Springs.
Highland Springs.
Hough's Mineral Springs.
Howard Springs.
Klamath Hot Springs.
Lane's Mineral Spring.
Litton Seltzer Spring.
Lower Soda Springs.
Madrone Mineral Springs.
Mark West Springs.
Matilija Hot Springs.
Montecito Hot Springs.

CALIFORNIA—continued.

Murrietta Springs.
Napa Soda Springs.
New Almaden Springs.
Newsome's Arroyo Grande Springs.
Ojai Hot Springs.
Palm Valley Springs.
Paraiso Springs.
Piedmont White Sulphur Springs.
Rubicon Soda Springs.
San Bernardino Hot Springs.
Santa Barbara Hot Springs.
Santa Rosa Springs.
Santa Ysabel Springs.
Seigler's Springs.
Shasta Springs.
Skagg's Hot Springs.
St. Helena White Sulphur Springs.
Summit Soda Springs.
Tolenas Springs.
Tuscan Springs.
Ukiah Vichy Springs.
Upper Soda Springs.
Warner's Ranch Springs.
Wilbur Springs.
Witter's Springs.
Zem Zem Springs.

COLORADO.

Canyon City Springs.
Cottonwood Springs.
Douglas City Springs.
Glenwood Springs.
Hartsell Springs.
Heywood Springs.
Hot Springs, of Middle Park.
Idaho Mineral Springs.
Liberty Hot Springs.
Manitou Springs.
Mineral Springs, of Pueblo.
Ouray Mineral Springs.
Pagosa Springs.
Poncho Springs.
Rock Creek Springs.
Seltzer Mineral Springs.
Siloam Springs.
Steamboat Springs.
Trimble Springs.

CONNECTICUT.

Highland Rock and Tonica Springs.
Stafford Mineral Springs.

FLORIDA.

Benson's Salt Spring.
Blue Springs.
Dixon Bay Sulphur Spring.
Green Cove Springs.
Magnolia Springs.
Newport Sulphur Springs.
Orange Springs.
Suwannee Sulphur Springs.
Tarpon Springs.
Turner Springs.
Wakulla Spring.
Wesson's Iron Springs.
White Springs.
White Sulphur Springs.

GEORGIA.

Angiers Mineral Spring.
Beall's Springs.
Bowden Lithia Springs.
Catoosa Springs.
Chalybeate Springs.
Daniels Mineral Spring.
Franklin Springs.
Indian Springs.
Laurence Springs.
Magnolia Springs.
New Holland Springs.
Porter's Springs.
Powder Springs.
Warm Springs.
Watson's Springs.
White Sulphur Springs.

IDAHO.

Ahlfors Springs.
Easbly Springs.
Elliott's Springs.
Guyer Hot Springs.
Hailey Hot Springs.
Soda Springs.
Worsurck's Springs.

ILLINOIS.

Alcyone Springs.
American Carlsbad Springs.
Diamond Mineral Spring.
Glen Flora Springs.
Greenbush Mineral Well.
Green Lawn Springs.
Hygienic Western Saratoga Springs.
Illinois Lithia Springs.
Kirkwood Mineral Springs.
Moonlawn Springs.
Okawsville Mineral Spring.
Peoria Magnetic Artesian Springs.
Perry Springs.
Piasaqua Spring.
Sailor Springs.
Silver Spring.

INDIANA.

Ash Iron Springs.
Azalia Springs.
Avoca Springs.
Barnard's Spring.
Buffalo Saline Spring.
Cameron Springs.
Cartersburg Magnetic Spring.
Central Springs.
Eaton's White Sulphur Well.
Elliott's Spring.
French Lick Springs.
Greencastle Springs.
Hosea Saline Sulphur Springs.
Indiana Mineral Springs.
Inlow Springs.
Kickapoo Magnetic Mineral Springs.
Lithium Springs.
Milburn Springs.
Spencer Mineral Spring.
Spring Beach Springs.
Saint Ronan's Well.
Trinity Springs.
Sulphur Well.
Terre Haute Magnetic Mineral Spring.
West Baden Springs.
Workman Springs.

IOWA.

Black Hawk Mineral Springs.
Cherokee Magnetic Mineral Springs.
Colfax Mineral Springs.
Lake View Medical Springs.
Linwood Springs.
Ottumwa Mineral Springs.
Siloam Springs.
White Sulphur Springs.

KANSAS.

Arlington Mineral Springs.
Geuda Springs.
Louisville Springs.
Mound Valley Springs.
Providence Mineral Wells.
Topeka Mineral Wells.
Waconda Springs.

KENTUCKY.

Allen Springs.
Anita Springs.
Bedford Springs.
Blue Lick Springs.
Buena Vista Springs.
Cerulean Springs.
Crab Orchard Springs.
Drennon Springs.
Forrest Springs.
Hardin Springs.
Kentucky Alum Springs.
Lower Blue Lick Springs.
Rock Castle Springs.
White Sulphur Springs.

