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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR
1888

DAVID T. DAY
CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1890

CONTENTS.

LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF MINING STATISTICS AND TECHNOLOGY,
Washington, D. C., March 29, 1890.

SIR: I have the honor to transmit herewith the sixth volume of the series "Mineral Resources of the United States." The present volume contains a summary statement of the mineral substances produced in the calendar year 1888, and chapters showing the features of the principal mining industries during that period. A similar volume for the calendar year 1889 will be prepared in cooperation with the Eleventh Census.

During the progress of this work I have frequently sought your counsel, which has always been cheerfully given, and I beg to tender you my grateful acknowledgments for the uniform kindness and consideration which you have shown me and for your untiring interest in the work.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

HON. J. W. POWELL,
Director U. S. Geological Survey.

INTRODUCTION.

This report is the sixth volume of the series "Mineral Resources of the United States." The object of the series is to record annually the most important facts concerning the development of the minerals found in the United States. In this report the method of treatment in previous volumes has been continued. The report opens with a summary statement as to the condition of each mineral industry at the close of the period under review—the calendar year 1888. There is no attempt in this place to show the products of separate sections of the country. The division is entirely according to the minerals themselves. At the close of this summary is a table in which the values of the various products are added so as to furnish an estimate of the relative importance of the mining industry as a whole. Following the summary each important mineral industry is discussed in a separate chapter. The statistical tables given in former reports have been extended to include 1888, but otherwise the material in each chapter is intended to show the developments in 1888 and not in previous years. It is expected that the reader will consult the corresponding chapters of the six reports which constitute the series. For this purpose an index to the six volumes is in preparation.

The methods used in collecting the information presented in the following pages, and explanations of the units employed, etc., have been given in connection with previous volumes. As usual, the names of the contributors of the several chapters are given in connection with the subjects treated.

Delay in publication.—The date of publication of a volume including so many diverse topics can never be predicted, but the comparatively late date at which this report appears was anticipated by publishing the principal totals as soon as they were determined.

MINERAL RESOURCES OF THE UNITED STATES.

CALENDAR YEAR 1888.

DAVID T. DAY,
Chief of Division of Mining Statistics and Technology.

SUMMARY, 1888.

METALS.

Iron and steel.—The principal statistics for 1888 were: Domestic iron ore consumed, about 12,060,000 long tons; value at mines, $28,944,000. This is an increase over 1887 in quantity of 760,000 tons, but a decrease in value of $4,956,000. Imported iron ore consumed, 587,470 long tons; total iron ore consumed in 1888, about 12,650,000 long tons, or 150,000 tons more than in 1887. Pig iron made in 1888, 6,489,738 long tons; value at furnace, $107,000,000. This is an increase over 1887 of 72,590 tons in quantity, but a decrease of $14,925,800 in value. Steel of all kinds produced in 1888, 2,899,440 long tons; value at works, $89,000,000. This is a decrease from 1887 of 439,631 tons in quantity and of $14,811,000 in value. Total spot value of all iron and steel made in 1888, in the first stage of manufacture, excluding all duplications, $145,000,000, a decrease of $26,103,000 as compared with 1887. Limestone used as a flux in the manufacture of pig iron in 1888, about 5,438,000 long tons; value at quarry, about $2,719,000.

Gold and silver.—According to the Director of the Mint, the gold product was 1,604,927 fine ounces, valued at $33,175,000. This is about the same as in 1887, being an excess of only $75,000. The silver product was 45,783,632 fine ounces, of the commercial value of about $43,000,000 and of the coining value of $59,195,000. This is an increase of 4,514,392 ounces over the product in 1887. In addition to the product of our own mines some 10,000,000 ounces of silver were extracted in the United States from foreign ores and bullion.

Copper.—The total product, including the yield of imported ores, increased to 231,270,622 pounds, or 115,635 short tons, during 1888, which is 46,600,098 pounds more than the product of 1887. During the first quarter of 1889 the production was increasing at even a more rapid rate. The prices received by American producers averaged 15½ cents per pound for Lake copper, 14½ for Arizona, and 14 for other districts; making the total value $33,833,954. Montana led in the production, making 97,897,968 pounds. Consumption was somewhat reduced by the high prices.

Lead.—The product increased to 180,555 short tons from 160,700 tons in 1887. The increase was due principally to the heavier receipts of lead in Mexican silver-lead ores from 15,000 tons in 1887 to over 27,000 tons in 1888. The average price in New York was 4.41 cents per pound, making the total value $15,921,951. The production of white lead, chiefly from pig lead, was 84,000 short tons, valued at $10,680,000.

Zinc.—The erection of new works and the extension of old ones led to a further notable increase in the production of zinc in 1888. The additions to capacity were fairly uniformly distributed in the West, East, and South. Production in 1888, 55,903 short tons, with a total value of $5,500,855; in 1887, 50,340 tons, worth $4,782,300. The production of zinc white in 1888, directly from ores, was 20,000 short tons, worth $1,600,000.

Quicksilver.—The product was 33,250 flasks (of 76½ pounds each) from California, a decline in that State of 575 flasks from 1887, in spite of a very satisfactory price, which averaged $42.50 per flask, making the total value $1,413,125. No new valuable deposits were discovered in 1888, and without them it is not probable that the yield of quicksilver will increase. In 1889 the decline was much more significant. The entire product was only 26,278 flasks.

Nickel.—The industry remains unchanged except for indications of further developments at Lovelock's, Nevada, and Riddles, Oregon. The product includes 190,637 pounds of metallic nickel, valued at $114,382 at 60 cents per pound, and 13,691 pounds, worth $13,250, contained in ores and nickel salts. Total value, $127,632. The corresponding value in 1887 was $133,200.

Cobalt oxide.—The total product, including the contents of exported ores and matte, was 8,491 pounds, worth $15,782. In 1887 the total was 18,340 pounds, worth $18,774, the lower rate of value in that year resulting from a larger proportion of exported nickel in matte and ore. The price of cobalt oxide remained at $2 per pound.

Chromium.—The product of chrome iron ore declined from 3,000 tons in 1887 to 1,500 tons in 1888. The average price in San Francisco remained $15 per ton. Increased operations are probable in 1889.

Manganese.—The product of manganese and manganiferous iron ores in the United States in 1888 was 231,330 tons, valued at $854,416. Of this amount some 29,198 tons would be classed as manganese ores; the remainder as manganiferous iron ores. Of the manganiferous iron ores 11,462 tons, averaging 11 per cent. of manganese, and 189,574 tons, averaging 4 per cent. of manganese, were from the Colby mine, Michigan. In addition to the above, some 60,000 tons of argentiferous manganese ores, valued at $10 a ton, chiefly for the silver contained in them, were produced in the Rocky Mountain region.

Aluminum.—The past year was more promising than ever before for the production of cheap aluminum. The production of metallic aluminum as an industry distinct from the production of alloys began toward the close of the year, and 500 pounds had been made up to December 31; the product of 3,000 pounds since then indicates that the industry may continue. The exact amount of alloys produced by the Cowles process has not been furnished, but was not markedly different from the product of 1887, when 18,000 pounds of aluminum contained in bronze and ferro-aluminum were produced. The price for metallic aluminum declined to $4.50 per pound for less favored brands. In 1889 it was sold in ingots for $2 per pound.

Platinum.—Including the platinum and iridium separated from gold by the assay offices and that saved in placer gold mining, the product was about 500 ounces, valued at $2,000.

FUELS.

Coal.—The total product of all kinds of commercial coal in 1888 was 142,037,735 short tons (increase over 1887, 18,022,480 short tons), valued at the mines at $204,222,790 (increase, $30,626,794). This may be divided into Pennsylvania anthracite 43,922,897 short tons (increase, 4,416,642 short tons), or 39,216,872 long tons, including 38,145,718 long tons shipped by the railroads and canals and reported by their statistician, Mr. John H. Jones, and 1,071,155 long tons sold to the local trade at the mines (increase, 3,943,431 long tons), valued at $85,649,649 (increase, $6,284,405); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 4,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 98,114,838 short tons (increase, 13,605,838 short tons), valued at $118,573,141 (increase, $24,342,389).

The colliery consumption at the individual mines varies from nothing to 8 per cent. of the total output of the mines, being greatest at special Pennsylvania anthracite mines and lowest at those bituminous mines where the coal bed lies nearly horizontal, and where no steam power or ventilating furnaces are used. The averages for the different States vary from 2 to 6.4 per cent., the minimum average being in the Pennsylvania bituminous and the maximum average in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was: Pennsylvania anthracite 41,624,611 long tons (increase over 1887, 4,045,864 long tons), or 46,619,564 short tons (increase, 4,531,367 short tons); all other coals, 102,039,838 short tons (increase, 14,152,478 short tons), making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 148,659,402 short tons (increase, 18,683,845 short tons), valued as follows: anthracite, $89,020,483 (increase, $4,468,302); bituminous, $122,498,141 (increase, $24,493,485); total value, $211,518,624 (increase, $28,961,787). The above figures show a notable increase in 1888 over 1887 in the aggregate output and value of both anthracite and bituminous coal, although not so great an increase as occurred in 1887 over 1886 in the value of the anthracite, or in the total tonnage of the bituminous coal.

Coke.—The product of coke in the United States in 1888 was 8,540,030 short tons, valued at about $12,445,963. Pennsylvania produced by far the largest amount, the Connellsville region alone producing 4,955,553 tons; West Virginia, 531,762 tons; Alabama, 508,511 tons; Tennessee, 385,693 tons, and Virginia, 149,199 tons.

Petroleum.—The product of petroleum in the United States in 1888 was 27,615,929 barrels (of 42 gallons each), valued at about $17,950,353. Of this amount Pennsylvania produced 16,484,668 barrels; Ohio, 10,010,868 barrels; West Virginia, 119,448 barrels; California, 704,619 barrels; and other States 20,000 barrels.

Natural gas.—The amount of natural gas consumed is given in coal displacement; that is, the amount of coal displaced by the use of natural gas. It is estimated that the amount of coal displaced by natural gas in the United States in 1888 was 14,063,830 tons, valued at $22,629,875. Of this amount 12,443,830 tons were displaced in Pennsylvania, 750,000 tons in Ohio, and 660,000 tons in Indiana.

STRUCTURAL MATERIALS.

Building stone.—Direct returns from producers of the various kinds of building stone show that there was but a small gain in value over the figures of 1887. The value of the stone produced in 1888 was $25,500,000, or $500,000 more than in the preceding year.

Brick and tile.—Value, $48,213,000. This figure represents only a small gain over 1887. This is due rather to increase in the number of manufacturing plants than to increased production at the older and more important sources of supply; in fact, many of the latter show a falling off in production. Prices also were generally somewhat lower than in 1887.

Lime.—The product is estimated at 49,087,000 barrels, with an average value of 50 cents per barrel, making a total of $24,543,500 as the value of the year's product. These figures are not largely in advance of those for 1887, and the gains are not so much the results of increased production in the leading lime regions as in localities of minor importance.

Cement.—The amount of cement produced in 1888 was less than for 1887, being 6,253,295 barrels for 1888, valued at 72½ cents per barrel, making $4,533,639 as the value of the year's product.

ABRASIVE MATERIALS.

Buhrstones.—The product which is used for grinding cement, plaster, paints, feed, etc., comes from New York, Pennsylvania, and North Carolina, and is valued at $81,000.

Grindstones.—Ohio and Michigan furnish practically all the sandstone from which grindstones are made. The product in 1888 increased slightly, 41,000 long tons, worth $281,800, being produced, against 40,000 long tons worth $240,000, in 1887. The price varied from $6.50 to $10 per ton at the quarries, before being finished into grindstones.

Corundum.—Production was limited to the old mines in North Carolina and Georgia; 589 short tons, valued at $91,620, were produced in 1888, against 600 tons in 1887.

Oilstones and whetstones.—The production of novaculite from Arkansas increased slightly, making the total, including Labrador oilstone, etc., 1,500,000 pounds, valued at $18,000 in the rough state.

MISCELLANEOUS.

Precious stones.—No systematic mining was carried on in search of gems in 1888. But in mining for other substances, and in chance discoveries, gems worth $64,850 in the rough state, and gold-quartz worth $75,000, were found.

Phosphate rock.—The production declined to 448,567 long tons, but the total value increased slightly to $2,018,552 on account of better prices. The trade in manufactured fertilizers was very prosperous.

Marls.—The production in the Southern States, particularly in Virginia, North Carolina, Alabama, Mississippi, and Florida, is increasing, while the production of New Jersey decreased from 1887. About 300,000 tons, valued at $150,000, were produced.

Salt.—The industry shows only slight changes: In 1888 the production was 8,055,881 barrels of 280 pounds, valued at $4,374,203. In 1887 the product was 8,003,962 barrels, worth $4,093,846. Kansas became a commercial source of salt in 1888, producing 155,000 barrels, with a prospect of still greater increase in 1889.

Bromine.—The product was 307,386 pounds, worth $95,290, an increase from 199,087 pounds in 1887, worth $61,717. The price remained at 31 cents per pound.

Borax.—The production was restricted to 7,589,000 pounds, worth $455,340, at 6 cents per pound for the average quality. In 1887 the product was 11,000,000 pounds, worth 5 cents per pound.

Sulphur.—The sulphur refinery in Utah was partially burned. This and litigation over the property prevented any production in 1888. The supply came principally from Sicily, with small importations from Japan. It was practically all made into sulphuric acid.

Pyrites.—Product, 54,331 long tons, valued at the mines at $167,658; a slight increase in quantity over the previous year.

Barytes.—The production from Missouri, Virginia, and New York increased to 20,000 long tons, worth at the mines $110,000. In 1887 the product was 15,000 long tons, worth $75,000.

Gypsum.—The domestic supply comes principally from Ohio and Michigan, with smaller amounts from New York, Virginia, Kansas, Colorado, California, Dakota, and Utah. The product in 1888 was 110,000 short tons of crude gypsum, valued at $550,000. A large portion of the supply is imported from Nova Scotia, where 126,118 tons, worth $121,579, were produced in 1888.

Ozokerite.—From the region of Soldier's Summit, Utah, about 65,000 pounds of crude mineral wax were produced, worth $3,000 in New York, where the material was sold. An increase is probable in 1889.

Soapstone.—Product about 15,000 tons, worth $50,000 before shipment.

Asphaltum.—The product of 1888 includes 700 tons of gilsonite mined in Utah; 3,100 tons of ordinary asphaltum, principally from California, and 50,000 tons of bituminous rock quarried in California for pavements in competition with asphaltum; total value, $331,500.

Feldspar.—The consumption for potters' use declined to 8,700 long tons, worth, in Trenton, N. J., $50,000. In 1887, 10,200 long tons were produced, worth $56,100.

Flint.—For potters' use the consumption was 16,250 long tons. Including that for sand-paper and for glass, the consumption was about 30,000 tons, worth, unground, $175,000.

Potters' clay.—The consumption included 18,000 long tons of kaolin, or china clay, 5,250 tons of ball clay, and 13,500 tons of fire clay, worth, altogether, $300,000.

Mica.—Owing principally to the use of smaller sizes in stoves, the production of sheet mica decreased from 70,500 pounds in 1887 to 48,000 in 1888, valued at $70,000. There is increased demand for mica waste.

Mineral paints.—The production, including ocher, metallic paints, and small amounts of umber and sienna, increased to 24,000 long tons, valued at $380,000.

Graphite.—The production of pure graphite was limited to Ticonderoga, New York, and is reported as practically unchanged. The total product of pure material was 400,000 pounds, worth $33,000. Small amounts of less pure material for foundry facings, etc., were produced in North Carolina, and at Cranston, R. I.

Fluorspar.—The production, limited to the neighborhood of Rosiclare, Illinois, and Evansville, Indiana, is reported at 6,000 short tons, worth $30,000, an increase of 1,000 tons over 1887.

Infusorial earth.—The product came principally from Maryland, and amounted to 1,500 short tons, worth, before shipment, $7,500.

Zircon.—During 1887 and 1888, 25 tons of zircon were mined, principally in Henderson county, North Carolina, and sold for $10,000 for the manufacture of incandescent gas-burners. About 4 tons of monazite, one ton of allanite, 600 pounds of samarskite, and $500 worth of yttrium minerals were produced for the same use. About 6 tons of monazite and 5 tons of cerite were also imported.

Mineral waters.—Amount sold in 1888, 9,628,568 gallons, valued at $1,709,302. In 1887 the product was 8,259,609 gallons, worth $1,261,-473.

Totals.—The total value of the minerals produced in 1888 was $584,-550,676. It is recognized that this is the sum of the values of substances taken in various stages of manufacture and hence not strictly comparable with each other; still it is the most valuable means for comparing the total products of different years. The result is an increase of over $40,000,000 beyond the value of the product of 1887. In that year nearly every mineral industry showed an increase, and hence an increased total was evident. But the fact that the increase was so very large was due to rather exceptional conditions in a few important industries, and it could not reasonably be expected that a similar combination of circumstances would result in even a larger total value for 1888. Nevertheless the unprecedented stimulus given to the production of copper by an artificial price increased the total value of that product nearly $13,000,000, or nearly enough to offset the decline in the total value of pig iron. The other important factors in the increase were coal and the other fuels which followed the increased quantity of metals. With the anticipated decline of copper to the normal demand, a decline in the total value of the product in 1889 will not be inconsistent with the natural development of our mineral resources.

Metallic products of the United States in 1888.

	Quantity.	Value.
Pig iron, spot value ....long tons..	6, 489, 738	$107, 000, 000
Silver, coining value ....troy ounces..	45, 783, 632	59, 195, 000
Copper, value at New York City ....pounds..	231, 270, 622	33, 833, 954
Gold, coining value..........troy ounces..	1, 604, 927	33, 175, 000
Lead, value at New York City..........short tons..	180, 555	15, 924, 951
Zinc, value at New York City ....do....	55, 903	5, 500, 855
Quicksilver, value at San Francisco..........flasks..	33, 250	1, 413, 125
Nickel, value at Philadelphia..........pounds..	203, 328	127, 632
Aluminum, value at Philadelphia ....do....	19, 000	65, 000
Antimony, value at San Francisco..........short tons..	100	20, 000
Platinum, value (crude) at New York City ...troy ounces..	500	2, 000
Total	....	$256, 257, 517

Non-metallic mineral products of the United States in 1888 (spot values).

	Quantity.	Value.
Bituminous coal ....long tons..	91, 106, 998	$122, 498, 141
Pennsylvania anthracite ....do....	41, 624, 611	89, 020, 483
Building stone	....	25, 500, 000
Lime ....barrels..	49, 087, 000	24, 543, 500
Natural gas	....	22, 629, 875
Petroleum ....barrels..	27, 615, 929	17, 950, 353
Cement ....do....	6, 253, 295	4, 533, 639
Salt ....do....	8, 055, 881	4, 374, 203
Limestone for iron flux ....long tons..	5, 438, 000	2, 719, 000
South Carolina phosphate rock ....do....	448, 567	2, 018, 552
Mineral waters ....gallons sold..	9, 628, 568	1, 709, 302
Zinc white ....short tons..	20, 000	1, 600, 000
Gypsum ....do....	110, 000	550, 000
Borax ....pounds..	7, 589, 000	455, 340
Mineral paints ....long tons..	24, 000	380, 000
Asphaltum ....short tons..	53, 800	331, 500
Manganese ore ....long tons..	29, 198	279, 571
Flint ....do	30, 000	175, 000
Pyrites ....do ..	54, 331	167, 658
New Jersey marls ....short tons..	300, 000	150, 000
Crude barytes ....long tons..	20, 000	110, 000
Bromine ....pounds..	307, 386	95, 290
Corundum ....short tons..	589	91, 620
Gold-quartz, souvenirs, jewelry, etc	....	75, 000
Mica ....pounds..	48, 000	70, 000
Precious stones	....	64, 850
Feldspar ....long tons..	8, 700	50, 000
Graphite ....pounds..	400, 000	33, 000
Fluorspar ....short tons..	6, 000	30, 000
Slate ground as pigment ....long tons..	2, 500	25, 000
Chrome iron ore ....do....	1, 500	22, 500
Novaculite ....pounds..	1, 500, 000	18, 000
Cobalt oxide ....do....	8, 491	15, 782
Rutile ....do	1, 000	3, 000
Asbestus ....short tons..	100	3, 000
Total	....	$322, 293, 159

Résumé of the values of the metallic and non-metallic mineral substances produced in the United States in 1888.

Metals	$256, 257, 517
Mineral substances named in the foregoing table	322, 293, 159
Estimated value of mineral products unspecified	6, 000, 000
Grand total	$584, 550, 676

Summary of the mineral products of the United

	Products.	1882.		1883.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig-iron, spot value.................long tons..	4, 623, 323	$106, 336, 429	4, 595, 510	$91, 910, 200
2	Silver, coining value..............troy ounces..	36, 197, 695	46, 800, 000	35, 733, 622	46, 200, 000
3	Gold, coining value ....do....	1, 572, 186	32, 500, 000	1, 451, 249	30, 000, 000
4	Copper, value at New York City....pounds..	91, 646, 232	16, 038, 091	117, 151, 795	18, 064, 807
5	Lead, value at New York City... short tons..	132, 890	12, 624, 550	143, 957	12, 322, 719
6	Zinc, value at New York City ....do ...	33, 765	3, 646, 620	36, 872	3, 311, 106
7	Quicksilver, value at San Francisco..flasks..	52, 732	1, 487, 042	46, 725	1, 253, 632
8	Nickel, value at Philadelphia........pounds..	281, 616	309, 777	58, 800	52, 920
9	Aluminum, value at Philadelphia. troy ounces.	....	....	1, 000	875
10	Antimony, value at San Francisco. short tons.	60	12, 000	60	12, 000
11	Platinum, value (crude) at New York City, troy ounces................................	200	600	200	600
	Total value metallic products	....	219, 755, 109	....	203, 128, 859
	NON-METALLIC (SPOT VALUES).				
12	Bituminous coal ....long tons..	60, 861, 190	76, 076, 487	68, 531, 500	82, 237, 800
13	Pennsylvania anthracite................do....	31, 358, 264	70, 556, 094	34, 336, 469	77, 257, 055
14	Building stone	....	21, 000, 000	....	20, 000, 000
15	Lime...............................barrels..	31, 000, 000	21, 700, 000	32, 000, 000	19, 200, 000
16	Petroleum .... do....	30, 053, 500	23, 704, 698	23, 400, 229	25, 740, 252
17	Natural gas	....	215, 000	....	475, 000
18	Cement ....barrels..	3, 250, 000	3, 672, 750	4, 190, 000	4, 293, 500
19	Salt......................................do....	6, 412, 373	4, 340, 140	6, 192, 231	4, 211, 042
20	Limestone for iron flux ....long tons..	3, 850, 000	2, 310, 000	3, 814, 273	1, 907, 136
21	South Carolina phosphate rock ....do....	332, 077	1, 992, 462	378, 380	2, 270, 280
22	Zinc white ....short tons..	10, 000	700, 000	12, 000	810, 000
23	Mineral waters ....gallons sold..	....	....	7, 529, 423	1, 119, 603
24	Borax .... pounds..	4, 236, 291	338, 903	6, 500, 000	585, 000
25	Gypsum ....short tons..	....	....	....	....
26	Manganese ore......................long tons..	3, 500	52, 500	8, 000	120, 000
27	Mineral paints.........................do ...	7, 000	105, 000	7, 000	84, 000
28	New Jersey marls..................short tons..	1, 080, 000	540, 000	972, 000	486, 000
29	Pyrites ....long tons..	12, 000	72, 000	25, 000	137, 500
30	Flint...do ...	25, 000	100, 000	25, 000	100, 000
31	Mica ....pounds..	100, 000	250, 000	114, 000	285, 000
32	Corundum ....short tons..	500	80, 000	550	100, 000
33	Sulphur......................................do....	600	21, 000	1, 000	27, 000
34	Precious stones................................	....	75, 000	....	74, 050
35	Gold-quartz souvenirs, jewelry, etc	....	75, 000	....	115, 000
36	Crude barytes.........................long tons..	20, 000	80, 000	27, 000	108, 000
37	Bromine ....pounds..	250, 000	75, 000	301, 100	72, 264
38	Feldspar..............................long tons..	14, 000	70, 000	14, 100	71, 112
39	Chrome iron ore..........................do ...	2, 500	50, 000	3, 000	60, 000
40	Graphite..............................pounds..	425, 000	34, 000	575, 000	46, 000
41	Fluorspar..........................short tons..	4, 000	20, 000	4, 000	20, 000
42	Slate ground as a pigment.........long tons..	2, 000	24, 000	2, 000	24, 000
43	Cobalt oxide ....pounds..	11, 653	32, 046	1, 096	2, 795
44	Novaculite...................................do ...	....	....	....	....
45	Asphaltum..........................short tons..	3, 000	10, 500	3, 000	10, 500
46	Asbestus ....do....	1, 200	36, 000	1, 000	30, 000
47	Rutile.....................................pounds..	500	1, 800	550	2, 000
	Total value non-metallic mineral products	....	228, 410, 380	....	242, 111, 889
	Total value metallic products..............	....	219, 755, 109	....	203, 128, 859
	Estimated value of mineral products unspecified................................	....	8, 000, 000	....	8, 000, 000
	Grand total	....	456, 165, 489	....	453, 240, 748

States, calendar years 1882 to 1887, inclusive.

1884.		1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,097,868	$73,761,624	4,044,525	$64,712,400	5,683,329	$95,195,760	6,417,148	$121,925,800	1
37,744,605	48,800,000	39,910,279	51,600,000	39,445,312	51,000,000	41,269,240	53,441,300	2
1,489,949	30,800,000	1,538,376	31,801,000	1,881,250	35,000,000	1,596,500	33,100,000	3
147,805,407	18,106,162	170,962,607	18,292,999	161,235,381	16,527,651	185,227,331	21,115,916	4
139,897	10,537,042	129,412	10,469,431	135,629	12,667,749	160,700	14,463,000	5
38,544	3,422,707	40,688	3,539,856	42,641	3,752,408	50,340	4,782,300	6
31,913	936,327	32,073	979,189	29,981	1,060,000	33,825	1,429,000	7
64,550	48,412	277,904	191,753	214,992	127,157	205,556	133,200	8
1,800	1,350	3,400	2,550	....	27,000	18,000	59,000	9
60	12,000	50	10,000	35	7,000	75	15,500	10
150	450	250	187	50	100	448	1,838	11
....	186,426,074	....	181,599,365	....	215,364,825	....	250,466,854	
73,730,539	77,417,066	64,810,668	82,347,648	65,810,676	78,481,056	78,470,857	98,004,656	12
33,175,756	66,351,512	34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	13
....	19,000,000	....	19,000,000	....	19,000,000	....	25,000,000	14
37,000,000	18,500,000	40,000,000	20,000,000	42,500,000	21,250,000	46,750,000	23,375,000	15
24,089,758	20,476,294	21,842,041	19,193,694	28,110,115	20,028,457	28,249,597	18,856,606	16
....	1,460,000	....	4,854,200	....	9,847,150	....	15,838,500	17
4,000,000	3,720,000	4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,186,877	18
6,514,937	4,197,734	7,038,653	4,825,345	7,707,081	4,736,585	8,003,962	4,093,846	19
3,401,930	1,709,965	3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	20
431,779	2,374,784	437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	21
13,000	910,000	15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	22
10,215,328	1,459,143	9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,473	23
7,000,000	490,000	8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	24
....	....	90,405	405,000	95,250	428,625	95,000	425,000	25
10,000	120,000	23,258	190,281	30,193	277,636	34,524	333,844	26
7,000	84,000	3,950	43,575	15,800	285,000	20,000	310,000	27
875,000	437,500	875,000	437,500	800,000	400,000	600,000	300,000	28
35,000	175,000	49,000	220,500	55,000	247,500	52,500	210,000	29
30,000	120,000	30,000	120,000	30,000	120,000	32,000	185,000	30
147,410	368,525	92,000	161,000	40,000	70,000	70,500	142,250	31
600	108,000	600	108,000	645	116,190	600	108,000	32
500	12,000	715	17,875	2,500	75,000	3,000	100,000	33
....	82,975	....	69,900	....	79,056	....	88,600	34
....	140,000	....	140,000	....	40,000	....	75,000	35
25,000	100,000	15,000	75,000	10,000	50,000	15,000	75,000	36
281,100	67,464	310,000	89,900	428,334	141,350	199,087	61,717	37
10,900	55,112	13,600	68,000	14,900	74,500	10,200	56,100	38
2,000	35,000	2,700	40,000	2,000	30,000	3,000	40,000	39
....	....	327,883	26,231	415,525	33,242	416,000	34,000	40
4,000	20,000	5,000	22,500	5,000	22,500	5,000	20,000	41
2,000	20,000	1,975	24,687	3,000	30,000	2,000	20,000	42
2,000	5,100	68,723	65,373	....	36,878	18,340	18,774	43
....	....	1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	44
3,000	10,500	3,000	10,500	3,500	14,000	4,000	16,000	45
1,000	30,000	300	9,000	200	6,000	150	4,500	46
600	2,000	600	2,000	600	2,000	1,000	3,000	47
....	220,059,674	....	240,114,544	....	243,963,063	....	285,864,942	
....	186,426,074	....	181,599,365	....	215,364,825	....	250,466,854	
....	7,000,000	....	7,000,000	....	6,000,000	....	6,000,000	
....	413,485,748	....	428,713,909	....	465,327,888	....	542,331,796	

IRON.

THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES IN 1888 AND 1889.

By James M. Swank,

General Manager of the American Iron and Steel Association.

Production, importation, and consumption of iron and steel in 1888.—The remarkable prosperity which characterized the iron and steel industries of this country in 1886 and 1887 was not continued in 1888; the year was one of only moderate prosperity for these industries as a whole, while in some branches there was all through the year an entire absence of prosperity. The aggregate production and consumption of iron and steel in 1888 was much less than in 1887, and prices were much lower.

In the following table is presented, in short tons, except in reference to nails, the statistics of the production of leading articles of iron and steel in the United States in the last three years.

Production of leading articles of iron and steel in the United States in the last three years.

Short tons, of 2,000 pounds. (Except nails.)	1886.	1887.	1888.
Pig iron, including spiegeleisen	6, 365, 328	7, 187, 206	7, 268, 507
Spiegeleisen	47, 982	47, 598	54, 769
Bessemer steel ingots	2, 541, 493	3, 288, 357	2, 812, 500
Bessemer steel rails	1, 763, 667	2, 354, 132	1, 552, 631
Open-hearth steel ingots	245, 250	360, 717	352, 036
Open-hearth steel rails	5, 255	19, 203	5, 261
Crucible steel ingots	80, 609	84, 421	78, 713
Rolled iron, except rails	2, 259, 943	2, 565, 438	2, 397, 402
Rolled steel, except rails	800, 000	902, 156	1, 201, 885
Iron rails	23, 679	23, 062	14, 252
Pig, scrap, and ore blooms	41, 909	43, 306	39, 875
Kegs of iron-cut nails (100 pounds)	5, 191, 984	3, 419, 578	2, 170, 107
Kegs of steel-cut nails (100 pounds)	2, 968, 989	3, 489, 292	4, 323, 484
Kegs of steel-wire nails (100 pounds)	600, 000	1, 250, 000	1, 500, 000

This table shows a slight increase in the production of pig iron in 1888 as compared with 1887, but a marked decrease in the production of Bessemer steel, and a still larger decrease in the production of steel rails; other leading products also show a decrease. The decrease in the production of Bessemer steel rails is very remarkable. It is explained chiefly by the great shrinkage in the construction of new railroads in 1888, the mileage of new railroads built in that year being about 7,100 miles, against 13,080 miles in 1887. This influence affected unfavorably in 1888 nearly every other branch of our iron and steel industries.

The rapid substitution in this country of steel for iron is forcibly shown in the table. Iron rails have almost entirely given way to steel rails; rolled steel for other purposes than rails is seen to be a serious and growing competitor of rolled iron; steel cut nails are rapidly taking the place of iron cut nails; and steel wire nails are fast growing in popularity as a rival of all cut nails.

Our imports of all iron and steel products, the weight of which is ascertained at the custom houses, have been as follows in the last three calendar years, in short tons: 1886, 1,230,393 tons; 1887, 1,997,247 tons; 1888, 1,024,524 tons. The leading articles imported in 1888 were as follows, in short tons: Pig iron, 220,905 tons; steel rails, 70,578 tons; steel ingots, blooms, billets, bars, etc., 116,129 tons; tin-plates, 333,616, tons; and iron and steel wire rods, 114,030 tons. The imports of pig iron in 1888 include 80,198 short tons of spiegeleisen and ferro-manganese, for use in our Bessemer and open-hearth steel works. Tin-plates constituted almost one-third of our total importations in 1888. Our imports of this necessity of our American civilization are steadily increasing from year to year.

It will be noticed that our aggregate imports of iron and steel declined almost 50 per cent. in 1888 as compared with 1887. This great shrinkage was due to the lower prices of iron and steel which prevailed in this country in 1888 as compared with 1887, and to the higher prices which prevailed in Europe, the condition of the European iron trade having greatly improved in 1888. This improvement still continues, so that, with continued low prices in our own country even for a few months longer, our imports of iron and steel in 1889 are likely to be even less than in 1888.

The foreign value of our imports of iron and steel, including machinery, cutlery, fire-arms, and other manufactures, the weight of which is not obtainable, was $42,308,256 in 1888, $56,420,607 in 1887, and $41,630,779 in 1886. The foreign value of our imports of tin-plates in 1888 was $19,752,180.

The consumption of iron and steel in any given year may be approximately ascertained by adding the quantity manufactured at home to the quantity imported, our exports of iron and steel, except in the form of machinery, being inconsiderable. As our production of all leading articles, pig iron, rolled steel, and steel nails excepted, was much less in 1888 than in 1887, and as our imports of iron and steel were very much less, it follows that our consumption of iron and steel in 1888 was below that of 1887. This was true even of pig iron, as the shrinkage in our imports of this article in 1888 was much greater than the excess of our production in 1888 over 1887. The shrinkage in our consumption of iron and steel in 1888 as compared with 1887 is most noticeable, however, in the figures relating to steel rails. The following table shows approximately, in long tons, our consumption of both foreign and domestic Bessemer steel rails in these two years.

Consumption of Bessemer steel rails in the United States in 1887 *and* 1888.

	1887.	1888.
	Long tons.	*Long tons.*
Production	2,101,904	1,386,278
Importation	137,588	63,016
Approximate consumption	2,239,492	1,449,294

The consumption of iron and steel has been carefully calculated as amounting to about 300 pounds per capita in 1887, and to about 285 pounds per capita in 1888, the average population of the country in 1887 being placed at 60,000,000, and in 1888 at 62,000,000.

Production of iron and steel by States and Territories.—Twenty-three States and one Territory made pig iron in 1888; eleven States made Bessemer and nine States made open-hearth steel; eleven States made steel rails; twenty-five States and one Territory produced rolled iron and nineteen States produced rolled steel, and twelve States made cut nails. In the following table is given the production of these leading iron and steel products by States and Territories in 1888, in short tons.

Production of leading articles of iron and steel in 1888, by States and Territories.

States and Territories.	Short tons of 2,000 pounds, except nails.						
	Pig iron.	Bessemer steel ingots and other steel.	Steel rails.	Total iron and steel rails.	Rolled iron, including iron rails and nails.	Rolled steel, including nails but not rails.	Iron and steel cut nails (kegs of 100 pounds).
Maine	5,574				9,669		
New Hampshire		4,200			5,220	2,500	
Massachusetts	13,248	29,097	9,533	9,533	39,786	78,440	280,301
Rhode Island					14,624		
Connecticut	21,644	1,969			14,339	5,516	
New England	40,466	35,266	9,533	9,533	83,638	86,456	280,301
New York	257,180	78,766	27,692	27,692	97,476	18,084	
New Jersey	101,882	11,208			58,294	22,167	275,591
Pennsylvania	3,589,186	1,941,676	930,790	934,095	1,263,776	688,973	2,072,969
Delaware					41,340	384	
Middle States	3,948,248	2,031,650	958,482	961,787	1,460,886	729,608	2,348,560
Maryland	17,606	1,263			13,973	1,171	
Virginia	197,396	967			41,289	2,996	245,755
North Carolina	2,400						
Georgia	39,397						
Alabama	449,492	500		1,000	32,816		
Texas	6,587			444	1,136	483	
West Virginia	95,259	140,402	136	233	49,440	75,162	1,145,151
Kentucky	56,790			150		12,339	206,783
Tennessee	267,931	5,425	5,221	6,117	17,767		
Southern States	1,132.858	148,557	5,357	7,944	156,421	92,151	1,597,689
Ohio	1,103,818	334,304	38,294	39,193	412,391	225,162	1,522,951
Indiana	15,260	2,725	425	1,442	32,012	6,880	175,397
Illinois	579,307	623,056	488,639	493,146	106,484	38,698	241,981
Missouri	91,783	49,792	40,791	40,791	12,887	7,739	
Iowa					6,000		
Michigan	213,251	2,215			26,344	6,352	
Wisconsin	116,037				60,630		41,715
Western States	2,119,456	1,012,092	568,149	574,572	656,748	284,831	1,982,044

Production of leading articles of iron and steel in 1888—Continued.

States and Territories.	Short tons of 2,000 pounds, except nails.						
	Pig iron.	Bessemer steel ingots and other steel.	Steel rails.	Total iron and steel rails.	Rolled iron, including iron rails and nails	Rolled steel, including nails but not rails.	Iron and steel cut nails (kegs of 100 pounds).
Colorado	20,877	14,249	9,706	11,006	4,372	1,863	44,997
Wyoming Territory				487	7,987		
California		5,559	6,665	6,815	41,602	6,976	240,000
Oregon	2,509						
Washington Territory	4,093						
The Far West.	27,479	19,808	16,371	18,308	53,961	8,839	284,997
Grand total	7,268,507	3,247,373	1,557,892	1,572,144	2,411,654	1,201,885	6,493,591

In addition to the products named in the table the States of New York and Tennessee produced in 1888, in Catalan forges, direct from the ore, 14,088 short tons of charcoal blooms.

In the following table is given the approximate consumption in the United States of pig iron and of iron and steel rails in the last thirty-four years. The production in calendar years is added to the importations in fiscal years, the result being the yearly consumption in calendar years as nearly as can be ascertained. Long tons are used.

Consumption of pig iron and of iron and steel rails in the last thirty-four years.

Calendar years.	Production—long tons.		Fiscal years ended June 30—	Importation—Long tons.		Calendar years.	Consumption—Long tons.	
	Pig iron.	Iron and steel rails.		Pig iron.	Iron and steel rails.		Pig iron.	Iron and steel rails.
1855	700,159	123,816	1855	98,925	127,516	1855	799,084	251,332
1856	788,515	160,730	1856	59,012	155,495	1856	847,527	316,225
1857	712,640	144,570	1857	51,794	179,305	1857	764,434	323,875
1858	629,548	146,171	1858	41,986	75,745	1858	671,534	221,916
1859	750,560	174,513	1859	72,517	69,965	1859	823,077	244,478
1860	821,223	183,070	1860	71,498	122,175	1860	892,721	305,245
1861	653,164	169,480	1861	74,026	74,490	1861	727,190	243,970
1862	703,270	190,993	1862	22,247	8,611	1862	725,517	199,604
1863	846,075	246,221	1863	31,007	17,088	1863	877,082	263,309
1864	1,014,282	299,437	1864	102,223	118,714	1864	1,116,505	418,151
1865	831,770	318,118	1865	50,652	77,518	1865	882,422	395,636
1866	1,205,663	384,623	1866	102,392	78,007	1866	1,308,055	462,630
1867	1,305,023	412,596	1867	112,042	96,272	1867	1,417,065	508,868
1868	1,431,250	452,423	1868	112,133	151,097	1868	1,543,383	603,520
1869	1,711,287	529,988	1869	136,975	237,703	1869	1,848,262	767,691
1870	1,665,179	553,571	1870	153,283	279,765	1870	1,818,462	833,336
1871	1,706,793	692,619	1871	178,138	458,055	1871	1,884,931	1,150,674
1872	2,548,713	892,857	1872	247,528	531,536	1872	2,796,241	1,424,393
1873	2,560,963	794,712	1873	215,495	357,629	1873	2,776,458	1,152,341
1874	2,401,262	651,262	1874	92,041	148,918	1874	2,493,303	800,180
1875	2,023,733	707,600	1875	53,748	42,082	1875	2,077,481	749,682
1876	1,868,961	785,383	1876	79,455	4,708	1876	1,948,416	790,091
1877	2,066,594	682,776	1877	67,922	30	1877	2,134,516	682,806
1878	2,301,215	788,112	1878	55,000	11	1878	2,356,215	788,123
1879	2,741,853	993,993	1879	87,576	2,611	1879	2,829,429	996,604
1880	3,835,191	1,305,212	1880	754,657	152,791	1880	4,589,848	1,458,003
1881	4,144,254	1,646,518	1881	417,849	302,294	1881	4,562,103	1,948,812
1882	4,623,323	1,507,851	1882	496,045	295,666	1882	5,119,368	1,803,517
1883	4,595,510	1,214,905	1883	433,602	118,062	1883	5,029,112	1,332,967
1884	4,097,868	1,022,188	1884	283,172	7,971	1884	4,381,040	1,030,159
1885	4,044,526	976,978	1885	151,959	4,203	1885	4,196,485	981,181
1886	5,683,329	1,600,537	1886	261,674	10,507	1886	5,945,003	1,611,044
1887	6,417,148	2,139,640	1887	418,919	77,043	1887	6,836,067	2,216,683
1888	6,489,738	1,403,700	1888	325,517	137,024	1888	6,815,255	1,540,724

Prices of iron and steel in 1888 *and* 1889.—Students of industrial statistics do not expect and do not want cotemporaneous tables of prices of any given commodity at many places of production or consumption in any country. What they desire are comparative tables of prices from year to year at one or two leading markets. Such tables enable them, in connection with other facts which can not be tabulated, to trace the development of industries, the changes in cost of production, the increasing use of machinery, the condition of the markets, and the prosperity or lack of prosperity of consumers. The record of our prices is given for statistical and historical and not for commercial purposes. With this explanation we present below a table of the average monthly prices at two leading markets in the United States of nine leading articles of iron and steel from January 1, 1888, to July 1, 1889, averaged from weekly quotations. The prices are per ton of 2,240 pounds, except for bar iron and nails, which are quoted by the pound and the keg, respectively.