LOUISIANA.

Abita Springs.
Castor Sulphur Springs.
Chinchula Spring.
Claiburn Spring.
De Sota Mineral Springs.
Ocean Springs.
White Sulphur Springs.

MAINE.

Addison Mineral Springs.
American Chalybeate Spring.
Boothbay Medicinal Spring.
Lake Auburn Mineral Spring.
Lubec Saline Spring.
Old Point Indian Spring.
Poland Spring.
Rosicrucian Spring.
Scarboro Mineral Spring.
Summit Mineral Spring.
Wilson Springs.

MARYLAND.

Bentley's Springs.
Carroll Springs.
Chattolanee Mineral Springs.
Flintstone Mineral Springs.
River Springs.
Mardella Springs.
Windsor Sulphur Springs.

MASSACHUSETTS.

Allandale Springs.
Berkshire Soda Springs.
Bethlehem Spring.
Echo Grove Spring.
Fulton Natural Spring.
Massasoit Spring.
Robbins Spring.
Simpson Spring.

MICHIGAN.

Alpena Mineral Well.
Americanus Well.
Bethlehem Magnetic Mineral Springs.
Butterworth's Magnetic Spring.
Cascade Spring.
Clark Red Cross Springs.
Eastman Springs.
Eaton Rapids Magnetic Springs.
Erie Sulphur Springs.
Flint's Magnetic Springs.
Grand Haven Mineral Spring.
Hubbardston Magnetic Well.
Lansing Magnetic Well.
Leslie Magnetic Well.
Medea Mineral Spring.
Midland Magnetic Well.
Moorman Well.
Mt. Clemens Original Mineral Spring.
Mt. Clemens Sprudel Spring.
Otsego Mineral Springs.
Riverside Mineral Spring.
Salutaris Spring.
Shawnee Mineral Springs.
Spring Lake Mineral Springs.
Sprudel Well.
St. Clair Mineral Spring.
St. Louis Magnetic Spring.
Ypsilanti Mineral Springs.
Zauber-wasser Springs.

MINNESOTA.

Geissinger Springs.

MISSISSIPPI.

Artesian Springs.
Belmont Spring.
Brown's Wells.
Castalian Springs.
Iuka Mineral Springs.
Lafayette Springs.
Ocean Springs.
Robinson Mineral Spring.
Stafford Mineral Springs.
White's Springs.
Winston Springs.

MISSOURI.

Arkoe Springs.
Aurora Spring.
Barnard's Mineral Well.
B. B. Springs.
Belcher's Artesian Well.
Blankinship Medical Springs.
Blue Lick Springs.
Boon's Lick Springs.
Clinton Artesian White Sulphur Well.
Denver Mineral Spring.
Eldorado Springs.
Electric Springs.
Elk Lick Springs.
Excelsior Springs.
Fairhaven Springs.
Forest Springs.
Fountain of Youth.
Glasgow Mineral Springs.
Greene Springs.
Greenwood Springs.
Harris Springs.
Haupt's Mineral Well.
Indian Springs.
Jamesport Mineral Springs.
Jericho Springs.
Landreth's Mineral Well.
Lebanon Springs.
Lineville Mineral Spring.
McAllester Springs.
Mineola Springs.
Monegaw Springs.
Montesano Springs.
Mooresville Mineral Spring.
Panacea Springs.
Paris Springs.
Randolph Springs.
Reed Springs.
Rogers's Springs.
Siloam Springs.
Spaulding Springs.
Vichy Springs.
Windsor Medical Spring.
Young's Medicinal Well.

MONTANA.

Alhambra Springs.
Allan's Mineral Springs.
Boulder Hot Springs.
Ferris Hot Springs.
Helena Hot Springs.
Hunter's Hot Springs.
Lou Lou Hot Springs.
Mill Creek Apollinaris Spring.
Pipestone Springs.
Puller's Springs.
Ryan's Hot Springs.
Warm Springs, Deer Lodge Valley.
White Sulphur Springs.

NEVADA.

Elko Hot Springs.
Steamboat Springs.

NEW HAMPSHIRE.

Amherst Soda Springs.
Birchdale Springs.
Bradford Mineral Spring.
Ponemah Springs.
Unity Springs.
Yacum Springs.

NEW JERSEY.

Schooleys Mountain Spring.
Spa Spring.
Warnoch Spring.

NEW MEXICO.

Aztec Spring.
Baca Springs.
Coyote Soda Spring.
Hudson Hot Spring.
Jamez Hot Springs.
Las Vegas Springs.
Ojo Caliente Springs.

NEW YORK.

Adirondack Mineral Springs.
Avon Sulphur Springs.
Ballston Spa Springs.
Cairo White Sulphur Springs.
Chappaqua Mineral Springs.
Chittenango White Sulphur Springs.
Clifton Springs.
Colonial Mineral Springs.
Columbia Springs.
Crystal Springs.
Dansville Springs.
Darien Mineral Spring.
Deep Rock Springs.
Doxtatter's Mineral Well.
Dryden Springs.
Excelsior and Chlorine Springs, Syracuse.
Florida Springs.
Franklin Springs.
Geneva Mineral Springs.
Lebanon Thermal Spring.
Massena Springs.
Nunda Mineral Springs.
Oak Orchard Acid Springs.
Oneita Springs.
Reed Springs.
Richfield Springs.
Saratoga Springs.
Sharon Springs.
Slaterville Magnetic Springs.
Verona Mineral Springs.
Victor Sulphur Springs.

NORTH CAROLINA.

Barium Springs.
Black Mountain Iron and Alum Spring.
Blackwell's White Sulphur Spring.
Cherokee Springs.
Cleveland Spring.
Creswell's White Sulphur Spring.
Ellerbe Springs.
Haywood White Sulphur Spring.
Jackson Springs.
Lemon Springs.
Lincoln Lithia Springs.
Millenheimer's Sulphur Springs.
Minnekahta Springs.
Mount Vernon Mineral Spring.
Panacca Springs.
Park's Alkaline Springs.
Piedmont Spring.
Seven Springs.
Shaw's Healing Springs.
Thompson's Bromine Arsenic Springs.

OHIO.

Adams County Mineral Spring.
Bellbrook Magnetic Spring.
Cedar Springs.
Crystal Mineral Spring.
Crystal Rock and Mustcash Springs.
Electro-magnetic Springs.
Greene Mineral Spring.
Howland Springs.
Kinseley's Springs.
Lenape Spring.
Marquis Mineral Spring.
Oak Ridge Spring.
Ohio Magnetic Springs.
Rex Mineral Water.
Stryker Mineral Well.
Sulphur Lick Springs.
Sulphur Spa.
Williamsport Sulphur Spring.
Yellow Springs.

OREGON.

Belknap Hot Springs.
Foley Springs.
Lehman's Springs.
McAlister's Soda Springs.
Siskiyou Soda Springs.
Snowden Mineral Spring.
Sodaville Spring.
Wilhoit Spring.

PENNSYLVANIA.

Allegheny Spring.
Bedford Springs.
Black Barren Mineral Spring.
Blossburg Springs.
Carlisle White Sulphur Spring.
Cloverdale Lithia Spring.
Corry Artesian Fountain.
Cresson Springs.
Doubling Gap Springs.
Euphrata Spring.
Eureka Mineral Springs.
Frankfort Springs.
Gettysburg Spring.
Gray Spring.
Kingsland Spring.
Magnesia Fountains, Cambridgeboro.
Minnequa Springs.
Parker's Magnetic Mineral Spring.
Pavilion Spring.
Perry County Warm Spring.
Pulaski Mineral Spring.
Rosscommon Spring.
Saltillo Springs.
Sizerville Magnetic Spring.
Susquehanna Spring.
Wildwood Springs.
Yellow Springs.
York Sulphur Springs.

RHODE ISLAND.

Darling's Mineral Spring.
Gladstone Spring.

SOUTH CAROLINA.

Ambler's Mineral Spring.
Charleston Artesian Well.
Cherokee Springs.
Clucks Springs.
Glen Springs.
New Springs, near Spartanburg.
Reedy Creek Springs.
West Springs.

SOUTH DAKOTA.

Dakota Hot Springs.
Wessington Springs.

TENNESSEE.

Allegheny Springs.
Austin Springs.
Beersheba Springs.
Black Sulphur Springs.
Bon Aqua Springs.
Cascade Springs.
Castalian Springs.
Clarkstown Springs.
Dandridge Springs.
Draper Springs.
Epperson Springs.
Estill Springs.
Fernvale Springs.
Galbraith Springs.
Graham's Springs.
Glovers Springs.
Hager Springs.
Hinson Springs.
Howard Springs.
Idaho Springs.
Jordan's Springs.
Kleppert's Springs.
Lea's Spring.
Melrose Spring.
Mineral Hill Springs.
Montegle Springs.
Montvale Springs.
Nashville Sulphur Springs.
Oliver's Springs.
Park's Sulphur Springs.
Patterson's Springs.
Pettigrew Springs.
Pickwick Springs.
Price's Springs.
Primm's Springs.
Red Boiling Springs.
Rhea Springs.
Shady Springs.
South Saratoga Springs.
Tate's Epsom Spring.
White Cliff Springs.
White Creek Spring.
White Sulphur Spring.

TEXAS.