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 Pittsburgh.	Bessemer pig iron, at Pittsburgh.	Steel rails at mills in Pennsylvania.	Best refined bar iron, from store, Philadelphia.	All muck bar iron, at Pittsburgh.	Iron nails, (gross price), at Pittsburgh.
1888.							*Cents.*	*Cents.*	
January	$21.75	$21.00	$16.75	$17.00	$18.10	$31.50	2.20	1.85	$1.90
February	22.00	20.75	17.00	16.75	17.80	31.50	2.20	1.80	1.90
March	21.50	20.50	17.00	16.50	17.35	31.50	2.10	1.80	1.90
April	21.50	19.75	16.50	15.65	17.25	31.50	1.95	1.75	1.90
May	21.75	18.50	16.00	15.50	16.55	31.00	1.90	1.75	1.90
June	21.00	18.00	15.75	15.25	16.65	30.00	1.85	1.70	1.90
July	21.25	18.00	15.75	14.75	17.10	30.00	1.90	1.70	1.90
August	21.00	18.00	15.75	15.00	17.15	29.00	1.90	1.70	1.90
September	23.25	18.00	16.00	16.25	17.95	28.50	2.00	1.80	1.90
October	23.75	18.00	16.00	16.50	18.00	28.00	2.10	1.80	1.90
November	24.00	18.00	16.00	16.50	17.50	27.50	2.00	1.80	1.90
December	24.00	18.00	16.00	16.25	17.15	28.00	2.00	1.80	1.90
1889.									
January	23.50	18.00	15.50	15.50	16.75	27.50	2.00	1.75	1.90
February	23.50	18.00	15.25	14.75	15.35	27.50	1.90	1.70	1.90
March	23.50	18.00	15.25	15.00	16.50	27.50	1.80	1.65	1.90
April	23.50	17.35	15.00	14.25	16.25	27.50	1.80	1.65	1.90
May	22.75	17.00	14.75	14.00	16.00	27.00	1.85	1.60	1.85
June	22.50	17.25	14.90	14.00	16.00	27.50	1.90	1.60	1.85

This table shows a steady decline in all prices, except for old iron rails and nails, from January, 1888, to May, 1889. In June, 1889, however, prices generally were firmer, particularly the prices of pig iron and steel rails. The great floods of June which interrupted transportation and interfered with production, helped to advance prices.

There has for some time been an extraordinary demand for old iron rails, due to the fact that they may be worked into various finished products for which pig iron is used, but without the expense of the puddling process to which pig iron must first be subjected. Nails had fallen to so low a price at the beginning of 1888 that a lower price than that named in the table was scarcely to be expected. The decline in prices generally which took place in 1888 was a continuation of the decline which commenced in the spring of 1887, and which was fully recorded in the volume of Mineral Resources covering the results of that year.

Production and importation of iron ore in 1888.—The production of iron ore by the leading iron-ore districts of the country in the last three years was as follows, in long tons, the figures in nearly every instance denoting shipments from the mines.

Shipments of iron ore from leading districts.

Districts.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*
Lake Superior mines of Michigan and Wisconsin	3, 263, 626	4, 344, 651	4, 511, 326
Vermilion Lake mines of Minnesota	304, 396	394, 252	511, 953
Missouri mines	379, 776	427, 785	217, 931
Ohio mines	344, 484	377, 465	253, 352
Cornwall mines, Pennsylvania	688, 054	667, 210	722, 917
New Jersey mines	500, 501	547, 889	447, 738
Chateaugay mines, near Lake Champlain, New York	214, 800	219, 390	132, 966
Crown Point mines, New York	60, 084	64, 940	67, 578
Port Henry mines, New York	298, 868	428, 522	419, 009
Other Lake Champlain mines, New York	15, 000	29, 000	45, 000
Hudson River Ore and Iron Company, New York	75, 000	142, 422	58, 000
Tilly Foster mines, New York	17, 728	14, 316	4, 332
Forest of Dean mines, New York	18, 000	21, 164	12, 017
Salisbury region, Connecticut	36, 000	30, 000	32, 599
Cranberry mines, North Carolina	24, 106	45, 032	10, 129
Tennessee Coal, Iron, and Railroad Company's Inman mines	81, 650	102, 601	123, 159
Alleghany County, Virginia	(*a*)	150, 000	156, 126
Preston County, West Virginia	(*a*)	15, 408	13, 260
Calhoun, Etowah, and Shelby Counties, Alabama	(*a*)	129, 000	134, 932
Total of the above districts	6, 322, 073	8, 151, 047	7, 874, 324

a Statistics not collected.

The following table shows the shipments of iron ore from the various districts of the Lake Superior region in the last five years, in long tons, shipments to neighboring furnaces being included.

Iron ore shipments from the Lake Superior region in the past five years.

Districts.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Marquette Range, Michigan	1, 558, 033	1, 430, 422	1, 627, 383	1, 860, 043	1, 921, 525
Menominee Range, Michigan and Wisconsin	895, 634	690, 435	880, 006	1, 199, 343	1, 165, 039
Gogebic Range, Michigan and Wisconsin	1, 022	119, 590	756, 237	1, 285, 265	1, 424, 762
Vermillion Lake, Minnesota	62, 124	225, 484	304, 396	394, 252	511, 953
Miscellaneous mines, Michigan	1, 879	441	....	....	....
Total	2, 518, 692	2, 466, 372	3, 568, 022	4, 738, 903	5, 023, 279

The shipments of Lake Superior iron ore to Eastern points of consumption greatly increased in 1888. In that year a market was found for 276,000 tons of this ore in eastern Pennsylvania and New York; no shipments were made to New Jersey.

In reaching the probable production of iron ore by the whole country we are guided by the exact quantity of pig iron produced, the quantity of Catalan blooms produced, and the probable consumption of iron ore for fettling purposes in rolling mills; these elements give the probable total consumption of iron ore, from which is deducted the quantity imported; the remainder fairly represents the home production. The writer has estimated the total consumption of iron ore in the United States in 1888 at 12,650,000 long tons, against 12,500,000 tons in 1887, and a little over 11,000,000 tons in 1886. Our imports of iron ore in 1888 amounted to 587,470 long tons; this amount subtracted from the amount consumed would leave 12,062,530 tons as the product of domestic mines in 1888, against 11,300,000 in 1887 and 10,000,000 in 1886.

Our imports of iron ore in 1888, as has been stated, amounted to 587,470 long tons, valued abroad at $1,313,589 against 1,194,301 tons in 1887, valued at $2,206,958. The great shrinkage in our imports of iron ore in 1888 was due to two co-operating influences: the lower prices prevailing for domestic ore and the increased ocean freight charges on foreign ore.

Of the iron ore imported in 1888 the mines of the Juragua Iron Company, in Cuba, which are owned by Pennsylvania capitalists, supplied 198,040 long tons, or more than one-third of the total imports of the year. Messrs. George H. and S. P. Ely, of Cleveland, Ohio, have recently purchased extensive iron-ore mines near to the mines of the Juragua Iron Company, which they will develop and the product of which they will place upon the markets of the United States and Europe. The ore of these mines is said to be like that of the Juragua Iron Company, rich in iron and low in phosphorus and sulphur, a true Bessemer ore.

The domestic iron trade in 1889.—Since the beginning of the present year the condition of the iron trade has not been favorable, although the consumption of iron and steel products, steel rails excepted, is still active and the volume of production is therefore large. Manufacturers have less reason to complain of a decreased demand than of unsatisfactory and unremunerative prices. The general range of prices of iron and steel in this country is to day almost as low as has ever been experienced. Present prices would be ruinous to all manufacturers but for the numerous economical improvements in the various processes of manufacture which have been introduced in the last few years.

The outlook for an improvement in the iron trade of the country in the immediate future was not favorable as late as the end of May, but as these lines are written, late in June, there is a general feeling of hopefulness that this improvement can not be much longer deferred. Prices of all forms of iron and steel are now so low that only manufacturers who are supported by abundant capital can afford to continue production, and a tendency to a decrease in production must of itself soon have a favorable effect on prices. We had reached in May the lowest cost of producing iron and steel that is possible under existing conditions.

The decline in our imports of iron and steel which was so noticeable in 1888 is being continued in 1889. During the first four months of the present year we imported 285,428 long tons, against 313,953 tons in the corresponding period of 1888. The quantity of tin-plates imported in the first four months of 1889 was, however, enormous, exceeding the quantity imported in the first four months of 1888 by over 21,000 long tons, and forming about two-fifths of our total importations of iron and steel during the period mentioned. Our imports of iron ore in the first four months of 1889 amounted to 232,036 long tons, against 215,059 tons in the first four months of 1888, showing a slight increase.

The increasing uses of Bessemer and other steel.—Originally our Bessemer steel industry, which supplies us with most of our steel, was established solely for the manufacture of rails, but at most of our Bessemer works steel is now made for conversion into many forms other than rails—into plates and sheets; into structural shapes for ships, bridges, and buildings; into nails, wire, axles, springs, tools, shafting, etc. Upon the other hand, our open-hearth steel works were originally established to produce these miscellaneous products, and have never made many rails. In recent years our Bessemer steel works have been employed more and more each year in the production of miscellaneous articles, mainly because of the uncertain and capricious market for rails. Of the ability of this country to supply any domestic demand for steel which may be created in the future, whether Bessemer, open-hearth, or crucible steel, there can be no doubt whatever in view of the great production of 1887.

A fresh illustration of the readiness of our steel manufacturers to meet the home demand for any steel product which may be required is found in the promptness with which they have responded to the wants of the Government for heavy and light armor plate and for heavy and light guns for our new Navy. Without disparagement to other establishments, it may be specially mentioned that the facilities now possessed by the Midvale steel works at Philadelphia for the manufacture of gun forgings, and by the Homestead steel works of Carnegie, Phipps & Co., limited, at Pittsburgh, for the manufacture of armor plate, are a great credit to the country; while the preparations which have been made during the last three years by the Bethlehem Iron Company, whose works are located at Bethlehem, Pennsylvania, to supply the Government with both heavy armor plate and heavy guns are unsurpassed in Europe for either magnitude or thoroughness. This company has already commenced the delivery of steel forgings to the Government.

Another illustration of the readiness of our steel manufacturers to promptly meet any new demand for steel is found in the erection within the last few years of a sufficient number of plants to supply all the steel wire rods that the country needs for fence wire and other wire. In 1888 we produced 298,770 short tons of steel wire rods, most of which large tonnage was drawn into fence wire. Our wire-rod industry would have been impossible if we had not previously built up our Bessemer steel industry, which supplies the steel for conversion into rods and afterwards into wire so cheaply, that the cost of fencing a farm of 160 acres with barbed wire four strands high is now only a little over 56 cents an acre. The manufacture of wire rods in this country is now a widely distributed industry, and it is still growing. Massachusetts, Pennsylvania, Ohio, and Illinois are prominently engaged in the manufacture of wire rods, while other States have made a beginning in their manufacture. In 1888 a very complete wire-rod plant was commenced at Joliet, Illinois, and new plants are now in course of erection at New Castle and Allentown, in Pennsylvania, and at Anderson, in the natural gas district of Indiana.

The manufacture of Bessemer and open-hearth steel in this country is to-day a powerful stimulant to the manufacture of domestic pig iron, as the following details of our production of pig iron in the last two years will show:

Proportion of Bessemer to non-Bessemer pig iron produced in 1887 *and* 1888.

	1887.	1888.
	Short tons.	*Short tons.*
Bessemer pig iron and spiegeleisen	3,268,115	3,009,171
Car-wheel, foundry, and mill pig iron	3,919,091	4,259,336
Total	7,187,206	7,268,507

A large part of our imports of pig iron is also for use in the manufacture of Bessemer and open-hearth steel, as will be seen from the following statistics of our imports in the last two years:

Details of pig iron imports in 1887 *and* 1888.

	1887.	1888.
	Short tons.	*Short tons.*
Spiegeleisen and ferro-manganese	176,153	80,198
Other pig iron	347,472	140,707
Total	523,625	220,905

The manufacture of tin-plates in the United States.—Another new use of steel in this country, which is soon to be established, is the manufacture of tin-plates, our supply of which is now wholly imported. Tin-plates are sheets of iron or steel which have been coated with tin or with a mixture of tin and lead. Some of the tin-plates which we import are still made of iron sheets, but the tendency abroad is to use steel sheets exclusively in the manufacture of tin-plates. The tin-plate industry of this country will be wholly an outgrowth of our steel industry. The Illinois Steel Company, the largest manufacturer of steel not only in this country but in the world, has announced its intention to engage in the manufacture of tin-plates if Congress increases the duty on this article.

This country does not produce block tin, which is essential to the manufacture of tin-plates, but we can easily import all the block tin that we may need for tin-plates. We now import large quantities for other purposes. Block tin is free of duty. It is not an unusual circumstance for a country which is largely engaged in the manufacture of metals to import its raw materials in large part, if not wholly, from other countries. Our magnificent Bessemer steel industry has always been dependent upon foreign countries for its supply, in whole or in part, of spiegeleisen and ferro-manganese. When we commenced the manufacture of Bessemer steel we were wholly dependent upon foreign countries for our supply of spiegeleisen. The Bessemer steel industry of our great industrial rival, Great Britain, is still more dependent upon foreign countries for its supply of raw material than we are. One-half of the iron ore which is used in the manufacture of Bessemer pig iron and spiegeleisen in that country is imported from Spain, Elba, and other countries. Upon this subject Sir Isaac Lowthian Bell, a very high English authority, made the following statement in reply to a toast at the annual meeting of the Wolverhampton Chamber of Commerce, on Wednesday, January 30, 1889:

"When the so-called Black Country first began to make iron it was necessary that the ores and the coal should be found in juxtaposition, but now the more rapid communication possible between centers of the country had lessened this necessity, and we were in the presence of very changed conditions of things. Of all the changes which had taken place, the most important was the introduction of the Bessemer converter. The improvements in steam navigation enabled us to import large quantities of foreign ores. But for these importations steel at the present time would have been almost a luxury in England. As a result of this interchange of products the price of steel had been reduced. It was now possible to send to Bilbao, 1,000 miles away, and bring over ore for the manufacture of steel rails, which could be produced at much less than the price of iron rails made from Cleveland ironstone, which lay almost at the gates of the Cleveland rolling mills. And the quality of the steel rails was twice that of the iron rails."

In a letter which the writer recently addressed to the Hon. William B. Allison the following statements were made: "Nearly all the tin-plates of commerce are manufactured in Great Britain, and the greater part of the tin-plates of that country are produced in South Wales. Tin itself, with which iron and steel sheets are coated, is obtained chiefly from Cornwall in England, from the Malayan peninsula, and neighboring islands in the Straits of Malacca, and from Australia. The supply of tin which Great Britain obtains from Cornwall is far from sufficient to meet her wants, and she is consequently a large importer of tin from the East Indies and Australia. Indeed a large part of the Cornwall supply is annually exported to other countries in the form of block tin, imported tin being regarded as superior to that of

Cornwall for coating iron or steel sheets. An English authority states that Cornish tin 'is not so fluid, not so soft, and will not cover so large a surface of plate' as imported tin."

Illustrations of the propriety of sending to other countries for a supply of tin to enable us to engage in the manufacture of tin-plates need not be confined to industries which embrace the metals only. The great cotton industry of Great Britain was wholly built up from supplies of raw cotton drawn at first from India and afterwards from the United States, Egypt, and other countries. Its chief supply has long come from the United States. Our own country is a large producer of woolen goods and carpets, but it derives its supply of both the coarser and the finer qualities of wool in part from Australia, South America, and other countries. We are also largely engaged in the manufacture of silk goods, but all the raw silk we consume is imported from Asiatic and European countries. Dyes for all textile goods we import largely from other countries. We are large importers of hides to be used in the manufacture of leather and of various raw materials to be used in the manufacture of chemicals and other manufactured products.

It is not, therefore, a valid or even a plausible objection to the proposition to establish a tin-plate industry in this country that we do not have among our native resources a supply of tin to be used in coating iron and steel plates. It may be found, upon further investigation, that we possess an ample supply of this raw material; it has already been sufficiently demonstrated that we possess in the Black Hills of Dakota at least a partial supply, which is in process of development. But, if it should be necessary for us to import our whole supply of tin before we could establish a tin-plate industry on American soil, there exists no commercial or metallurgical reason why we should not do this. If Great Britain can make tin-plates with imported tin we can certainly do the same. If our own country could successfully establish a Bessemer steel industry by depending wholly upon foreign countries for a supply of spiegeleisen surely we could meet with equal success in establishing a tin-plate industry, even if compelled to rely wholly on foreign countries for a supply of tin to coat the iron or steel sheets we know so well how to make.

The facilities which we possess for the manufacture of tin-plates certainly warrant the expectation, in the light of previous experience in the introduction of new industries, that if the tin-plate industry should be established in this country, the price of tin-plates would soon be reduced instead of being increased. That their quality would be improved if made at home there cannot be the slightest doubt.

Is Pennsylvania losing her leadership in the manufacture of iron and steel?—This question is frequently asked, and it receives various answers. In view of the rapid and gratifying development of the iron and steel industries of our country in the West and South in recent years it may properly receive attention in these pages.

The two leading and controlling iron and steel products of this country are pig iron and Bessemer steel; they form the foundation of nearly all our finished iron and steel products. Fortunate is the State which can economically make both pig iron and Bessemer steel, for it can then economically make in great variety the finished iron and steel products which are derived from them.

To show the growth and present position of the manufacture of both these leading products in various sections of the country we give herewith the statistics of their production by States and sections, the figures relating to pig iron commencing with 1880 and those relating to Bessemer steel commencing with 1874. It was in 1879 that our pig iron industry took a fresh start after a long period of depression, and it was after 1874 that the statistics of our production of Bessemer steel by States were first published, since which time this industry has had a rapid growth. First a table is presented showing our production of pig iron in the last eight years:

Comparative production of pig iron in various sections.

NEW ENGLAND, NEW YORK, NEW JERSEY, AND PENNSYLVANIA.

States.	Pig iron—Short tons of 2,000 pounds.							
	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
New England ..	53, 997	39, 987	35, 136	19, 076	18, 809	32, 574	37, 252	40,466
New York.......	359, 519	416, 156	331, 964	239, 486	160, 157	233, 618	296, 572	257, 180
New Jersey	171, 672	176, 805	138, 773	82, 935	73, 667	157, 886	172, 554	101, 882
Pennsylvania....	2, 190, 786	2, 449, 256	2, 638, 891	2, 385, 402	2, 445, 496	3, 293, 289	3, 684, 618	3, 589, 186
Total	2, 775, 974	3, 082, 204	3, 144, 764	2, 726, 899	2, 698, 129	3, 717, 367	4, 190, 996	3, 988, 714

SIX WESTERN STATES.

Ohio	710, 546	698, 900	679, 643	567, 113	553, 963	908, 094	975, 539	1, 103, 818
Indiana..........	7, 300	10, 000	9, 950	2, 568	6, 634	16, 660	13, 211	15, 260
Illinois	251, 781	360, 407	237, 657	327, 568	327, 977	501, 795	565, 453	579, 307
Michigan	187, 043	210, 195	173, 185	172, 834	143, 121	190, 734	213, 543	213, 251
Wisconsin	192, 029	85, 859	51, 893	52, 815	24, 632	65, 933	133, 508	116, 037
Missouri.........	109, 799	113, 644	103, 296	60, 043	51, 408	74, 523	138, 643	91, 783
Total	1, 368, 498	1, 479, 005	1, 255, 624	1, 182, 941	1, 107, 735	1, 757, 739	2, 033, 897	2, 119, 456

NINE SOUTHERN STATES.

Alabama	98, 081	112, 765	172, 465	189, 664	227, 438	283, 859	292, 762	449, 492
Tennessee	87, 406	137, 602	133, 963	134, 597	161, 199	199, 166	250, 344	267, 931
Virginia	83, 711	87, 731	152, 907	157, 483	163, 782	156, 250	175, 715	197, 396
West Virginia...	66, 409	73, 220	88, 398	55, 231	69, 007	98, 618	82, 311	95, 259
Kentucky	45, 973	66, 522	54, 629	45, 052	37, 553	54, 844	41, 907	56, 790
Georgia.....	37, 401	42, 440	45, 364	42, 655	32, 924	46, 490	40, 947	39, 397
Maryland........	48, 756	54, 524	49, 153	27, 342	17, 299	30, 502	37, 427	17, 606
Texas..........	3, 000	1, 321	2, 381	5, 140	1, 843	3, 250	4, 383	6, 587
North Carolina ..	800	1, 150	....	435	1, 790	2, 200	3, 640	2, 400
Total	471, 540	577, 275	699, 260	657, 599	712, 835	875, 179	929, 436	1, 132, 858

The facts established by this table with regard to the manufacture of pig iron are very important. The pig iron industry of New England is making no progress and shows signs of decadence; at best, the quantity of pig iron which this section annually produces is very small, although it is of superior quality, being all made with charcoal, and most of it from superior ores. In New York there has been positive retrogression in the manufacture of pig iron in the last decade. In the pig iron industry of New Jersey we find a fitful activity during this period, but no progress, with a decided tendency to lower production. Unitedly New England, New York, and New Jersey now produce much less pig iron than formerly. Their failure to keep their pig iron industry in line with that of other sections of the country is partly due to the absence of mineral fuel within their territorial limits, partly to the scarcity of desirable ores for the manufacture of Bessemer pig iron, and partly to the great expense of mining many of the ores which they do possess. Anthracite coal and bituminous coke are taken to New Jersey and New York from Pennsylvania, Bessemer iron ore from Lake Superior is taken to New York, and foreign ore is imported into both New York and New Jersey. These are not favorable economical conditions.

By reference to the table, it will be seen that Pennsylvania has increased her production of pig iron from 2,083,121 short tons in 1888, to 3,589,186 tons in 1888; a gain of 1,506,065 tons, or 72 per cent. Her production in 1887 was even larger than 1888. The growth of the pig iron industry of Pennsylvania was of a most aggressive character from 1880 to 1885,and it has since been phenomenal in its magnitude.

The six western States in our table have increased their production of pig iron from 1,194,084 short tons in 1880, to 2,119,456 tons in 1888; a gain of 925,372 tons, or 77 per cent. This is a greater percentage of increase than that of Pennsylvania, which was 72 per cent., but the increase in quantity of pig iron produced was 580,693 tons less than the increase of Pennsylvania. It will be noticed that almost the entire gain in production in the western States in the last decade has been made since 1885, and that it has been very great.

The nine southern States in the table have increased their production of pig iron from 397,301 short tons in 1880 to 1,132,858 tons in 1888; a gain of 735,557 tons, or 185 per cent. This percentage is nearly two and a half times as large as that of the western States, and more than two and a half times as large as that of Pennsylvania, but the increase in the quantity of pig iron produced by the southern States from 1880 to 1888 was 189,815 tons less than that of the western States, and 17,475 tons less than half the increase of Pennsylvania in the same period.

The comparisons above given, while indicating rapid progress in recent years in the manufacture of pig iron in the West and South, do not show that Pennsylvania is losing her leadership as a pig iron producer. This conclusion is corroborated by the following statement of Pennsylvania's percentage of the total production of pig iron in the United States in the last nine years:

Pennsylvania's percentage of the total production of pig iron in the United States.

Years.	Short tons of 2,000 pounds.			Percentage of Pennsylvania.
	Pennsylvania.	Other States.	Total.	
1880	2,083,121	2,212,293	4,295,414	48.4
1881	2,190,786	2,450,778	4,641,564	47.1
1882	2,449,256	2,728,866	5,178,122	47.3
1883	2,638,891	2,508,081	5,146,972	51.2
1884	2,385,402	2,204,211	4,589,613	51.9
1885	2,445,496	2,084,373	4,529,869	53.9
1886	3,293,289	3,072,039	6,365,328	51.7
1887	3,684,618	3,502,588	7,187,206	51.2
1888	3,589,186	3,679,321	7,268,507	49.3

It will be seen that Pennsylvania's percentage of the total production was greater in 1888 than in 1880 or in either of the two following years. It was, however, less than in any of the years from 1883 to 1887. Enthusiasts outside of Pennsylvania will call attention to the greater percentage of growth in the West, and particularly in the South, since 1880, than in Pennsylvania, and ask whether these figures do not foretell a material decline in the percentage of her pig iron production as it existed in 1888. They will call attention particularly to the decline in her percentage from 1885 to 1888. It may be answered that Pennsylvania can lose a little of her percentage from year to year and still remain for many years to come the dominant leader of all the sections in the manufacture of pig iron.

Representations of the pig iron industry of any section of the country which are based on the percentage of its growth from year to year as compared with the percentage of growth of some other section are misleading. The true test of progress is to be found in the quantity of pig iron which the sections compared respectively produce. From 1880 to 1888 the increase in the quantity of pig iron produced by Pennsylvania was 580,693 tons greater than the increased production of the six western States in the same period, and it was 373,207 tons greater than the total production of pig iron by the nine southern States in 1888.

We now turn to the second leading product, Bessemer steel. The following table shows the production of Bessemer steel ingots in Pennsylvania and in other States from 1874 to 1888:

Production of Bessemer steel ingots in Pennsylvania and in other States from 1874 to 1888.

Years.	Short tons of 2,000 pounds.				Percentage of Pennsylvania.
	Pennsylvania.	Illinois.	Other States.	Total.	
1874	85,625	62,492	43,816	191,933	44.6
1875	148,374	136,356	90,787	375,517	39.5
1876	258,452	171,963	95,581	525,996	49.1
1877	328,599	111,299	120,689	560,587	58.6
1878	426,481	179,500	126,245	732,226	58.2
1879	514,165	250,980	163,827	928,972	55.3
1880	643,894	304,614	254,665	1,203,173	53.5
1881	844,501	375,763	318,893	1,539,157	54.8
1882	933,631	397,436	365,383	1,696,450	55.0
1883	1,044,396	273,325	336,906	1,654,627	63.1
1884	1,031,484	339,068	170,043	1,540,595	66.9
1885	1,109,039	366,659	226,064	1,701,762	65.1
1886	1,507,577	535,602	498,314	2,541,493	59.3
1887	1,752,445	857,513	678,399	3,288,357	53.2
1888	1,592,629	620,856	599,015	2,812,500	56.6

This table shows that since 1877 Pennsylvania has annually produced more than one-half of the Bessemer steel that has been made in the United States, and that the competition of no other State has seriously weakened her position as the great leader in our Bessemer steel industry, rapid and gratifying as has been the progress of Illinois and of some other States. It will be noted, however, that Pennsylvania made a larger percentage of the total production of Bessemer steel in 1884 and 1885 than in any succeeding year. But this decline in her percentage still leaves her leadership secure. Here again, as in the production of pig iron, it is not the comparative percentage of growth which is significant, but the quantity of Bessemer steel that is annually produced.

The fallacy of measuring the growth of the industries of the country from year to year by percentages was fully exposed in a report submitted to the House of Representatives on June 16, 1886, by the minority of the Ways and Means Committee of that body, from which the following is quoted:

"To illustrate, take, for example, the population of Ohio, which in 1800 was 45,365; in 1810, 230,760, an increase of 409 per cent.; in 1820 it had reached 581,295, a remarkable and healthy increase you will say, but apply the test of the majority of this committee, and we find that the increase during this decade has been but 152 per cent. In 1830 this State had reached a population of 937,903, numerically a most satisfactory increase, but submit it to the percentage test, and it is found to be but 61 per cent. In 1840 the population of Ohio had reached 1,519,467, an increase of 62 per cent.; in 1850 it was 1,980,329, an increase of 30 per cent.; in 1860 it was 2,339,511, an increase of 18 per cent.; in 1870 it was 2,665,260, an increase of 13 per cent.; and in 1880 it had reached 3,198,062, an increase of 16 per cent.

"Apply this method of reasoning to the population of the State of Ohio, or to any of our western States, and we should find that, while the percentage of increase had decreased from 409 per cent. in the decade ending in 1810 to 16 per cent. in the decade ending in 1880, the world at large would be marveling at the tremendous increase of population in this State from 45,365 in 1800 to 3,198,062 in 1880. If the doctrine of percentages is to be the test of growth and population, then Ohio has been most unfortunate. Her percentage between 1800 and 1810, if continued, would have given her a population of over seventeen billions.

"What is true in the case of population is equally true when applied to agriculture. Thus between 1870 and 1880 we find the increase in the production of corn in Ohio was about 66 per cent., while in Nebraska during the same period the increase was 1,279 per cent., and in Kansas 521 per cent. If the increase during the next decade in the State of Nebraska is to be figured by percentages, the product would be 901,866,000 bushels of corn, or more than one-half of the total corn product of the United States in 1884. What is true of the State of Nebraska is equally true of the United States. The percentage of growth in population and in wealth is always greater in the earlier periods of the history of a nation."

In the statistics of pig iron and Bessemer steel above presented, we have referred only to those leading products in the manufacture of which other sections of the country as well as Pennsylvania are prominent. In the manufacture of open-hearth steel and crucible steel she makes annually a larger proportion of the country's total product than she does of either pig iron or Bessemer steel.

Looking at the question before us from a statistical standpoint, and without considering either the advantages or disadvantages of competing sections, we conclude that Pennsylvania is not losing her leadership in the manufacture of iron and steel. She has steadily maintained her position as the leading producer of pig iron and all kinds of steel, and pre-eminence in the supply of these foundation products, joined to her great advantage in the possession of a variety of excellent fuel, has enabled her to keep far in advance of all competition in the manufacture of finished iron and steel products. Southern competition in the manufacture of pig iron and western competition in the manufacture of Bessemer steel may narrow the markets for her finished products, but a large part of the country will still supply her with willing customers for these products, while the market within her own borders for all forms of iron and steel can not be seriously invaded by domestic competition from any section. The only competition in her own iron market that now confronts her manufacturers is that of Southern pig iron, but this competition can only take place in the eastern part of the State, and even here the use of cheaper and better ores, both foreign and domestic, is annually reducing the cost of production. Lower freight rates and cheaper fuel will also be insisted upon by the pig iron manufacturers of eastern Pennsylvania before they will permanently blow out their furnaces.

This subject may be dismissed with the remark that we may all rejoice at the wonderful progress that has been made in late years in developing the iron and steel industries of the West and the South. The localization in any State or section of our Country of any great industry is certainly not desirable. The strength and the perpetuity of all our industries depend upon their distribution wherever the conditions of production are favorable. The law of the survival of the fittest will determine where these industries shall receive their highest development; but our Country is so large and its resources are so ample, that no State and no section can hereafter be truthfully referred to as the sole producer of any leading manufactured product—iron and steel in their crude and finished forms, stoves and hardware, iron and steel bridges, heavy and light machiney, tools of all kinds, cotton and woolen goods, silk goods, pottery and glassware, furniture, leather, agricultural implements, and many other products. Largely through the influence of our railroads and the wide distribution of our manufacturing industries we are rapidly becoming a homogeneous and a thoroughly united as well as an industrially independent people. Our farther progress as a nation through these mighty influences can not be prevented.

Production of iron ore and coal by countries.—In the production of iron ore and coal, "raw materials" of the manufacture of pig iron, the United States is only surpassed by Great Britain. The following table shows our production of these minerals in 1888 in comparison with their production by other countries in that year or in the most recent years for which official statistics or data for a careful estimate are available. English tons of 2,240 pounds are used in giving the statistics of Great Britain and the United States, and metric tons of 2,204 pounds are used for all the continental countries of Europe.

World's annual product of iron ore and coal.

Countries.	Iron ore.		Coal.	
	Years.	Tons.	Years.	Tons.
Great Britain	1888	14, 166, 000	1888	169, 935, 219
United States	1888	12, 062, 530	1888	126, 819, 406
Germany and Luxemburg	1888	10, 664, 789	1888	81, 863, 811
France	1888	2, 750, 000	1888	22, 951, 940
Belgium	1887	185, 186	1888	19, 185, 181
Austria and Hungary	1887	2, 000, 000	1886	20, 779, 441
Russia	1887	1, 500, 000	1886	4, 650, 000
Sweden	1887	903, 186	1887	300, 000
Spain	1888	4, 500, 000	1887	977, 559
Italy	1887	230, 575	1887	327, 665
Other countries	1888	2, 000, 000	1888	10, 000, 000
Total		50, 962, 266		457, 790, 222
Percentage of the United States		23		27

Production of pig iron and steel by countries.—The following table gives the world's production of pig iron and steel in the most recent years for which statistics are available, but chiefly for 1888. English tons of 2,240 pounds are used in giving the statistics of Great Britain and the United States, and metric tons of 2,204 pounds for all the continental countries of Europe. As in the case of iron ore and coal, the United States is only surpassed by Great Britain in the production of pig iron and steel.

World's annual product of pig iron and steel.

Countries.	Pig iron.		Steel.	
	Years.	Tons.	Years.	Tons.
Great Britain	1888	7, 898, 634	1888	3, 405, 536
United States	1888	6, 489, 738	1888	2, 899, 440
Germany and Luxemburg	1888	4, 258, 471	1888	1, 785, 354
France	1888	1, 688, 976	1888	525, 616
Belgium	1888	826, 984	1888	223, 638
Austria and Hungary	1888	761, 606	1888	355, 038
Russia	1886	541, 951	1886	246, 000
Sweden	1887	456 625	1887	111, 565
Spain	1885	159, 225	1887	24, 500
Italy	1887	12, 265	1887	73, 262
Other countries	1888	100, 000	1888	30, 000
Total	....	23, 194, 475	....	9, 679, 979
Percentage of the United States	....	27. 98	....	29. 95

It will be seen that in 1888 the United States produced 28 per cent. of the world's product of pig iron, and 30 per cent. of its product of all kinds of steel. In 1887 its percentage of pig iron was 29 per cent., and of steel it was 35 per cent. The explanation of the reduced percentage of the United States in 1888 is found in the increased activity in that year of the iron and steel industries of Great Britain and Germany and the decreased activity as a whole of the iron and steel industries of the United States. But taking even the percentages of the United States for 1888 and comparing them with the relation of our iron and steel industries to those of other countries and what a marvelous growth do they record!

The world's progress in the manufacture of iron and steel during the last decade.—The statistics of the production of iron and steel for 1888 which have been given in the table above possess special interest in view of the fact that they show that there are now three great iron and steel producing countries—Great Britain, the United States, and Germany, whereas twenty-five years ago Great Britain was so far ahead of all other countries in the manufacture of these products that her manufacturers and statesmen did not dream that she would ever have serious competitors in the world's markets. The iron and steel consuming countries of the world were supposed to be helplessly at her mercy—hopelessly dependent upon her for Welsh rails for their railroads, Sheffield cutlery and all English tools made of steel, the finer qualities of Scotch pig iron for foundry purposes, Low Moor and other favorite brands of plate iron for boilers, Crown and other choice brands of bar iron from Staffordshire, English-drawn wire, English hoops and cotton ties, and all kinds of iron and steel machinery in the manufacture of which great skill is required. At that time the Bessemer steel industry had not been established in the United States, and we had but just commenced to develop our rich stores of Lake Superior iron ores and to apply our excellent Connellsville coke to their reduction. Germany lagged far behind as a producer of pig iron and steel and all their products. Bismarck had not then adopted the protective policy, nor had the basic process of manufacturing steel from highly phosphoric ores, with which Germany is abundantly supplied, been invented. But Great Britain was busy making steel by the Bessemer and other processes; she had long known the virtues of Durham and other coke, and she had a variety of iron ores in abundance everywhere. She had great fleets to take the products of her blast furnaces, rolling mills, and machine shops to all parts of the world. Her supremacy in the manufacture of all iron and steel products appeared to be not only unchallenged, but unassailable.

Since those days the United States and Germany have rapidly and even phenomenally increased their production of pig iron and steel and all articles made from them. The whole world, indeed, has greatly increased its production of iron and steel in the last twenty-five years, a result which is largely due to the extraordinary increase in that period of railroad mileage in all civilized countries; but the United States and Germany have made more progress than any other countries, and very much more than Great Britain.

The following table shows the world's product of pig iron and steel in 1878, ten years ago, complete statistics for an earlier period being inaccessible. Long tons are used for Great Britain and the United States, and metric tons for all other countries.

World's product of pig iron and steel in 1878.

Countries.	Pig iron.	Steel.
	Tons.	*Tons.*
Great Britain	6,381,051	1,100,000
United States	2,301,215	731,976
Germany and Luxemburg	2,147,641	570,328
France	1,417,072	281,800
Belgium	493,544	95,000
Austria and Hungary	434,250	129,478
Russia	409,633	66,593
Sweden	333,496	25,918
Spain	60,000	250
Italy	20,000	3,000
Other countries	120,000	16,750
Total	14,117,902	3,021,093

By comparing this table with the preceding table for 1888 it will be seen that the world's product of pig iron increased from 14,117,902 tons in 1878 to 23,194,475 tons in 1888, or 64 per cent., while the world's product of steel increased in the same period from 3,021,093 tons to 9,679,979 tons, or 220 per cent. This is marvelous progress. The figures given are most significant, however, in showing how rapid has been the substitution of steel for manufactured iron. The cheapness with which steel can be produced by modern methods has in turn stimulated the production of steel-making pig iron.

The following tables exhibit in percentages the relative positions of Great Britain, the United States, Germany, and all other iron and steel producing countries in 1878 and 1888. Long and metric tons are used as heretofore explained. The small pig iron product of Luxemburg is included in that of Germany:

World's pig iron product, with the percentage of each country, for 1878 and 1888.

Countries.	Pig iron.			
	Product, tons.		Percentage.	
	1878.	1888.	1878.	1888.
Great Britain	6,381,051	7,898,634	45.20	34.05
United States	2,301,215	6,489,738	16.30	27.98
Germany and Luxemburg	2,147,641	4,258,471	15.21	18.36
France	1,417,072	1,688,976	10.04	7.28
Belgium	493,544	826,984	3.50	3.57
Austria and Hungary	434,250	761,606	3.08	3.29
Russia	409,633	541,951	2.90	2.33
Sweden	333,496	456,625	2.36	1.97
Spain	60,000	159,225	.42	.69
Italy	20,000	12,265	.14	.05
Other countries	120,000	100,000	.85	.43
Total	14,117,902	23,194,475	100.00	100.00

This table shows that Great Britain's product of pig iron has decreased in the last ten years from 45.20 to 34.05 per cent. of the total product, while that of the United States has increased from 16.30 to 27.98 per cent., and that of Germany from 15.21 to 18.36 per cent.

Percentages of world's steel product for 1878 and 1888.

Countries.	Steel.			
	Product, tons.		Percentage.	
	1878.	1888.	1878.	1888.
Great Britain	1,100,000	3,405,536	36.41	35.18
United States	731,976	2,899,440	24.23	29.95
Germany	570,328	1,785,354	18.88	18.45
France	281,800	525,646	9.33	5.43
Belgium	95,000	223,638	3.14	2.31
Austria and Hungary	129,478	355,038	4.29	3.67
Russia	66,593	246,000	2.20	2.54
Sweden	25,918	111,565	.86	1.15
Spain	250	24,500	.01	.25
Italy	3,000	73,262	.10	.76
Other countries	16,750	30,000	.55	.31
Total	3,021,093	9,679,979	100.00	100.00

This table shows that Great Britain has not quite maintained her relative position as a steel producer during the past ten years, that Germany has maintained her position a little better than Great Britain, and that the United States has made a decided gain in the percentage of her production.

But Great Britain, while fast losing her leadership in the manufacture of iron and steel and sharing it with the United States and Germany, is destined to remain a powerful competitor with all iron and steel producing countries. Although a large importer in late years of iron ores of special qualities, she still mines large quantities of native ores, while the exhaustion of her vast supplies of coal is only a remote possibility. The foreign ores which she imports are easily obtained, chiefly from mines in Spain. From the recent report of Mr. J. S. Jeans, the secretary of the British Iron Trade Association, we compile the following table, showing the products of coal, iron ore, and iron and steel in Great Britain in 1888, with other valuable information, compared with the two previous years.

Coal and iron statistics of Great Britain in 1886, 1887, *and* 1888.

Products—Long tons.	1886.	1887.	1888.
Coal	157, 518, 482	162, 119, 812	169, 935, 219
Iron ore	14, 110, 013	13, 098, 041	14, 166, 000
Pig iron	6, 870, 665	7, 441, 927	7, 898, 634
Stocks of pig iron, December 31	2, 491, 506	2, 778, 684	2, 588, 708
Puddled bar	1, 616, 701	1, 701, 312	2, 031, 473
Bessemer steel ingots	1, 570, 520	2, 064, 403	2, 012, 794
Open-hearth steel ingots	694, 150	981, 104	1, 292, 742
Bessemer steel rails	730, 343	1, 021, 847	979, 083
Tonnage of ships launched	481, 233	577, 327	904, 329
Exports of iron and steel	3, 388, 494	4, 143, 028	3, 966, 984
Imports of iron ore	2, 878, 469	3, 765, 788	3, 562, 071

In the production of both Bessemer steel ingots and Bessemer steel rails the United States has for many years been in advance of Great Britain, and in 1886 and 1887 we excelled the mother country in the production of all kinds of steel. This latter honor we yielded to her, however, in 1888, which was a year of great but temporary reaction for our Bessemer steel industry.

It only remains to mention that the iron and steel industries of all European iron and steel producing countries were very active in 1888, and that this activity still continues.

JUNE, 1889.

IRON IN THE ROCKY MOUNTAIN DIVISION.

BY F. F. CHISOLM.

Colorado.—The two furnaces of the Colorado Coal and Iron Company were not in blast continually during the year 1888, one only being steadily worked. A great deal of interest has been shown in the State's iron resources, and investigations have been made especially with a view to making pig iron in Denver, but the results have not proved very satisfactory. The iron ores of Castle creek and the Roaring Fork of Grand river, lying in Pitkin and Garfield counties, remain undeveloped. The mines of the Colorado Coal and Iron Company, the only operators, are still able to supply the furnaces when supplemented by special iron ores from Leadville. The demand for steel rails fell off with the cessation of railway building by Colorado companies. During the year little was done by local railways in the way of extensions, and the foreign roads entering the State brought their rails from east of the Missouri river. The rapid growth of the cities and towns along the Front range kept the demand for building material, such as nails, very active.