Bell Mineral Well.
Boston Chalyneate Spring.
Burdett's Sour Wells.
Capps' Mineral Wells.
Dalby Springs.
Duffau's Well.
Elkhart Mineral Wells.
Georgetown Mineral Well.
Glenmore Sulphur Springs.
Hancock Springs.
Hughes' Springs.
Hynson's Iron Mountain Springs.
Mineola Mineral Wells.
Mineral Wells of Palo Pinto.
Page's Well.
Richard's Wells.
Rockdale Mineral Wells.
Roxboro Springs.
Saratoga Springs.
Slack Mineral Well.
Sulphur Springs.
Sutherland Springs.
Sour Lake Mineral Springs.
Sour Springs, Caldwell county.
Texas Sour Springs.
Thorps' Springs.
Tioga Mineral Well.
Winnsboro Chalybeate Springs.
Wisner's Springs.
Wooten Wells.

UTAH.

Castilla Springs.
Salt Lake City Warm Springs.
Utah Hot Springs.

VERMONT.

Alburg Sulphur and Lithia Springs.
Brunswick White Sulphur Springs.
Clarendon Springs.
Equinox Spring.
Guilford Springs.
Highgate Springs.
Lunenburg Springs.
Middletown Mineral Spring.
Montebello Springs.
Plainfield Spring.
Sheldon Spring.
Walcot Springs.
Welden Spring.

VIRGINIA.

Alleghany Springs.
Bath Alum Springs.
Bear Lithia Springs.
Blue Ridge Springs.
Buckingham White Sulphur Springs.
Buffalo Lithia Springs.
Cedar Bluff Springs.
Chase City Mineral Spring.
Chilhowie Sulphur Springs.
Clifton Springs.
Cold Sulphur Springs.
Coyners Sulphur Springs.
Eggleston Springs.
Elk Lithia Springs.
Farmville Lithia Springs.
Grayson Sulphur Springs.
Harris Antidyspeptic and Tonic Spring.
Healing Springs.
Hot Springs.
Huguenot Springs.
Hunter's Pulaski Alum Springs.
Jordan Alum Springs.
Jordan White Sulphur Springs.
Kimberling Springs.
Massanetta Springs.
Millboro Springs.
Montgomery Springs.
Nye Lithia Springs.
Orkney Springs.
Otterburn Lithia and Magnesia Springs.
Paeonian Springs.
Powhatan Lithia Springs.
Rawley Springs.
Roanoke Red Sulphur Springs.
Rock Enon Springs.
Rockbridge Alum Springs.
Rockbridge Baths.
Rockingham Virginia Springs.
Sharon Springs.
Shenandoah Alum Springs.
Stafford Springs.
Steep Hill Springs.
Stribling Springs.
Sweet Chalybeate Springs.
Valley View Springs.
Virginia Arsenic, Bromine, and Lithia Springs.
Washington Springs
Yellow Springs.

WASHINGTON.

Cascade Springs.
Medical Lake.
Yakima Soda Springs.

WEST VIRGINIA.

Berkeley Springs.
Blue Sulphur Springs.
Capon Springs.
Columbia Sulphur Springs.
Floding Springs.
Greenbrier White Sulphur Springs.
Hart Mineral Well.
Parkersburg Mineral Well.
Red Sulphur Springs.
Salt Sulphur Springs.
Shannondale Springs.
Sweet Springs.

WISCONSIN.

Allouez Magnetic Springs.
Almanaris Springs.
Arctic Springs.
Ashland Mineral Springs.
Black Earth Mineral Spring.
Gihon Springs.
Green Bay Mineral Springs.
Iodo-Magnesian Springs.
Jacob's Artesian Well.
New Saratoga Springs.
Palmyra Great Geyser Spring.
St Croix Mineral Spring.
Shealtiel Mineral Springs.
Sheboygan Mineral Spring.
Sheridan Springs.
Sparta Mineral Wells.
Vita Mineral Spring.
Waukesha Mineral Springs.

Summary of Mineral-Spring Resorts.

States.	Number of resorts.	States.	Number of resorts.
California	64	Maine	11
Virginia	48	Mississippi	11
Missouri	43	Iowa	8
Tennessee	43	Massachusetts	8
New York	31	Oregon	8
Texas	30	South Carolina	8
Arkansas	29	Idaho	7
Michigan	29	Kansas	7
Pennsylvania	28	Louisiana	7
Indiana	26	Maryland	7
North Carolina	20	New Mexico	7
Colorado	19	New Hampshire	6
Ohio	19	New Jersey	3
Wisconsin	18	Utah	3
Georgia	16	Washington	3
Illinois	16	Arizona	2
Alabama	14	Connecticut	2
Florida	14	Nevada	2
Kentucky	14	Rhode Island	2
Montana	13	South Dakota	2
Vermont	13	Minnesota	1
West Virginia	12		
		Total	674

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