During 1888 the Colorado Coal and Iron Company used 2,808 tons of manganese ores from Leadville and made some spiegel iron. From the Company's mines at Calumet, near Salida, 5,659 tons of magnetic iron ore were mined, and from the Hot Springs mine in Saguache county 19,954 tons of rich hematite were taken. The mines at these two points are the only ones in the State operated for iron manufacturing. The iron ores of Leadville are generally too low in iron to be available, and are generally consumed by the silver-lead smelters, who pay for all silver contained, if the ore contains 40 per cent. of metallic iron. By the smelters probably 20,000 tons of iron ores, containing a small percentage of silver, are used. No record is kept of this consumption.

Product of iron by the Colorado Coal and Iron Company in 1888.

	Short tons.
Pig iron, including some spiegel	20,877
Iron castings	1,068
Cast-iron water-pipe	1,323
Steel rails	8,011
Steel nails (kegs of 100 pounds)	55,075
Spikes (kegs of 150 pounds)	3,270
Merchant iron, mine rail, etc	5,245
Iron ore:	
Calumet mine	5,659
Hot Springs mine	19,954
Leadville manganiferous ore	2,808
Total	28,421

Montana.—Mr. O. C. Mortson, of Great Falls, has kindly furnished a description of the iron ores of north-central Montana. These deposits have not as yet been developed, but considerable attention was paid to them during 1888, with a view to their development in the near future. Several kinds of ore are found in various localities in the region. Close to the suburbs of Great Falls, in the Sand Coulee region, is a deposit of limonite, of the subclass bog ore, which has been analyzed by Professor Dodge, of the State University of Minnesota, with the following results:

Analysis of bog iron ore near Great Falls, Montana.

	Per cent.
Silica	3.04
Alumina	Trace.
Peroxide of iron	79.06
Lime	.56
Manganese	.30
Sulphur	.09
Phosphorus	None.
Water	17.00
Magnesia	None.
Metallic iron	55.00

Little development has yet been made on this deposit. The whole of the Sand Coulee and Belt Creek coal field is underlaid about 40 to 60 feet below the coal, by a stratum of carbonate of iron. This stratum varies from 3 to 6 feet in thickness and is very similar in character to the clay ironstones of Yorkshire and Staffordshire, England. The following analysis is given by Professor Dodge:

Analysis of carbonate ore from the Sand Coulee district, Montana.

	Per cent.
Silica	12.07
Peroxide of iron	13.00
Carbonate of iron	66.00
Corbonate of lime	4.08
Phosphorus	.04
Moisture	Small amount.
Sulphur	None.
Metallic iron	41.00

This carbonate of iron is again underlaid by an unknown thickness of very pure limestone, which, analysed by Professor Sticht, of Pueblo, Colorado, gave carbonate of calcium, 98.39; silica, 1.21 per cent. Taking into consideration the existence at the same place of coking coal, iron, and lime—all the materials required for the manufacture of iron—it is a remarkable combination which will shortly be utilized by the railroads which are tapping every part of this vicinity.

In the summer of 1888, Mr. Mortson explored the iron ores of these mountains with a view to determining their character and extent. He found that the principal veins occur at the contact of the Carboniferous limestone with granite. At the head of Sage, Willow, and Wolf creeks is a very large contact vein of specular hematite, which is traced for a number of miles. Between Willow and Running Wolf creeks it shows on the surface from 24 to 38 feet in thickness of iron ore, which, in analyses by Professor Dodge, gave:

Analysis of specular hematite from Willow creek, Montana.

	Per cent.	Per cent.
Silica	2.37	3.58
Alumina	Trace.	None.
Peroxide of iron	90.40	95.20
Lime	Trace.	1.02
Manganese	....	.20
Sulphur	....	.40
Phosphorus	.04	.12
Water	6.31	....
Total	99.12	100.52
Metallic iron	63.28	66.64

A similar contact vein occurs on the northern slope of these mountains, across about two miles of Belt park. The vein here has been located in six places. On the western location the vein is 17 feet in thickness. Prof. W. T. Wenzell, of San Francisco, California, after a thorough analysis gave the following composition:

Analysis of iron ore from Belt park, Montana.

	Per cent.
Sesquioxide of iron	76.96
Protoxide of iron	.03
Peroxide of manganese	.08
Silica	8.80
Alumina	.74
Sulphur	.03
Water	13.36
Total	100.00

In addition to iron ore of the above character, on the head of the North and Middle Forks of the Judith river are vast blanket deposits of limonite of great thickness and carrying a small amount of gold. In places the deposits are found 45 feet in thickness. On the head of Dry Wolf creek is one very large vein of magnetic iron ore. Another one in the same locality of 150 feet in width is specular iron ore.

Wyoming.—None of the iron-ore deposits attracted any attention except that near the Cheyenne and Northern Railway. The ore here is of very superior quality, but as the price paid for iron ore is seldom over 10 cents per unit of metallic iron contained, the mine can not profitably be worked at present, as the nearest market is Pueblo, Colorado, about 300 miles distant.

Dakota.—Nothing has been done toward the development of the iron ores in and around the Black Hills.

Idaho.—A little iron ore is mined to supply the intermittent demand of the silver-lead smelters at Ketchum and Bonanza, but no record of the amount mined is kept.

GOLD AND SILVER.

Production statistics.—According to the Director of the Mint, whose statistics are accepted as authoritative in this report, the product of gold was 1,604,927 fine ounces, with the value of $33,175,000, in the calendar year 1888. This is about the same as in 1887, being an excess of only $75,000. The silver product, however, increased notably, being 45,783,632 fine ounces in 1888, with the commercial value of about $43,000,000, or a coining value of $59,195,000. In 1887, the silver product was 41,269,240 ounces, with a coining value of $53,441,300. The totals given above are the products from ores mined in the United States. In addition, some 10,000,000 ounces of silver were extracted in the United States from foreign ores and bullion, principally from Mexico. In the following table the effort has been made to distribute the totals to the States and Territories where produced, a task of increasing difficulty, owing to the extended practice of shipping ores to distant smelters for treatment and to the increase in number and importance of the sampling works. In the tables the increased importance of Montana and Colorado as producers of silver is especially apparent, the increase in Montana having been largely due to the heavy stimulus to copper production.

Approximate distribution in round numbers, by States and Territories, of the estimated total product of precious metals in the United States during the calendar years 1881 to 1888, inclusive.

States and Territories.	1881.			1882.		
	Gold.	Silver.	Total.	Gold.	Silver.	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

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.	1883.			1884.		
	Gold.	Silver.	Total.	Gold.	Silver.	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

	1885.			1886.		
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	2, 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

	1887.			1888.		
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

The following table shows the production of gold and silver in the United States since 1804, silver being valued at the coining rate in silver dollars, equivalent to $1.2929 per troy ounce fine:

Product of gold and silver in the United States to December 31, 1888.

Periods.	Gold.	Silver.	Total.
Output of the Southern States from 1804 to the discovery of gold in California in 1848 (based on estimates of Prof. J. D. Whitney)	$13, 243, 475	....	$13, 243, 475
Product from 1848 to 1879, inclusive, by fiscal years	1, 484, 041, 532	$422, 722, 260	1, 906, 763, 792
Fiscal year ending June 30, 1880 (census figures, covering a period one month earlier, assumed)	33, 379, 663	41, 110, 957	74, 490, 620
July 1, 1880, to December 31, 1880 (estimated on the basis of half the product of the fiscal year 1881, as reported by Hon. Horatio C. Burchard, Director of the Mint)	18, 250, 000	21, 050, 000	39, 300, 000
Calendar years 1881 to 1884, inclusive (as reported by Hon. Horatio C. Burchard, Director of the Mint)	128, 000, 000	184, 800, 000	312, 800, 000
Calendar years 1885, 1886, 1887, and 1888 (as reported by Dr. James P. Kimball, Director of the Mint)	133, 116, 000	215, 236, 300	348, 352, 300
Total product of the United States to close of 1888	1, 810, 030, 670	884, 919, 517	2, 694, 950, 187

The price of silver in London at the commencement of the calendar year 1888 was 44½ pence. There was a steady decline until May 19, when the price reached 41⅝ pence, the lowest on record. It quickly rose to 42 pence, and remained almost stationary for the succeeding three months, June, July, and August, the price not varying more than five-sixteenths from 42 pence. Early in September a rapid rise took place, owing to a demand for Spanish coinage, coupled with speculation, so that the price rose 2 pence in one week, from $42\frac{3}{16}$ pence to $44\frac{3}{16}$ pence. When the orders for Spanish coinage were filled, no improvement in the rate of exchange, which had been depressed, having occurred, the price of silver fell rapidly to 43 pence, from which rate the variations were only three-eighths pence up to December 1. At that date, owing to a stringency in the London money market, there was a further fall in the price, and on December 20 it reached $42\frac{5}{16}$ pence. Subsequently it rose to 42⅝ pence, at which rate it closed on December 31, 1888.

The average price in London of silver, British standard, .925 fine, according to daily dispatches to the Bureau of the Mint, was 42.869 pence, equivalent at the par of exchange to $0.93974 per fine ounce. At this price the bullion value of the silver contained in the standard silver dollar was $0.72683. At the highest rate for silver during the year, $44\frac{9}{16}$ pence, the bullion value of the silver dollar was $0.75554, and at the lowest rate, 41⅝ pence, $0.70574. The following table exhibits the highest, lowest, and average price of silver in London each month during the calendar year, and the equivalent value of an ounce of fine silver at the par of exchange, and also at the average monthly rate of exchange:

Highest, lowest, and average price in London of silver bullion, 925-thousandths fine, and value of a fine ounce, each month, during the calendar year 1888.

[Compiled from daily telegraphic cable dispatches to the Bureau of the Mint.]

Date.	Highest.	Lowest.	Average price per ounce, British standard, .925.	Equivalent in U. S. money, per ounce fine, with exchange at par, $4.8665.	Average monthly price at New York of exchange on London.	Equivalent in U. S. money of fine bar silver, 1,000 fine, based on average monthly quotations, with exchange at average monthly rate.	Average monthly New York price of fine bar silver.
1888.	*Pence.*	*Pence.*	*Pence.*				
January	$44\frac{9}{16}$	$44\frac{3}{16}$	44.380	$0.97286	$4.8637	$0.97219	$0.97342
February	$44\frac{3}{16}$	$43\frac{13}{16}$	44.033	.96525	4.8613	.96421	.96630
March	$43\frac{3}{4}$	43	43.293	.94903	4.8757	.95083	.95514
April	$42\frac{7}{8}$	$42\frac{1}{2}$	42.669	.93535	4.8754	.93709	.94085
May	$42\frac{5}{8}$	$41\frac{5}{8}$	42.048	.92174	4.8867	.92577	.92803
June	$42\frac{1}{4}$	42	42.092	.92271	4.8857	.92633	.92639
July	$42\frac{5}{16}$	42	42.111	.92312	4.8836	.92634	.92640
August	$42\frac{1}{8}$	$41\frac{15}{16}$	42.007	.92085	4.8753	.92251	.92287
September	$44\frac{1}{4}$	$42\frac{1}{16}$	43.160	.94612	4.8801	.94971	.94947
October	$43\frac{3}{8}$	$42\frac{7}{8}$	43.097	.94474	4.8780	.94697	.94903
November	$43\frac{1}{8}$	$42\frac{7}{8}$	43.029	.94325	4.8799	.94595	.94656
December	$42\frac{7}{8}$	$42\frac{5}{16}$	42.516	.93200	4.8864	.93581	.93625
Average for the year	....	....	42.869	.93974	4.8777	.94190	.94300

The Government purchased 28,920,398 standard ounces of silver during the year, costing $24,491,340, an average price of 94 cents per fine ounce. The total amount of silver purchased for the coinage of the silver dollar since March 1, 1878, has been 275,007,939 standard ounces, costing $266,091,445, an average price of $1.075 per fine ounce or $0.967 per standard ounce.

The value of the gold deposited at the mints during the year, not including re-deposits, was $41,496,410, or, including re-deposits, $48,794,988. The foreign material comprised in this was $7,055,046. The amount of silver deposited and purchased was 35,512,789 standard ounces of the coining value of $41,323,973, exclusive of re-deposits.

The coinage, in comparison with that of the preceding calendar year, is exhibited in the following table:

Coinage executed at the mints of the United States during the calendar years 1887 *and* 1888.

Coins.	1887.		1888.	
	Pieces.	Value.	Pieces.	Value.
Gold	3,086,873	$23,972,383.00	2,238,562	$31,380,808.00
Silver dollars	33,611,710	33,611,710.00	31,990,833	31,990,833.00
Subsidiary silver	15,754,809	1,579,371.40	8,456,153	1,034,773.45
Minor	60,498,096	1,215,686.26	48,255,980	912,200.78
Total	112,951,488	60,379,150.66	90,941,528	65,318,615.23

In addition to the coinage, bars were manufactured at the mints containing gold of the value of $21,650,798 and of silver $7,635,490.

Imports and exports.—The following table, arranged by the Director of the Mint, shows the movement of gold and silver during the last calendar year:

Imports and exports of gold and silver during the calendar year ended December 31, 1888.

Metals.	Imports.	Exports.	Gain.	Loss.
Gold bullion	$1,599,691	$25,799,677		$24,199,986
Gold in ores	71,168	125,153		53,985
Gold coin, foreign	8,191,756	5,920,089	$2,271,667	
Total foreign	9,862,615			
Gold coin, United States	1,169,326	2,774,748		1,605,422
Total, foreign and domestic	11,031,941	34,619,667	2,271,667	25,859,393
Silver bullion	5,977,036	22,581,516		16,604,480
Silver ores	5,684,093	15,045	5,669,048	
Silver coin, foreign	9,691,977	7,233,385	2,458,592	
Total foreign	21,353,106			
United States coin	238,028	65,276	172,752	
Trade-dollars	928		928	
Total, foreign and domestic	21,592,062	29,895,222	8,301,320	16,604,480
Total gold and silver	32,624,003	64,514,889		
Net loss				31,890,886

World's production of gold and silver for 1887 and the three preceding years.

Years.	Gold.		Silver.	
	Kilograms.	Value.	Kilograms.	Value.
1884	153,070	$101,729,600	2,537,564	$105,461,350
1885	156,156	103,779,600	2,841,573	118,095,150
1886	149,338	99,250,877	2,896,882	120,394,400
1887	151,712	100,826,800	3,016,044	125,346,310

Industrial consumption.—The total consumption of the precious metals in the industrial arts, according to the statements furnished the Bureau of the Mint, has been very much larger during the past year than in preceding years, both in gold and in silver. The increase has been large both in bars furnished by the Government institutions and in bars furnished by private refineries, but especially large in the value of silver bars for industrial use furnished by private refineries in the United States. According to the figures presented in these tables, the value of gold bars for industrial use furnished during the calendar year 1888 was $13,324,025.46, against $11,672,606.40 in 1887 and $9,934,791.10 in 1886, showing a steady increase each year in the consumption of gold in the industries in the United States. The value (coining value) of the silver bars furnished for industrial uses during the calendar year 1888 was $7,908,148.79, against $5,241,998.19 in the calendar year 1887, and $4,858,323.58 in the calendar year 1886, showing a steady increase also in the value of silver used in the United States in the industries, but a very large increase during the last year.

Imports of gold and silver, 1868 to 1885, inclusive.

Fiscal years ending June 30—	Gold.			Silver.	
	Dust. (*a*)	Bullion.	Coin.	Bullion.	Coin.
1868	....	$1,909,503	$6,558,602	$151,238	$5,304,835
1869	....	890,064	13,240,191	54,267	5,622,548
1870	....	697,904	11,452,414	161,932	14,217,406
1871	....	1,177,387	5,704,298	69,836	11,591,875
1872	$258,329	1,101,617	7,339,572	405,631	4,647,034
1873	7,771	1,549,899	7,092,011	476,608	12,318,911
1874	20,842	1,319,316	18,089,155	830,639	8,153,087
1875	15,222	1,562,767	12,018,537	1,294,763	5,913,474
1876	28,802	1,167,102	6,596,692	1,057,377	6,885,795
1877	85,858	2,032,997	24,131,925	4,693,605	9,829,666
1878	17,602	1,955,005	11,365,656	6,971,849	9,512,704
1879	17,949	1,275,749	4,373,168	2,424,675	12,203,871
1880	883,690	19,453,755	60,420,951	1,981,425	10,294,489
1881	697,467	30,301,452	69,032,340	2,303,472	8,240,766
1882	647,551	8,758,502	24,971,001	2,121,833	5,973,603
1883	....	3,334,708	14,399,441	2,475,968	8,279,274
1884	....	4,997,571	17,833,746	2,910,451	11,684,494
1885	....	3,849,237	17,842,459	4,530,384	12,020,243

a In 1868–1871 and 1883–1885 included under head of gold bullion.

Imports of gold and silver for the calendar years 1886 to 1888.

Years.	Gold.			Silver.			Total.	
	Bullion.	United States and foreign coin.	Ores.	Bullion.	Coin.	Ores.	Gold.	Silver.
1886	$17,947,528	$23,361,663	$654	$4,321,855	$12,901,610	$2,536,949	$41,309,845	$19,760,414
1887	19,524,641	25,364,658	14,028	5,373,001	11,399,613	4,228,107	44,903,327	21,000,721
1888	1,599,691	9,361,082	71,168	5,977,036	9,930,933	5,684,093	11,031,941	21,592,062

Exports of gold and silver of domestic production, 1851 to 1885, inclusive.

Fiscal years ending June 30—	Gold and silver coin. (*a*)	Gold.		Silver.	
		Bullion.	Coin.	Bullion.	Coin.
1851	$18,069,580	....	....	....	....
1852	37,437,837	....	....	....	....
1853	23,548,535	....	....	....	....
1854	38,062,570	....	....	....	....
1855	19,842,423	$34,114,995	....	....	....
1856	15,458,333	28,689,946	....	....	....
1857	28,777,372	31,300,980	....	....	....
1858	19,474,040	22,933,206	....	....	....
1859	24,172,442	33,329,863	....	....	....
1860	26,033,678	30,913,173	....	....	....
1861	10,488,590	13,311,280	....	....	....
1862	....	13,267,739	$17,776,912	....	....
1863	44,608,529	11,385,033	....	....	....
1864	....	10,985,703	86,148,921	$836,387	$2,502,551
1865	....	21,145,055	35,413,651	6,311,986	1,747,432
1866	....	20,731,473	49,395,993	10,832,849	1,683,059
1867	....	13,867,641	22,362,035	15,853,530	2,892,990
1868	....	23,841,155	44,390,003	12,978,311	2,536,506
1869	....	13,584,407	14,858,369	13,573,427	899,763
1870	....	15,812,108	12,768,501	11,748,864	3,554,329
1871	....	9,089,959	55,491,719	17,285,916	2,535,765
1872	....	7,986,145	40,391,357	22,729,657	1,691,081
1873	....	8,810,175	35,661,863	27,759,066	1,674,442
1874	....	3,878,543	28,766,943	22,498,782	4,555,418
1875	....	2,233,775	59,309,770	17,197,914	5,115,670
1876	....	1,888,896	27,542,861	15,240,344	5,366,590
1877	....	1,084,536	21,274,565	11,182,894	9,292,743
1878	....	205,319	6,427,251	15,035,045	5,394,270
1879	....	24,774	4,120,311	11,883,064	1,526,886
1880	....	87,066	1,687,973	6,912,864	659,990
1881	....	84,943	1,741,364	11,852,995	547,642
1882	....	1,598,336	29,805,289	11,653,547	423,099
1883	....	4,118,455	4,802,454	12,551,378	150,894
1884	....	23,052,183	12,242,021	14,241,050	690,381
1885	....	395,750	2,345,809	20,422,924	1,211,627

a In 1862 and 1864–1885 segregated, appearing in the other columns.

Exports of gold and silver for the calendar years 1886 *to* 1888.

Years.	Bullion.	Coin.		Ores.
		United States.	Foreign.	
GOLD.				
1886	27, 862, 637	4, 525, 872	8, 873, 821	....
1887	1, 085, 889	4, 005, 659	4, 048, 991	....
1888	25, 799, 677	2, 774, 748	5, 920, 089	125, 153
SILVER.				
1886	16, 152, 717	99, 630	10, 779, 529	....
1887	19, 671, 571	47, 396	7, 894, 041	600
1888	22, 581, 516	65, 276	7, 233, 385	15, 045

TOTAL EXPORTS.

Years.	Gold.	Silver.
1886	41, 262, 330	27, 031, 876
1887	9, 140, 539	27, 613, 608
1888	34, 619, 667	29, 895, 222

COPPER.

By C. Kirchhoff, Jr.

High prices, maintained during the whole of the year 1888 through the operations of the French syndicate, created a pressure upon producers throughout the United States, to which they responded by an unprecedented increase in the output. On the part of consumers resistance was passive, the financial resources of those engaged in cornering the world's supply being so great that no opposition was made either collectively or individually. At no time during the year did any signs of weakness appear. No indications came to the surface of the tremendous strain upon the financial resources of the speculators themselves or upon the banking institutions which backed them. What supplies came upon the markets of the world through channels not controlled by the clique were taken unflinchingly. Its own strength proved an element of discomfiture to the syndicate, since it gave encouragement beyond the hope of temporary profit to many nascent enterprises. It was argued with much force by those who were engaged in floating new copper-mining ventures that the syndicate possessed the power, and had shown its determination to exercise it, to hold the price of the metal for years to come. It was urged that the period most dangerous to its existence had passed, since the supply of old material and scrap collected all over the world was showing indications of exhaustion. Then consumers would be compelled to fall back upon new copper, which could only be procured from the speculators at their own price. It may be admitted that from a statistical point of view the accumulation of supplies in the hands of the syndicate exaggerated the dangers of the situation. In other words, the additions to stocks through the double effect of an increase in the output, and of a decline in the consumption, could not alone account for the accumulation of metal in the hands of the syndicate. The "invisible supply," when it began its operations, was converted into a "visible" supply through them. That "invisible" supply was the stock of copper in the hands of smelters and refiners in process of treatment, the stock in the hands of manufacturers as partly finished and as marketable goods, the stock of manufactured articles in the hands of merchants, dealers, and consumers. All along the line every one handling the metal or its alloys reduced his holdings to a minimum, holdings probably large in the aggregate at the outstart, but never counted by statisticians. In addition to this, the metal scattered all over the world as old material and scrap became an important factor, enabling manufacturers to cut down their purchases of new metal, thus crowding into stock copper which would otherwise have gone into consumption. No data are available to measure the quantity of metal which was thus converted from "invisible" to "visible" supply. It is probable that it played a more important rôle in bringing about the final collapse of the syndicate than the reduction in the consumption incident to a high price or the diversion from copper to other metals as a material for finished goods. In fact, the leader in the speculation himself has practically confessed that it was the magnitude of this factor in the situation which was the chief source of embarrassment, baffling as it did all calculations.

If this view is correct, it possesses considerable significance for the future, since it will take years before the quantities of metal thus drawn out by high prices can be again distributed in a normal degree. The process of the creation of an "invisible" supply, average in quantity, must necessarily be slow.

The statistics of production and the accumulation of stocks during 1888 bear out this interpretation of the situation. In 1886 the production of the world was 214,502 long tons, while the stocks in England and France, concerning which we alone possess reliable data, increased 5,120, thus making the apparent consumption 219,622 long tons. In 1887, with an output of 223,470 tons and a decline in stocks of 18,169 tons, the apparent consumption was 241,639 tons. In 1888 the product rose to 259,778 tons, while stocks in England and France rose from 42,301 tons on January 1 to 104,105 tons on December 31. Now, it is conceded that in 1888 consumption really did fall off considerably. It is evident, therefore, that large quantities of metal, constituting the "invisible" supply before the rise, were diverted into the hands of those who were engaged in the cornering operation.

However interesting and instructive from a historical point of view the operations of the syndicate and its final collapse may be, the subject of direct practical interest to those connected with the copper industry from the time the ore is raised until the manufactured goods leave the retailer's counter is the price at which the metal rests on a sound basis. On the one side the leading interests in the metal are the mining companies throughout the world, and the banking concerns controlling nearly the whole stock of the metal. In past years the former have shown their ability to supply the world's markets at a low price, and since then many have extended plant and facilities, while some important new concerns have sprung into existence. So far as they are concerned, there must be a restriction of output, either voluntary at a moderate price or enforced through an exceptionally low range of values. The latter would be immediately established were any attempt seriously made by those controlling the accumulated stock to market a part of their holdings. Neither consumers nor speculators would consent to carry a part of the load, unless the price were depressed to a point where the new purchasers felt reasonably sure of a good profit in the near future. That price must be close to the cost of production of the richest and best equipped mines in the world, or considerably less than the metal has ever sold in the past. Now, virtually the owners of by far the greater part of the accumulated supply are the Bank of France and a number of French financial institutions and bankers, to whom the copper was turned over as the principal asset of the Comptoir d'Escompte, in consideration of loans, the Comptoir d'Escompte having advanced heavily on copper warrants for the Société des Métaux and M. Sécretan. The greater part of the stock was therefore in the strongest hands when the collapse came, and was not thrown on the market indiscriminately. Still, even that great banking institution will not be content to postpone realizing indefinitely, allowing interest and charges to cause a steady increase in cost. Instead of one source of supply, current production, the market was forced after the collapse, and must still deal with the added quantity, represented by the necessary reduction in the stock, until a safe limit is reached.

The report of the liquidators of the Comptoir d'Escompte is of interest, since it shows how rapidly, once embarked in the speculation, its advances continued to grow without adequate security, until at last its entire assets were swallowed up. The first guaranty of contracts entered into by the Société des Métaux made by the Comptoir was in December, 1887, in favor of the Anaconda mine. This was followed on January 4 and March 13 by other contracts. In the meantime M. Sécretan had formed a syndicate of capitalists, at first sixteen in number, who undertook to advance $13,580,000 for a period of one to three years. Three members of the group, however, withdrew before February 1, 1888, when the arrangements were completed. The capital of the syndicate was, however, reduced to $10,718,500, and of that sum the Société des Métaux entered for $2,910,000, and M. Sécretan personally for $2,328,000. Neither that company nor M. Sécretan furnished the called-for share of the capital when a first call of 20 per cent. was made on the members of the syndicate, and it was provided by the Comptoir d'Escompte. On March 13, the director of the Comptoir, M. Denfert-Rochereau, for the first time brought the matter before the board of directors, and obtained authority to guarantee two new contracts with American mines. On March 27, the Comptoir guaranteed contracts with the Rio Tinto, Cape, Tharsis, and Mason & Barry companies. A further call of 20 per cent. of the advances from the syndicate was made by the Comptoir, but at the same time a further fresh sum of $15,132,000 was guaranteed under a contract with the Rio Tinto Company. At the end of May the advances on tin had reached $9,538,000, and the advances on copper $16,297,000, a total of $25,831,000, of which $6,111,000 were unsecured. At the end of June the Comptoir was in such straits that it was forced to obtain from the syndicate permission to pledge warrants it held for them, and which represented the value received for the advances to the syndicate. The warrants were employed to obtain funds from the Bank of France and other establishments. The syndicate which had engaged to advance the $12,028,000 to the Société des Métaux then demanded that the affairs in tin should be disjoined from those in copper, in consequence of which M. Sécretan engaged to transfer land to a value of $582,000, and the Société des Métaux acknowledged its liability for a sum of $3,046,000. Then the Comptoir agreed reluctantly to guarantee new contracts presented by the Société des Métaux. At the end of July the unsecured advances had risen to $11,452,000; towarde the end of August the total advances were $24,805,000, of which $11,146,000 were unsecured. On the 4th of September the Comptoir demanded from the Société des Métaux the payment of the sums due on credits applied to extinguish the loss on tin, and the settlement of its regular account, but received no satisfaction. In December the negotiations with the object of forming an English company to take over the stock of copper had fallen through. The Comptoir threatened in vain to refuse to make any further payments in behalf of the Société des Métaux. M. Sécretan replied that such a step would bring about an immediate collapse. At the end of the month the advances of the Comptoir amounted to $33,368,000, of which $16,878,000 were unsecured. In January the Comptoir was forced to borrow $3,974,000 in order to carry the Société. A month alter the Comptoir was compelled to part with warrants representing a security of $7,382,000, in order to permit the Société to raise a loan of $5,000,000. In return for that concession M. Sécretan engaged to sell from March 1, 12,000 tons of copper monthly by public sales if unable to find purchasers privately; but that arrangement was superseded by the formation of the Société Auxiliaire des Métaux, which was to take over 75,000 tons of copper, at the price of £70 per ton, and pay over the value to the Comptoir d'Escompte. That contract was, however, only partly carried out, and as the Comptoir had subscribed a part of the capital of the new company, the effective reduction in the advances to the Société des Métaux was of insignificant amount. Early in March the collapse came in a dramatic manner. On March 31 the position of the company, according to the report of the liquidators, showed that the advances to the Société were $28,421,000, against which there remained 67,827 tons of copper. The assets aggregated 299,880,007 francs ($57,887,000), including the 67,827 tons of copper, valued at 1,000 francs a ton, or £40. Of these assets, 203,089,846 francs ($39,196,000) were pledged to secure a loan of 140,000,000 francs from the Bank of France, and loans of 37,107,250 francs by a number of French banks and banking institutions, made as the result of efforts by the Minister of Finance to allay the panic. The liabilities were 293,325,330 francs, including the loans of 37,107,250 francs. There was, therefore, a balance of assets of 6,554,676 francs, providing the copper realize the estimated value. The engagements with the mining companies, by which the Comptoir guaranteed the payment of future deliveries of 320,000 tons of copper, it was believed might be canceled.

At a meeting of the Banque de Paris et des Pays Bas, which was one of the banking institutions advancing to the Comptoir d'Escompte, it was stated that the bank had advances on warrants representing 12,400 tons, made at the price of £48, the greater part of which dated from the month of January.

The collapse of the Comptoir d'Escompte led to the default on May 16, on all the contracts made between American mining companies and the Société, whose guarantor it was, except in the case of two groups of interests. In these, which include a leading Montana company and some Arizona mines, the contracts of the Société were guaranteed by other bankers, who in turn appear to have covered themselves thoroughly. In both cases three years' product was bought outright, the basis of the transaction being gradually lower prices for successive years. The companies in question are delivering and will continue to deliver their product to the bankers under their contracts.

The history of the brief sway of the syndicate has established one important fact, that the great copper deposits in the United States which are at all accessible are thoroughly known, especially so far as the territory west of the Mississippi is concerned. With the brilliant coloring of surface copper ores, deposits of that metal naturally attract attention readily; in fact, the surface show is generally far more impressive than the metal contents would warrant. During 1888 every prospect was eagerly examined by American and European capitalists, and with the exception of isolated cases nothing was found to warrant the belief that important new sources of supply would be developed. Since the collapse, with an era of low prices staring every adventure in the face, the probabilities that new producers will enter the ranks are very slight indeed. The trade will therefore deal only with the well-established enterprises.

Under normal conditions the safe price would be that at which enough copper could be produced at an adequate profit to the mines throughout the world to supply its requirements. There are few commodities with which this price can be fixed with greater accuracy, because in nearly every great producing district of the world, Chili alone excepted, there are public companies whose published annual reports allow of a close approximation to the cost of production. Under ordinary conditions the normal price thus arrived at, approximately, if borne out by a study of the history of the trade during the depression, would represent the figure below which purchases would be safe, providing consumption came up to a fair average.

Turning first to the United States, it may be stated at the outset that the home consumption, putting it at 130,000,000 pounds, can be furnished without real hardship to the leading mines at 10½ cents for lake and 10 cents for other brands. At 10½ cents the Calumet and Hecla, Tamarack, Quincy, Osceola, Atlantic, Central, and Franklin mines could live, they representing a total product of about 80,000,000 pounds. At

10 cents for other brands, in Montana the Anaconda, Boston and Montana, Parrott, and the mines working chiefly on argentiferous ore could run to full capacity and pay relatively small dividends. They would represent an output of at least 90,000,000 pounds. Among the Arizona mines, the Copper Queen, Holbrook and Cave, Detroit and Old Dominion, could stand 10-cent copper and supply the markets with 20,000,000 pounds. Add that part of the product of Colorado which is derived from argentiferous ores, and the copper coming from the lead smelters and desilverizers, say 3,000,000 pounds, and a grand total is reached of 193,000,000 pounds of copper, which could be marketed with present facilities at 10 and 10½ cents, respectively, without any loss whatever to the weakest of the mines participating in the product, and with a very good profit to the best equipped and richest of them. These are not rough guesses, but are based, in the majority of cases, upon actual cost of production. Placing the consumption of the country at 130,000,000 pounds, which is very liberal, we would have available for export 63,000,000 pounds annually, which could be laid down in Liverpool at less than £50 for best tough cake, or, say, £45 for Chili bars.

In Europe we must look to the year 1886 to judge of the capacity of the copper companies to meet low prices. In Spain and Portugal, in that year, Rio Tinto dividends went down to 3 per cent. and Tharsis to 7½ per cent., while Mason & Barry distributed nothing. The average price of Chili bars during that year was slightly over £40, so that at £45 the three concerns could produce at a moderate profit at the rate of about 50,000 tons per annum, not counting any of the other Spanish mines.

In Germany the Mansfeld Company, with a product of about 13,000 tons, was hard pressed when the price fell to £40, but would certainly continue at £45. Chili fell off rapidly at low prices, but might be expected to supply at least 25,000 tons. The Cape makes good dividends at the lowest prices, and could ship 7,500 tons. Australia is weak, and, judging from the Wallaroo and Moonta reports, could not supply more than 7,000 tons at £45. Japan has gone right along at a 10,000-ton rate in bad times. Venezuela lost money in former years, but has improved its practice after American models, and might furnish 3,000 tons. The Boleo mines in Mexico may be credited with 2,500 tons; Canada with 2,000 tons, of which the bulk comes to this country in the form of pyrites, and Newfoundland may be put down at 1,000 tons. Then there are several sources of supply, partly local, like the Russian, which would aggregate about 12,000 tons. Summarizing, we have:

Probable output of copper with the price at £45 per ton.

	1888.	1886.	At £45 (Chili bars).
	Long tons.	*Long tons.*	*Long tons.*
United States	101,054	69,971	86,000
Spain and Portugal	63,800	49,653	50,000
Mansfeld	13,380	12,595	13,000
Chili	31,240	35,025	25,000
Cape	7,500	6,015	7,500
Australia	7,450	9,700	7,000
Japan	11,000	10,000	10,000
Venezuela	4,000	3,708	3,000
Mexico	2,766	250	2,500
Canada	2,250	1,440	2,000
Newfoundland	2,050	1,125	1,000
All others	13,288	15,020	12,000
Total	259,778	214,502	219,000

It is evident, then, that with copper ruling in London on the basis of £45 for Chili bars or its equivalent here of about 10½ cents for lake, enough metal can be produced without loss to the mining companies to supply the world with about as much metal as it received in 1886. In that year, with the price averaging £40½ in London, and the lake companies' sales for the year ranging between 10½ and nearly 11 cents as the average, the stock in England and France increased from 58,170 tons on January 1, to 63,290 tons on December 31.

It is probable that in addition to the quantity of copper which would be produced at £45, as estimated, there would be amounts of some importance coming from mines really unable to meet the market, but run at a loss in the face of an unfavorable outlook. On the other hand, consumption withheld within the narrowest limits for over a year might be expected to deal with larger quantities, and might be able to cope with a considerable addition to the supply coming from the holdings of the banks.

The year 1887 witnessed a steady decline in the stocks of metal in the leading markets and justified the claim made by the supporters of the speculation that the world's consumption had outstripped its production. Stocks declined for months after the rise had been initiated, but the accumulation of metal once begun progressed at a very rapid rate, supplies from all parts of the world being rushed to market, especially by those who were not under contract with the syndicate. There is every reason to believe that the latter held back large quantities of copper at the mines under their control, notably in Spain. The stock statements do not include the accumulations in this country. It is officially reported that the agents of the syndicate held in the United States, on January 1, 1889, in round numbers 59,000,000 pounds of copper. It should be noted, however, that this figure included all the copper which could in any way be classed as stock, metal in ore at the mouth of the mine, in the stamp mills, concentrators, at smelters, and in transit.

More than one-half of the stock in England and France was in Chili bars, the details being as follows:

Stocks of copper in England and France.

Brands.	Where held.	Mar. 1, 1887.	Mar. 1, 1888.	Jan. 1, 1889.	Mar. 1, 1889.
Chilian	Liverpool and Swansea	41,104	33,656	29,118	33,401
Do	France	1,637	2,607	29,533	30,996
American	Liverpool	70	2,625	12,441	17,710
Do	France	1,230	1,735	4,279	4,225
Sundries	Liverpool and Swansea	3,165	771	3,475	4,271
Do	London	4,742	2,746	5,630	7,110
Do	France	347	803	5,676	5,800
Good merchantable copper.	Liverpool and Swansea			4,513	9,935
Total		52,295	44,943	94,665	113,448

The interesting features are the transfer of large quantities of copper to French warehouses and the heavy accumulations of American metal in Europe, the greater part of the stock in England being Anaconda matte, of which the stock on March 1, 1889, was 25,721 long tons.

The following statement shows, on the authority of Messrs. Henry R. Merton & Co., of London, the stock in England and France, and the quantities afloat from Chili and Australia; also the imports into England and France from North America, Spain and Portugal (excluding pyrites) and other countries, on the first of each month.

Copper stocks and imports into England and France.

Dates.	Stocks in England and France, and afloat from Chili and Australia.	Imports into England and France from— North America.	Spain and Portugal (excluding pyrites).	Other countries.
1887.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
January	63,290	983	422	1,350
February	61,375	726	1,397	1,932
March	59,546	166	1,875	634
April	57,023	394	1,151	982
May	56,172	541	828	584
June	54,770	2,101	1,233	1,529
July	51,972	3,168	1,445	1,631
August	52,256	1,609	1,722	1,168
September	51,206	1,637	1,156	2,015
October	49,176	1,580	1,257	595
November	48,503	2,693	2,340	1,714
December	45,121	3,193	1,688	1,453
1888.				
January	42,301	2,625	2,128	1,764
February	45,492	3,219	966	2,334
March	52,593	4,513	1,656	2,448
April	58,747	2,638	1,752	3,053
May	64,349	2,469	1,335	3,575
June	69,487	3,583	1,628	3,471
July	72,243	2,486	1,550	1,782
August	79,187	2,758	2,116	4,961
September	86,701	2,215	2,255	3,414
October	90,754	1,563	2,752	1,904
November	93,988	1,686	1,006	3,928
December	97,906	1,931	1,403	2,220
1889.				
January	104,105	2,588	2,164	2,738
February	109,528	2,778	1,209	3,079
March	118,140	3,372	1,217	2,720

It is estimated by good authority that the stock of copper throughout the world on March 1, 1889, when the speculation collapsed, was not less than 175,000 long tons, the syndicate having held back considerable quantities at the mines to avoid the payments of freights and charges, and having retained some copper at English smelting works controlled by Spanish and Cape companies whose product they had agreed to purchase. Although the history of the copper trade furnishes a precedent for the carrying of a large stock for many years, in the case of a great Anglo-Chilian estate, the quantity having been upward of 40,000 tons, it is not probable that the banking institutions which have taken over the assets of the Comptoir d'Escompte will be content to carry the stock indefinitely. For at least two or three years to come a considerable part of the world's consumption must be covered by a reasonable proportion of the stock in excess of the quantity which the industry can carry. The latter amount, judging from past experience, should not be placed higher than 75,000 tons, which, however, could not be transferred to dealers, speculators, manufacturers, smelters, and consumers without the inducement of low prices. The balance, 100,000 tons, to be pushed into consumption would have to replace an equal amount of new copper; in other words, it must be marketed at a price low enough to cause suspension of work at a number of mines having nearly the equivalent aggregate annual capacity, allowance being made for the effect of a low price in stimulating consumption. Efforts were made to secure the consent of the leading mines of the world to a reduction of output. The negotiations failed utterly, and since then the market has been allowed to shape its own course, the principal feature of interest developed being the very rapid and very general increase in the consumption of the metal as contrasted with the long period when every consumer was starving himself.

Taking into consideration the transfer of part of the stock of Chili bars to France, the exports from Great Britain showed a decline from 69,453 long tons to 49,509 tons, a falling off of 20,000 tons in round figures. The returns clearly prove how consumption in the world was restricted as the result of high prices, since England supplies all countries outside of the leading continental nations and the United States. The most striking decrease is in yellow metal, the copper contents of which fell from 10,153 to 4,513 tons in the metal exported. India is England's greatest customer, it taking 13,400 tons less of English copper in 1888 than in 1887. The statistics showing the direct imports of ingot into British India from Australia are not available. It is probable that the shipments from Australia were made to England.

DOMESTIC PRODUCTION.

The growth in the production of copper in the United States, compiled up to 1888, inclusive, from the best data available, is shown in the following table. It proves in a striking manner how preponderating was, until the past few years, the influence of the Lake Superior district; and again of one great mine in it, the Calumet and Hecla, for more than a decade. In order to point out more clearly how the influence of the lake district has declined, a column has been added giving its percentage of the total product from year to year. It should be stated that the yield of copper from pyrites is not here included.

Product of copper in the United States from 1845 *to* 1888, *inclusive.*

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	1867...	10,000	7,824	603	78.2
1846...	150	26	....	17.0	1868...	11,600	9,346	2,276	80.6
1847...	300	213	....	71.0	1869...	12,500	11,886	5,497	95.1
1848...	500	461	....	92.5	1870...	12,600	10,992	6,277	87.2
1849...	700	672	....	96.0	1871...	13,000	11,942	7,242	91.9
1850...	650	572	....	88.0	1872...	12,500	10,961	7,215	95.7
1851...	900	779	....	86.6	1873...	15,500	13,433	8,414	87.3
1852...	1,100	792	....	72.0	1874...	17,500	15,327	8,984	87.6
1853...	2,000	1,297	....	64.9	1875...	18,000	16,089	9,586	89.4
1854...	2,250	1,819	....	71.1	1876...	19,000	17,085	9,683	88.9
1855...	3,000	2,593	....	86.4	1877...	21,000	17,422	10,075	82.9
1856...	4,000	3,666	....	91.6	1878...	21,500	17,719	11,272	82.4
1857...	4,800	4,255	....	88.7	1879...	23,000	19,129	11,728	83.2
1858...	5,500	4,088	....	74.3	1880...	27,000	22,204	14,140	82.2
1859...	6,300	3,985	....	63.3	1881...	32,000	24,363	14,000	76.1
1860...	7,200	5,388	....	74.8	1882...	40,467	25,439	14,309	62.1
1861...	7,500	6,713	....	89.1	1883...	51,574	26,653	14,788	50.1
1862...	9,000	6,065	....	67.4	1884...	63,555	30,916	17,812	48.4
1863...	8,500	5,797	....	67.0	1885...	74,053	32,206	21,093	43.5
1864...	8,000	5,576	....	69.7	1886...	69,971	35,666	22,553	50.1
1865...	8,500	6,410	....	75.4	1887...	80,768	33,693	20,543	41.7
1866...	8,900	6,138	....	68.8	1888...	103,245	38,604	22,453	38.2

The significance of these figures must be pointed out, since the facts which they so clearly establish are frequently ignored by writers not familiar with the history of the copper-industry during the past decade, and with its present development. Previous to the opening of the Arizona and Montana mines the producers of the Lake Superior district possessed undisputed sway over the domestic market. For years they exported the small excess of product over consumption, often at a sacrifice, with the avowed object of exacting a higher price from American consumers. This fact is still often alluded to by economic writers, who forget, however, that since 1883 that policy has been abandoned as utterly hopeless under the new conditions since prevailing. When export sales were made at prices lower than those demanded from domestic consumers, the excess of supply over demand was very small. But when the United States rose to the position of being one of the greatest copper-exporting countries of the world, when three great districts struggled for the domestic trade, then the repetition of former practices became impossible.

The following is, in detail, the output of the Lake Superior mines. In the majority of cases it is the official product based on smelting works' returns; in a few instances it is an official estimate of the ingot product based on the known output of mineral. The total is accurate, therefore, within a few thousand pounds.

Product of Lake Superior copper mines, 1882 to 1888.

Mines.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Calumet and Hecla	32,053,539	33,125,045	40,473,585	47,247,990	50,518,222	46,016,123	50,295,720
Quincy	5,665,796	6,012,239	5,650,436	5,848,530	5,888,517	5,603,691	6,367,809
Osceola	4,176,782	4,256,409	4,247,630	1,945,208	3,560,786	3,574,972	4,134,320
Franklin	3,264,120	3,488,708	3,748,652	4,007,105	4,264,297	3,915,838	3,655,751
Allouez	1,683,557	1,751,377	1,928,174	2,170,476	1,725,463	885,010	314,198
Atlantic	2,631,708	2,682,197	3,163,585	3,582,633	3,503,670	3,641,865	3,974,972
Pewabic	1,482,666	1,171,847	227,834	....	....	....	....
Central	1,353,597	1,268,556	1,446,747	2,157,408	2,512,886	2,199,133	1,817,023
Grand Portage	757,080	735,598	255,860	....	....	....	....
Conglomerate	734,249	222,117	1,198,691	....	....	....	....
Mass	737,440	659,474	481,396	363,500	247,179	....	....
Copper Falls	587,500	804,000	891,168	1,150,538	1,378,679	719,150	1,199,950
Phœnix	537,177	512,291	631,004	344,355	1,101,804	11,000	....
Hancock	540,575	484,906	562,636	203,037	150,000	....	....
Huron	364,579	720,213	1,927,660	2,271,163	1,992,695	1,881,760	2,370,857
Ridge	102,936	60,155	74,030	63,390	158,272	84,902	50,924
Saint Clair	87,126	125,225	139,407	....	....	....	....
Cliff	66,053	10,374	28,225	....	22,342	....	....
Wolverine	25,623	699,622	751,763	328,610	3,125	2,300	....
Nonesuch	46,450	....	23,867	28,484	....	....	....
Isle Royal	35,447	....	16,074	....	....	....	....
Minong	21,380	3,582	....	....	....	....	....
National	17,060	26,006	87,368	162,252	184,706	25,187	....
Minesota	10,672	6,226	1,144	12,608	....	....	....
Belt	5,625	16,402	130,851	27,433	7,300	....	....
Sheldon and Columbia	3,299	....	9,828	....	....	....	....
Aztec	3,129	....	....	....	....	....	....
Adventure	429	....	4,333	4,000	1,000	....	....
Peninsula	....	849,400	1,225,981	....	....	....	....
Tamarack	....	7,435	....	181,669	3,646,517	7,396,529	11,411,325
Ogima	4,207	3,000	1,106	12,000	....	....	....
Concord	....	....	....	....	....	....	....
Kearsarge	....	....	....	....	....	21,237	829,185
Evergreen Bluff	....	....	954	1,500	1,000	....	....
Flint Steel River	....	....	....	....	....	....	....
Madison	....	....	....	....	....	....	....
Ash Bed	72,636	....	1,517	....	....	....	....
Centennial	83,554	....	....	....	....	....	....
Sundry companies—tributers	....	....	21,696	34,000	50,000	50,000	50,000
Total	57,155,991	59,702,404	69,353,202	72,147,889	79,918,460	76,028,697	86,472,034

For the Western States and Territories the geographic distribution of the product is becoming more and more difficult.

Territorially distributed, the production of the United States in 1888 has been as follows as compared with previous years:

Total copper production in the United States, 1883 *to* 1888.

Sources.	1883.	1884.	1885.	1886.	1887.	1888.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	59, 702, 404	69, 353, 202	72, 147, 889	79, 918, 460	76, 028, 697	86, 472, 034
Arizona	23, 874, 963	26, 734, 345	22, 706, 366	15, 657, 035	17, 720, 462	31, 797, 300
Montana	24, 664, 346	43, 093, 054	67, 797, 864	57, 611, 621	78, 699, 677	97, 897, 968
New Mexico	823, 511	59, 450	79, 839	558, 385	283, 664	1, 631, 271
California	1, 060, 862	876, 166	469, 028	430, 210	1, 600, 000	1, 570, 021
Colorada	1, 152, 652	2, 013, 125	1, 146, 460	409, 306	2, 012, 027	1, 621, 100
Utah	341, 885	265, 526	126, 199	500, 000	2, 500, 000	2, 131, 047
Wyoming	962, 468	....	....	....	....	232, 819
Nevada	288, 077	100, 000	8, 871	50, 000	....	50, 000
Idaho	....	46, 667	40, 381	....	....	50, 000
Missouri	260, 306	230, 000	....	....	....	....
Maine and New Hampshire	212, 124	249, 018	211, 602	315, 719	200, 000	271, 631
Vermont	400, 000	655, 405				
Southern States	395, 175	317, 711	40, 199	29, 811	....	18, 201
Middle States	64, 400	2, 114	190, 641	....	....	....
Lead desilverizers, etc.	782, 880	950, 870	910, 144	1, 282, 496	2, 432, 804	2, 618, 074
Total domestic copper	115, 526, 053	144, 916, 653	165, 875, 483	156, 763, 043	181, 477, 331	226, 361, 466
From imported pyrites and ores	1, 625, 742	2, 858, 754	5, 086, 841	4, 500, 000	3, 750, 000	4, 909, 156
Total (including copper from imported pyrites)	117, 151, 795	147, 805, 407	170, 962, 324	161, 263, 043	185, 227, 331	231, 270, 622

Lake Superior.—The high price of copper during 1888 and the general belief among producers in its continuance led to the re-opening of a number of the old mines on Lake Superior. The Allouez, which suspended operations in 1887, resumed in November, 1888. The Peninsula, which did considerable work in 1883 and 1884, after heavy outlays on modern equipment, began unwatering in June, and was ready for underground work in August. Active work was done on the National, and the Centennial was reorganized preparatory to resumption early in 1889. The Wolverine was leased late in 1888 to Mr. N. F. Leopold, of Chicago. In the Kearsarge stoping began in August.

The Calumet and Hecla suffered during 1888 from the fire in its mine, and was forced to draw heavily upon its reserves in the Black Hills territory in order to keep up its product.

The annual report of the Tamarack for the year ending June 30, 1888, showed a product of 13,607,224 pounds of mineral, which at 76.36 per cent. gave 10,390,476 pounds of ingot, for which was realized $1,448,943.88, or an average of 13.95 cents per pound. The total running expenses were $597,239.07, equal to 5.75 cents a pound. During the year $150,985.95 were expended on mine plant and $120,000 were paid out in dividends. The second shaft of the company, which will strike the lode at a depth of about 2,500 feet, is being sunk at the rate of 85 feet a month, so that it would enter the productive ground during the summer. The yield of the rock stamped was 3.60 per cent. Of 152,355 tons of rock sent to the rock-house, 144,412 tons went to the mill, 11,203 tons thereof being crushed in the Osceola mill at a cost of 55.15 cents, while at the Tamarack it was 53.06 cents. The third head was started late in the fiscal year, the average duty of the stamps during the last two months of the year being over 230 tons in twenty-four hours.

The Quincy made its greatest product in 1888, yielding 7,141,570 pounds of mineral from 117,514 tons of stamp-rock treated and 621,375 pounds of masses, from which 6,367,809 pounds of refined copper were obtained. This sold for $1,014,315.38, or 15.93 cents per pound. The running expenses, exclusive of building and construction account, were $467,427.23. Including that account, the cost was $500,860.24, or 7.86 cents per pound. The management has charged in addition $67,117.37 for the Quincy and Torch Lake railroad and $75,000 for machinery contracted for. This left the earnings of the year $386,256.66. Adding a balance of $536,509.75, the dividends paid during the year aggregated $360,000, leaving a balance of assets of $562,766.41, from which dividends aggregating $200,000 were paid. The principal event during 1888 was the decision to build a stamp mill at Torch Lake, and the Quincy and Torch Lake railroad to connect mill and mine. Two steam stamp mills have been contracted for, with a capacity of crushing 250 tons of rock per twenty-four hours each, with 56 iron jigs, an 8,000,000 high-duty pumping engine, a 14 by 36 inch Corliss engine, and six 6 by 16 foot return tubular boilers.

The Franklin suffered from a further reduction in the percentage of copper in the rock hoisted, declining as it did to 1 per cent., against 1.12 per cent. in 1887 and 1.21 per cent. in 1886. Although a greater quantity was hoisted (181,451 tons in 1888 as compared with 173,874 tons in 1887), the product of copper was smaller, though 143,347 tons were stamped against 137,137 during the previous year. The cost was slightly increased from $1.87 to $1.89 per ton of rock hoisted. The treasurer's statement shows receipts aggregating $554,738.24, including 3,655,751 pounds of copper, sold at 15.0754 cents per pound, while the expenditures were $406,583.02, leaving a profit of $148,155.22, the dividends declared during the year aggregating $120,000, with a surplus at the end of the year of $289,332.34, out of which a dividend of $80,000 was declared. The superintendent reports that in the lower levels, in the vicinity of shaft No. 5, a large amount of ground is opened which will yield as much copper per fathom as any ground in any part of the property during the last ten years. During the latter part of 1888 diamond-drill explorations, followed by drifting from the lower levels, have opened up very promising developments on a 20-foot amygdaloid lying 47 feet east of the main lode.

Cost has been reduced at the Atlantic mine in spite of an advance in the wages paid to the workmen, as the following comparison shows:

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

Items of cost.	1885.	1886.	1887.	1888.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Mining, selecting, breaking, and all surface expenses, including taxes	78.62	80.88	87.23	83.73
Transportation to mill	4.80	3.48	3.80	3.47
Stamping and separating	30.36	26.53	27.31	26.89
Freight, smelting, marketing, and New York expenses	25.45	24.25	23.07	21.42
Total working expenses	139.23	135.14	141.41	135.51
Total expenditures	143.60	138.01	145.22	142.82
Net profit	22.05	15.29	30.53	54.36
Yield of copper, per cent	0.743	0.709	0.712	0.667

The falling off in the grade of the rock, notably during the last six months of the year, led to higher cost of refined copper. The quantity of rock stamped was again increased, being 298,055 tons in 1888, against 255,750 tons in 1887 and 247,035 tons in 1886. The mine produced 5,383,910 pounds of "mineral," equal to 3,974,972 pounds of ingot against 3,641,865 pounds in 1887, the average price realized being 14.78 cents. The total income was $593,282.60; the costs were $403,887.53, showing a mining profit of $189,395.07. Additions to plant, purchases of real estate, and explorations called for $31,796.40, leaving a net gain of $157,598.67, out of which a dividend of $60,000 was paid during the year, leaving a surplus at the close of $382,564.80, from which a dividend of $80,000 was paid.

Owing to a falling off in the quality of the rock, from August to December, coupled with the usual phenomenon in leaner ground, of a narrowing of the lode, the results at the Osceola were not as favorable. The quantity of refined copper per ton of rock stamped fell from 24.68 pounds in 1887 to 22.59 pounds in 1888. In December, however, the yield recovered to 27.12 pounds, and the January returns were as satisfactory. The cost was increased in spite of the fact that larger quantities were handled, the mining cost rising from $1.74 per ton of rock hoisted to $1.95, and the cost per ton of rock stamped rose from $2.05 in 1887 to $2.21 in 1888. The total quantity of stuff passed through the rock-houses was 207,292 tons, of which 24,256 tons were discarded, or 11.7 per cent., against 15.1 per cent. in 1887. The mill stamped 183,036 tons of Osceola rock, and besides crushed 9,978 tons for the Tamarack and 19,425 tons for the Kearsarge mine, the cost for the whole being 37.9 cents per ton against 35.05 cents per ton in 1887. Still, owing to the high price realized through the contract with the Société des Métaux, the profit per pound was considerably larger. In 1887 the mining cost was 8.31 cents, the cost of smelting, freight, and marketing was 1.57, making a total cost of 9.88 cents. Since in 1887 the average price obtained was 11.86 cents, the profit was 1.98 cents per pound of ingot. In 1888 the cost at mine was 9.78 cents, the other expenses added 1.83 cents, making a total of 11.61 cents. Deducting this from the average price (15.03 cents) the profit was 3.42 cents per pound. The total income during 1888 was $621,950.31, while the costs were $479,873.42, showing a mining profit of $142,076.89. There was expended for mine plant $22,907.89, the principal item being a new compound 16-drill compressor, and $150,000 was paid out in dividends, reducing the balance of assets from $235,516.15 to $204,685.15. Since 1874 the Osceola has paid dividends aggregating $1,172,500 on a capital stock of $1,250,000.

The production of the Central mine fell off principally on account of a lesser quantity of masses attained, this mine being the leading and practically the only representative of the once famous mass mines. Out of a total production of "mineral" of 2,284,795 pounds, 1,266,150 pounds were "stamp" copper, 351,010 "barrel" copper, and 667,635 pounds masses, the ingot yield at 79.53 per cent. being 1,817,023 pounds refined copper. The gross income was $274,202.68, the costs being $196,605.55. Deducting a further small sum for purchase of property, a profit of $74,017.60 was realized, of which $70,000 was paid out in dividends.

The Kearsarge mine is one of the new properties added to the list of Lake Superior producers during 1888, the first rock being sent in August to the Osceola mill, where it is crushed for 50 cents a ton. From 24,250 tons stamped the yield has been 823,385 pounds, or 1.2 per cent. The work is carried on in the eastern of two parallel amygdaloid lodes, one shaft having been sunk to a depth of 790 feet, the best ground having been developed thus far in the upper levels. The product, 829,185 pounds of refined copper, yielded $137,609.71, or 16.59 cents per pound, the company not having any contract with the syndicate. The running expenses were $83,134.03, or 10.02 cents, leaving a mining profit of $54,465.68. There was, however, expended for mine plant $18,173.79. Up to January 1 the total expenses, including $474,000 for real estate, were $701,886.13, while the receipts were $796,126.23, including $650,000 on 50,000 shares, $13 paid in per share.

Work on the Allouez was resumed during 1888. It was found necessary to thoroughly repair and renew the surface plant and underground workings, at an aggregate cost of $86,104.39 for repairs and $22,755.85 for new machinery. The mine again became a producer in November, yielding 314,198 pounds of copper, sold for $43,092.57, at a cost of $45,782.94. The company levied an assessment of $79,674, and called for additional funds early in 1889.

Montana.—Work was pushed with great vigor in the State during 1888, no additions being made to the ranks of the producers. The Anaconda, the largest copper mine in the country, operates two separate plants, the "upper" and the "lower" works. The former treats ores from the Anaconda and Saint Lawrence mines only. The lower works treat the free milling ores from the surface of the Chambers syndicate group of mines in two steam-stamp batteries, pans, and settlers. Early in 1889 the 60-stamp mill was replaced by the steam stamps in question. In addition thereto the works are equipped for concentrating and smelting the copper ores from the Chambers syndicate mines. The matte produced contains in the neighborhood of 30 to 35 ounces of silver and about $5 in gold. This is on the border line between pay and no pay for the precious metal, and by the addition of a few ounces of silver to the charge the whole contents is realized upon. The company when running this part of the plant is in the market for all classes of "dry" silver ore, and is in a position to smelt at a very low rate. Two blast-furnaces have been constructed to be used ultimately on lead ores, but a short time during the close of 1888 they were employed in working copper ore. In 1889 the smelter-building at the lower works was destroyed by fire, but a contract was entered into for the building of new works, of iron, to be completed in ninety days from May 1. The Brueckner roasting furnaces and the reverberatory smelting furnaces in the building were not injured by the fire. It is estimated that when running, both works together are capable of handling 5,000 tons of ore per day.

Arizona.—No events of any consequence have affected the position as producers of the leading, long established copper districts of the Territory. Generally speaking, costs were higher, through the advance in freights on coke and copper which followed the rise in the metal. The Copper Queen and the Holbrook and Cave in the Bisbee district, the Arizona Copper Company, and the Detroit in the Clifton district ran to full capacity, all of them having sold their product to the syndicate. The Bisbee district is now accessible by rail through the completion of the Arizona and Southeastern railroad.

At Globe the Old Dominion ran during 1888 with one furnace. In March, 1889, a second was started, but the high river and bad roads prevented the transportation of coke and copper, and for a while smelting was stopped entirely. Subsequently contracts for wood and timber were canceled, so that a restriction of production has followed the collapse of the syndicate. The high price of coke, $48 per ton at the furnace, and the heavy cost of transportation militate against the district. To some extent the high grade of the ores compensates for these disadvantages. It is estimated that the cost of producing 98½ per cent. black copper is slightly below 5 cents a pound, and that 3 cents a pound will cover the cost of laying down the refined metal sold at the sea-board. A number of efforts were made, unsuccessfully, during 1888 to revive the Buffalo and the Long Island groups of mines which were productive in the early history of the district.

The most important accession to the list of active mines in Arizona was the United Verde, leased by Mr. W. A. Clark, and largely interested in Butte, Montana. Copper production began in March, 1888, and was carried on during the summer at the rate of about 600,000 pounds per month, the quantity which its contract with the syndicate limited it to. Work was, however, interfered with during the winter months by the bad condition of the roads. At Copper Basin considerable work was done during 1888, but no copper was made. The ore is highly siliceous so that it can not be smelted alone. In April, 1889, two car loads of ore were received from a new mine in Mohave county, the plan being to test the question whether it will pay to transport it to Copper Basin. The future of the district would appear to depend upon utilizing the auriferous pyrites known to exist in considerable quantity within reasonable distance of the Copper Basin district, and by combined treatment, work both classes of ore, the extraction of which singly is impossible under local conditions. The Yuma Copper Company, of Saint Louis, opened out mines in the Harcuvar mountains, and began the construction of furnaces. An effort was also made to revive the old Caledonia mine, south of Picacho.

New Mexico.—During 1888 a number of efforts were made to revive some of the copper mines of New Mexico, but only in one prominent case, that of the San Pedro, was much accomplished. Some copper was also smelted at the Flagler reduction works.

Utah.—The leading copper producer in Utah is the Comet mine near Frisco, which is controlled by French capital. A smelting plant has been built at Frisco for the treatment of its ore.

California.—Several mines were re-opened during 1888, among them being the Union and the Napoleon at Copperopolis, in Calaveras county, the Newton in Amador county, and the Buchanan in Fresno county. From the Union about 4,000 tons of 16 per cent. ore were shipped around Cape Horn. Some copper cement was also produced from old dumps at Spenceville, Nevada county.

Wyoming.—Wyoming produced some copper during 1888, a mine and plant which had been idle some time having been started again under a lease by the Mathesons, of London.

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 1888, inclusive.

Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	Fine copper contained in ores.		Regulus and black copper. (*a*)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1867	....	$936, 271	....	....	$936, 271
1868	3, 496, 994	197, 203	....	....	197, 203
1869	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	581, 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
1886	4, 530, 400	341, 558	1, 960	98	341, 656
1887	3, 886, 192	194, 785	27, 650	1, 366	196, 151
1888	4, 850, 812	381, 477	4, 971	324	381, 801

a Not enumerated until 1871.

Copper imported and entered for consumption in the United States, 1867 to 1888, inclusive.

Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	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.*	
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, 695	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	609
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	....	......
1886	276	37	37, 149	2, 407	....	584	....	......
1887	212	22	39, 957	2, 374	....	129	....	......
1888	1, 787	299	37, 620	2, 535	....	....	....	......

a Not enumerated until 1873.

b Includes "plates not rolled" since 1884.

Copper imported and entered for consumption in the United States, 1867 *to* 1888—Continued.

Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	Plates rolled, sheets, pipes, etc.		Sheathing metal, in part copper. (*a*)		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$1,101	220,889	$37,717	$15,986	$424,565
1868	....	1	101,488	18,852	21,492	89,932
1869	....	39	43,669	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	71,919
1877	....	203	110	22	41,762	75,761
1878	....	1,201	647	55	35,473	68,318
1879	....	786	300	20	39,277	58,035
1880	....	4,134	6,044	693	130,329	432,522
1881	....	82	39,520	4,669	281,509	390,318
1882	5,855	1,551	....	....	77,727	141,372
1883	2,842	379	6,791	1,047	40,313	78,601
1884	6,529	2,330	19,637	926	55,274	71,290
1885	470	120	86,619	9,894	61,023	79,027
1886	3,770	339	21,573	1,917	31,871	34,127
1887	37,925	5,493	18,189	1,067	37,289	44,649
1888	5,208	737	23,622	2,696	14,567	18,000

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

Brass imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive*.

Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	Bars and pigs.		Old, fit only for remanufacture.		Not otherwise provided for.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$3,099	....	$26,468	$170,873	$200,440
1868	31,104	2,671	120,913	11,699	181,114	194,881
1869	33,179	2,457	131,640	10,838	198,310	211,605
1870	54,108	3,791	98,8[illegible]5	6,918	49,845	60,554
1871	28,453	2,803	438,085	37,922	13,659	54,384
1872	17,963	1,664	829,964	73,098	23,738	98,500
1873	56,656	7,147	699,478	71,494	114,767	193,408
1874	253	19	682,151	64,848	350,266	415,133
1875	370,273	38,867	124,285	12,786	273,873	325,526
1876	....	....	618,191	54,771	232,870	287,641
1877	....	....	689,633	59,402	207,642	267,044
1878	....	....	713,171	57,551	205,209	262,760
1879	950	49	485,354	32,278	232,030	264,357
1880	....	....	958,590	75,093	339,131	414,221
1881	85,370	11,202	1,615,402	151,541	331,506	494,249
1882	30,769	3,768	2,954,148	263,891	400,477	667,536
1883	6,380	559	1,015,345	84,786	485,321	570,666
1884	1,611	445	508,923	40,766	429,224	470,435
1885	2,305	532	166,317	15,717	400,175	416,424
1886	6,705	295	143,121	30,517	374,364	405,176
1887	2,332	562	189,157	30,158	331,800	362,520
1888	....	....	257,748	40,373	156,738	197,111

EXPORTS.

In a very brief time the United States, with its exuberant production, has become one of the largest contributors to the supply of the world. The following tables show the quantities of copper, copper ore (including matte) and manufactured copper exported for a series of fiscal years.

Value of copper, brass, and manufactured copper exported from the United States, 1791 *to* 1863, *inclusive.*

Fiscal years ending September 30 until 1842, and June 30 since.	Value.	Fiscal years ending September 30 until 1842, and June 30 since.	Value.
1791	$493	1833	$203, 880
1803	6, 233	1834	198, 273
1804	8, 654	1835	69, 791
1805	12, 977	1836	72, 991
1806	25, 340	1837	91, 724
1807	12, 742	1838	81, 363
1808	4, 031	1839	81, 334
1809	3, 095	1840	86, 954
1810	17, 426	1841	72, 932
1811	9, 282	1842	97, 021
1812	2, 644	1843 (nine months)	79, 234
1813	....	1844	91, 446
1814	....	1845	94, 736
1815	366	1846	62, 088
1816	16, 152	1847	64, 980
1817	8, 765	1848	61, 468
1818	33, 379	1849	66, 203
1819	12, 721	1850	105, 060
1820	18, 547	1851	91, 871
1821	26, 694	1852	103, 039
1822	36, 974	1853	108, 205
1823	16, 768	1854	91, 984
1824	26, 981	1855	690, 766
1825	30, 472	1856	534, 846
1826	60, 083	1857	607, 054
1827	52, 341	1858	1, 985, 223
1828	60, 452	1859	1, 048, 246
1829	129, 647	1860	1, 664, 122
1830	36, 601	1861	2, 375, 029
1831	55, 755	1862	1, 098, 546
1832	105, 774	1863	1, 026, 038

Copper and copper ore of domestic production exported from the United States, 1864 *to* 1888 *inclusive.*

[Cwts. are long hundred-weights of 112 pounds.]

Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	Ore.		Pigs, bars, sheets, and old.		Manufactured.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Cwts.		*Pounds.*			
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
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

a Evidently errors in quantities.

Value of brass and its manufactures, exported from the United States, 1867 *to* 1888, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.	Calendar yeas ending December 31, from 1886 to 1888; previous years end June 30.	Value.
1867	$12, 864	1875	$1, 000, 629	1882	$322, 439
1868	16, 841	1876	256, 974	1883	287, 847
1869	40, 063	1877	327, 817	1884	301, 014
1870	169, 997	1878	589, 451	1885	538, 118
1871	210, 816	1879	200, 871	1886	183, 686
1872	229, 458	1880	183, 468	1887	275, 019
1873	494, 575	1881	216, 057	1888	327, 170
1874	503, 531				

The following table gives the exports of copper ore, matte, ingot, sheets, and manufactures for the calendar years 1886, 1887, and 1888:

Exports of copper ore, matte, ingot, sheets, and manufactures of copper for the calendar years 1886, 1887, *and* 1888.

Articles.	1886.		1887.		1888.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ore and matte, long tons..	20, 876	$2, 341, 164	25, 064	$2, 774, 461	39, 748	$6, 779, 294
Ingots, bars and old, pounds	19, 504, 087	1, 960, 189	12, 347, 507	1, 223, 260	31, 664, 046	4, 899, 423
Sheets..........pounds..	49, 334	8, 583	123, 886	24, 668	42, 481	7, 382
All other manufactures of	....	76, 386	....	92, 064	....	211, 141
Total	....	4, 386, 322	....	4, 114, 456	....	11, 897, 240

Unfortunately the copper contents of ore and matte are not given. Since during the years enumerated only a small quantity of ore was shipped, the balance being matte, a rough estimate of 50 per cent. for the copper contents will be safely below the average. On this basis the exports were about 43,000,000 pounds in 1886 and 40,000,000 pounds in 1887, but rose above 76,000,000 pounds in 1888.

CONSUMPTION.

As in former years, this office collected from a large number of consumers statistics giving the quantity of new copper used by them in the manufacture of copper and brass in many forms. The following establishments have reported:

Adams & Westlake Company, Chicago, Illinois.
American Tube Works, Boston, Massachusetts.
Ansonia Brass & Copper Company, Ansonia, Connecticut.
C. Aultman & Co., Canton, Ohio.
Ashcroft Manufacturing Company, Bridgeport, Connecticut.
Baltimore Copper Smelting and Rolling Mill Company, Baltimore, Maryland.
Barnett Brass Company, Mansfield, Ohio.
H. Belfield & Co., Philadelphia, Pennsylvania.
Best, Fox & Company, Pittsburgh, Pennsylvania.
The Brass and Iron Works Company, Fostoria, Ohio.
Bristol Brass and Clock Company, Bristol, Connecticut.
Bridgeport Brass Company, Bridgeport, Connecticut.
Buckeye Iron and Brass Works, Dayton, Ohio.
J. I. Case Thresher Machine Company, Racine, Wisconsin.
A. W. Cadman & Co., Pittsburgh, Pennsylvania.
Carnegie, Phipps & Co., limited, Beaver Falls Mills, Beaver Falls, Pennsylvania.
Cheshire Brass Manufacturing Company, West Cheshire, Connecticut.
Chicago Brass Company, Chicago, Illinois.
Coe Brass Manufacturing Company, Torrington, Connecticut.
E. & G. Cooper Company, Mount Vernon, Ohio.
Craighead & Kintz Manufacturing Company, Ballard Vale, Massachusetts.
Crane Brothers Manufacturing Company, Chicago, Illinois.
Crosby Steam Gauge and Valve Company, Boston, Massachusetts.
Davis, Creswell & Co., Denver, Colorado.
Dayton Manufacturing Company, Dayton, Ohio.
Detroit Copper and Brass Rolling Mills, Detroit, Michigan.
Douglas & Connard, Reading, Pennsylvania.
Dubuque Brass and Metal Company, Dubuque, Iowa.
Eaton, Cole & Burnham Company, Bridgeport, Connecticut.
Eddy Valve Company, Waterford, New York.
Eben Folsom & Co., Exeter, New Hampshire.
Frick Company, Waynesborough, Pennsylvania.
Gaar, Scott & Co., Richmond, Indiana.
Galvin Brass and Iron Works, Detroit, Michigan.
Haines, Jones & Cadbury, Philadelphia, Pennsylvania.
Haxtun Steam Heater Works, Kewanee, Illinois.
Peter Hayden, Newark, New Jersey.

Charles Harrison & Co., New York.
Haydenville Manufacturing Company, Haydenville, Massachusetts.
Hardwicke & Ware, Buffalo, New York.
Hendricks Brothers, New York.
Hinckley Locomotive Works, Boston, Massachusetts.
Hoffman & Billings Manufacturing Company, Milwaukee, Wisconsin.
Holland & Thompson Manufacturing Company, Saint Paul, Minnesota.
Fred. H. Holton & Co., Boston, Massachusetts.
C. G. Hussey & Co., Pittsburgh, Pennsylvania.
Jarecki Manufacturing Company, Erie, Pennsylvania.
W. Kirkup & Son, Cincinnati, Ohio.
Kinsley & Mahler Company, Peoria, Illinois.
Lane & Bodley Company, Cincinnati, Ohio.
Landers, Frary & Clark, New Britain, Connecticut.
Lehner, Johnson, Neyer & Co., Chicago, Illinois.
R. Leitch & Son, Washington, District of Columbia.
Ludlow Valve Manufacturing Company, Troy, New York.
F. Lunkenheimer, Cincinnati, Ohio.
Mayor, Lane & Co., New York.
Manhattan Brass Company, New York.
Mansfield & Co., Pittsburgh, Pennsylvania.
George R. Meneely & Son, Troy, New York.
McCambridge & Co., Philadelphia, Pennsylvania.
A. Y. McDonald, Dubuque, Iowa.
John H. McGowen Company, Cincinnati, Ohio.
T. R. McMann & Brother, New York.
McNab & Harlin Manufacturing Company, Troy, New York.
Henry McShane & Company, Baltimore, Maryland.
E. Miller & Co , Meriden, Connecticut.
J. L. Mott Iron Works, New York.
T. M. Nagle, Erie, Pennsylvania.
N. O. Nelson Manufacturing Company, Saint Louis, Missouri.
Nelson & Finkel, New York.
New Bedford Copper Company, New Bedford, Connecticut.
New Haven Copper Company, Seymour, Connecticut.
Osborne & Cheeseman Company, Birmingham, Connecticut.
Peck Brothers & Co., New Haven, Connecticut.
The Phosphor Bronze Smelting Company, limited, Philadelphia, Pennsylvania.
Portsmouth Machine Company, Portsmouth, New Hampshire.
Post & Co., Cincinnati, Ohio.
The William Powell Company, Cincinnati, Ohio.
Providence Steam and Gas Pipe Company, Providence, Rhode Island.
Revere Copper Company, Boston, Massachusetts.
Randolph & Clowes, Waterbury, Connecticut.
The J. A. Roebling's Sons Company, Trenton, New Jersey.
The Rome Iron Works, Rome, New York.
M. Rumley & Co., La Porte, Indiana.
Rundle, Spence & Co., Milwaukee, Wisconsin.
Russell & Co., Massillon, Ohio.
Scovill Manufacturing Company, Waterbury, Connecticut.
Seymour Manufacturing Company, Seymour, Connecticut.
Shaw, Kendell & Co., Toledo, Ohio.
T. Somerville & Sons, Washington, District of Columbia.
Springfield Brass Company, Springfield, Ohio.
E. Stebbins Manufacturing Company, Springfield, Massachusetts.
Stewart & Mattson Manufacturing Company, Philadelphia, Pennsylvania.
Swamscot Machine Company, South Newmarket, New Hampshire.
Tamarack and Osceola Manufacturing Company, Boston, Massachusetts.
Taunton Copper Manufacturing Company, Taunton, Massachusetts.
Thomas & Wentworth Manufacturing Company, Milwaukee, Wisconsin.
Union Foundry and Machine Company, Pittsburgh, Pennsylvania.
Wallace & Sons, Waterbury, Connecticut.
Walworth Manufacturing Company, Boston Massachusetts.
Washburn & Moen Manufacturing Company, Worcester, Massachusetts.
Waterbury Brass Company, Waterbury, Connecticut.
Westinghouse Company, Schenectady, New York.
Wilson & Snyder Manufacturing Company, Pittsburgh, Pennsylvania.
L. Wolff Manufacturing Company, Chicago, Illinois.
R. D. Wood & Co., Philadelphia, Pennsylvania.
Henry R. Worthington, New York.
Yale & Towne Manufacturing Company, Stamford, Connecticut.

The total quantity of new copper melted by these concerns was 80,696,981 pounds in 1888, against 83,148,058 pounds in 1887. They include, however, a few important works which practically began operations in 1888, like the Tamarack and Osceola Manufacturing Company and the Beaver Falls mills of Carnegie, Phipps & Co., formerly the Hartman Steel Company. These and a few others together did much toward filling the gap caused by the decline in consumption at other works. The figures given would indicate a falling off in consumption of about 3 per cent. It cannot be claimed that this percentage represents more than an approximation to the true decline, because the number of returns is not large enough. It does, however, indicate that the consumption of copper did not fall off so heavily as is generally supposed and as the experience of some consumers themselves would appear to indicate. One reason, already alluded to, is the fact that new works participated in the trade, so that the business of some of the older firms was cut into—an effect which would naturally be ascribed by them rather to the decline in the consumption as the result of high prices of the raw material than to successful competition on the part of newcomers. The only deduction which can fairly be drawn from the data collected is that the decline in the consumption was by no means so great as is generally believed. It is probable, however, that if their aggregate were known the purchases of consumers would show a larger falling off. In other words, the stocks of raw material, partly manufactured goods, scrap and finished articles in the hands of manufacturers, and the stock in the possession of branch establishments, jobbers, and the retail trade, were probably much smaller at the close of 1888 than they were at the opening of the year. Sellers of the metal, therefore, too, would be likely to considerably overrate the decline in the consumption, judging from the facts in their possession concerning the quantity of metal marketed.

In reality the most important effect of high prices on the consumption of copper during 1888 was to check the rapid increase which had developed in previous years as the combined result of a period of low values and the rapid development of the demand for copper wire for electrical purposes. With the exception of eleven of the firms enumerated in the list given, the returns for consumption in 1886 are available. They show that the consumption rose from 74,283,362 pounds in 1886 to 81,193,939 pounds in 1887, and declined again to 77,715,229 pounds in 1888. From 1886 to 1887 consumption had increased by 9.3 per cent. This development was stopped by the high prices, and instead a notable decline followed.

THE COPPER MARKETS.

The following table summarizes the highest and lowest prices obtained for Lake copper monthly in the New York market from 1860 to 1888, both inclusive:

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 to 1888.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	24	23 1/2	24	23 3/4	23 3/4	23	23 1/2	23	23 1/4	22 1/2	22 1/2	21 3/4
1861	20	19	19 1/2	19	19 3/4	19 1/4	19 3/4	19	19 3/4	19 1/4	19	18
1862	28	27	28	25	25	23	23	21 1/2	21 1/2	20 3/4	23	20 3/4
1863	35	31	37	35	37	31	31	30	30 1/2	30	30 1/2	30
1864	41 1/4	39	42	41 1/4	42 1/2	41 1/2	44	42 1/2	44	43	49	44
1865	50 1/2	46	46	44	44 1/2	34	35	34	34	30	30 1/2	28 1/2
1866	42	38	38	35 1/2	35 1/2	29 1/2	30	28 1/2	31	29	33	31
1867	29 1/4	27	27 3/4	27 1/2	27 1/2	24	24 1/2	23 1/2	24 1/4	24	24 1/2	24
1868	23 1/2	21 1/2	24	22 1/2	24	23 1/4	24 1/4	23 1/4	24 1/4	24	24	23 1/8
1869	26 1/4	23 3/4	27	26	26 3/4	24	24	23 1/4	24 1/4	23 3/4	23 3/4	22
1870	22	21 1/8	21 1/4	20 7/8	20 3/4	19	19 3/4	19 1/4	19 1/2	19	20 5/8	19
1871	22 7/8	22	22 3/8	21 7/8	22	21 1/2	21 3/4	21 1/4	21 3/4	21 3/8	21 1/2	21 1/4
1872	28 1/2	27 1/8	28 3/8	28 1/4	30 1/2	28 3/8	44	30 1/2	42	36	34 3/4	33
1873	35	32 1/2	35	34	35	34 1/2	34 1/2	33 1/2	33 1/2	32	31 1/2	29 1/8
1874	25	24 1/2	25	24 1/8	24 3/4	24	25	24 3/4	25	24 1/2	24 3/4	24 1/4
1875	23 1/2	21 1/2	22 3/4	21 3/4	21 3/4	21 1/2	21 3/4	21 1/2	23 1/4	22 5/8	23	23
1876	23 1/4	23	22 7/8	22 1/2	22 1/4	22	22 5/8	22	22 1/8	21	21	19 1/2
1877	19 1/2	19	20 1/2	19 1/2	19 1/2	19	19 1/2	19 1/4	19 1/4	19	19 3/8	19
1878	17 5/8	17 1/4	17 1/2	17 1/8	17 1/8	16 7/8	17	16 7/8	16 3/4	16 1/4	16 3/8	16 1/4
1879	16	15 1/2	15 1/2	15 1/2	15 3/4	15 3/4	16	15 3/4	16 1/4	16	16 1/4	16 1/8
1880	25	21 3/8	24 1/2	24	24	22 3/4	22 1/2	24	21	18	18 1/2	17 7/8
1881	19 3/8	19 1/8	19 3/8	19 1/8	19 3/8	19	19	18 3/4	18 7/8	18 1/4	18 1/4	16 3/8
1882	20 3/8	20 1/4	20	19	19 1/4	18 7/8	18 7/8	17 7/8	18 1/4	18	18 1/4	18
1883	18 1/8	18	17 7/8	17 3/4	17 5/8	17 1/8	16	15 3/4	16	15 7/8	15 7/8	15
1884	15	14 7/8	15	14 7/8	15	14 7/8	15	14 1/2	14 1/4	14 1/3	14 1/4	14
1885	11 1/2	10 3/8	11 1/8	10 4/5	11 1/8	10 3/5	11 1/4	10 1/10	11 1/2	9 4/5	11 1/2	11
1886	11 5/8	11 3/8	11 5/8	11 3/8	11 1/2	11 3/8	11 1/2	11 3/8	11 1/3	10	10 1/8	10
1887	12	11 1/8	11 1/8	10 1/2	10 1/2	10 3/8	10 1/5	10	10	9 19/20	10 1/4	10
1888	17 1/10	15 17/20	16 6/10	16	16 7/20	15 19/20	16 9/10	16	16 3/4	16 3/10	16 13/20	16 9/20

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

The prices recorded during the greater part of 1888 in the above table are those obtained in the market for small lots, and largely on speculative dealings. Consumers have been supplied by the syndicate directly at 16½ cents during the greater part of the year. The price realized by the mining companies was considerably below the latter figure, since they received, with the exception of a few producers, one-half of the excess realized by the syndicate above 13½ cents.

The best data to compute an average of the prices of the year are obtained from the reports of a number of the Lake companies. The following table, not including the Calumet and Hecla sales, is compiled from these reports:

Prices realized for Lake Superior copper in 1883, 1885, 1886, 1887, *and* 1888.

[Cents per pound.]

Mines.	1883.		1885.	
	Sales.	Average price.	Sales.	Average price.
	Pounds.		*Pounds.*	
Allouez	1,751,377	15.13	(a)1,050,516	11.03
Franklin	3,418,456	15.66	3,291,806	11.04
Atlantic	2,385,585	15.08	(b)2,729,588	11.08
Central	1,125,910	15.08	(b)1,609,899	11.02
Huron	647,787	15.69	2,729,588	10.92
Osceola	4,256,409	14.96	1,639,169	10.75
Quincy	....	....	....	....

Mines.	1886.		1887.		1888.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.		*Pounds.*		*Pounds.*	
Allouez	....	....	(c)85,640	10.38	314,198	13.71
Franklin	2,943,794	10.71	3,475,664	11.84	3,655,751	15.07
Atlantic	(b)3,488,790	10.92	3,641,865	12.34	3,974,972	14.78
Central	2,033,922	10.67	1,923,279	12.12	1,817,023	14.80
Huron	2,059,206	10.99	....	....	....	....
Osceola	3,560,786	10.51	3,583,723	11.86	4,134,320	15.03
Quincy	....	....	....	....	6,367,809	15.93

a First five months. *b* Not including copper on hand sold. *c* Early part of 1887.

The differences in the prices realized in 1888 are due probably to the fact that the companies sold more or less eagerly for forward delivery early in the year before they entered upon their contracts with the syndicate.

A very good illustration of the fluctuations of copper prices from year to year is furnished by the following sales and averages of the Osceola Consolidated Mining Company:

Sales of copper and average prices by the Osceola Mining Company, 1874 *to* 1888.

Years.	Sales.	Average price.	Years.	Sales.	Average price.
	Pounds.	*Cts. per lb.*		*Pounds.*	*Cts. per lb.*
1874	936,002	23.37	1882	4,179,782	17.70
1875	1,330,313	22.77	1883	4,256,409	14.96
1876	1,693,737	20.57	1884	4,247,630	12.82
1877	2,774,777	18.19	1885	1,639,169	10.75
1878	2,705,998	15.53	1886	3,560,786	10.51
1879	3,197,387	17.79	1887	3,583,723	11.86
1880	3,381,061	19.15	1888	4,134,320	15.03
1881	4,176,976	17.77			

The early part of the year was eventful since the syndicate was negotiating with some of the principal producers in this country, and the market was made active through the fact that considerable quantities of metal were still in the hands of dealers and speculators. Transactions in January were very heavy, and fluctuations were fairly large, spot Lake opening at 17 cents, declining gradually to 16¼ cents, advancing again to 16½ cents to drop back to 15⅞ cents, from which the price rebounded to 17⅜ cents to decline towards the end of the month to 16½ cents. The operations of bear speculators connected with the other exchanges caused futures for the spring and early summer months to be sold at considerably lower prices than spot and early months. In England cash Chili bars advanced early in January from £85 to £85 12*s.* 6*d.*, but the syndicate offering to sell they fell rapidly to £74 10*s.*, but rose to £77 10*s.* on the covering of sales, fell to £74 12*s.* 6*d.*, recovered to £79, relapsed to £73 7*s.* 6*d.*, rose to £78 7*s.* 6*d.*, and closed at £76 12*s.* 6*d.*, the price rising or falling as the syndicate sold or abstained from selling. They realized about 3,000 tons in two days at £74 to £75 for cash, sales which, during February, the syndicate replaced at £78 to £79, the market fluctuating during the month between £74 and £79, while three months' futures were accepted at 7*s.* 6*d.* to 15*s.* less than spot. The manipulation of the London market did not influence ours, the price declining slowly in spite of fair buying by smaller speculators and the steady purchasing of floating lots by the syndicate. March opened with a more active market, and with the exception of a sagging tendency during the middle of the month and a bear raid on futures during the close the price was steady, the syndicate being purchasers of outside lots and exporting heavily. Having practically completed its control over the principal American mines, and absorbing promptly what other supplies reached the market, the general trade fell off. Although the tin corner, in which the same speculators were interested, collapsed on April 30, the domestic copper market fluctuated but little. The syndicate supplied consumers at 16½ cents for Lake, and showed a decreasing interest in the operations of speculators for the fall. A temporary decline towards the middle of July was caused by the appearance of some spot copper from a consumer. August witnessed a slight rise, due to the covering of shorts.

In December the syndicate effected a sale to American consumers of about 20,000,000 pounds Lake and other brands at 16½ cents and 16 cents, respectively, for delivery during December, January, and February.

On March 1, the syndicate agents in London ceased supporting the spot copper market, the price dropping at once. This was followed on the fifth by the suicide of the managing director of the Comptoir d'Escompte, M. Denfert-Rochereau, creating a run on that institution and precipitating a panic on the Paris Bourse. On the same day negotiations pending between the representatives of the syndicate and the financial interests and the leading American mining companies culminated at a meeting in New York in an agreement in which all participated. The mines agreed to suspend deliveries to the syndicate for the two months following and to restrict production to the extent of 20 per cent. afterward. So far as the American companies were concerned, the contracts existing were merely in abeyance, the greater part of the credits securing them being still available in spite of the collapse of the Comptoir d'Escompte. They had sold to the majority of the leading consumers for delivery up to the end of May.

Subsequently a further sale was effected to consumers for March, April, and May delivery on the basis of 16½ cents for Lake, one important consumer declining to purchase, however. Since October, 1888, a series of propositions and counter propositions had been made between the syndicate and the American mining companies, looking toward an extension of existing contracts over a longer period, coupled with better terms to the mines. Finally, in the first half of March a meeting was held between the American interests and the French speculators, at which the former agreed to suspend deliveries of copper under their contracts for two months, till May 15, representatives going abroad to confer with the principals in Europe and the leading mines in other parts of the world. While the American representatives were on the high seas the collapse came in Paris. Up to the date of their departure the bankers who had issued the credits in favor of the American mines had accepted and paid for all copper delivered.

Since the American mines were under agreement to suspend deliveries, their contracts could not terminate by default until May 15, so that technically they were bound up to that date in spite of the fact that the Société des Métaux and the Comptoir d'Escompte had failed. This led to a complete deadlock, there being practically no copper in the market and little available for re-importation duty free in the original packages. With consumers the American mining companies reached an understanding. They agreed to pay them in the form of a rebate the differences between the price at which deliveries were being made under existing contracts, 16½ cents for Lake, and the price fixed upon for the subsequent sale under contracts as soon as they were free agents. In the meantime the representatives of the American mines in Europe carried on negotiations with the bankers, who controlled the stock of syndicate copper as collateral for advances made, and with the leading mines in other parts of the world, who like them had entered into contracts for the delivery of their copper. Some of the interests appear to have followed a vacillating course, the negotiations dragging until the early part of May without leading to any result. Their exact development is not known to the public, but it is believed that the proposition favored by the American mines was that the price being fixed at £45 for good merchantable bars, the bankers undertaking to market the stock gradually over a period of five years, transferring the supplies on the American market to Europe, the mines in the United States agreeing to restrict their product by 20 per cent., while the other mines demanded that they restrict their exports by 20 per cent.

The American representatives arrived at New York without having closed their negotiations. A series of negotiations and conferences followed, which, so far as the international situation was concerned, did not lead to any result. Upon the expiration of the time suspending deliveries, all those mining companies who had contracts guarantied by the Comptoir d' Escompte went through the formality of tendering copper. So far as the domestic market was concerned, the Lake companies agreed upon fixing the price to consumers at 12 cents, which involved the payment of a rebate of 4½ cents on copper delivered in April and May. No effort was made, however, to secure contracts for delivery over any extended period to consumers, the price of 12 cents being far above the parity of European quotations. Manufacturers could not be expected to take more than their immediate requirements so long as the possibility existed that the stock in the hands of European bankers might be pressed upon the market in competition with the supplies of the mining companies themselves. The failure of negotiations pending would lead to an immediate attempt to sell copper from stock in the American market relatively far higher than any other.

In England the history of the trade was more eventful, the "backwardation" on futures increasing steadily during April, May, June, and July. During August it became evident that the Chili bar market had been oversold. The syndicate declined to sell, except at advanced rates, so that the value of cash warrants was run up from £80 1*s.* 10*d.* to £92, the month closing with sellers of cast at £89 and buyers of three months at £79. The scarcity of Chili warrants became more acute in September, the syndicate raising the selling price from £90 on the 1st to £95 on the 4th, £100 on the 7th, £105 on the 8th, £107 10*s.* on the 10th, £112 10*s.* on the 11th, and to £115 on the 13th, at which figure it was nominally maintained during the rest of month, although the syndicate canceled contracts on the payment of £20 per ton. This squeezing of the bears caused a rise in the open market, considerable quantities being sold. Since the prices paid represent the climax during the existence of the syndicate, they may be quoted as follows, on the authority of James Lewis & Son, of Liverpool: £91 on the 1st, £95 on the 4th, £99 17*s.* 6*d.* and £99 on the 7th, £102 on the 8th, £105 on the 11th, £95 on the 12th, £101 on the 13th, £90 2*s.* 6*d.* on the 17th, £95 and £97 on the 19th, £99 5*s.* on the 25th, £104 and £103 on the 26th, and £101 10*s.* on the 1st of October, the price of the syndicate to the consumers being £78. Early in October the price of warrants declined rapidly from £101 10*s.* to £82, the sellers being importers and dealers. This led to the announcement by the syndicate on the 15th that it would sell cash bars "without restriction" at £78 10*s.* This change of policy was chiefly due to the fact that what profit the syndicate might secure as sellers of warrants they were losing as buyers of furnace material and bars which they were receiving under contracts based on the current price of Chili bars.

An important revolution in the copper trade in England was effected during 1888 by the introduction and general acceptance of a form of contract available for speculative purposes, which includes English, American, Australian, Chilian, German, and Japanese ingot, cake, and bars. The first effort to deliver these miscellaneous grades was made in July, when it was not allowed. Subsequently, however, as the result of the September corner, the contracts based on G. M. C. (abbreviation for good merchantable copper) became good delivery. This led to the syndicate having to pay for and hold some 10,000 tons of English copper which would otherwise have been retained by smelters. The new form of contract has nearly susperseded that for Chili bars as a speculative medium, having considerably increased the quantity of copper available for the purpose and greatly facilitated the sale of copper from other countries than Chili, as well as the sale of the product of English smelters.

On January 24, the syndicate declined to buy forward deliveries, and at the close of February its agents in London refused to continue to purchase good merchantable copper for immediate delivery. Until that time they took all cash warrants offered to them at £77 10*s.* Their refusal to continue caused a rapid decline to £51 on the eleventh, forward deliveries selling at £47 15*s.* for two months prompt and £46 for all the year. A more confident feeling sprung up on the report that the Mathesons, of London, had arranged to give the syndicate financial assistance and take charge of the sale of its copper. At first it was stated that the selling price was to be £62 for good merchantable copper, £67 for best selected, and 12*s.* 4*d.* for matte, but subsequently it was announced that the syndicate price was reduced to £57 for good merchantable copper and £62 for best selected. The negotiations with the firm fell through, however, and there was a sharp drop to £50 on the thirteenth. Five days later the London agents of the syndicate failed and prices dropped to £40 on the fourteenth, and holding steady between £42 10*s.* and £39 5*s.*, 1,100 tons of good merchantable copper having been sold at auction on behalf of the creditors of the collapsed firm at an average of about £42.

The average prices for Chili bars, ores, and precipitates in England are given in the following table for a series of years:

Average values of copper in England.

Years.	Chili bars.			Ore, 25 per cent.			Precipitate.		
	Long ton.			*Per unit.*			*Per unit.*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
1880	62	10	0	0	12	9	0	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

THE PRINCIPAL FOREIGN PRODUCERS.

The copper production of the world, 1881 to 1888, inclusive.

Countries.	1888.	1887.	1886.	1885.	1884.	1883.	1882.	1881.
EUROPE.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Great Britain	(*a*)1, 500	389	1, 471	2, 773	3, 350	2, 620	3, 464	3, 875
Spain and Portugal:								
Rio Tinto	(*a*)32, 000	26, 663	(*a*)24, 700	23, 484	21, 564	20, 472	17, 389	16, 666
Tharsis	(*a*)11, 500	(*a*)11, 000	(*a*)11, 000	(*a*)11, 500	(*a*)10, 800	9, 800	9, 000	10, 203
Mason & Barry	(*a*)7, 000	(*a*)7, 000	(*a*)7, 000	(*a*)7, 000	7, 509	8, 000	8, 000	8, 170
Sevilla	1, 700	2, 300	2, 135	1, 800	2, 000	2, 026	1, 885	1, 340
Portugueza	(*a*)900	(*a*)856	1, 258	1, 665	(*a*)2, 300	2, 357	1, 700	1, 410
Poderosa and others	(*a*)7, 200	4, 050	3, 560	2, 424	2, 251	1, 000	800	800
Germany:								
Mansfeld	13, 380	13, 025	12, 595	12, 450	12, 582	12, 634	11, 536	10, 999
Other German	(*a*)1, 850	(*a*)1, 850	1, 870	(*a*)2, 800	(*a*)2, 200	3, 568	3, 552	1, 743
Austria	1, 010	883	733	585	670	572	474	474
Hungary	858	531	366	504	614	661	661	800
Sweden	(*a*)900	905	520	775	662	732	798	995
Norway	1, 570	1, 450	2, 220	2, 560	2, 796	2, 630	2, 590	2, 640
Italy	(*a*)2, 500	(*a*)2, 500	900	835	1, 325	1, 600	1, 400	1, 480
Russia	4, 700	5, 000	4, 875	(*a*)5, 100	4, 700	3, 500	3, 537	3, 411
Total Europe	88, 568	78, 402	75, 203	76, 255	75, 224	72, 172	66, 786	65, 006
NORTH AMERICA.								
United States	101, 054	80, 768	69, 971	74, 053	63, 555	51, 574	40, 467	32, 000
Canada	(*a*)2, 250	1, 400	1, 440	2, 500	236	1, 055	500	500
Newfoundland	2, 050	1, 180	1, 125	778	668	1, 053	1, 500	1, 718
Mexico	2, 766	2, 050	850	375	291	489	401	333
Total North America	108, 120	85, 398	73, 386	77, 706	64, 750	54, 171	42, 868	34, 551
SOUTH AMERICA.								
Chili	31, 240	29, 150	35, 025	38, 500	41, 648	41, 099	42, 909	37, 989
Bolivia:								
Corocoro	1, 450	(*a*)1, 300	1, 100	(*a*)1, 500	(*a*)1, 500	1, 680	3, 259	2, 655
Peru	250	50	75	229	362	395	440	615
Venezuela:								
New Quebrada	4, 000	2, 900	3, 708	4, 111	4, 600	4, 018	3, 700	2, 823
Argentine Republic	150	170	180	233	159	293	800	307
Total South America	37, 090	33, 570	40, 088	44, 573	48, 269	47, 485	51, 108	44, 389
AFRICA.								
Algiers	50	150	110	250	260	600	600	600
Cape of Good Hope	7, 500	7, 250	6, 015	5, 450	5, 000	5, 975	5, 716	3, 467
Total Africa	7, 550	7, 400	6, 125	5, 700	5, 260	6, 575	6, 316	4, 067
ASIA.								
Japan	(*a*)11, 000	(*a*)11, 000	10, 000	(*a*)10, 000	(*a*)10. 000	7, 600	4, 800	3, 900
Total Asia	11, 000	11, 000	10, 000	10, 000	10, 000	7, 600	4, 800	3, 900
AUSTRALIA.								
Australia	7, 550	7, 700	9. 700	11, 400	14, 100	12, 271	8, 512	10, 000

a Estimated.

The copper production of the world, 1881 to 1888, inclusive—Continued.

RECAPITULATION.

Countries.	1888.	1887.	1886.	1885.	1884.	1883.	1882.	1881.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Europe	88, 568	78, 402	75, 203	74, 839	73, 959	72, 172	66, 786	65, 006
North America	108, 120	85, 398	73, 386	77, 706	64, 750	54, 171	42, 868	34, 551
South America	37, 090	33, 570	40, 088	44, 573	48, 269	47, 485	51, 108	44, 389
Africa	7, 550	7, 400	6, 125	5, 700	5, 260	6, 575	6, 316	4, 067
Asia	11, 000	11, 000	10, 000	10, 000	10, 000	7, 600	4, 800	3, 900
Australia	7, 450	7, 700	9, 700	11, 400	14, 100	12, 271	8, 512	10, 000
Total	259, 778	223, 470	214, 502	224, 218	216, 338	200, 274	180, 390	161, 913

Great Britain.—The high prices for copper and the constant danger of a collapse caused the majority of producers all over the world to rush their supplies to the English markets as fast as possible. The British imports therefore show a very heavy increase. It is known, however, that towards the close of the year the syndicate kept copper bought from mines under its control to remain in the producing countries in order to avoid the payment of freights and to make the statistical situation appear less critical.

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, 692	51, 263
1885	41, 933	81, 616	123, 549	62, 050	54, 323
1886	42, 969	65, 046	108, 015	60, 510	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

(*a*) Including 22,557 tons of Chili bars transferred to France.

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 1881 to 1888 inclusive.

Character.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pure in pyrites	13, 551	15, 672	15, 016	14, 077	16, 333	13, 905	14, 940	15, 448
Pure in precipitate ..	18, 619	17, 935	23, 645	19, 688	21, 398	19, 323	21, 819	26, 366
Pure in ore	15, 396	15, 489	15, 880	24, 677	15, 683	13, 749	15, 148	19, 452
Pure in regulus......	6, 491	9, 270	8, 952	11, 181	28, 202	18, 069	21, 984	29, 601
Bars, cakes, etc	32, 170	35, 509	35, 653	39, 767	41, 933	42, 969	29, 198	44, 603
Total	86, 227	93, 875	99, 146	109, 390	123, 549	108, 015	103, 089	135, 470

It will be observed that the principal increase took place in bars.

Imports of precipitate and regulus into Great Britain.

Countries.	1882.	1883.	1884.	1885.	1886.	Fine copper.	1887.	Fine copper.	1888. Fine copper.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Portugal	7, 301	8, 873	7, 161	8, 283	6, 657	24, 032	10, 758	24, 754	30, 119
Spain	21, 398	28, 962	27, 621	38, 267	38, 666		37, 892		
Chili	10, 882	6, 384	10, 699	5, 255	1, 637	737	1, 595	718	734
United States ...	....	....	5, 805	29, 861	13, 105	10, 853	24, 229	15, 039	20, 752
Other countries .	9, 716	13, 509	11, 124	6, 000	5, 240	1, 770	5, 366	2, 292	4, 362
Total	49, 297	57, 728	62, 410	87, 666	68, 305	....	79, 840	....	....
Fine copper	27, 205	32, 597	34, 172	49, 600	....	37, 392	....	42, 803	55, 967

The Peninsula and the United States contributed chiefly to the increased deliveries.

In detail the imports of copper in the form of bars, cakes, etc., into Great Britain was as follows:

Imports of copper, wrought and unwrought, into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	24, 258	21, 019	22, 585	22, 799	22, 843	24, 832	24, 748	17, 516	21, 534
Australia	9, 406	9, 150	8, 152	9, 531	9, 329	8, 564	9, 933	5, 412	5, 398
America	....	....	....	1, 773	3, 584	3, 375	2, 110	1, 469	4, 680
Other countries .	2, 845	2, 001	4, 772	1, 550	4, 011	5, 160	6, 178	4, 801	12, 991
Total......	36, 509	32, 170	35, 509	35, 653	39, 767	41, 931	42, 969	29, 198	44, 603

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of other than Chili copper into Liverpool, London, and Swansea, during the years 1882, 1883, 1884, 1885, 1886, 1887, and 1888, which represents 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:

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

Countries.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	30, 112	27, 504	31, 298	28, 985	27, 191	20, 008	24, 479
United States	745	9, 410	17, 309	24, 037	13, 483	16, 534	25, 730
Spain and Portugal	464	2, 788	2, 359	4, 655	5, 721	5, 178	5, 915
Spain (precipitate)	8, 757	11, 249	10, 009	9, 186	10, 038	13, 042	15, 568
Spain (pyrites)	15, 673	15, 017	14, 077	16, 333	13, 905	14, 940	15, 448
Australia	9, 847	9, 694	9, 685	8, 951	10, 096	6, 047	6, 746
Cape of Good Hope	5, 298	5, 670	6, 042	5, 405	7, 073	8, 271	8, 829
New Quebrada	3, 164	3, 960	3, 675	4, 074	3, 055	2, 261	3, 574
Japan	....	....	1, 064	3, 010	3, 572	200	4, 469
Italy	1, 386	1, 091	1, 310	835	889	1, 055	1, 058
Norway	446	296	289	27	....	....	545
Canada	347	448	266	....	8	94	156
Newfoundland	1, 362	1, 185	224	723	891	359	465
Mexico	372	489	291	374	243	61	158
Peru	821	426	408	229	68	13	202
River Plate	260	319	131	233	179	167	135
Other countries	925	946	284	325	1, 049	1, 074	4, 054
Total tons fine	79, 979	90, 492	98, 721	107, 382	97, 461	89, 304	117, 531

The following table, giving the details of the imports of copper from the United States into England and France, for a series of years in different forms, is particularly interesting as showing how closely this country is pushing Chili as a rival contributor to the world's markets:

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

	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
England:							
Ore	274	4, 940	11, 023	1, 875	420	26	298
Matte	471	2, 512	2, 722	18, 895	10, 853	15, 039	20, 752
Bars and ingots	....	1, 773	3, 584	3, 375	2, 210	1, 469	4, 680
Total England	745	9, 225	17, 329	24, 145	13, 483	16, 534	25, 730
France	1, 072	4, 513	7, 205	9, 235	4, 167	3, 910	6, 496
United States into England and France	1, 817	13, 738	24, 534	33, 380	17, 650	20, 444	32, 226
Chili into England and France	42, 306	43, 568	42, 384	35, 342	35, 448	29, 019	32, 947

So far as the imports of bars and ingots into England and France for the year 1888 are concerned they do not agree with our export statistics. During the year 1888 official data show that our exports amounted to 14,136 long tons. The total in the table is 11,176 long tons. This apparent discrepancy may be accounted for partly by differences in the quantities afloat on January 1, 1888, and the same date of 1889, and partly by the fact that American copper was shipped to other countries.

The exports of copper from Great Britain in different forms were as follows:

Exports of copper from Great Britain from 1880 *to* 1888, *inclusive.*

Character.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Raw English	15, 202	18, 737	12, 776	16, 777	17, 943	18, 766	19, 036	40, 700	32, 058
Sheets	16, 580	15, 960	15, 698	16, 071	20, 669	21, 108	17, 927		
Yellow metal, at 60 per cent	10, 128	9, 939	10, 892	11, 918	11, 602	12, 551	11, 958	10, 153	4, 513
Brass at 70 per cent.	2, 677	3, 263	3, 499	3, 381	3, 735	3, 233	3, 001	3, 146	2, 650
	44, 587	47, 899	42, 865	48, 147	53, 949	55, 658	51, 922	53, 999	39, 221
Fine foreign	14, 895	13. 790	12, 818	11, 203	10, 742	6, 422	8, 589	15, 454	*a*32, 845
Total	59, 482	61, 689	55, 683	59, 350	64, 691	62, 080	60, 511	69, 453	72, 066

a Including 22,557 tous Chili bars transferred to France.

Making due allowance for the transfers of copper to France, the exports from England fell off from 69,453 tons in 1887 to 49,509 tons in 1888. It should be stated, however, that probably a notable quantity of copper shipped in former years from England to India and other eastern countries was supplanted in 1888 by direct shipment to those countries from Australia and Japan.

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

Direct imports into France.

Countries.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	16, 064	11, 086	6, 357	8, 257	9, 011	8, 468
United States	4, 513	7, 205	9, 235	4, 167	3, 910	6, 496
Mexico	....	....	....	......	....	2, 700
Other countries	317	392	995	1, 600	1, 048	6, 905
Total	20, 894	18, 683	16, 587	14, 024	13, 969	24, 569

These statistics do not, of course, include the quantities, notably of Chili copper, transferred from English to French warehouses.

The French copper consumption is estimated as follows:

French copper consumption from 1883 *to* 1889.

Years.	Stocks.	Imports direct.	Apparent consumption.	
			Exclusive of imports from England.	Including imports from England.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1883	3, 040	20, 894	20, 358	26, 435
1884	2, 194	18, 683	19, 529	23, 421
1885	1, 434	16, 587	17, 347	22, 302
1886	2, 555	14, 024	12, 903	20, 595
1887	913	13, 969	15, 581	25, 354
1888	(*a*) 39, 488	(*b*) 24, 569	8, 581	29, 069

a Including 22,557 tons of Chili bars transferred from England to France.
b Omitting 22,557 tons of Chili bars transferred from England to France.

LEAD.

By C. Kirchhoff, Jr.

A very heavy increase in the production of lead took place in the year 1888, the amount of the metal made from domestic and foreign ores being far in excess of that of any previous year, and placing the United States far in advance of any country in the world as a producer of the metal. The greater part of the increase in the quantity produced at our smelting works was, however, the result of heavy importations of Mexican ores. It may be questioned whether it is just to include the tonnage thus added in the strictly American product. It is not usual to do so, for instance, in the case of copper production in England or in this country from imported ores or furnace material. On the other hand, statisticians usually count the total pig iron product, however large a proportion of it is derived from ores drawn from sources beyond the producing country. The question possesses a direct practical interest in the case of lead, because any events which might cut off partly or wholly the supply of foreign ores would have a notable effect upon prices, and would lead to stimulating activity in domestic mines. Assuming that the lead contents of Mexican ores smelted in the United States in 1887 were equal to 15,000 tons, which is the figure generally accepted, the American mines in that year yielded 145,000 tons of metal. Deducting 28,636 tons, the quantity returned by the Bureau of Statistics as the lead contents of Mexican ores during the calendar year 1888, from the product of 180,555 tons, a balance of about 152,000 tons remains as the quantity of the metal produced from American ores.

As bearing on the consumption of lead, it is of interest to state that the total product of the white lead manufacturers of the United States, estimating two firms, was 89,000 tons in 1888. Estimating the lead contents of the pigment at 75 per cent. this would represent a consumption of 66,750 tons of lead by corroders.

Production of lead in the United States, from 1825 to 1888, both inclusive.

Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.	Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.
	Short tons.	*Short tons.*	*Short tons.*	*Per cent*		*Short tons.*	*Short tons.*	*Short tons.*	*Per cent.*
1825	1,500	....	....	....	1859	16,400	....	....	....
1830	8,000	....	....	....	1860	15,600	....	....	....
1831	7,500	....	....	....	1861	14,100	....	....	....
1832	10,000	....	....	....	1862	14,200	....	....	....
1833	11,000	....	....	....	1863	14,800	....	....	....
1834	12,000	....	....	....	1864	15,300	....	....	....
1835	13,000	....	....	....	1865	14,700	....	....	....
1836	15,000	....	....	....	1866	16,100	....	....	....
1837	13,500	....	....	....	1867	15,200	....	....	....
1838	15,000	....	....	....	1868	16,400	....	....	....
1839	17,500	....	....	....	1869	17,500	....	....	....
1840	17,900	....	....	....	1870	17,830	....	....	....
1841	20,500	....	....	....	1871	20,000	....	....	....
1842	24,000	....	....	....	1872	25,880	....	....	....
1843	25,000	....	....	....	1873	42,540	20,159	22,381	47.7
1844	26,000	....	....	....	1874	52,080	....	....	....
1845	30,000	....	....	....	1875	59,640	34,909	24,699	58.5
1846	28,000	....	....	....	1876	64,070	37,649	26,421	58.8
1847	28,000	....	....	....	1877	81,900	50,748	31,152	62.0
1848	25,000	....	....	....	1878	91,060	64,290	26,770	70.6
1849	23,500	....	....	....	1879	92,780	64,650	28,130	69.7
1850	22,000	....	....	....	1880	97,825	70,135	27,690	71.7
1851	18,500	....	....	....	1881	117,085	86,315	30,770	73.7
1852	15,700	....	....	....	1882	132,890	103,875	29,015	78.3
1853	16,800	....	....	....	1883	143,957	122,157	21,800	84.8
1854	16,500	....	....	....	1884	139,897	119,965	19,932	86.4
1855	15,800	....	....	....	1885	129,412	107,437	21,975	83.0
1856	16,000	....	....	....	1886	135,629	114,829	20,800	85.0
1857	15,800	....	....	....	1887	160,700	135,552	25,148	84.3
1858	15,300	....	....	....	1888	180,555	151,465	29,090	83.9

Ores from Mexico.—The principal event of the year 1888 was the great development of the imports of lead in silver ores from Mexico. According to figures supplied by the Bureau of Statistics, the following amounts of lead were returned by collectors of customs as contained in the silver-lead ores imported:

Imports of lead contained in Mexican silver-lead ores in 1888.

Ports of entry.	Lead.	Value.
	Pounds.	
Corpus Christi, Texas	5,629,780	$49,170
Paso del Norte, for Texas and New Mexico	41,647,291	832,944
Saluria, Texas	9,995,300	84,438
Total	57,272,371	966,552

On October 18, 1889, the Secretary of the Treasury rendered a decision on the classification of ores containing both silver and lead, upholding the practice of the Treasury Department, and enjoining upon customs officers a strict enforcement of the regulations of the Department intended to correct abuses which formerly existed in the methods of entry, sampling, and classification.

The most important district in Mexico from which ores are shipped into the United States is the Sierra Mojada, Coahuila, concerning which Mr. C. O. Shields, of Denver, furnishes the following data: The largest and wealthiest company in the camp is the Compania Minera "La Constancia," owning "La Esmeralda," "Buena Vista," "Las Playas," and "San Francisco," and having a part interest in the "Guarda-Raya Salvador," and the "Guarda-Raya Perreña." The same company has lately acquired the "Providencia" and "El Volcan" mines of the Compania Minera "Poder de Dios." A fourth group contains the San José mines leased and worked by the Mexican Ore Company, an American organization, intimately connected with one of the leading refining and desilverizing concerns of the country. Early in 1889 the shipments of this company averaged about 4,500 tons per month. The officers of the company, however, obtained a lease for a term of eight years, dating from April 15, 1889, of all the property owned by the Perreña company, including those in which it has a joint interest with La Constancia Company, in which large bodies of ore are exposed. Hoisting engines were being put in, and preparations for work on a more expensive scale followed them. It is estimated that this will lead to an increase in the shipments of 2,000 tons a month and may reach 2,500 tons. The shipments of the Mexican Ore Company from the district are therefore expected to reach from 6,500 to 7,000 tons a month by the middle of 1889. Next in importance is the Compania Minera "La Perreña," controlling the "San Salvador," "Socavon," "Perreña," and others. In addition thereto the Saint Louis and Zacatecas Ore Company ships about 500 tons a month, averaging 20 ounces of silver and 45 per cent. of lead.

As all the mines of the camp are nearly of the same grade, a good idea of the character of the ore shipped from the Sierra Mojada will be obtained from the following average assay of seventy lots, aggregating about 18,000 tons of ore, shipped by the Mexican Ore Company from the mines of "La Constancia" alone during the period from December 18, 1888, to April 22, 1889: Silver, 25.52 ounces per ton; lead, 38.97 per cent. The ore is carbonate, with an excess of bases, and is therefore a very desirable smelting ore, which will admit of carrying considerable quantities of dry silver ores.

The cost of mining is estimated at $1, American money. The freight to Escalon is $8.44 for 2,035 pounds advoirdupois. Offers to carry the ore to El Paso, Texas, from Escalon have been made at $4.50 and $5, while the rate to Denver is $11.50. The cost of delivery at El Paso would therefore be from $13.79 to $14.29 per ton, less a small rebate paid on freights to some shippers. Based on 4 cents as the price of lead in New York and 90 per cent. per ounce for silver, the El Paso smelters pay 2 cents per pound on the lead; after deducting 8 per cent. of lead to cover loss, they pay 90 per cent. of the value of the silver, and deduct $10 for smelting charges. Ore containing 25.52 ounces of silver and 38.97 per cent. of lead would therefore yield $16.75, leaving a profit of about $3 per ton to the mining company.

So far as the smelters are concerned, the following data will throw light on the subject: Assuming the yield of an ore to be 33⅓ per cent., carrying 25.5 ounces of silver, and the cost of smelting to be $6.50 per ton of ore, the freight per ton of bullion to the refinery is $13, the reduction of the refiner for silver is $3, and the reduction for lead $17; making the total charges $33 per ton of bullion to obtain New York prices for lead and silver. These would therefore amount to $11 per ton of ore.

The possibilities of delivering Mexican lead in New York are alluded to as follows by Mr. C. C. Fitzgerald, of El Paso, Texas.

It is estimated that lead smelted in Mexico would cost delivered on cars $20 per net ton. The average freight, starting at a point 600 miles north of the City of Mexico, to El Paso would be $12. The freight from El Paso via New Orleans has recently been reduced to $15.50. Adding $30 duty, the cost of the lead would be $77.50, or 3.87½ cents a pound. If it carried any notable quantity of silver a balance would remain, placing the cost of refining and desilverizing and the cost of marketing to the charge of the silver, which would be available to pay for mining and an adequate profit to the Mexican mines and smelter. For shipments to England the figures would be: Cost of lead, free on board cars in Mexico, $20 per ton; freight to Liverpool, $18, and charges $4; a total of $42. With the English market at $50 per ton for the lead, the balance would be in favor of shipments to England, providing the American lead market were under 4 cents at New York.

Partial statement of the quantities and values of silver ores imported into each customs district of the United States, during the calendar year 1889, with the quantities and values of lead, copper, silver, and gold contained in these ores as far as ascertained.

Customs districts.	Total ore.	Lead.		Copper.	
		Quantity.	Value.	Quantity.	Value.
	Pounds.	*Pounds.*		*Pounds.*	
Boston and Charlestown, Mass	....	....	....	....	....
Corpus Christi, Tex	44,506,698	6,221,390	$52,253	....	....
Duluth, Minn	28,800	....	....	....	....
Minnesota, Minn	27,730	....	....	....	....
New Orleans, La	1,076,764	....	....	....	....
New York, N. Y	....	27,569	....	....	....
Omaha, Nebr	33,644	....	....	....	....
Oswegatchie, N. Y	161,540	....	....	....	....
Paso del Norte, N. Mex	140,116,091	32,622,256	761,322	280,573	$14,273
Saluria, Tex	55,543,040	14,295,587	183,379	....	....
San Francisco, Cal	....	....	....	....	....
Total	....	....	....	....	....

Partial statement of the quantities and values of silver ores imported into each customs district of the United States, during the calendar year 1889, *etc.*—Continued.

Customs districts.	Silver.		Gold.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Ounces.		*Ounces.*		
Boston and Charlestown, Mass					$2, 000
Corpus Christi, Tex	1, 295, 917	$1, 125, 506	1, 710	$33, 179	1, 210, 938
Duluth, Minn	8, 488				7, 800
Minnesota, Minn					15, 000
New Orleans, La	56, 880		295		47, 961
New York, N. Y					497, 685
Omaha, Nebr	2. 007	1, 750			1, 750
Oswegatchie, N. Y					118, 230
Paso del Norte, N. Mex		3, 729, 591		2, 901	4, 508, 087
Saluria. Tex		633, 325			827, 549
San Francisco, Cal					559, 719
Total					7, 796, 719

NOTE.—Where the information is not given, it was impracticable to obtain it.
The collectors of the customs districts of Minnesota, Oswegatchie, and San Francisco report that the ores returned by them did not contain any appreciable quantity of lead.

REVIEW OF THE LEAD MARKET.

The following table gives the highest and lowest prices monthly for a series of years:

Highest and lowest prices of lead at New York City, monthly, from 1870 *to* 1888 *inclusive.*

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870	(*a*)6. 30	6. 20	6. 25	6. 17	6. 20	6. 10	6. 25	6. 15	6. 25	6. 20	6. 25	6. 20
1871	(*a*)6. 30	6. 15	6. 25	6. 20	6. 20	6. 15	6. 20	6. 10	6. 18	6. 10	6. 15	6. 12
1872	(*a*)6. 00	5. 90	6. 00	5. 87	6. 00	5. 87	6. 12	5. 90	6. 62	6. 25	6. 62	6. 40
1873	(*a*)6. 37	6. 25	6. 50	6. 40	6. 50	6. 25	6. 50	6. 25	6. 62	6. 35	6. 55	6. 12
1874	(*a*)6. 00	5. 90	6. 25	6. 00	6. 25	6. 12	6. 25	5. 90	6. 00	5. 75	6. 00	5. 62
1875	(*a*)6. 20	6. 00	5. 90	5. 85	5. 75	5. 62	5. 87	5. 80	5. 95	5. 90	5. 90	5. 75
1876	(*a*)6. 00	5. 87	6. 37	6. 00	6. 50	6. 40	6. 40	6. 12	6. 50	6. 10	6. 50	6. 25
1877	(*b*)6. 15	6. 12	6. 40	6. 20	6. 75	6. 50	6. 50	6. 25	6. 00	5. 55	5. 70	5. 60
1878	4. 35	4. 00	3. 87	3. 65	3. 87	3. 62	3. 75	3. 50	3. 50	3. 25	3. 50	3. 12
1879	4. 50	4. 00	4. 50	4. 50	4. 50	3. 25	3. 25	2. 87	3. 12	2. 87	3. 80	3. 12
1880	6. 10	5. 50	6. 00	5. 87	5. 95	5. 30	5. 75	5. 40	5. 25	4. 40	4. 75	4. 50
1881	5. 00	4. 30	5. 10	4. 80	4. 85	4. 62	4. 85	4. 37	4. 70	4. 25	4. 50	4. 25
1882	5. 15	4. 95	5. 20	5. 00	5. 12	4. 85	5. 00	4. 90	4. 85	4. 60	4. 90	4. 55
1883	4. 70	4. 60	4. 60	4. 50	4. 65	4. 50	4. 62	4. 40	4. 55	4. 40	4. 45	4. 40
1884	4. 50	3. 75	4. 10	3. 75	4. 15	4. 10	4. 05	3. 62½	3. 75	3. 52½	3. 65	3. 57½
1885	3. 70	3. 55	3. 70	3. 60	3. 70	3. 62½	3. 70	3. 62½	3. 75	3. 60	3. 85	3. 62½
1886	4. 70	4. 50	4. 90	4. 60	4. 95	4. 85	4. 90	4. 65	4. 75	4. 65	4. 90	4. 65
1887	4. 45	4. 15	4. 50	4. 25	4. 45	4. 25	4. 32½	4. 20	4. 70	4. 30	4. 70	4. 50
1888	4. 90	4. 50	5. 15	4. 60	5. 25	5. 00	5. 05	4. 55	4. 62½	4. 00	4. 10	3. 65

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870	6.30	6.20	6.37	6.32	6.37	6.30	6.37	6.25	6.35	6.25	6.35	6.25
1871	6.15	6.10	6.12	6.00	6.10	6.00	6.00	5.87	6.00	5.90	6.00	5.75
1872	6.62	6.40	6.50	6.40	6.50	6.30	6.62	6.40	6.60	6.50	6.60	6.42
1873	6.12	6.00	6.25	6.00	6.62	6.37	6.75	6.25	6.50	6.00	6.12	6.00
1874	5.80	5.62	5.80	5.65	6.10	5.65	6.35	6.10	6.50	6.25	6.40	6.12
1875	6.00	5.95	5.95	5.87	5.87	5.70	5.65	5.60	5.87	5.65	5.95	5.87
1876	6.35	6.20	6.37	6.25	6.25	6.00	6.00	5.80	5.80	5.70	5.70	5.65
1877	5.60	5.37	5.12	4.90	4.85	4.75	4.85	4.25	4.75	4.50	4.60	4.50
1878	3.62	3.25	3.50	3.20	3.45	3.25	3.60	3.37	3.95	3.60	4.00	3.90
1879	4.10	3.90	4.05	4.00	4.00	3.75	5.50	4.00	5.62	5.00	5.60	5.50
1880	4.75	4.25	5.00	4.30	4.90	4.80	4.87	4.65	4.85	4.75	4.75	4.25
1881	4.90	4.50	4.95	4.75	5.37	4.95	5.25	4.87	5.25	4.90	5.25	5.00
1882	5.15	4.90	5.10	4.95	5.15	4.95	5.15	4.85	4.90	4.50	4.75	4.50
1883	4.40	4.30	4.30	4.20	4.32	4.30	4.32	4.12	4.05	3.65	3.75	3.60
1884	3.70	3.55	3.70	3.52½	3.75	3.55	3.75	3.60	3.55	3.37½	3.75	3.50
1885	4.15	3.87½	4.25	4.12	4.25	4.00	4.25	4.00	4.60	4.00	4.67½	4.50
1886	4.90	4.75	4.80	4.75	4.70	4.45	4.30	4.00	4.40	4.10	4.35	4.25
1887	4.67½	4.40	4.62½	4.55	4.55	4.25	4.40	4.20	4.75	4.25	5.15	4.90
1888	4.07½	3.85	4.97½	4.15	5.12½	4.90	5.12½	3.62½	3.82½	3.60	3.82½	3.60

a Gold. *b* Currency.

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 1888, both inclusive:

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

[Cents per pound.]

Months.	1884.	1885.	1886.	1887.	1888.
January	4.09	3.65	4.57	4.27	4.80
February	3.98	3.65	4.75	4.43	4.92
March	4.12	3.67	4.87	4.35	5.14
April	3.84	3.63	4.77	4.29	4.72½
May	3.64	3.67	4.72	4.49	4.24
June	3.62	3.73	4.77	4.62	3.88
July	3.58	4.06	4.88	4.50	3.96
August	3.58	4.25	4.75	4.55	4.43
September	3.61	4.26	4.63	4.44	4.99
October	3.69	4.10	4.23	4.30	4.45
November	3.46	4.12	4.32	4.35	3.67½
December	3.60	4.57	4.32	5.00	3.73
Yearly average	3.73	3.95	4.63	4.47	4.41

The following table shows the daily price of lead during 1888, as compiled by Mr. E. A. Caswell:

Price of common pig lead in New York City.

[Year's average for 1888, 4.41.]

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Month's average...	4.80	4.92	5.14	4.72½	4.24	3.88	3.96	4.43	4.99	4.45	3.67½	3.73
1......	S.	4.70	5.17½	S.	4.62½	4.00	S.	4.17½	4.90	5.12½	3.82½	3.60
2......	H.	4.65	5.17½	5.05	4.62½	4.00	3.90	4.15	S.	5.12½	3.75	S.
3......	4.90	4.60	5.17½	4.85	4.62½	S.	4.05	4.20	H.	5.05	3.70	3.60
4......	4.90	4.60	S.	5.00	4.62½	4.00	H.	4.20	4.95	4.85	S.	3.75
5......	4.90	S.	5.17½	4.90	4.60	3.92½	4.07½	S.	4.95	5.05	3.75	3.75
6......	4.90	4 80	5.25	4.75	S.	3.85	4.05	4.25	4.95	5.10	H.	3.80
7......	4.90	4.90	5.25	4.75	4.60	3.85	4.05	4.27½	5.00	S.	3.75	3.75
8......	S.	4.90	5.25	S.	4.50	3.75	S.	4.30	5.00	5.10	3.77½	3.75
9......	4.90	4.90	5.25	4.62½	4.40	3.75	4.05	4.30	S.	5.00	3.75	S.
10......	4.80	4.90	5.10.	4.55	4.25	S.	4.05	4.32½	5.05	5.00	3.75	3.75
11......	4.80	4.90	S.	4.75	4.20	3.75	4.05	4.32½	5.00	4.65	S.	3.75
12......	4.80	S.	5.00	4.70	4.20	3.65	3.95	S.	4.97½	4.80	3.75	3.75
13......	4.62½	4.90	5.00	4.75	S.	3.65	3.95	4.40	4.97½	4.97½	3.65	3.70
14......	4.50	4.95	5.10	4.75	4.20	3.70	3.95	4.40	4.97½	S.	3.65	3.70
15......	S.	4.87½	5.00	S.	4.20	3.70	S.	4.40	4.97½	4.97½	3.65	3.65
16......	4.50	4.95	5.12½	4.75	4.20	3.75	3.95	4.40	S.	4.80	3.65	S.
17......	4.50	4.95	5.10	4.70	4.10	S.	3.95	4.40	4.97½	4.75	3.65	3.65
18......	4.65	5.00	S.	4.70	4.00	3.75	3.95	4.40	4.97½	4.10	S.	3.65
19......	4.60	S.	5.12½	4.70	4.00	3.75	3.85	S.	4.97½	3.90	3.65	3.65
20......	4.90	5.00	5.15	4.70	S.	4.05	3.85	4.35	5.00	3.90	3.65	3.65
21......	4.90	5.00	5.15	4.70	4.00	4.10	3.85	4.35	5.00	S.	3.65	3.82½
22......	S.	H.	5.15	S.	4.00	4.10	S.	4.30	5.00	4.00	3.60	3.77½
23......	4.90	5.05	5.17½	4.70	4.00	4.10	3.92½	4.45	S.	3.90	3.60	S.
24......	4.90	5.05	5.15	4.70	4.00	S.	3.92½	4.60	5.00	3.85	3.60	3.77½
25......	4.90	5.10	S.	4.65	4.00	4.10	3.92½	4.60	5.00	3.82½	S.	H.
26......	4.90	S.	5.15	4.60	4.00	4.10	3.92½	S.	5.00	3.80	3.60	3.77½
27......	4.90	5.12½	5.15	4.60	S.	3.80	3.90	4.70	5.00	3.62½	3.60	3.77½
28......	4.80	5.12½	5.10	4.60	4.05	3.92½	3.90	4.80	5.05	S.	3.60	3.77½
29......	S.	5.15	5.10	S.	4.05	3.92½	S.	4.80	5.12½	3.62½	H.	3.77½
30......	4.80	....	5.10	4.60	H.	3.90	4.00	4.85	S.	3.65	3.60	S.
31......	4.80	....	5.05	....	4.05	....	4.00	4.97½	....	3.65	....	3.77½

The year 1888 was particularly eventful in the lead trade, having witnessed a long struggle to force prices upward, and the final disastrous collapse of the speculator who had manipulated the market. It was followed by a period of depression, due largely to the uncertainty concerning the disposal of large stocks which had passed into the hands of bankers who had made advances on lead carried in warehouses. The year opened with an effort to sell, creating a decline from 4.90 cents on the 3rd to 4.50 cents on the 14th. The buying of futures caused a reaction from which there was a decline late in January and early in February, until 4.90 cents was reached. Rumors of a movement to form a syndicate and the intercession of the speculative interest put up the price, producers and dealers selling heavily on the rise, which, however, was pushed till 5.25 cents was reached early in March. Fluctuations followed as the speculators bought or sold, the weaker members of the clique letting their holdings go. This caused a drop to 4.55 cents on the 10th. The leading operator becoming a buyer once more, the price was raised a little, but fluctuated in an unsettled way during the balance of the month. During the entire period consumers bought very little, the market remaining entirely in the control of the speculative element. In May, and up to the middle of June, the bears succeeded in driving down the price until it touched 3.65 cents. Purchases were then chiefly made to cover future contracts entered into months previously, and the market reacted, holding in the vicinity of 4 cents during the balance of the month and the greater part of July. During that month the leader on the bull side of the speculation continued to make heavy purchases both of spot and future supplies, and the idea began to gain ground that the corner aimed at had some chances of success. Under heavy buying the market advanced almost uninterruptedly during August, closing near 5 cents, while it had opened at 4.15 and 4.17½ cents. The first half of September began quietly, but was followed by very active speculative trading, chiefly for October delivery, at a shade under 5 cents. The second half of the month passed more quietly, but with a steady increase in prices; business with consumers, however, being practically at a stand-still. October opened with a weaker speculative market, and offerings became more plentiful. While values were artificially held up by the leading speculator at the Metal Exchange, lead was being offered to consumers at lower and lower prices, until on the 18th 4.10 cents was accepted, the nominal quotations on the previous day having been 4.75. On that day Mr. Corwith, the leader in the speculation, failed. Numerous sales were made at the Metal Exchange, "under the rule," to settle the contracts which had been defaulted upon. It was found that all of the lead actually delivered to him had been pledged to bankers and dealers, the advances made being about at the rate of 4 cents a pound. This fact, and the appearance of consumers as buyers, gave the metal some support, and caused the crisis to be less acute than might have been expected, the market fluctuating during the balance of the year between 3.65 and 3.77½ cents.

THE LEAD-PRODUCING REGIONS OF THE UNITED STATES.

While considerable interest attaches to data bearing on the territorial distribution of the lead product of the United States, it is possible only to indicate it in a general way. It would obviously lead to erroneous conclusions to accept as the product of a State or Territory the aggregate quantity cast by its smelters. Ores are shipped from one State or Territory to another, and distant refiners have become more and more purchasers of ores. It would be practically impossible to assign their receipts to the different districts where they originated, because often they come to the smelters and refiners from sampling works. As an alternative, efforts might be made to secure direct returns from the mines. Such an inquiry would involve labor quite out of proportion to the results obtainable, especially since the danger of failing to secure scattering returns would be great. Nor would a minute knowledge of the source of the metal be of much greater service than the broad facts obtainable without so minute an inquiry.

Utah.—According to the statement of Messrs. Wells, Fargo & Co. the production of the smelters of Utah was as follows:

Wells, Fargo & Co.'s statement of the lead product of Utah for 1885, 1886, 1887, *and* 1888.

Works.	1885, base bullion.	1886, base bullion.	1887, base bullion.	1888, base bullion.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Germania Lead Works	7, 975, 400	9, 834, 700	7, 215, 616	7, 072, 700
Hanauer	9, 352, 644	11, 741, 763	12, 064, 000	9, 882, 000
Horn Silver Mining Company	4, 905, 932			
Mingo Furnace Company	11, 744, 000	11, 743, 749	5, 215, 310	5, 129, 100
Other smelters		523, 631		
Net product base bullion	33, 977, 976	33, 843, 843	24, 494, 926	22, 083, 800
Lead in ores and matte shipped	20, 340, 800	14, 612, 417	21,182, 035	22, 483, 357
Total lead	54, 318, 776	48, 456, 260	45, 676, 961	44, 567, 157

In 1888 the high price of lead opened up many small mines, which it is believed can not pay at prices ruling towards the end of the year. The only new development during 1888 worthy of notice was the discovery on the Woodside claim at Park City of a body of carbonate ore, which yielded considerable quantities during the latter part of the year. It is still producing in increasing quantities, but does not yet throw upon the market enough lead to seriously affect the lead production of Utah. The Territory has few lead mines which have not worked through the oxidized into the sulphuret ores. The mines which have hitherto produced only siliceous ores, low in lead, are apparently running into heavier lead bodies as they sink down. The smelting industry of Utah is struggling against growing difficulties. The fact alone that the proportion of sulphurets is increasing is gradually making smelting costlier, because it increases the loss in lead and the consumption of iron ore, which in Utah is a barren flux. In 1888 more Utah ore was smelted outside of the Territory than ever before, most of the ore going to Denver, Kansas City, and Pueblo, while small quantities were shipped to Aurora, Illinois, and San Francisco. More favorable rates to eastern and western points decreased the quantity of Idaho ore treated by the smelters of the Territory. In the fall of 1888 the bullion rate to the Missouri river was reduced to $15 per ton, and coke was lowered to $11 per ton; but on the other hand, a rate of $8 per ton was given on low grade ore to Denver, a reduction of $2.60 per ton. The apparent reason for the discrimination complained of by Utah smelters, who are handicapped by their distance from the fuel and from the lead markets, is that the railroads have an excess of west-bound freight. In order to fill their empty cars going east, they have placed low rates on ore to Colorado and Missouri River points.

Nevada.—Aside from a few small undertakings, the Richmond and the Eureka companies remain the only notable producers in the State. The latter has now a desilverizing plant.

Since 1877 the production of lead in the State has been as follows:

Production of lead in Nevada since 1877.

Years.	Quantity.	Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1877	19,724	1881	12,826	1885	3,500
1878	31,063	1882	8,590	1886	3,400
1879	22,805	1883	6,000	1887	3,400
1880	16,659	1884	4,000	1888	2,400

Colorado.—The total output of the Colorado smelters for the year 1888 was 73,749 short tons as compared with 74,815 short tons in 1887. Two of the smelters report their product in such a way that the quantity of lead derived from Colorado ores is segregated, which would make the product of the State 64,202 tons. In the absence of data relating to the ore receipts of other large Colorado smelting plants from outside sources and of details of the shipments of ore from the State to distant points, it is impossible to estimate with sufficient accuracy the quantity of the metal really obtained from ores mined in the State. The following table gives the production of the individual smelting works:

Production of lead by Colorado smelting works.

Name of works.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*
American Smelting Works, Leadville and Cañon City	6,134	9,168	7,329
Arkansas Valley Smelting Company, Leadville	8,613	7,801	7,941
Harrison Reduction Works, Leadville	4,020	5,428	4,213
La Plata Smelting Company, Leadville	4,370	2,719	....
Manville Smelting Works, Leadville	2,826	2,548	3,036
Colorado Smelting Company, Pueblo	9,327	8,668	8,330
Pueblo Smelting and Refining Company, Pueblo	9,250	5,795	8,811
San Juan and New York Smelting Company	2,006	....	1,978
Royal Gorge Smelting Works	2,342	700	....
Golden Smelting Company	1,020	1,800	....
Holden Smelting Company	1,454	9,743	(a)7,620
Omaha and Grant Smelting Company (Colorado ores)	8,645	(b)12,171	(b)14,444
Miscellaneous	1,282	2,800	500
Total	61,289	69,341	64,202

(a) The total lead produced by the Holden Smelting Company was 11,687 tons.
(b) The total lead produced by the Omaha and Grant works from ores from all sources was, in 1887, 17,645 tons, and in 1888, 19,924 tons.

The Leadville smelters lost some ground during 1888, their total product being 22,490 tons of base bullion, against 30,575 tons in 1887. The ore production of the camp fell off somewhat, owing chiefly to the cessation of shipments by the small slopes and the reduction of the product of some of the other larger mines.

In the Monarch district the output of two of the leading mines, the Madonna and the Eclipse, fell off, the lead contents of the ores shipped declining from 7,571 tons in 1887 to 5,733 tons in 1888.

On the other hand, Aspen has become quite a heavy contributor to the lead supply of Colorado, the ore shipped by the Aspen Mining and Smelting Company, the Enterprise, and the Aspen containing about 8,000 tons of lead.

Idaho.—Considering the fact that it was made early in 1888, the estimate by Mr. Burbidge, of the Coeur d'Alene Sampling Works, that the Coeur d'Alene district would produce between 25,000 and 26,000 tons of lead was well borne out by the record of the year. Mr. Burbidge has collected data on which he bases the following report of the actual shipments of the year 1888:

Shipments of Idaho lead ores in 1888.

	Total product.	Per cent. of lead.	Lead.
	Tons.		*Tons.*
Ore	5,500	40	2,200
Concentrates	34,000	57½	19,550
Total	39,500	....	21,750

It is estimated that 30,000 tons of the material shipped went to Montana smelters, while 3,500 tons went to Denver works, 3,000 tons to Omaha, and the same quantity to Aurora, the total cost of freight and treatment being about the same at all the points in question. During the year the competition among buyers resulted in much better terms for the mines, the prices paid for product being about $5 to $6 higher at the close of the year than at the opening of 1888. The total cost of freight and treatment charges in April, 1889, averaged about $36 per ton, the works paying on the basis of New York quotations for 90 per cent. of the lead and 95 per cent. of the silver contents. The freights were $23 to Omaha and Aurora, $18.30 to Denver, and from $14 to $16 to Montana points. It is stated, however, that the Montana smelters have secured a "milling in transit" rate, enabling them to ship concentrates to the smelter and the bullion thence to the eastern refineries for the same rate at which a ton of concentrates is shipped direct to the East.

The extension of the Oregon Railway and Navigation Company from Farmington to Coeur d'Alene City is being actively pushed. Instead of the Northern Pacific building a connecting link, as was first believed, it now seems likely that the new road will be operated jointly by the two companies. This will not give the mines the expected benefit of competition, but it is probable that rates will have to be made which will enable the smelters on the Union Pacific system to secure some ore, so that the mines will have the advantage of the increased competition on the part of smelters thus created. A line has been surveyed toward the Sunset Peak district, which is known to possess promising mines, but good authorities question whether further work will be done in that direction this year.

During the latter half of 1888 three new concentrating works were started, two of them closing down, however, when the price of lead declined. A fourth plant began operations in April, 1889, at the Hunter mine, at Mullan, soon after the completion of a branch railroad to that point. In addition to these, three other concentrating plants were under construction in the spring of 1889, which are expected to be in operation in the summer of 1889, and will probably increase the daily output by about 75 to 80 tons of 55 per cent. concentrates. Mr. Burbidge estimates that the lead product of the district will reach 33,000 tons, providing the price of the metal is maintained at a figure which will justify active work throughout the year.

New Mexico.—No developments of general interest took place during 1888. The Graphic mine was closed down for a considerable period, no satisfactory leases being obtainable because the affairs of the property were much involved. The Kelley mine, while it is shipping some ore, has fallen off in production. Some dead work was being done in the spring of 1889, which stopped the work of the lessees. A small concentrator at the mine is treating some low-grade ores, but thus far it has worked only in a very desultory manner.

Montana.—It is estimated that Montana smelters produced 13,125 short tons of base bullion; but it should be stated that a large proportion of this quantity is from ore derived from Idaho, the Coeur d'Alene district in particular. Aside from the operations at Glendale, the smelting business is carried on by two large works, the Montana Smelting Company, at Great Falls, and the Helena & Livingston Smelting and Reduction Company, at Helena. It is reported that the former will soon add five furnaces in addition to the five already built, and that the latter contemplates an increase of its plant at an early date.

During 1888 the Hecla Consolidated Mining Company, at Glendale, produced 3,442 tons of lead, 208,605 pounds of copper, 716,859.88 ounces of silver, and 1,210.71 ounces of gold from 17,545 tons smelted. The average assay was 44.8 ounces of silver and 26.7 per cent. of lead, the ore carrying 29.7 per cent. of silica. For fluxing 4,765 tons of iron ore 4,348 tons of limestone and 7,065 tons of slag were used, the fuel consumption being 477,788 bushels of charcoal and 3,209 tons of coke, making the fuel cost per ton of charge mixture $3.36 in 1888, as compared with $4.06 in 1887. The gross income was $833,603.51, which after the payment of costs and expenses, aggregating $626,196.33, left net earnings of $207,407.18, out of which $180,000 was paid in dividends.

Missouri and Kansas.—The enlargement of capacity during 1887 by the Saint Joseph Lead Company and the development during the same year of the Doe Run Company came into full play during 1888 and chiefly contributed to the increase in the output. Since then no developments general in their character have been made likely to lead to a material increase in the output of this section of the country.

Lead imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	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, 331	1, 425	73, 080, 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
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

Old and scrap lead imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

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

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

Fiscal years ending September 30 until 1842, fiscal years ending June 30 until 1885, and calendar years ending December 31 since.	Manufactures of— Lead.		Manufactures of— Pewter and lead.	Bars, shot, etc.		Total value.
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
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					

Lead and manufactures of lead, of domestic production, exported, etc.—Continued.

Fiscal years ending September 30 until 1842, fiscal years ending June 30 until 1885, and calendar years ending December 31 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
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, 136
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
1843 (nine 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
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
1886		136, 666				136, 666
1887		140, 065				140, 065
1888		194, 216				194, 216

ZINC.

By C. Kirchhoff, Jr.

The erection of new works and the extension of the operations of older concerns led to a further notable increase in the production of spelter in the United States. The additions to capacity were fairly uniformly distributed in the West, East, and South, and a further growth is likely during 1889, additional facilities for production having been provided during 1888.

PRODUCTION.

Official returns from every producer of spelter in the United States in 1888, with the exception of one small concern in Colorado, show the following total, as compared with previous years:

Production of spelter in the United States.

Years.	Short tons.
1873	7, 343
1875	15, 833
1880 (census year ending May 31)	23, 239
1882	33, 765
1883	36, 872
1884	38, 544
1885	40, 688
1886	42, 641
1887	50, 340
1888	55, 903

Grouped by States, the product has been as follows:

Production of spelter in the United States, 1882 to 1888, inclusive, by States.

States.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	18, 201	16, 792	17, 594	19, 427	21, 077	22, 279	22, 445
Kansas	7, 366	9, 010	7, 859	8, 502	8, 932	11, 955	10, 432
Missouri	2, 500	5, 730	5, 230	4, 677	5, 870	8, 660	13, 465
Eastern and Southern States	5, 698	5, 340	7, 861	8, 082	6, 762	7, 446	9, 561
Total	33, 765	36, 872	38, 544	40, 688	42, 641	50, 340	55, 903

In Illinois, the production has remained nearly stationary, the three works, those of the Matthiessen & Hegeler Zinc Company, at La Salle, the Illinois Zinc Company, at Peru, and the Collinsville Zinc Company, having turned out about the same quantities as in previous years. In

Missouri, the new branch works of Robert Lanyon & Co., of Pittsburgh, Kansas, at Nevada, Missouri, were in operation during the greater part of the year. The plant consists of six Belgian furnaces of one hundred and twelve retorts each, the capacity being about 2,800 tons per annum. Early in 1889 the Joplin mines passed into the hands of the Heckscher interest, identified with the Lehigh Zinc and Iron Company, at Bethlehem, Pennsylvania, which has acquired considerable mining property in the district and will probably enlarge the works. In Kansas, the Scammonville Zinc Works, with two furnaces, started in March, and ran spasmodically until September, when work was stopped. The work of the Girard Zinc Company, at Girard, did not start in 1888, the plant not having been completed. It consists of one block, and has a capacity of 800 tons annually.

In the East, the Lehigh Zinc and Iron Company, at Bethlehem, Pennsylvania, is the leading producer, followed by the Passaic Zinc Company. The Friedensville Zinc Company erected new works at the famous mines of that name during 1888, and began work at the close of the year, manufacturing the Bergenport spelter, so long and so favorably known in this country and abroad. In the South, the Bertha Zinc Company, at Pulaski, Virginia, has increased its production, remaining by far the largest producer.

Zinc imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive.*

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Blocks or pigs.		Sheets.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
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
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

Imports of zinc oxide in 1885, 1886, 1887, *and* 1888.

Calendar years ending December 31 from 1886 to 1888; previous year ends June 30.	Dry.	In oil.
	Pounds.	*Pounds.*
1885	2,233,128	98,566
1886	2,526,389	79,788
1887	4,961,080	123,216
1888	1,401,342	51,985

Exports of zinc and zinc ore of domestic production, 1864 *to* 1888, *inclusive.*

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwt.		*Pounds.*			
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
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	18,034	62,234	4,270	19,098	41,402

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875 *to* 1888, *inclusive.*

[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

Prices of common western spelter in New York City, etc.—Continued.

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

The year having opened with spelter at $5\frac{3}{8}$ cents per pound, the market was dull, gradually declining during the first three months until $4\frac{7}{8}$ cents had been reached in March. This was followed by some buying, but as soon as it ceased the market drooped until 4.50 cents was reached in July and August. The speculation in lead began to affect dealings in spelter, and reacting temporarily, there was a more active demand at higher prices. During the rest of the year the market was dull, with a moderate consumptive demand.

Messrs. Henry Merton & Co., of London, have compiled the following statement of the product of spelter in the world for a series of years:

Merton's estimate of the world's product of zinc.

Countries.	1888.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	133,245	130,995	129,020	129,754	130,522	123,891	119,193	110,989	98,830
Silesia	83,375	81,375	81,630	79,623	76,116	70,405	68,811	66,497	64,459
Great Britain	26,633	19,319	20,730	23,099	29,259	28,661	25,581	24,419	(*a*)22,000
France and Spain	16,140	16,028	15,305	14,847	15,341	14,671	18,075	(*a*)18,358	15,000
Poland	3,785	3,580	4,145	5,019	4,164	3,733	4,400	(*a*) 4,000	(*a*) 4,000
Austria	3,829	3,566	3,760	3,890	4,470	4,672	5,094	4,270	(*a*) 2,520
Total, Europe	267,005	254,863	254,590	256,232	259,872	246,033	241,154	228,533	206,809
Total, United States	49,922	44,947	38,072	36,339	34,414	32,921	30,148	(*a*)30,000	20,749
Grand total	316,927	299,810	292,662	292,571	294,286	278,954	271,302	258,533	227,558

a Estimated.

In detail, the output of the works in the different districts was as follows:

Production of zinc by principal foreign producers.

	1888.	1887.	1886.
Rhenish Provinces and Belgium:	*Long tons.*	*Long tons.*	*Long tons.*
Vieille Montagne	51, 670	51, 517	50, 790
Stolberg	14, 036	14, 070	14, 065
Austro-Belge	9, 140	9, 280	9, 130
Rhein-Nassau	7, 586	7, 588	7, 730
L. de Laminne	6, 597	6, 745	6, 550
Nouvelle Montagne	5, 032	4, 975	4, 995
Märk.-Westf.-Bergw.-Ver	5, 537	5, 553	4, 950
G. Dumont & Frères	8, 759	8, 368	8, 000
Gladbach	4, 818	4, 890	4, 985
Escombrera Bleyberg	4, 930	4, 925	5, 315
Eschger Chesquière & Co	4, 137	4, 079	3, 710
Grillo	5, 299	5, 100	5, 075
Société Prayon	3, 906	3, 905	3, 725
Société de Boom	1, 798	....	....
	133, 245	130, 995	129, 020
Silesia:			
Schlesische Actien-Gesellschaft	22, 917	22, 680	22, 730
G. von Giesche's Erben	17, 594	17, 600	17, 505
Herzog von Ujest	15, 456	15, 835	15, 610
Graf H. Henckel von Donnersmarck	11, 193	11, 565	9, 355
Gräfin Schaffgotsch	6, 402	6, 430	6, 505
Graf G. Henckel von Donnersmarck	4, 114	1, 565	1, 670
Graf Lazy Henckel (included in H. Henckel v. Donnersmarck)	....	....	2, 450
H. Roth	1, 555	1, 670	1, 675
Wünsch	1, 906	1, 885	1, 860
Vereinigte Königs & Laurahütte	1, 166	1, 065	1, 185
Baron v. Horschitz'sche Erben	935	910	915
The State	137	170	170
	83, 375	81, 375	81, 630
Great Britain:			
Vivian & Sons,	6, 510	4, 840	7, 379
English Crown Spelter Company (Limited)	4, 980	4, 007	3, 248
Dillwyn & Co	3, 904	2, 843	3, 015
Swansea Vale Spelter Company	2, 150	1, 798	2, 060
Villiers Spelter Company	1, 993	1, 810	1, 880
Pascoe, Grenfell & Sons	1, 330	1, 124	727
Nenthead & Tynedale Company	1, 516	1, 317	1, 193
John Lysaght (Limited)	3, 750	1, 600	1, 218
H. Kenyon & Co	500	500	500
	26, 633	19, 839	21, 230

The product of Spain and France is that of the Société Asturienne.

QUICKSILVER.

The year 1888 developed only slight changes in the production of quicksilver in California, which is the only State where notable deposits of quicksilver have been found. The average price in San Francisco was $42.50 per flask, which was remunerative, and yet the production, 33,250 flasks, showed a slight decline from the previous year—a fact which is important in its bearing on the future of quicksilver mining in this country. Prospecting was active, but no considerable ore bodies were discovered, and history of the year indicates that without new ore bodies it is not likely that the yield of quicksilver will increase.

In the tables which follow, the statistics of production are given of all the quicksilver mines since the beginning of the industry in this country. In 1888 the table shows a rapid increase in product of the Napa Consolidated and Bradford mines. The latter was located in 1882 and began producing in 1887; it is situated 4½ miles south from the village of Middletown, on the stage road leading from that place to Calistoga. The vein here, which has a north and south trend, and inclines to the east at an angle of 45 degrees, lies between sandstones on the hanging wall and serpentine on the foot wall. The mine has been opened by a shaft sunk to a depth of 250 feet, and which, at a depth of 60 feet, leaves the vein and passes into the foot wall. This shaft, which is timbered throughout, is fitted with a single-reel 6 by 8 inch spur-geared reversing engine. A No. 4 Dow steam pump, run four hours per day, suffices to handle the water. At present work is confined to the 160-foot level, above which the vein is being stoped, no definite limit having yet been found to the ore shoot. The ore extracted consists of cinnabar mixed with jasper and country rock.

The coarse ore is treated in a Knox & Osborn furnace, of 20 tons daily capacity; the fines in a 30-ton Livermore furnace. Iron condensers are used, the draft being aided by an exhaust fan. The reduction works are connected with the shaft by a tramway 800 feet long. Thirty-five men are employed here; white men are paid $2.50 per day and Chinese $1.25.

The mines in Oregon, referred to in the report for 1887, were only worked to a slight extent, 32 flasks being the product. The mine at Marysvale, Utah, was not worked at all so far as known.

There is no doubt that the product of 1889 will be smaller than in 1888, probably 25,650 flasks, with 13,100 flasks from New Almaden.

Production of quicksilver in the United States to the close of 1888. (*Flasks of* $76\frac{1}{2}$ *pounds.*)

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Pope Valley.	Napa Consolidated. (a)	St. John.	Altoona.	Oceanic.	Oakland.	California.	Great Eastern.	Sunderland.	Cloverdale.	Abbott.	Bradford.	Various mines.	Total yearly production of California mines.
1850	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.			Yearly production previous to 1875 not obtainable (estimated at 20,000 flasks), included in production of various mines.					Some was produced prior to 1875, but no record kept (estimated production previous to 1875, 1,000 flasks), included in production of various mines.										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																			22,204
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	42,031
1863	32,803		852																6,876	40,589
1864	42,489		1,914				800												2,286	47,400
1865	47,194		3,545																2,261	53,000
1866	35,150	6,525	,2254																2,621	46,550
1867	24,461	11,493	7,862																3,184	47,000
1868	25,628	12,180	8,686				1,122												112	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				1,970												840	31,686
1872	18,574	8,171	3,046				1,830													31,621
1873	11,042	7,735	3,294			340	1,955												3,276	27,642
1874	9,084	6,911	6,678	573		1,122	1,645		1,743											27,756
1875	13,648	8,432	7,513	5,372	3,342	3,384	1,940		1,927	533				412					3,747	50,250
1876	20,519	7,272	9,183	8,367	7,381	4,322	300	573	1,683	1,979	2,358	2,150	965	387	1,570	1,028	1,436		3,571	75,074
1877	23,996	6,316	9,399	10,993	6,241	5,856	1,060	2,229	1,463	1,317	2,575	1,395	1,516	505	735	1,291	836		1,673	79,396
1878	15,852	5,138	6,686	9,465	9,072	4,963	1,075	3,049		1,534	1,679	1,615	1,640	1,366	472	116			158	63,880
1879	20,514	4,425	4,516	9,249	15,540	6,333	1,325	3,605	1,290	1,919	779	1,505	1,110	1,455		18			101	73,684
1880	23,465	3,209	2,139	10,706	6,670	6,442	275	4,416	492	245		166	422	1,279						59,926
1881	26,060	2,775	2,194	11,152	5,228	6,241		5,552						1,065		208			376	60,851
1882	28,070	1,953	2,171	5,014	1,138	5,179		6,842						2,124					241	52,732
1883	29,000	1,606	1,894	2,612	84	3,869		5,890						1,669					101	46,725
1884	20,000	1,025	881	890	1,179	3,292		4,307						332					7	31,913
1885	21,400	1,144	385	1,296	35	3,469		3,506						446					392	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				1,543	(b) 520	33,825
1888	18,000	1,320	126	2,164		625		5,024						1,151				3,848	992	33,250
Total	891,259	129,309	98,436	80,792	55,910	58,832	18,097	55,811	8,598	7,527	7,391	6,831	5,653	13,615	2,777	2,661	2,272	5,391	67,280	1,518,445

a Includes Ætna.

b Includes 65 flasks from Oregon.

Production of quicksilver (flasks) in California by months, from 1883 to 1888.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna. (a)	Napa. (a)	Great Eastern.	Bradford. (b)	Various.	Total.
1883.	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*
January	2,497	112	367	280	77	390	.....	590	262	.....	7	4,582
February	2,150	133	181	310	7	364	.....	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	1,900	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	2,047
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
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

a Production of Ætna and Napa mines in 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver (flasks) in California by months, from 1883 to 1888.—Cont'd.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.	Napa.	Great Eastern.	Bradford.	Various.	Total.
1887.	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*
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	205	......	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	2,862
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	......	440	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

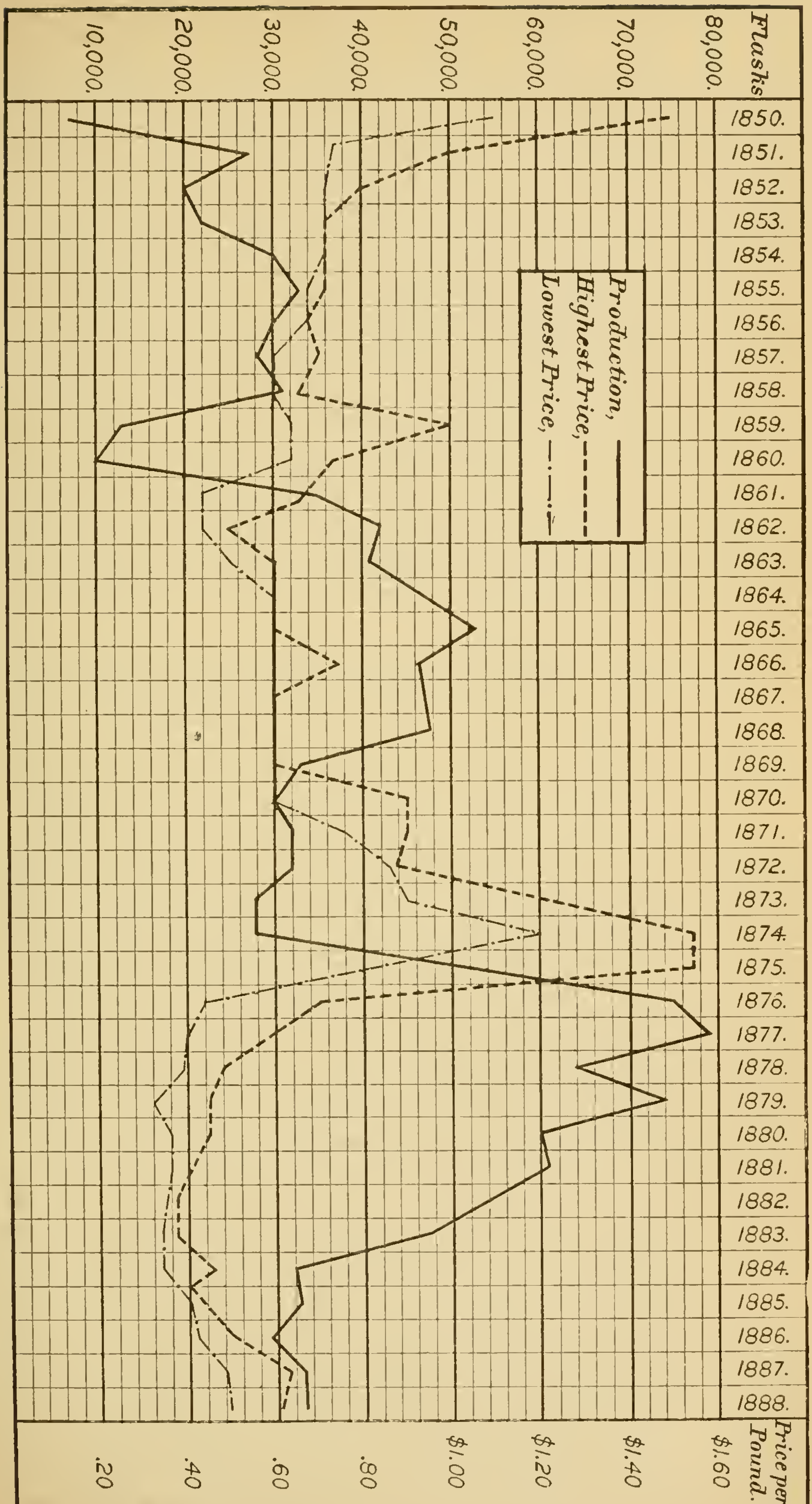

FIG. 2.—Production and price of quicksilver in the United States to December 31, 1888.

Prices.—While the range in the extremes of prices in 1888 was slightly less than in 1887 the general average of prices obtained was a little higher. The principal feature in the market was the course of the Messrs. Rothschild in maintaining a higher price than that of other holders for several months. When the year opened the London price of all holders was £10 per flask, but during January the Rothschild's price dropped to £8 10*s.*, with outside holders at £8 15*s.* In February the Rothschilds advanced the price to £9 while the outsiders sold at from £8 15*s.* to £8 5*s.* The market then fluctuated from this figure to £7, but the quotations from outside holders being always lower by several shillings. In October the Rothschilds fixed their price at £9 10*s.*, and held it there until February 5, 1889, when, without warning, they dropped to £8, outsiders falling to £7 12*s.* 6*d.* The next day the Rothschilds depressed their price again to £7 10*s.*, and the same day advanced to £8, causing very active speculative movements; but the changes were too willful to show any direct relation to the condition of the production at the time. Californian quicksilver was quoted in New York at prices slightly lower than the foreign prices plus the duty, as is shown in the table which follows.

Monthly quotations of quicksilver at San Francisco from 1884 *to* 1888, *per flask.*

Months.	1884.		1885.		1886.		1887.		1888.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
January	$26.25	$26.00	$33.00	$32.50	$32.50	$32.00	$38.75	$38.50	$47.00	$42.00
February	29.00	26.00	32.50	32.50	32.50	32.50	38.75	38.50	43.00	40.00
March	29.00	28.00	32.50	31.00	33.00	32.50	38.50	37.00	41.00	40.00
April	29.00	28.00	31.00	30.00	33.00	33.00	40.00	37.50	49.00	37.00
May	29.00	29.00	29.00	28.50	34.00	33.00	38.00	37.50	37.00	36.00
June	29.00	29.00	30.00	29.00	36.00	34.00	39.00	38.00	40.00	36.00
July	29.00	28.75	30.00	29.75	37.00	36.00	38.00	37.50	40.00	38.00
August	30.00	28.75	29.75	29.50	37.00	36.75	37.00	36.50	41.00	39.00
September	31.00	30.00	30.50	29.50	37.00	36.50	38.00	36.50	43.50	41.00
October	30.50	29.00	30.50	30.00	39.00	38.75	39.00	37.00	45.00	43.00
November	34.00	29.00	30.00	29.75	38.75	38.50	40.00	37.00	45.00	43.00
December	35.00	32.00	32.00	30.00	38.75	38.50	48.00	45.00	45.00	42.00
Extreme range	35.00	26.00	33.00	28.50	39.00	32.00	48.00	36.50	47.00	36.00
Average	$29.34		$30.53		$35.35		$42.25		$42.50	

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

Highest and lowest prices of quicksilver during the past thirty-nine years.

Years.	Price in San Francisco, per flask.		Price in London, per flask.					
	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
Extreme range in thirty-nine years	118.55	25.25	26	0	0	5	2	6

Disposition of the product in 1888.—The shipments by sea to foreign countries show a slight decline of 152 flasks. China bought a little more freely than in the previous year. There was a decline also in the eastern shipments, leaving altogether 13,500 flasks for stock and consumption in California, Nevada, and Arizona, against 11,641 flasks in 1887. The increase in gold mining, however, was sufficient to prevent any accumulation of stocks. The outlook for 1889 is for a further decrease in product and for higher prices, based on a larger consumption.

The use of quicksilver in an amalgam for the reflecting surface of mirrors has almost ceased. In its place silver, deposited in the usual way from solutions, is almost entirely used. The amalgam surface requires much more time and skill than the silver surface. Quicksilver mirrors are still occasionally made especially for very large surfaces, and it is claimed that they are more durable because the coating is thicker. The use of quicksilver in barometers, thermometers, pressure gauges, and similar instruments is constantly increasing. A careful estimate by Queen & Co. gives 2,500 pounds as the amount annually used for such instruments.

Movement of quicksilver from San Francisco in detail, from 1883 to 1888.

To—	1883.	1884.	1885.	1886.	1887	1888.
By sea:	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*
China	16, 330	200	233	....	3, 105	3, 761
Japan	1, 253	588	302	3	....	....
Mexico	10, 764	5, 404	5, 884	5, 530	6, 397	4, 766
South America	970	155	100	....	....	....
Australia	600	110	....	....	....	....
New Zealand	160	20	100	91	100	286
Central America	59	52	9	23	119	712
New York	3, 100	8, 350	9, 055	600	8, 370	2, 320
Various	11	22	47	54	28	72
Total by sea	33, 247	14, 901	15, 730	6, 301	18, 119	11, 917
By rail: Central Pacific, Southern Pacific, and Northern Pacific Railroads	4, 620	*a*7,000	*a*10,000	10, 000	4, 000	7, 833
Grand total	37, 867	21, 901	25, 730	16, 301	22, 119	19, 750

a Including about 3, 500 flasks to Mexico by Southern Pacific Railroad.

Product, and domestic consumption of quicksilver in and shipments from California during the last four years.

Years.	Total production.	Total shipments.	Stock and consumption on Pacific coast.
	Flasks.	*Flasks.*	*Flasks.*
1884	31, 913	21, 901	10, 012
1885	32, 073	25, 730	6, 343
1886	29, 981	16, 301	13, 680
1887	33, 760	22, 119	11, 641
1888	33, 250	19, 750	13, 500

Mercurial preparations imported and entered for consumption in the United States, 1867 to 1883, inclusive. (a)

Fiscal years ending June 30—	Blue-mass.		Calomel.		Mercurial preparations not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	....	....	....	$4, 242	....	$4, 242
1868	....	....	....	4, 440	....	4, 440
1869	....	....	....	4, 516	....	4, 516
1870	....	....	....	6, 306	....	6, 306
1871	....	....	....	3, 147	....	3, 147
1872	1, 009	$667	8, 241	6, 590	$629	7, 886
1873	919	660	5, 520	5, 240	699	6, 599
1874	259	192	6, 138	6, 676	4, 334	11, 202
1875	125	109	2, 424	2, 817	52	2, 978
1876	489	365	5, 433	5, 820	92	6, 277
1877	455	327	4, 649	4, 305	90	4, 722
1878	397	252	4, 133	3, 576	363	4, 191
1879	485	266	5, 875	4, 635	6, 453	11, 354
1880	533	262	4, 780	3, 230	30	3, 622
1881	395	236	8, 177	5, 640	116	5, 992
1882	207	124	5, 215	3, 411	58	3, 593
1883	188	79	8, 732	5, 503	190	5, 772

a Not specified since 1883.

Quicksilver imported and entered for consumption in the United States, 1867 to 1888, inclusive.

Calendar years ending December 31, from 1886 to 1888; previous years ending June 30.	Quantity.	Value.	Calendar years ending December 31 from 1886 to 1888; previous years ending June 30.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$15,248	1878	294,207	$135,178
1868	152	68	1879	519,125	217,770
1869	....	11	1880	116,700	48,463
1870	239,223	107,646	1881	138,517	57,733
1871	304,965	137,332	1882	597,898	233,057
1872	370,353	189,943	1883	1,552,738	593,367
1873	99,898	74,146	1884	136,615	44,035
1874	51,202	52,093	1885	257,659	90,416
1875	6,870	20,957	1886	629,888	249,411
1876	78,902	50,164	1887	419,934	171,431
1877	38,250	19,558	1888	132,850	56,997

Foreign production.—The production of quicksilver from Russia was begun in December, 1886, by re-opening an old mine near Nikitowka station in Ekaterinoslav, southern Russia. From 12,295 tons of low grade cinnabar about 1,870 flasks of quicksilver were obtained in 1887 and perhaps as much more in 1888.

The principal foreign supply came from the well-known sources, Almaden, Spain; Idria, Austria; and the Italian mines. The production at Almaden in 1888 is given in the following table:

Production of quicksilver at Almaden, Spain, in 1888.

Months.	Spanish flasks.
January	8,246
February	7,972
March	7,956
April	6,856
May	1,950
October	3,318
November	7,609
December	7,965
Total	51,872

The production for other regions to the end of 1887 is given below:

Production of the Almaden mine (Spain) and the Idria mine (Austria) from 1850 *to close of* 1887.

Years.	Almaden (in periods of five years).	Idria.	Italian mines.
	Flasks.	*Flasks.*	
1850		4, 100	....
1851		4, 092	....
1852	101, 517	4, 085	....
1853		4 409	....
1854		4, 060	....
1855		4, 416	....
1856		5, 935	....
1857	110, 058	9, 189	....
1858		4, 977	....
1859		8, 239	....
1860		4, 821	....
1861		6, 493	....
1862	122, 117	4, 712	....
1863		5, 878	....
1864		7, 263	....
1865		4, 908	....
1866		5, 327	....
1867	153, 224	7, 532	....
1868		8, 253	....
1869		9, 179	....
1870		10, 745	....
1871		10, 904	....
1872	165, 608	11, 116	....
1873		10, 939	....
1874		10, 789	....
1875		10, 717	....
1876		10, 794	....
1877	208, 200	11, 020	....
1878		10, 403	....
1879		11, 153	....
1880	*a*41, 640	12, 356	....
1881	*a*50, 353	11, 333	....
1882	*a*46, 591	11, 663	....
1883	*a*46, 143	13, 152	6, 065
1884	*a*43, 099	13, 967	7, 850
1885	*a*46, 739	13, 503	6, 965
1886	*a*51, 199	14, 496	7, 375
1887	*a*53, 276	14, 676	*b*7, 500

a Yearly. *b* Estimated by Mr. J. B. Randol.

Concerning the disposition of the world's product the following table has been prepared by Mr. J. B. Randol, from the board of trade returns for the United Kingdom.

Imports of quicksilver into and exports from England during the year 1888.

Countries.	Flasks.
Russia, Norway, Sweden, and Denmark	123
Germany	4, 101
Holland and Belgium	1, 358
Channel Islands	40
France	4, 884
Austria, Italy, and Roumania	8
Spain and Portugal	475
Turkey	33
Egypt, Morocco, and Gold Coast	88
Cape of Good Hope and Natal	717
Madras, Bombay, and Bengal	3, 076
China	10, 267
Japan	334
New South Wales, Victoria, Queensland, and South Australia	1, 598
New Zealand	146
Canada	13
United States, North America	4, 649
Mexico	9, 967
West Indies	218
Central America	253
Colombia, British Guiana, and Venezuela	190
Brazil, Argentine Republic, Uruguay, and Bolivia	764
Peru and Chili	3, 831
Total imports	73, 768
Total exports	47, 133

Comparison with 1887.

	1887.	1888.
Total imports	61, 114	73, 768
Total exports	62, 606	47, 133

Messrs. J. Bennett Brothers, London, estimate the stock in London, roughly calculated, as about 49,000 flasks on December 31, 1888, against 38,000 at end of 1887. The London supply embraces all the product of the great mine of Almaden, Spain, and the surplus product of the Idria mine, Austria, and the Italian mines. Of the total imports, 73,768 flasks, it is estimated about 53,000 were from Spain, and it will be noted that 475 flasks were re-exported to Spain and Portugal.

NICKEL.

Production.—Only slight changes in the totals were apparent in 1888. The total product, including the nickel in small shipments of ores, was 207,328 pounds, worth $128,382. In 1887 the product was 203,328 pounds, worth $127,632. The decline in the total value in 1888 was due to the less satisfactory condition of the market, the price in first hands at Philadelphia being 60 cents per pound. The imports for the year 1888 were somewhat decreased, but, like the preceding year, largely above the amounts in 1886 or any previous year.

Production of nickel in the United States in 1886, 1887, *and* 1888.

	1886.		1887.		1888.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Metallic nickel	182, 345	$109, 407	183, 125	$117, 200	190, 637	$114, 382
Nickel in nickel ammonium sulphate	7, 047	9, 000	11, 595	12, 000	12, 691	13, 000
Nickel in matte	20, 000	7, 000	10, 846	4, 000		
Nickel in ore	5, 600	1, 750			1, 000	250
Total	214, 992	127, 157	205, 566	133, 200	203, 328	127, 632

Cobalt oxide.—The production of this substance as a by-product in connection with the nickel industry amounted to 7,491 pounds, worth $15,782. It will be referred to again in connection with the subject of mineral paints.

Nickel imported and entered for consumption in the United States, 1868 *to* 1888, *inclusive.*

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
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
1886			277, 112	141, 546	(*b*) 141, 546
1887			439, 037	205, 232	(*c*) 205, 232
1888			316, 895	138, 290	(*d*) 138, 290

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.

Value of exports of nickel and nickel ore of domestic production from the United States.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Manufactured nickel.	Nickel coin.	Nickel ore.
1864	....	....	$25, 494
1865	....	....	36, 710
1869	....	....	11, 350
1872	..	....	43, 500
1873	$19, 780	....	19, 891
1874	16, 062	....	75, 696
1875	26, 000	....	72, 020
1876	168, 050	....	35, 100
1877	8, 200	....	....
1878	......	....	2, 452
1880	4, 120	....	....
1881	6, 600	$32, 880	....
1882	12, 474	7, 200	....
1883	9, 911	....	(*a*)12, 182
1884	....	....	(*a*)22, 249
1885	1, 223	....	10, 500
1886	45, 653	....	5, 700
1887	39, 209	....	7, 500
1888	38, 951	....	625

a Classed as "nickel and cobalt ore."

The mines at Lovelock's station, Nevada, have been developed to a slight extent with reported satisfactory results. The property has been bonded to an English capitalist, who extracted some rich ore, but did not complete the purchase. It has since been investigated by other Englishmen. Some 30,000 pounds of the ore showed 11 per cent. of nickel and 7 per cent. cobalt when reduced to matte in San Francisco. A 5-ton water-jacket furnace has since been erected at the mines and is running. The mines are conveniently located for securing fuel and fluxes. At Riddles, in Oregon, the developments made during 1888 consisted of open cuts and a shaft sunk to a depth of 35 feet. The shaft was started on 18-inch croppings which widened to 4 feet in sinking 35. This is the first indication here of the occurrence of the ore in a vein. About 100 tons, containing 5 per cent. nickel, have been taken out, of which 10 tons were shipped to Paris for treatment by a new process, which, if successful, will insure the erection of works at the mine. No nickel ore was mined in either locality on Upper Dads creek or near Rock Point, in Jackson county. A small shipment of nickel ore from Webster to New York constitutes the only development which has been reported from North Carolina. Colonel Whitthorne reports from Benton, Arkansas, that development work was continued during 1888 at the Rabbit Foot mine, but in a limited way, as capital was wanting. No ores have yet been shipped for reduction. The average assays give 2.7 per cent. of nickel and cobalt together, ranging from 1.46 to 8.7 per cent. The greatest depth reached from the surface is 50 feet. Active work is expected in 1889.

According to Prof. F. R. Carpenter, dean of the Rapid City School of Mines, Dakota, the numerous and extensive copper deposits found in both the eastern and western series of Archæan rocks in the Black Hills are derived from pyrite or pyrrhotite containing nickel. The claims most studied are on Spring creek. Professor Carpenter thinks there is no body of magnetic pyrite in the Black Hills which does not carry nickel. The average of his assays is 1.5 per cent., though samples carrying 8 per cent. have been found. This report is interesting in view of the developments expected from the nickel-bearing pyrrhotite at Sudbury, Canada.

Outlook.—The developments in recent years of garnierite in New Caledonia and the discovery of nickel-bearing pyrrhotite at Sudbury, Canada, promising large development, place the nickel industry in much the same relation to the demand as the present condition of copper or tin. Further, the uses are more limited; the newest finds, though apparently of large extent, do not seem able to deliver the metal in the general markets for much less than the present price. The opening of a single one of these new sources means the extinction of a corresponding element in the present supply. In this country, particularly, the problem of present interest is the selection of the best suited deposit for the needs of this market, there being little doubt that any one of several has sufficient nickel for the entire demand. The known deposits in this country include: (1) two deposits of silicate of nickel in North Carolina and one in Oregon, similar to deposits now worked in New Caledonia; (2) arsenides and derived arseniates of nickel and cobalt at Mine la Motte, Missouri, and in Nevada, and the pyrrhotite of the Gap mine in Pennsylvania (which has been the main source of our supply) and (3) a possible supply of similar character in the Black Hills of Dakota. The long experience in working pyrrhotite will lead to prejudice in favor of similar ores, if other conditions are equal. A careful description of the Gap mine and its workings will be found in volume C. C. C. of the Second Geological Survey of Pennsylvania, in the geological sketch of Lancaster county, by Dr. Persifor Frazer, jr.

In this connection the recent developments of nickeliferous pyrrhotite at Sudbury, Canada, should also be considered. The following detailed description of the deposit and the practice in developing it has been written by Dr. E. D. Peters, manager of the Canada Copper Company.

NICKEL ORES AT SUDBURY, CANADA.

Mode of occurrence.—The geology, for hundreds of miles in every direction, belongs to the Huronian and Laurentian systems, and comprises the very oldest rocks known to man. Greenstone, diorite, graywacke, gneiss, and crystalline schists form a large part of the rocks, and as the vein matter does not differ essentially from much of the surrounding country rock, it is plain from the very beginning that the smelting of the ores is greatly favored by the basic character of nearly all these rocks. Instead of having to contend with the solid quartz and acid silicates of many geological horizons, we meet chiefly hornblende and very fusible feldspars, to which is added the iron from the ore itself, thus forming a slightly basic mixture, which is rendered all the more favorable by being polybasic; for the lime, soda, potash, magnesia, etc., of the rock minerals assist greatly in forming a fusible slag, while one pound of iron already combined with silica and other bases in the shape of feldspar or hornblende, is better than two pounds of the same substance, if added extraneously in the ordinary shape of hematite, or other iron oxides. The same remark applies to the lime, and this brief notice opens up a very important and interesting metallurgical question, which, so far as the writer is aware, has never yet been treated upon by writers or satisfactorily explained.

The only openings of any depth in this immediate vicinity are the three mines belonging to the above company, and named, respectively, the "Copper Cliff," "Evans," and "Stobie." These three mines differ somewhat among themselves in quality, richness, proportion of nickel to copper, and other minor details, but are near enough alike to be described as one, so far as their grosser features are concerned.

The ore which first attracted attention to these mines was a very pure chalcopyrite, occurring in masses of considerable size and close to the surface and generally in conjunction with such an immense capping of gossan as to indicate the presence of large bodies of mineral below. On sinking a few feet, the line of active decomposition is passed and the unaltered ore is found in a more or less massive condition. The great body of the mineral is a monosulphide of iron, usually called magnetic pyrites, or pyrrhotite, and bearing so remarkable a resemblance to the pyrrhotite found in such quantities at Ely, Vermont, that no one has as yet been able to distinguish between them. And yet, strange as it may appear, the Sudbury pyrrhotite is highly nickeliferous, while the Ely mineral barely shows a trace of that valuable metal. It is a very interesting fact that in this pyrrhotite, nickel may replace iron to the extent of one-half or more, so that over 30 per cent. of nickel shall be present, and yet the chemically altered mineral shows no signs of its changed composition. But it is seldom that nickel is present in such quantities as just noted. The ordinary pyrrhotite of this district carries seldom less than 2½ or more than 8 or 9 per cent. of nickel, and as a rule the coarsely crystalline pyrrhotite is the richest in nickel. The chalcopyrite does not mix intimately with the nickel ore, so as to form a homogeneous mass, assaying pretty regularly in copper, iron, and nickel. On the contrary, the chalcopyrite occurs by itself in pockets, or threads, or bunches, or veinlets, but frequently intermixed with or inclosed by massive pyrrhotite. It is seldom so finely intermixed, however, that it is not easy, on breaking the specimen, to select chalcopyrite that will assay over 30 per cent. in copper, and to separate pyrrhotite that will only show a trace of the same metal. But it should be noted that such a separation would not be possible in practice, for careful examination and trial have shown that the two ores are too completely intermixed to make hand sorting at all practicable; while any system of concentration depending upon gravity is out of the question, owing to the almost identical weights of the iron and copper minerals. It is not yet known whether the only remaining obvious method of separation by magnetism is feasible or not, though my former experiments on utilizing the feeble magnetic qualities of pyrrhotite were not at all satisfactory. Still the replacement of so considerable a portion of the iron by the highly magnetic nickel lends a certain air of plausibility to the scheme. Although the copper mineral seldom occurs free from the pyrrhotite, and it must be recollected that all our pyrrhotite is nickeliferous, yet the pyrrhotite is sometimes found in quite massive deposits containing many hundreds or even thousands of tons of the same, comparatively free from copper. In one of the company's mines such a stope has furnished nearly 2,000 tons of quite massive pyrrhotite rich in nickel and containing not more than 1 per cent. of copper. This stope is now exhausted, but it is curious to note that just before the end boundaries of the great pocket were reached the massive pyrrhotite changed without warning into a 3-foot vein of almost pure chalcopyrite that furnished some 15 or 20 tons of beautiful ore.

These mines have hardly yet been developed sufficiently to speak with any certainty as to their precise character, and in any case this is always a vexed and uncertain question. They are certainly not fissure veins, and that is about as far as one would care to speak with any positiveness. They seem to occur at intervals in a belt of diorite that traverses this district for a long distance, and many of the prospectors believe that all the mineral that has been discovered is situated on this same belt—an hypothesis which they prove by the exceedingly simple and ingenious process of marking down the different discovery locations on the map and then connecting them all by a single line, which they assert represents the ledge of diorite. The truth of this assertion cannot be denied. It can only be said that the course of this diorite ledge would already puzzle the most experienced mining surveyor, and as it becomes more and more complicated with each new discovery, it will soon be seen to be ridiculous. But it is quite certain that diorite seems to be a very important country rock for these deposits and also forms a considerable portion of what gangue is found in the ore bodies. These bodies are about as irregular as nature could well make them, having every possible size, shape, and direction, and though at times a certain sloping surface is obtained that seems to have a uniform pitch for some distance, and from the amount of water it furnishes is occasionally looked upon as a wall, yet it seems very doubtful if there are any regular walls in the miner's sense of the term. The ore deposits seem almost entirely unconnected, and it is not uncommon in a single blast to go from absolutely barren rock into first-class smelting ore, though as a rule the vicinity of an ore body is usually marked by the occurrence of specks of iron and copper pyrites in the country rock.

These pockets are frequently very extensive, being some hundreds of feet in length and 100 or more in breadth by 50 or more in depth. In fact, the writer does not know that any one of them has been entirely worked out, and it is only known that they come to an end by not finding them in the levels below. As there is no wall to follow, and scarcely any connection between the ore bodies, and no means by which one can tell whether the levels are being run in the right direction or whether they may be diverging entirely from the ore bodies beyond, it is evident that mining is somewhat difficult and uncertain. But this uncertainty is more than recompensed for by the extent and massiveness of the bodies when they are found and by carefully mapping out the apparent course of bodies already known, and following the little stringers that tail out in all directions from them, we have so far opened up new bodies faster than we have worked out old ones, and as this has been accomplished by less than 15 per cent. of development work to 85 per cent. of stoping, no mining man should complain of the ratio of dead work to ore breaking. But the above remarks refer more particularly to the Copper Cliff mine, which usually carries its copper most concentrated, and, being central, has had more work done on it than the other mines. The Evans and Stobie mines are either of a different and more continuous nature or else their ore bodies are so enormous as to give one the impression of a continuous vein or dike of quite massive pyrrhotite, interspersed with bands, beds, nodules, veinlets or grains of chalcopyrite. These veins have both been opened for a couple of hundred feet or more and show about as massive a formation of cupriferous pyrrhotite as is often found. In certain places it is so entirely free from gangue that in many tons only a few small pieces of rock would be found. In others it is not so massive, and bowlders of diorite seem to be inclosed in the vein. Again, sharp fragments of diorite are completely intergrown with the pyrrhotite and chalcopyrite, the sharp edges of the easily fusible diorite showing that it was hardly possible for heat to have put them into that shape.

A few small crystals of millerite, sulphide of nickel, were found at the depth of about 150 feet in the Copper Cliff mine, but so far that is the only ocular evidence of the presence of nickel in any of these mines.

A minute proportion of cobalt, about one-fiftieth as much as the nickel present, also occurs in the pyrrhotite, and the chemist of the company, Mr. Francis L. Sperry, also assures us that platinum occurs in quite appreciable quantities, so that the matte from these ores contains some ounces per ton of that rare metal. Gold and silver occur in strong traces, while arsenic, antimony, tellurium, bismuth, or other harmful elements are entirely absent. The consequence is that the copper made from several thousand tons of this ore ranked with the best Arizona brands.

Treatment of the ore.—After a rough hand-sorting, which is all that most of this ore requires to fit it for smelting, the ore is put through a 15 by 9 Blake breaker, set to about $1\frac{3}{4}$ inches. A revolving screen sizes it into "coarse," "ragging," and "fines," the three sizes essential for heap roasting, and the ore is loaded onto railroad cars that run on an elevated trestle over the roast ground, so that it is dumped on elevated platforms near the heaps and wheeled onto the latter very cheaply. The only wood obtainable is dead pine, the whole timber of this and the surrounding country having been destroyed by fire some twenty-five years since.

The pine is procured very cheaply, though it is but a poor fuel for roasting; only about a cord is needed for 20 tons or more of ore. Hard wood, though it would probably carry no heavier burden of ore, would last so much longer that it would give a better roast, the pine wood being too light and going out like so many shavings after yielding a short, fierce heat. The piles usually contain 600 to 800 tons of ore and have to be carefully covered with ragging and fines, the latter being applied almost continuously for the first forty-eight hours to prevent too quick a heat and the consequent matting of this fusible pyrrhotite. Such a heap burns about fifty days, and although it shows on opening a thick outside layer of ore that seems only scorched, while the inside, though looking better, yet shows none of that swelling and fissuring of each lump that indicates a good roast with ordinary yellow pyrites. Subsequent smelting of this very unsatisfactory-looking material shows that, however it may look, the sulphur has been removed, it being almost invariably necessary to add from 10 to 25 per cent. of raw fines during the smelting to prevent the matte from being too rich. Assays of large samples of these roast heaps have varied from 2½ to 8 per cent. sulphur, the average being about 6 per cent. A sunken railroad alongside the heaps conveys the roasted ore to the side hill on which the smelter is located, and is high enough so that the cars of ore are dumped directly into the bins back of the furnace.

The smelting plant consists of a Herreshoff water-jacket furnace, built of rolled steel plates, with only a 2-inch water space, and with not a single brick of any description below the charging door, except a few cheap brick used temporarily on the bottom of the furnaces and around the inside of the cast-iron forehearth or "well" to keep the slag from cracking the cold iron. The water jacket extends from the bottom to the charging door, and the well is also jacketed so that no brick are needed, thus effecting a saving in material and repair that only the practical smelter can thoroughly appreciate. The furnace is a rectangle, with rounded corners and slightly convex sides and ends to strengthen it. It is about 6½ by 3½ feet inside at the tuyeres and flares slightly to the top. It has thirteen 2½-inch tuyeres, and is supplied by a No. 6 Baker blower, run at about ninety revolutions, the normal pressure at the furnace being about 9 ounces. The great advantage of this style of furnace and the reason that we have succeeded here in America in removing what Vivian characterizes as "the sole objection to blast-furnaces," and what has hitherto prevented them from being superior in every way to the Swansea reverberatory on suitable ores, is that we overcome the hitherto great bugbear to cupola smelting, *i. e.*, the deposition of "sows" or "salamanders" of metallic iron in the crucible, that not only soon choked up the furnace but also tied up large quantities of copper and other valuable metals in a form from which it was very expensive to separate them. The way we have conquered this is by smelting so rapidly and with such a powerful blast that the iron has no time to be reduced and all goes into the slag, where it is wanted. To make it certain that no such deposition shall take place American smelters have added a forehearth or well, into which all the material that is melted in the furnace flows as fast as it becomes molten. This well is on wheels and is water-jacketed, so that it lasts for months and is quickly and easily replaced. In it the matte sinks quietly out of the slag and is tapped out into a slag pot in lots of 500 pounds every few minutes without stopping the blast or interfering in any way with the regular running of the furnace. The slag flows constantly over a water-jacketed lip, which is at such a height that the communicating passage between well and furnace is 8 or 10 inches "under water" all the time, and the blast is thus completely trapped and can never blow through. As any ordinary brick or clay tap hole is certain to cut out shortly and become so large and shapeless that it cannot be plugged against a powerful stream of matte, the well tap hole is a separate water-jacketed bronze casting, being formed of an alloy that withstands the constant shrinking and swelling of the metal due to the immense changes of temperature that it experiences during the tapping operation. This jacketed tap hole is only 1$\frac{3}{4}$ inches in diameter, and thus can be easily and certainly plugged with a small ball of clay as soon as the desired amount of matte is drawn off.

Coke is used as a fuel, and under ordinarily favorable conditions 125 tons of ore per day are smelted, the record having risen to 154 tons in twenty-four hours and frequently exceeding 140 tons without special effort. No flux is used, and about 8 tons of ore are smelted with 1 ton of Pennsylvania coke, which is brought up the Great Lakes in steamers and transported to the works by the Algoma branch of the Canadian Pacific railroad.

The matte produced resembles an ordinary copper matte, except that a certain amount of the copper, or, more correctly speaking, of the iron, is replaced by nickel. This considerable addition of nickel, which amounts to at least 50 per cent. of the copper present, has a most peculiar effect on the physical qualities of the matte. As is natural, it decidedly lessens its fusibility, raising its melting point several hundred degrees and making it difficult to receive it in iron molds, as the high temperature causes a softening of the iron surface and a consequent welding of the matte to the mold, so that the inner skin of the latter is destroyed after about the second tapping, and the mold is worthless. We avoid this by tapping into slag pots that are thickly washed with clay water before each tap.

Another effect of the nickel is to completely obliterate the ordinary appearances by which we can determine the grade of copper matte so accurately by eye. This copper-nickel matte is a very dense, heavy substance, with a very fine-grain almost bell-metal fracture and a pinkish-white color, though if broken hot it assumes a purplish color and luster that imitates closely some of the higher grades of copper matte and leads one completely astray as to the percentage of valuable metal present. In a word, we have none of us yet learned to estimate the percentage of this matte by eye either in copper or in nickel, and it is doubtful if we ever find a way of doing it without chemical aid. The slag is usually pretty near a singulo-silicate, though mostly with a slight mixture of bi-silicate, and owing to its numerous favorable bases is very fusible and unusually free from metal. For at least six weeks the daily samples have not once showed any loss of either of the valuable metals present beyond what must be expected in producing a matte rather above the usual grade.

Uses.—Common observation would suggest that the consumption of nickel for plating has increased markedly in late years, and as a fact it has more than doubled in the last decade, and even in the past two years has shown a further though moderate increase, which is true also of the German silver manufacture. But the effort is being made in Europe to extend the consumption of nickel in all possible directions. For example, by the introduction of rolled nickel plate as an advance over tin plate. Among the proposed uses none attract so much interest as the use of nickel in alloy with steel to increase the latter's strength. A French invention has effected means for preparing such alloys with regularity and even composition. Lately Mr. James Riley, of Glasgow, Scotland, has published a valuable contribution to the knowledge of the physical characteristics of various sorts of steel when alloyed with nickel which is here abstracted from "Engineering." In the first place, a visit to the place of manufacture in France demonstrated to his entire satisfaction the degree of certainty with which the desired products could be obtained from the crucible. A number of casts were made, the composition being varied at will and the quality and properties of the metal being indicated beforehand. Subsequently it was shown at English works that the composition of the metal can be as effectually controlled in the open-hearth furnace as in the crucible. Mr. Riley states that the alloys can be made in any good open-hearth furnace working at a fairly high temperature. The charge can be made in as short time as an ordinary "scrap" charge of steel—about seven hours. Working the steel requires no extraordinary care; in fact, not so much as is required in working many other kinds of charges, the composition of the resulting steel being easily and definitely controlled. No special arrangements are required for casting, ordinary ladles and molds being sufficient. If the charge is properly worked, nearly all the nickel will be found in the steel; almost none is lost in the slag—very different in this respect from charges of chrome steel.

The steel is steady in mold, it is less viscous than ordinary steel, it sets more rapidly, and appears to be thoroughly homogeneous. The ingots are clean and smooth in appearance on the outside, but those richest in nickel are a little more "piped" than ingots of ordinary mild steel. Any scrap produced in the subsequent operations of hammering, rolling, shearing, etc., can be remelted without loss of nickel in making another charge. No extraordinary care is required when reheating the ingots for hammering or rolling. They will stand quite as much heat as ingots having equal contents of carbon but no nickel, except perhaps in the case of steel containing over 25 per cent. nickel, when the heat should be kept a little lower and more care taken in forging. If the steel has been properly made and is of correct composition, it will hammer and roll well whether it contains little or much nickel; but it is possible to make it of such poor quality in other respects that it will crack badly in working, as is the case with ordinary steel. In obtaining a correct idea of the value or usefulness of alloys of nickel with iron or steel, it should be remembered that the composition is complicated by manganese, carbon, silicon, sulphur, and phosphorus, whose influence must be carefully watched, requiring long series of experiments. In the absence of these extended series the following will still give valuable results:

In table 1, test No. 6, the carbon present (0.22) is low enough to enable us to make comparison with ordinary mild steel, which would give, when annealed, results about as follows: elastic limit, 16 tons; breaking strain, 30 tons; extension, 23 per cent. on 8 inches, and contraction of area 48 per cent. Therefore, in this case the addition of 4.7 per cent. of nickel has raised the elastic limit from 16 up to 28 tons and the breaking strain from 30 up to 40 tons without impairing the elongation or contraction of area to any noticeable extent. In test No. 3 somewhat similar results were found with an addition of only 3 per cent. of nickel, combined with an increase of the carbon to 0.35 per cent. In tests Nos. 2 and 5 there is extreme hardness, due in part to the large quantity of carbon present, but also to the presence of nickel in addition. In test No. 9, with the carbon very much reduced, this characteristic hardness is intensified by the increase of nickel to 10 per cent. This quality of hardness obtains as the nickel is increased, until about 20 per cent. is reached, when a change takes place and successive additions of nickel tend to make the steel softer and more ductile, and even to neutralize the influence of carbon as is shown in the test No. 2, in which there is 25 per cent. nickel and 0.82 carbon. In this matter of hardness, due to increased additions of nickel, there is some resemblance to Hadfield's manganese steel, but valuable qualities of nickel steel are reached before machining becomes extremely difficult. There are experiments showing that by hardening and tempering it may be possible to increase largely the breaking strain and elastic limit of these alloys. The alloys polish well, the color being lighter as the proportion of nickel increases. They do not corrode as easily as other steel, the 1 per cent. nickel steel welds fairly well, but this quality deteriorates with each addition of nickel. Considerable ultimate advantage may be expected from these alloys, particularly where the percentage of nickel is less than five.

TABLE No. 1.—*Physical tests of steel alloyed with varying proportions of nickel.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11	No. 12
Composition:												
Nickel ...per cent..	1.0	2.0	3.0	3.0	4.0	4.7	5.0	5.0	10.0	25.0	25.0	49.4
Carbon ....do..	.42	.90	.35	.60	.85	.22	.30	.50	.50	.27	.82	.35
Manganese .....do..	.58	.50	.57	.26	.50	.23	.30	.34	.50	.85	.52	.57
Tensile tests as cast:												
Elastic limit..tons..	(*a*)	(*b*)	19.8	......	(*b*)	......	......	......	(*c*)	......	......	......
Breaking strain.do..	......	......	34.9	......	......	......	......	......	......	......	......	......
Extension, per cent. in 4 inches	......	......	2.5	......	......	......	......	......	......	......	......	......
Contraction of area, per cent...........	......	......	5.6	......	......	......	......	......	......	......	......	......
Tensile tests as cast and annealed:												
Elastic limit..tons..	27.3	......	24.0	......	......	......	......	......	......	......	......	......
Breaking strain do..	54.6	......	34.9	......	......	......	......	......	......	......	......	......
Extension, per cent. in 4 inches	1.5	......	2.5	......	......	......	......	......	......	......	......	......
Contraction of area, per cent...........	9.5	......	9.0	......	......	......	......	......	......	......	......	......
Tensile tests as rolled:												
Elastic limit..tons..	32.1	......	31.4	29.4	......	25.1	30.0	31.1	......	38.2	22.0	20.5
Breaking strain.do..	57.6	......	51.0	51.5	......	40.5	46.4	52.0	......	51.4	47.6	37.4
Extension, per cent. in 8 inches	......	......	....	9.0	......	17.75	10.0	14.0	......	10.5	43.5	......
Extension, per cent. in 4 inches	11.0	......	20.3	10.1	......	23.4	12.5	15.6	......	11.7	47.6	12.0
Contraction of area, per cent...........	24.0	......	37.0	9.0	......	42.0	22.5	14 0	......	......	60.0	24.0
Tensile tests as rolled and annealed:												
Elastic limit..tons..	30.1	......	28.0	30.3	......	28.0	28.0	32.5	......	12.75	15.1	21.0
Breaking strain do	55.1	......	48.5	42.9	......	40.6	42.6	46.8	......	45.8	42.1	37.0
Extension, per cent. in 8 inches	......	......	......	7.5	......	20.0	15.0	13.5	......	29.0	40.0	......
Extension, per cent. in 4 inches	18.7	......	20.3	9.0	......	25.0	17.5	14.0	......	30.0	45.3	20.0
Contraction of area, per cent...........	45.0	......	42.0	12.0	......	44.8	18.5	17.0	......	28.6	43.6	29.0

a Test piece defective.
b Too hard to machine with Mushet steel. Makes a fine tool tempered at dull red in boiling water.
c Too hard to machine. Makes a good cutting tool when tempered in cold-air blast.

TABLE NO. 2.—*Torsion tests of steel alloyed with varying proportions of nickel.*

Sample number.	Number of twists in 3-inch length.	Diameter of bar 1 inch, lever 1 foot long. Elastic limit.	Diameter of bar 1 inch, lever 1 foot long. Breaking strain.	Condition.	Composition. Nickel.	Composition. Carbon.	Composition. Manganese.	Remarks.
		Lbs.	*Lbs.*		*p. ct.*	*p. ct.*	*p. ct.*	
1	1⅞	857	1849	As hammered	1.0	0.42	0.58	No. 1 sample in No. 1 table (unannealed)
2	2⅛	677	1507	....do	5.0	0.30	0.30	No. 7 sample in No. 1 table (unannealed).
3	1¾	665	1729	....do	3.0	0.35	0.57	No. 3 sample in No. 1 table (unannealed).
4	1⅞	621	1493	... do	4.7	0.22	0.23	No. 6 sample in No. 1 table (unannealed).
5	2⅝	553	1554	.. do	50.0	0.35	......	
6	3	510	1950	....do	25.0	0.27	0.85	No. 10 sample in No. 1 table (unannealed).
1A	1⅞	697	1809	Annealed.....	1.0	0.42	0.58	No. 1 sample in No. 1 table (annealed).
2A	2⅜	653	1485	....do	5.0	0.30	0.30	No. 7 sample in No. 1 table (annealed).
4A	2⅝	652	1443	....do	4.7	0.22	0.23	No. 6 sample in No. 1 table (annealed).
6A	5	360	2100	....do	25.0	0.27	0.85	No. 10 sample in No. 1 table (annealed).
7	1 15/16	601	1689	....do	......	0.51	......	47.2 tons per square inch (Siemens steel).
8	1 9/16	601	1697	As hammered	......	0.51	......	50.4 tons per square inch (Siemens steel).
9	3⅛	445	1229	....do	.....	......	......	30.1 tons per square inch (Siemens steel.)

CHROMIUM.

The known localities in California where chrome iron ore has been produced, and can still be mined, remain sufficient for maintaining a large industry whenever conditions of freight rates and quality of the ore permit successful competition. But while freights are high and ore of high grade from Asia Minor can be imported, it is useless to look for large developments in California, especially since the miner has, in addition to the chance of sudden exhaustion of promising pockets, the knowledge that the quality of his ore usually becomes poorer with increasing depth. Already the ore of highest grade, over 50 per cent. chromic oxide, has been selected from the best-known deposits, and the State presents the general condition of large known bodies of chrome iron ore scattered over many counties of the State and averaging up to 45 per cent. chromic oxide, but which will not be sought while the consuming centers are so distant and so favorably connected with richer foreign ores. Active prospecting is still carried on in the State through the stimulus of good prices for ores of high grade. These are readily sold to the San Francisco agents of Eastern manufacturers. The most interesting feature of the situation is the ease with which sales are made provided the quality is high. There is sale for any ore containing over 47 per cent. chromic oxide, and probably no ore of higher grade is in stock in California at present.

The production in 1888 was limited to 1,500 tons, worth $20,000 in California. This product came from Del Norte, San Luis Obispo, Shasta, and Placer counties, and comprised all the offers of ore over 47 per cent., and some shipments of lower grades, which were hardly profitable and will only be worked up in case of tardy deliveries from Asia Minor. In Del Norte county there are two mines, the French Hill and Mountain View, both connected by good wagon roads with Crescent City, whence the ore is shipped to San Francisco. These mines are now practically held as reserves by the Eastern men and produced very little in 1888 except small shipments of ore taken out in the previous year. The mines may be worked again in 1889. The mine at Sims Station, Shasta county, shows a large body of ore which can be shipped cheaply. A shipment of a few hundred tons proved of high grade, nearly 52 per cent., but as other shipments have turned out of low quality it is evident that intelligent selection is necessary. In San Luis Obispo county only enough work was done to keep open a mine which is too valuable to abandon; a few tons were gathered by farmers and supplied a demand from Germany. The Forest Hill mine, in Placer county, has produced considerable ore in former years, but only did remnant work in 1888. Further statements in regard to California localities may be consulted in the report for 1888 of Mr. William Irelan, jr., the California mineralogist.

Production of chrome iron ore from 1882 to 1888.

Years.	Quantity.	Value in California.
	Long tons.	
1882	2,500	$50,000
1883	3,000	60,000
1884	2,000	35,000
1885	2,700	40,000
1886	2,000	30,000
1887	3,000	40,000
1888	1,500	20,000

The total production of potassium and sodium bichromates increased by a small percentage in 1888. The price of potassium bichromate averaged 10½ cents per pound in 1887, but had increased to 10¾ cents by the close of the year. Owing to less antagonism between the American producers, the price increased again in 1888, this time to 11½ cents, which held to the close of the year. The price of sodium bichromate is uniformly 2 cents lower than the potassium compound. It is used for the same purposes.

Imports.—The principal supply of ore for the world comes at present from Asia Minor. It was discovered there by Prof. J. Lawrence Smith when making mineralogical explorations for the Porte in 1848. He found it on a journey south from Brusa, a town 57 miles south-southeast from Constantinople. Near Harmanjick, 10 or 15 miles farther south, he found another abundant deposit. There is another field near Antioch. He describes the ore as in masses rather than in veins. The present supply comes from deposits somewhat farther south. It is taken on the backs of camels through a mountainous region to the seaports of Macri, near Smyrna, and Ghemlek, near Brusa. From the slight records that are accessible concerning these deposits, they are apparently irregular pockets, contained in serpentine, like our domestic ore. Mining has not gone to any depth. The ore is of higher grade than Californian, entire cargoes frequently averaging over 52 per cent. chromic oxide. It is used also in preference to the Russian ore, which formerly entered extensively into the supply.

The scattered references to Russian chrome iron ore have been collected by Mr. A. C. Gill, of the Johns Hopkins University, and show that it is found particularly in the soapstones of the Ural mountains; according to Gustav Rose, in three distinct conditions, in large granular masses, in serpentine in several places near Yekaterinboorg; also 8 miles from Bisserk, and again near Kyschtinsk. It is finally disseminated through the rock near Mostrowaja, north of Yekaterinboorg, and near Auschkul lake, and finally in the platinum and gold washings, especially at the platinum placers at Nizhnee-Taghilck, and at the gold placers at Malo-Mostowskoi.

Massive with lamellar or granular structure it is found also at Orenboorg, in Wiatka, Siberia, in Lilberberg and Grochen, in Silesia, Hrubschitz, in Moravia, Kriegland and Kraubat in Styria, in Hungary, and the Banat, but chiefly in extensive beds in Orsova, Drontheim, and Roeraas, in Norway. Chrome iron ore is also found in quantity at several places in New Zealand, chiefly near Nelson, in the Middle island; it is always in serpentine or olivine rock. It also occurs in North island. Extensive exports of ore have been made from New Caledonia, about 20 miles from Noumea.

Good ore is said to exist in shire McIvor, in Victoria, and at Jundagai and Tamworth, New South Wales, but facilities for transportation are not good. There are many deposits in Queensland, particularly near Ipswich. Quebec, Canada, also furnished 38 tons to the United States in 1887 and 60 tons in 1886.

With the high price of the Turkey ores it is very convenient to keep reserves even of poorer California ores; hence it is not probable that the domestic ores will ever be neglected altogether. The imports for 1888 increased largely, as shown in the following table, but as stock is frequently bought for more than one year's consumption it is difficult to determine what is the average amount required at present. The imports of potassium bichromate also increased slightly:

Chromate and bichromate of potash and chromic acid imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive*.

Fiscal years ending June 30—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
1867	875, 205	$88. 787	....	......	....	....	$88, 787
1868	777, 855	68, 634	....	.... .	....	....	68, 634
1869	877, 432	78, 288	....	$3	....	....	78, 291
1870	1, 235, 946	127, 333	....	8	....	....	127, 341
1871	2, 170, 473	223, 529	....	5	....	....	223, 534
1872	1, 174, 274	220, 111	514	49	....	....	220, 160
1873	1, 121, 357	178, 472	922	276	....	......	178, 748
1874	1, 387, 051	218, 517	44	13	....	....	218, 530
1875	1, 417, 812	183, 424	45	22	....	....	183, 446
1876	1, 665, 011	175, 795	120	45	....	....	175, 840
1877	2, 471, 669	264, 392	13	10	....	....	264, 402
1878	1, 929, 670	211, 136	32	35	....	....	211, 171
1879	2, 624, 403	221, 151	....	....	....	....	221, 151
1880	3, 505, 740	350, 279	5	3	....	....	350, 282
1881	4, 404, 237	402, 088	124	89	....	....	402, 177
1882	2, 449, 875	261, 006	52	42	....	....	261, 048
1883	1, 990, 140	208, 681	290	338	....	....	209, 019
1884	2, 593, 115	210, 677	....	120	2, 677	$73, 586	284, 383
1885	1, 448, 539	92, 556	....	39	12	239	92, 834
1886	1, 985, 809	139, 117	....	101	3, 356	43, 731	182, 949
1887	1, 722, 465	120, 305	....	5, 571	1, 404	20, 812	146, 668
1888	1, 755, 489	143, 312	....	281	4, 440	46, 735	190, 328

Chrome steel.—Mr. Rudolf Busek has lately written a valuable article in *Stahl und Eisen* upon the preparation of chrome steel and its properties. He reviews the attempts, some successful, which have been made during the past thirty years to prepare chromium, chrome steel and chrome iron. While most of these attempts have not passed the experimental stage, some have resulted in a sufficiently uniform product to be valuable, notably the well-known establishment at Brooklyn, and others at Moslyn in North Wales, Terre Noire, Hörde, and other places. At Unieux, rich, pure chrome iron ore, from Greece or the Urals, was reduced in clay crucibles, yielding very good ferro-chromium with 50 to 60 per cent. chromium. Grades of ferro-chromium have been made containing from 20 to over 75 per cent. of chromium. To obtain very rich pig chromium, potassium bichromate has been used. The great difficulty of reducing chrome iron ore and the expense of 3 tons of coke for 1 of ferro-chromium has been considerably reduced, and another step towards a practical variety of chrome steel by the patent of a German engineer, Mr. H. Eckardt. He produces, more properly, chrome-iron-manganese, using the discovery that chrome ores are comparatively easily and completely reduced by mixing with about an equal quantity of the slag from the acid Bessemer process. The slag acts as a solvent, and, further, the manganese in the slag when alloyed with the chromium renders it more fusible. Manganese ores are added to the slag when it is not rich enough in manganese.

The finely-ground ore and slag are mixed with tar which has been carefully freed from water. This furnishes sufficient carbon for reducing the ore. The mass is pressed into bricks and fed into a blast-furnace together with coke or charcoal.

To the various statements as to the peculiar properties of chromium steel, the following have been made by Mr. Eckardt as the results from steel made from his ferro-chrome:

Unhardened chrome steel is hard to break, and shows a fibrous fracture. In hardening at suitable temperature the texture becomes finer grained in proportion to the percentage of chromium and carbon. Steel with 1 per cent. to 1.5 per cent. carbon and 2.5 per cent. to 4 per cent. chromium is so hard that it cannot be worked with the ordinary hardened tools. But if such steel is hardened in water it gets brittle. Chrome steel does not peel off in hardening in water; the layer of oxide sticks on. By heating too long or too violently the steel loses its quality. Chrome steel solidifies much quicker than ordinary steel, and this is most noticeable at a percentage of 5. For this reason chrome steel production requires very high temperature. The castings shrink much more violently in cooling, resulting in many inconveniences. These are the harder to avoid in proportion as the castings are larger. Chrome steel shows very fine grain and extraordinary hardness, is more sensitive to sudden than to gradual strain, and is therefore better fitted for lathe tools and drills than for chisels. In this particular it excels the best ordinary cast steel. Chromium steel, though hard, bends well cold if the operation is slow enough. Chrome steel can be welded to iron and rolled out, and finds use as sheet metal or rod metal, especially as material for burglar-proof safes, etc.

There is little doubt that the use of chrome iron ore cemented with lime mortar will increase in use as a lining for open-hearth steel furnaces.

MANGANESE.

By Joseph D. Weeks.

In this report on the occurrence and production of manganese in the United States the ores of the metal will be divided into three general classes: first, manganese ores; second, manganiferous iron ores; and, third, argentiferous manganese ores. The dividing line between the first two grades is taken at 70 per cent. binoxide, equal to 44.252 per cent. of metallic manganese, this being the standard of shipments to the English chemical words. In the third class are included those argentiferous manganese ores of Montana and Colorado which are not only utilized for their silver contents, but have an added value by reason of the fluxing qualities imparted to them by the presence of the manganese.

The long ton of 2,240 pounds is uniformly used in this chapter.

Localities in which manganese occurs in the United States.—While there has been a constant and persistent search for new deposits of manganese during the past year, no new development of any importance has been reported outside of the localities that have been described in the previous volumes of Mineral Resources. Indeed, some localities regarded as quite promising at the time the report for 1887 was made up have proved to be of little value, and the chief production is still confined to the localities that have been noted as manganese producers for many years.

There are somewhat encouraging prospects of the discovery of manganese ore in North Carolina, and also in western Arkansas. Yet it is still true that Crimora (Virginia), Cartersville (Georgia), and Batesville (Arkansas) furnish practically all the manganese ores mined in the United States.

The production of manganese ore in the United States in 1888.—In this report it has been found impossible to make an exact separation between manganese ores and manganiferous iron ores. In Virginia, for example, a large proportion of the ores mined were manganese ores containing more than 70 per cent. of binoxide. The quantity of manganiferous iron ores mined in Virginia probably did not exceed 1,000 tons. On the other hand, all but 100 tons of the ore reported as mined in Michigan was manganiferous iron ore containing only about 11 per cent. of manganese. Some little of the Georgia ore was below the standard of 70 per cent. binoxide. All of the Arkansas was manganese ore, as was the Pennsylvania ore, but those from the other States were mixtures of manganese and manganiferous iron ores. In view of these facts, in the table given below manganese and manganiferous iron ores are reported together.

The total product of manganese ores in the United States in 1888 was 41,746 tons, valued at $321,709, or an average of $7.70 per ton. The production in 1888, therefore, shows on the face of the returns 7,23? tons more than in 1887. But if the 11,462 tons of manganiferous iron ores which were reported as mined in Michigan were subtracted, the production in 1888 would have been but 30,294 tons, or 4,230 tons less than in 1887. Of the 41,756 tons mined, Virginia produced 17,646 tons, or 2,189 tons less than in 1887. Georgia's production in 1888 was 5,568 tons, or 3,456 tons less than in 1887, when it produced 9,024 tons. The production of Arkansas in 1888 was 4,312 tons, a reduction of 1,339 tons from 1887, when it produced 5,651 tons. It will thus be seen that the States which are the chief producers of manganese ore, namely, Virginia, Georgia, and Arkansas, show a reduced production. These three States produced in 1888 but 27,526 tons, as compared with 34,510 tons in 1887, a reduction of 6,984 tons, or 20 per cent. On the other hand, Michigan, California, and Vermont, which in past years have appeared as small producers of ore, in 1888 produced considerable quantities. As is pointed out above, however, but 100 tons of the 11,562 tons produced in Michigan were manganese ores, the other 11,462 tons being manganiferous iron ores. Most of the Vermont ore was also of a grade that would bring it below the 44¼ per cent. of metallic manganese, which is assumed as the dividing line between manganese and manganiferous ores. The production of California, however, was of a high grade.

The production of the other States—that is, North and South Carolina, Pennsylvania, Nevada, and Tennessee—was the result of explorations rather than of regular mining.

The distribution of the product of manganese ores in the United States in 1888 was as follows:

Amount and value of manganese ores produced in the United States in 1888.

States.	Production.	Total value at mines.	Average value per long ton.
	Tons.		
Virginia	17,646	$171,848	$9.74
Michigan	11,562	37,000	3.20
Georgia	5,568	38,126	6.85
Arkansas	4,312	38,582	8.95
California	1,500	*a*30,000	20.00
Vermont	1,000	5,500	5.50
North Carolina	50	150	3.00
South Carolina	50	150	3.00
Pennsylvania	22	225	1.00
Nevada	20	80	4.00
Tennessee	16	48	3.00
Total	41,746	321,709	7.70

a Value at San Francisco.

The value of manganese ores.—From the above table it will be seen hat the total value of the 41,746 tons of manganese ores produced in he United States in 1888 was $321,709, or an average value of $7.70 a on. The average value of the ore of the several States varies from 51 in Pennsylvania to $20 in California. It should be distinctly under-tood that these values are free on board cars or carts at the mines, with he single exception of the California ore, for which the price in San Francisco is given, this being the only value which could be obtained. n other cases, where the given price is that at which the ore is deliv-ered on cars at localities distant from the mines, the cost of carting the ores to the cars is deducted from the free on board price.

Production of manganese ores, 1880 *to* 1888.—Continuing the table pub-ished in the last volume of Mineral Resources, we give below the product of manganese in the United States, so far as the same has been ascertained, in the years 1880 to 1888:

Production of manganese ores (over 44¼ *per cent. of metallic manganese) in the United States, from* 1880 *to* 1888, *inclusive.*

States.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Virginia	3, 661	3, 295	2, 982	5, 355	8, 980	18, 745	20, 567	19, 835	17, 646
Arkansas	....	100	175	400	800	1, 483	3, 316	5, 651	4, 312
Georgia	1, 800	1, 200	1, 000	....	....	2, 580	6, 041	9, 024	5, 568
Other States	300	300	375	400	400	450	269	14	1, 672
Total	5, 761	4, 895	4, 532	6, 155	10, 180	23, 258	30, 193	34, 524	29, 198

In the above table is given the production of strictly manganese ores. It is assumed that the amount of manganiferous iron ore produced in Virginia is small, and all the ores produced in Virginia, Arkansas, and Georgia are recorded as manganese ores, while it is estimated that 1,672 tons of the ores produced in the other States were manganese ores. The figures prior to 1885 are the best approximations to the actual figures that can be secured; the others are very nearly correct through all the years.

Production of manganiferous iron ores.—As has already been stated, it has been impossible in this report to distinguish, except approximately, between the manganese ores and the manganiferous iron ores; but, on the basis of the estimate given above, the production of manganiferous iron ores that were sold as such in 1888 was 12,558 tons. Of this amount 11,562 tons were from the Colby mine in Michigan, containing about 11 per cent. of manganese. In addition to this, the Colby mine also produced 189,574 tons, carrying 4 per cent. of manganese. As has already been stated in previous reports, the manganese in this latter amount of ore did not increase its value. The total production of manganiferous iron ores in the United States would be 202,132 tons, of which 201,036 tons were from the Colby mine, in Michigan.

Production of argentiferous manganese ores.—It is estimated from the best data obtainable that the product of manganiferous iron ores, containing silver, in the Rocky Mountain region in 1888 was some 60,000 tons, valued at $10 per ton. These ores are not utilized for their manganese directly, but for their silver, the manganese they contain adding to their value because of its fluxing qualities.

Total product of all classes of ores containing manganese in 1888.—Regarding all these three classes of ores as manganese ores, the total product of all manganese ores in the United States in 1888 was as follows:

Total product of all kinds of manganese ores in 1888.

	Quantity.	Value.
	Long tons.	
Manganese ores	29,198	$279,416
Argentiferous manganese ores	60,000	600,000
Manganiferous iron ores	202,132	575,000
Total	291,330	1,454,416

ARKANSAS.

Arkansas still maintains its relative rank in the production of manganese in the United States, being the third State in total amount of production. For the first time since 1885, however, it shows a reduced production, the production of 1888 being 4,312 tons, as compared with 5,651 tons in 1887, and with 3,316 tons in 1886, and 1,483 tons in 1885. The production of this State is practically all from the Batesville district.

The following shows the product of manganiferous ores in Arkansas since 1880. The remarks relative to the accuracy of the figures for Virginia will apply here also.

Product of manganese ores in Arkansas, from 1880 *to* 1888.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1880	....	1885	1,483
1881	100	1886	3,316
1882	175	1887	5,651
1883	400	1888	4,312
1884	800		

The above quantities are based on railroad and other shipments.

Some estimates place the production of ore in this State prior to 1885 at 5,000 tons. This is probably an overestimate.

One cause of the decline in production in 1888 has been the lack of water for washing the ore properly. In the latter part of the year the Keystone Manganese Company, limited, began to sink an artesian well for the purpose of securing an ample supply. At the close of the year it had reached a depth of 1,600 feet, but a sufficient body of water had not been secured. The well was to be sunk still deeper. This lack of water reduced the production not only at the mines of the Keystone Manganese Company, but also at those on the properties adjoining. The Saint Louis Manganese Company, for example, stopped mining after producing less than 300 tons, awaiting results of the borings on the Keystone property.

Near the close of 1887 and during the early part of 1888 considerable attention was directed to two deposits of manganese outside of the well known Batesville district. One of these was the Polk county deposit in the southwestern part of the State, to which reference has already been made in previous volumes of Mineral Resources. Practically no manganese was mined in this district, in a commercial way, in 1888. The second deposit is in what has been termed the Fletcher district. It is in the Fletcher range and lies about 12 miles southeast of Little Rock. It is claimed that manganese is found over an area of from 12 to 15 miles in length and from 2 to 4 miles in width, the deposit varying from 8 inches to 8 feet in thickness. It is claimed that the average analysis shows 52 per cent. of manganese, 6 per cent. of iron, and .014 of phosphorus. Several companies have been formed to operate the deposit.

GEORGIA.

Georgia is still the second State in the production of manganese. In 1888 the product was 5,568 tons, a reduction from 9,024 tons in 1887. Georgia, equally with Arkansas and Virginia, shows a decreased production. The product in 1886 was 6,041 tons, and in 1885, 2,580 tons. As above stated, practically all the ore mined in this State is from the Cartersville district.

The following shows the product in the Cartersville region, Georgia, since 1866:

Product of manganese ore in the Cartersville region, Georgia.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1866	550	1878	2,400
1867		1879	2,400
1868		1880	1,800
1869		1881	1,200
1870	5,000	1882	1,000
1871		1883	....
1872		1884	....
1873		1885	2,580
1874	2,400	1886	5,981
1875	2,400	1887	9,024
1876	2,400	1888	5,568
1877	2,400		

CALIFORNIA.

The output of manganese in California is governed by the consumption, which the principal dealer in San Francisco puts at 1,500 tons a year, for which he pays $20 per ton delivered in San Francisco. It is used chiefly for oxidizing linseed oil and in making petroleum gas. The principal sources of supply in California are near Tracy, in San Joaquin county, and Begessa district, in Santa Clara county. The deposit in Corral Hollow, Alameda county, has not been worked since 1887. The substance is also found in the San Rafael mountains, Santa Barbara county, and in some other places in the State.

MICHIGAN AND WISCONSIN.

But little can be added to statements given in previous volumes of Mineral Resources relative to the character of the deposits of manganese and manganiferous ores found in Michigan and Wisconsin, or in what is generally known, for want of a better term, as the Lake Superior region. A product of 100 tons of high-grade manganese ores from the Gogebic region is reported in 1888. The Colby mine, which produced 356,000 tons of manganiferous iron ores in 1886 and 210,000 tons in 1887, produced 201,036 tons in 1888, of which 11,562 tons contained 11 per cent. of manganese, and the remainder, 189,574 tons, contained 4 per cent.

At several mines in Saint Croix county, Wisconsin, some ore has been found. At the Arthur mines, in Wilson county, according to Col. G.W. La Pointe, the ore is more or less manganiferous. The work done at the close of the year showed a deposit of manganese from two to three feet thick between the ore proper and the inclosing rock. The quality of the ore varies greatly. A sample car load was taken out shortly after the beginning of 1889 for the purpose of testing the character of the deposit, the result of which will be given in the next report.

From Mr. L. M. Newman it is learned that there was considerable excitement early in 1888 relative to the discovery of manganese in Dunn county. The manganese existed in a layer as black oxide a few inches in thickness in some places, and was also found in pockets lying in a brown hematite iron ore, which is also quite rich in manganese. Mr. Newman writes that he has given the matter some attention and spent some money in investigating the find, and has reached the conclusion that there is neither iron nor manganese in sufficient quantities to warrant mining.

NEVADA.

But little can be added to what has been said in other volumes of Mineral Resources about deposits of manganese in Nevada. Some 20 tons, at $4 a ton, are reported as having been produced in this State in 1888.

NORTH CAROLINA.

Certain localities in North Carolina which gave promise of furnishing a quantity of manganese ores were described in the volumes of Mineral Resources for 1885 and 1886. This promise has not as yet been fulfilled. So far as could be learned, no manganese was mined and shipped from this State in 1888. In the "Report on the ores of North Carolina," which is contained in chapter XI of the second volume of the "Geology of North Carolina," it is stated that: "The ores of manganese are not abundant in North Carolina so far as known, but pyrolusite, psilomelane, wad, etc., are found in small quantities in many places. They are generally associated with iron, gold, and silver ores." There is a very promising bed or vein of psilomelane in Caldwell county, 5 miles west of Lenoir. It is found in irregular and rounded masses, embedded in light-colored gneissic schists, some of the masses being 10, 15, and 20 inches thick, and occurring in strata 3 or 4 feet thick. Another locality in this county is the Perkins mine, 10 miles west of Lenoir, where a bed of oxide of manganese was opened to a depth of 6 feet, and shown to have a thickness of 1 foot. A large bed carrying oxide of manganese is reported by Mr. S. A. Lowe to exist 10 miles north of Dobson, in Surry county. Half a mile west of Blue Ridge Gap, in Mitchell county, is a bed or seam of earthy pyrolusite or psilomelane 2 to 4 inches thick; it occurs in feldspathic and hornblende schist, extending in a nearly east and west direction across the fields for about one-third of a mile. There is also a small seam in the town of Danbury, Stokes county. Laminated masses of ½ inch to 2 inches in thickness occur in the Buckhorn iron ore beds. There are specimens in the State museum from Nash and other counties. A specimen of manganese ore from Jackson county gave on analysis the following:

Analysis of manganese ore from Jackson county, North Carolina.

	Per cent.
Silica	12.25
Alumina and sesquioxide of iron	14.10
Proto-sesquioxide of manganese	74.45
Total	100.80

This is probably braunite, variety marceline. A similar specimen was furnished by Chatham county. Manganese is found associated with iron ores in various parts of the State, as mentioned above; at Buckhorn it is found as a silicate, and probably in the form of knebelite. Beds of manganese garnets are of common occurrence, and often of great thickness.

There is a series of beds containing manganese associated with the King's mountain schists (slates) of Gaston, Lincoln, and Catawba counties, which is superficially changed to black oxide. One notable locality is near the old forge on Crowder's creek, formerly operated by Mr. Briggs; it is under the west flank of Crowder's mountain and quite near the Yellow Ridge ore bank.

Analysis of manganese ore from Gaston county, North Carolina.

	Per cent.		Per cent.
Silica	40.395	Lime and magnesia	Not determined.
Oxide of iron	12.146		
Alumina	9.029		
Phosphoric acid (anhydride)	.030	Metallic iron	8.602
Sulphuric acid (anhydride)	.024	Metallic manganese	21.450
Sulphide of iron	.218	Phosphorus	.015
Proto-sesquioxide of manganese	29.780	Sulphur	.112

A vein of oxide of manganese crosses the road from Iron to Maj. W. A. Graham's residence in Lincoln county. The bed is apparently a highly-altered silicate, and is fully 6 feet wide.

A vein of manganese ore, which is believed to be in the northeast extension of the above, is found about a quarter of a mile west of Vesuvius furnace, on the road to Big Ore bank.

Analysis of manganese ore from Lincoln county, North Carolina.

	Per cent.
Silica	47.93
Protoxide of manganese	12.86
Binoxide of manganese	5.60
Alumina and sesquioxide of iron	30.44

This has been used in a neighboring furnace as a mixing ore, and with very good results.

During 1888 the only mine worked in this State, so far as has been ascertained, was that of Whithorne & Smith, located in the northwest corner in Madison county. This mine was partially developed, not regularly worked. Three car loads of the ore were shipped during the year; two to Liverpool, the other to Pittsburgh. The ore consists of pyrolusite and a black oxide, containing 48 to 50 per cent. of metallic iron. It exists both in lumps and in a soft pulverulent variety, very pure and much crystallized. The formation is "pockety." The greatest depth at which the ore has been found is about 73 feet. The deposit, so it is stated, appears to be extensive, having an outcrop of three miles in length, and from one-fourth to one-half mile in width.

The product reported from this State in 1888 was but 50 tons, valued at $3 a ton, or a total of $150.

SOUTH CAROLINA.

Some explorations for manganese ores have been conducted in this State during the past year, but no details have been given relative to the character of the ore. The only fact ascertained is that about 50 tons were mined, which it is assumed were worth $3 a ton at the mines.

TENNESSEE.

A small quantity of ore was produced in Tennessee during the year 1888. It came from a mine located some 4 miles from Newport, in the county of Cocke. Mr. W. R. Smith writes concerning this mine: "So far as developed, this mine has yielded good returns of ore; it is in a pocket formation, very regular, and shows a thickness of 16 feet. The ore extends from the surface to a known depth of 25 feet. The outcrop extends over about 1,000 acres. The ore shows about 48 per cent. metallic manganese and 6 per cent. of iron. It is a black oxide, and is found in lumps from the size of a shot up to 2,000 pounds. It lies in the foot hills of the mountains, and is quite accessible."

VERMONT.

For the first time since the beginning of these reports Vermont appears as a producer of manganese. About a thousand tons have been produced at the mines of Messrs. Bradley & Lyons, near the town of South Wallingford, Rutland county. The mines are located at the foot of the Green Mountain range, half a mile east of the Bennington and Rutland railroad.

These deposits were worked to some extent some sixty or seventy years ago for iron ore. The quantity of manganese they carried, however, was such, in the condition of iron smelting at that time, that the persons mining were not able to utilize the ore and it went to waste. Some forty years ago Messrs. Lapham & Vail mined the ore and worked it in a forge near by, producing sleigh shoes, bars, butcher knives, etc. The mine was abandoned because the miners believed they had won all the ore. It is now known, however, that they had only worked on the top of the deposit. They tried to sink a shaft to reach ore which they supposed existed below, but they struck a large vein of water and abandoned the operation. Some fifteen years since a few hundred tons of ore were mined, and again the mine was abandoned. Some two years since Messrs. Bradley & Lyons commenced operations. They found it necessary to go deeper into the mine, and drove in a tunnel at the foot of the mountain 517 feet into a siliceous limestone formation. After drifting through this for 300 feet they encountered ocher for 100 feet or more, after which they turned north, encountering a large body of excellent manganese ore. The ore is found between a wall of siliceous limestone on the west and broken massive quartz on the east, the walls being 150 feet apart. Beneath the drift were found ochers, clays, kaolin, and manganese ore, the latter lying near the quartz with a seam of black ocher between the ore and wall. The deposit dips about 40 degrees to the east. The trend of the vein is south. Next to the manganese ore on the west is a shell of brown ore. In the mine all grades of ore, from the ordinary brown hematite to the highest grade of manganese, are found. Much of the hematite ore is of a beautiful stalactitic formation. Cubical and needle crystals are also found. One of the strange features of this mine is this ore channel, as the proprietors term it, between the two walls before noted. This channel appears to be thousands of feet long. It has already been explored for 1,000 feet in length without any apparent break in its continuity. At present the ore is mined by a vertical shaft 115 feet deep, the bottom being some 80 feet above water level. Writing in regard to this, Mr. G. W. Bradley says:

"At present we are into solid ore 60 or 70 feet, with mineral on all sides, or nearly so. Skirting on the eastern side of this find, we have found a body of geodes weighing from 1 pound to 300 pounds, the ore being of a superior quality and the inside of the geodes filled with water, sometimes also inclosing a little ocher or kaolin. These geodes are sown thickly in the inclosing ocher."

Analyses of this ore are as follows:

Analyses of shipments of manganese from South Wallingford, Vermont, for the winter of 1887–'8, shipped as mined, unwashed.

Silica.	Iron.	Manganese.	Phosphorus.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
(*a*) 9.520	33.383	20.141	0.088
(*a*) 10.000	26.104	26.182	.064
(*a*) 7.480	32.128	20.602	.073
(*b*) 12.500	14.650	34.393	11.151

a This ore was taken from only 30 to 50 feet below surface.
b Analysis of shipments for winter 1888–'9, ores at 50 to 60 feet deeper than specified above. Samples for analysis were from car loads of unwashed ore from vein some 100 feet south.

Analysis of washed ore from vein 500 *feet north of ore specified in first table, at* 27 *feet from surface, made June*, 1888.

Silica.	Iron. (*a*)	Manganese. (*b*)	Phosphorus.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
9.230	7.180	44.107	Not given.
3.100	25.000	35.000	.061
7.900	4.970	48.778	0.111

a Samples from face of drift, January 5, 1889, as near as could average; selection, ore 40 to 50 feet under that given in first table.
b From vein 100 feet south of above, average as near as possible. December 3, 1888.

VIRGINIA.

As to the character of manganese deposits in Virginia, but little can be added to what has already been stated in previous volumes of Mineral Resources. This State still maintains its pre-eminence as the principal producer of manganese ore in the country. The product in 1888 of manganese and manganiferous ores was 17,646 tons; in 1887 it was 20,860 tons.

The chief production of manganese in this State is still from the Crimora mine and its neighboring mines, owned by the Old Dominion Manganese Company, and leased by the American Manganese Company, which also operates the Crimora mine. Out of a total of 17,646 tons of manganese and manganiferous ores produced in this State in 1888, 16,100 tons were from these two properties. Their product in 1887 was 19,100 tons. The product of the Crimora mines brought down to 1888 is as follows:

Product of the Crimora mines, Virginia.

Periods.	Quantity.
	Long 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

The next largest producers of manganese ores in Virginia were the Houston mines in Botetourt county, at which point 985 tons were produced, 100 tons being select high grade, sold for chemical purposes; the remainder was shipped to Carnegie Bros. & Company, limited, at Pittsburgh. This deposit has already been described in previous volumes of Mineral Resources. The Leet mine, at Mount Athos, also produced about 225 tons of high-grade ore, used for chemical purposes. The Rockingham Manganese Mining Company, at Elkton, in Rockinham county, on the Shenandoah Valley railroad, produced 36 tons.

From what is known as the Rye valley, some 300 tons of ore of a low grade were produced in 1888. The ore is mixed with red hematite, and must be assorted; the manganese and manganiferous ore being about from one-half to two-thirds of that mined. At the Wimer mine, near Marion, Smyth county, a shaft has been sunk about 30 feet deep. At the Hull mine, Mr. Faux mined and shipped some ore, but the quality was not satisfactory. The work was only at the surface. The ore analyzed from 27 to 41 per cent. metallic manganese. Some dozen other mines have been opened in this neighborhood. These mines are from 8 to 12 miles from the Norfolk and Western railroad, near Marion, in Smyth county.

NOVA SCOTIA.

Concerning the occurrence and distribution of the ores of manganese in Nova Scotia, nothing can be added to the very full descriptions given in previous volumes of Mineral Resources. Mr. E. Gilpin, jr., chief inspector of mines for the province of Nova Scotia, has again furnished the production of manganese in that province for 1888, which is added to the tables in previous reports, giving in detail the production of manganese in Nova Scotia since 1861.

Production of manganese ore in Nova Scotia from 1861 to 1888, inclusive.

Years.	Mines.	Production.	Value.
		Long tons.	
1861 to 1871		1,500	$10,500
1872		40	1,400
1873		131	
1874			
1875		7	
1876		16	
1877		97	5,335
1878	Tenny Cape No. 1	79	4,345
	Tenny Cape No. 2	48	2,160
		127	6,505
1879	Tenny Cape No. 1	90	4,950
	Tenny Cape No. 2	55	2,220
		145	7,170
1880	Windsor	62	2,831
	Walton	81	3,600
	Cheverie	70	7,000
	Others	70	1,400
		283	14,831
1881	Tenny Cape	125	
	Walton	7	
	Cheverie	17	
	Pembroke	6	
	Windsor	6	
	Loch Lomond, Cape Breton	70	
		231	
1882	Tenny Cape	120	
	Walton	6	
	Cheverie	21	
	Onslow	6	
	Loch Lomond, Cape Breton	56	
		209	
1883	Tenny Cape	125	}
	Walton	5	} 12,462
	Cheverie	4	}
	Loch Lomond, Cape Breton	16	
		150	12,462
1884	Tenny Cape	126	11,970
	Windsor	5	550
	Cheverie	2	180
	Walton	89	8,430
	Onslow	30	2,700
	Loch Lomond, Cape Breton	50	
		302	23,830
1885		354	
1886	Tenny Cape	171	12,066
	Cheverie	6	358
	Cornwallis	250	750
	Onslow	20	85
	Stewiacke	18	590
		465	13,849
1887	Tenny Cape	235	16,150
	Cheverie	5	200
	Cornwallis	385	2,233
	Onslow	40	2,800
		665	21,683
1888	Windsor (Tenny Cape, etc.)	42	2,120
	Cheverie	6	240
	Walton	18	1,100
	East Mountain, Colchester county	40	3,000
		106	6,460

The ore mined in Colchester county, which was valued by the custom-house department at Halifax, the point of export, at $3,398, was obtained principally by washing nodules out of the earth overlying soft sandstones and by quarrying and crushing and jigging the sandstones whenever they show ore. The value at the mine, that is, cost of production, is not less than $15 a ton. The ore from Windsor and Cheverie is obtained from pockets and veinlets in the limestones, sandstones, and lime rocks. The cost of mining is heavy, and the inducements to mining are less this year than formerly.

NEW BRUNSWICK.

Two grades of manganese ores are produced in this province, which are known locally as "high-class" and "metallic" ore.

The "high-class" ore from the mines of Mr. Alfred Markham, successor to the Queen Manganese Company, whose mines are at Markhamville, has already been described in previous volumes of Mineral Resources, and is sold to glassmakers, varnish manufacturers, electricians, chemists, and all others using a high-class ore on its well-established reputation and its appearance, which as a rule indicates its quality. Sometimes it is sold by analysis, the best ore testing upward of 96 per cent. Three analyses by Government chemists are as follows:

Analyses of high-class manganese ore from Markhamville, New Brunswick.

	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Manganese binoxide	98.70		
Manganese peroxide		97.25	96.62
Silica	.55		
Iron	.75		
Iron peroxide		.85	.78
Barium	Trace.		
Baryta and silica		.95	.85
Water		Trace.	Trace.
Loss		.95	1.75
Total	100.00	100.00	100.00

This ore is granulated or powdered and packed in old petroleum barrels containing upwards of 1,000 pounds each. As so packed for shipment it is worth 5 cents per pound.

The "metallic" ore is sold by analysis, 50 per cent. manganese being the standard. The ore of this class produced at Mr. Markham's mines is handled in bulk, shipped to Saint John by rail, and thence by schooner to the United States, or under lumber cargoes to England, in lots of 100 to 300 tons. The price of this ore has advanced recently in England, and was worth near the close of the year $15 per ton.

The product of manganese in New Brunswick in 1887 was 823½ tons, valued at $20,260, as follows:

Product of manganese in New Brunswick in 1887.

	Tons.	Value.
Markham mines:		
High class	243½	$14,160
Metallic	560	5,600
Other mines	20	500
Total	823½	20,260

The "high-class" ore was valued at $60 per ton, the metallic at $10.

According to the report of the Geological and Natural History Survey of Canada the production of manganese in New Brunswick, in 1887, was 939½ tons.

Relative to the production of manganese ore in New Brunswick in 1888, we have only the figures showing the exports, which are as follows:

Exports of manganese from New Brunswick in 1888.

To—	Tons.	Value.
Great Britain	156	$2,646
United States	60	2,277
	238	3,262
	340	3,953
	300	3,935
Total	1,094	16,073

Assuming that the product in 1888 was the same as the exports, we have the following as the product of manganese in New Brunswick for the past three years, taking for 1886–'87 the figures given in the Mineral Statistics volume of the Geological and Natural History Survey of Canada.

Product of manganese in New Brunswick in 1886–'88.

Years.	Tons.
1886	1,324½
1887	939½
1888	1,094

QUEBEC.

For the year ending June 30, 1888, according to the report of the Customs department, there were exported from the province of Quebec, 3 tons of manganese ore, valued at $53. Concerning the deposits from which this ore has been taken, no information has been received.

CUBA.

Quite extensive deposits of manganese ore are known to exist in the neighborhood of Santiago de Cuba. From two mines in this neighborhood some 7,000 tons have been mined, of which 1,300 tons have been shipped to the United States. The great drawback to the development of these deposits is the want of transportation facilities from the mines to the coast. And though the prospect of their being large producers is excellent, the well-known uncertainty of manganese ore mining prevents capitalists from investing the sums necessary to build branch roads to the coast.

Some sixty mines have been "denounced" in the neighborhood of Santiago de Cuba in accordance with the Spanish law. These mines are divided into ten groups. All the ore that has been mined in this neighborhood, except about 100 tons, is from two of these mines in one of the groups. At the other mines the only work has been in the nature of exploration, and just what is sufficient to permit of "denouncing" the mines in accordance with the provisions of the Spanish law. Under this law a mine is the metallic deposit in the land on which mineral has been discovered and "denounced" to the Government. The discoverer of the mineral, whether he is the owner of the surface or not, owns the mines. If he does not hold the surface, he has to arrange with the owner of the surface for mining before commencing operations; or, if no arrangement can be made, the Government appraises the value of the surface, which value must be paid before mining operations can be begun. The owner of the surface has not himself the right to mine, or to give a lease for others to mine, unless he was the discoverer or owner of the mineral, or has purchased or leased the right of the discoverer. Not one of the sixty mines above referred to is on or in lands owned by the discoverer of the minerals. In other words the owner of the mine is not the owner of the surface. These mines are held by the discoverer and can be leased on a royalty with certain conditions in the lease as to the amount of ore to be taken out annually. The surface in addition to this is valued at from $3 to $6 an acre. Of the ten groups of mines mentioned above, seven groups are on the line of the Sabanillo and Marote railroad, and are situated from 1 to 20 kilometers distant from it. The other three groups are on the line of the old Cobre railroad, which was destroyed in the revolution of 1869. Under the decree of the Spanish Government, all manganese mines are exempt from all manner of taxes for twenty years. All machinery, tools, etc., which are to be used in the exploitation and working of manganese ores, as well as all material, coal, etc., for mining purposes, are free from import duty.

The two mines from which the ore to the United States was chiefly taken were the Ysabeblita and the Boston. They are worked by the Cuba Manganese Company, of New York. The workings at these mines have been only sufficient to demonstrate the quantity of ore present. As above stated, something over 7,000 tons of ore have been obtained at these two mines, of which only 1,298 tons have been exported. The ore must be washed, but no washing machinery has been erected. The mines are easily worked by open cuttings or drifts in the hillside.

The "Boletin Comercial" gave in its issue of August 1, 1888, what is said to be a fair estimate of the cost of the ore laid down in Philadelphia. Mr. Otto F. Reimer, consul at Santiago de Cuba, gave this statement, and comments on it as follows (price in Spanish gold):

Estimate of the cost in Philadalphia of manganese ore from Cuba.

Items.	Cost.
Royalty paid to owners of the mine	$1.10
Cartage, 2 miles, from mine to railroad	1.25
Freight, Cristo station to Santiago de Cuba	1.27½
Bagging	3.25
Lighterage and labor in Santiago de Cuba	.60
Freight to Philadelphia and discharging there	3.68½
Mining ore, including labor, salaries, and expenses at mines	4.65
Actual cost of 1 ton of ore	15.81

This, at $1.10, would make $14.23 in United States currency. This is an enormous expense, and the company, now that the ore has been proved to exist in large quantities, propose to reduce it to half either by making a rope tramway from the mines to Cristo station, or else building a branch railroad to connect with the Sabanillo and Marote railroad, and avail itself of an existing Spanish law and compel the Sabanillo and Marote Railroad Company to allow the company's ore cars to pass over the track. Then the company proposes to erect a dock of its own where its steamers can load the ore. The mines are worked by open cuttings or drifts on the sides of the hill. The analysis of the ore so far shipped has shown an average of—

Analysis of Cuban manganese ore.

	Per cent.
Silica	0.810
Iron	.300
Metallic manganese	56.880
Phosphorus	.030
Sulphur	.003
Moisture	2.000

The total receipts of manganese ore in the United States from Cuba during 1888 were 1,581 tons. It is believed that this is all the manganese ore produced in Cuba that entered into consumption in the year 1888. This ore was all sent to Carnegie Brothers & Company, limited, at Bessemer, Pennsylvania. Analyses of dried samples received during 1888, by this firm, ranged as follows:

Range of analyses of Cuban manganese ore.

	Per cent.	
Silica	3.55 to	11.91
Iron	2.02	2.85
Manganese	44.53	46.36
Phosphorus	0.063	0.116
Moisture	5.00	9.9

CHILI.

According to a report made by the Belgian Minister to this Government, manganese deposits were discovered about eight or ten years ago at Mansee. These beds were bought and worked by an English company for some years, but the deposits began to give out, and the working expenses increasing very considerably, it was considered advisable to reduce the output. The total cost of mining and interior shipment to the port of Carrizal Bago varied greatly. The building of a tramline, on which trucks could be drawn with horses, would reduce the cost one-third. If this were done it would facilitate the working and the transportation of the deposit, which could be easily made to reach 4,000 tons a month. With present facilities the monthly output does not average more than 1,000 tons.

In Coquimbo maganese ore has been known to exist for some time. These deposits were described in Mineral Resources for 1886, page 206. It is exceedingly difficult to secure reliable figures of exportation; the most reliable statements we have are as follows, for the years 1884–'85:

Exports of manganese ore from Chili in 1884–'85.

Years.	Kilograms.
1884	4,324,007
1885	8,160,215

It was reported that the exports for the first half of 1885 amounted to 38,000 tons, though no official figures to this effect have been received. The ore from Chili is quite high in manganese, running from 50 to 54 per cent. and as it is free from phosphorus, it is in very great demand for mixture with ores containing a larger percentage of this deleterious constituent. Messrs. Macqueen & Brothers write that they expect to have increased quantities of this mineral during the present year, and steps have already been taken looking to an increased production. The exports from Chili to Europe in 1888 were 24,746 long tons.

GREAT BRITAIN.

Relative to the manganese deposit in Great Britain, but little can be added to the information contained on pages 154 to 159, inclusive, in the volume of Mineral Resources for 1887. In that volume are described the three chief sources of manganese in that country, namely, Carnarvonshire, Merionethshire, and the Midlands, in Derbyshire. Through the kindness of Mr. C. Le Neve Foster a specimen of carbonate of manganese, found in the Cambrian rocks of Merionethshire, was sent to the United States Geological Survey for analysis. Prof. F. W. Clarke, Chief Chemist, reports on this as follows:

Analysis of carbonate of manganese from Merionethshire, Wales.

	Per cent.
Carbonic acid	19.04
Silica	21.69
Alumina	7.63
Metallic iron	4.02
Manganese	31.12

Relative to the product of Great Britain, the details are very meager. It has varied greatly in different years. It is estimated that from 1835 to 1839 the product was 5,000 tons a year. In 1873 it was 8,254 tons; in 1875 there were sixteen mines in operation, producing 3,725 tons; in 1882 there were 1,548 tons mined, valued at £3,907; in 1883, 1,287 tons, worth £2,976; in 1885 the product was 1,688 tons, which had risen in 1886, owing to the utilization of the manganese ore in the Cambrian rocks, to 12,763 tons. Of these, 99 tons, valued at £142, were produced in Carnarvonshire, 11,285 tons in Merionethshire, and 364 tons in the Midlands district. The product of 1887, so far as it can be ascertained from the reports of the inspectors of mines for that year, was 13,054 tons, of which there were produced in Carnarvonshire 208 tons, valued at £276; and Merionethshire, 12,391 tons, valued at £8,982. In the Midlands district the product was 455 tons. For the latter no value is given.

The Merionethshire mines are not so valuable as at first hoped. At this time they are producing but about 140 tons per week, and this almost entirely from a mine near Llanbedr and from the Hafodty mine, near Barmouth. The current value of the mineral is 15 shillings per ton at the railway station. From this has to be deducted an average cartage of 5 shillings per ton, leaving but 10 shillings for payment of labor, fixed charges, and royalty.

Quantity and value of manganese ore imported into the United Kingdom from 1885 to 1888, inclusive.

Countries whence imported.	1885.		1886.		1887.		1888.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*	
Russia	28,089	£99,927	36,552	£124,320	25,495	£76,134	29,841	£78,785
Sweden	1,497	3,291	3,407	10,053	3,706	10,235	5,089	14,464
Germany	(*a*)	(*a*)	1,133	4,103	(*a*)	(*a*)	311	1,234
Holland	(*a*)	(*a*)	(*a*)	(*a*)	2,658	8,164	1,107	2,817
Belgium	207	516	20	117	9	12	(*a*)	(*a*)
France	255	790	428	1,471	25	116	(*a*)	(*a*)
Portugal	3,495	9,932	1,891	5,203	6,011	16,384	5,495	16,173
Spain	2,519	6,255	2,230	4,934	3,981	10,316	1,840	5,520
Italy	(*a*)	(*a*)	1,484	2,353	1,652	4,208	(*a*)	(*a*)
Austria	(*a*)	(*a*)	4,314	12,499	2,050	4,100	(*a*)	(*a*)
Turkey	765	2,540	2,679	8,462	60	160	(*a*)	(*a*)
United States	2,822	8,691	813	2,685	38	118	(*a*)	(*a*)
Chili	4,567	16,748	15,183	54,625	40,967	131,400	23,223	68,723
British North America	535	1,150	345	1,185	437	1,146	(*a*)	(*a*)
Australasia	710	3,147	873	2,340	2,115	7,189	2,068	4,615
Other countries	2,120	9,097	2,072	5,472	1,179	3,557	3,114	8,771
Total	47,581	162,084	73,424	239,822	90,383	273,239	72,088	201,102

a Not stated.

FRANCE.

In an official report on the production of minerals in France, the following statements relative to manganese ore appear: The production of manganese ore in France has greatly decreased in the last few years owing to the great quantity of such minerals imported annually from the Caucasus into France by way of Germany. These importations, according to custom returns, amounted to 23,500 tons in 1886. The production of the mineral in France, however, increased one-half in 1886, amounting to 7,676 tons. Nearly three-fourths of this product was from the mines of the Grand-Fillon and of Romanèche (Saône-et-Loire). The balance was from the mines of Chaillac, in the Department l'Indre, with the exception of 400 tons from the grant of Ferronnière and of Villerambert in the department of the Aude. The poor ore is used in the iron works for the manufacture of ferro-manganese. The better quality is sold to chemical works after being sorted and undergoing a slight preparation. The average price of the ore is 34.59 francs ($6.80) per ton.

RUSSIA.

The amount of manganese produced in Russia, or at least the amount exported from that country from the region of the Caucasus, was 48,653 tons of 2,240 pounds each. This mineral is quite rich, containing from 53 to 55 per cent. of metallic manganese, but, as it contains from 0.15 to 0.16 per cent. of phosphorus, it requires the admixture of an ore lower in phosphorus when it is employed in the manufacture of ferro-manganese of high quality.

TURKEY.

A new discovery of manganese has been made in Asia Minor, near Trebizonde. The only information regarding it is that the mineral is of a very rich quality, and that the product will probably be about ten thousand tons per annum. It is possible that this mine is in the district referred to in Mineral Resources for 1886, pages 205 and 206.

SWEDEN.

The Swedish manganese is quite siliceous, but, being almost entirely free from phosphorus, it is in good demand for mixtures. The exports in 1888, which may be regarded as the product, were 6,089 tons.

BOSNIA.

According to Götting, one of the most important ore deposits in Bosnia is that of psilomelane at Cevljanovic, where a plateau 3,000 feet above the sea consists of alternating beds of sandstone and limestone of Triassic age. At the contact of the two rocks the ore formation appears in the form of a contact bed, which has been explored for a distance of 6 miles, the ore belt being 2 to 4 miles wide. The principal deposit forms the center of the entire belt. It courses in a north and south direction for a distance of 6 miles, with a varying width of 150 to 400 yards, 5 yards of which is psilomelane with a steel blue color, metallic luster, conchoidal fracture, and great hardness. Frequently stalactitic masses are met with, exhibiting a concentric structure. The percentage of metallic manganese varies from 45 to 50 in the dressed ore. The ore is associated with limonite. The explorations during several years indicate that the deposit contains 60,000 tons of manganese ore, averaging 45 per cent. of manganese. The annual product amounts to 4,000 tons, and by proper dressing of the ore it could be increased to 6,000 tons. The miners are exclusively natives, recruited from the Kresevo and Vares mines. They are lodged in barracks, and work by contract, earning 0.90 to 1 florin per twelve-hour shift. The workings are mostly open cuts. Among the poorer ores may be mentioned the so-called black ores, a porous variety resembling wad, that easily loses its color. These ores occur in enormous quantities above the better qualities of ore, and are not worked on account of the impossibility of concentrating them. Another variety is manganese silicate, which, however, does not occur in the same quantities as the black ore. The richest ore, with 48 per cent. of manganese, is used for making ferro-manganese, and finds an easy sale in England, France, and Austria.

NEW ZEALAND AND SOUTH AUSTRALIA.

According to the mineral statistics of the United Kingdom of Great Britain and Ireland for 1887, published as a Blue book, 328 tons of manganese ore were produced in New Zealand in 1886, valued at £1,316.

In the same year 1,550 tons were produced in South Australia, valued at £19,985. In Mineral Resources for 1886, page 207, a statement is given relative to manganese in South Australia and New Zealand.

THE WORLD'S PRODUCTION OF MANGANESE IN 1888.

From Messrs. Macqueen Bros., of London, the largest dealers in manganese in the world, we have the following statement, showing the imports of high-grade manganese, that is, manganese ore containing from 45 to 55 per cent. of metallic manganese, into European countries in 1888:

Imports of manganese ore in 1888.

	Long tons.
Imported into—	
Great Britain	74,906
France	6,174
Belgium	1,945
Germany	9,624
Total	92,649
From—	
Caucasus (Russia)	48,653
Chili	24,746
Spain	2,830
Portugal	5,638
Turkey	669
Italy	385
Greece	500
Sweden	6,089
Australia	1,572
New Zealand	787
Canada	248
Sundries	532
Total	92,649

To arrive at the world's product there should be added to the above the product of the United States, Great Britain, France, Belgium, Germany, Cuba, and the Canadian ore that comes to the United States. Taking the latest available figures of production, and, where these figures are not for 1888, regarding them as approximately the product of that year, the following is the estimated total product of manganese in the world in 1888:

Total product of manganese in the world in 1888.

	Long tons.		Long tons.
Caucasus (Russia)	48,653	Greece	385
United States	29,198	Italy (1887)	1,652
Chili	24,746	Cuba	1,581
France (1886)	7,676	Other countries	3,114
Sweden	6,089	Nova Scotia	106
Portugal	5,638	New Brunswick	1,094
Spain	2,830	Quebec	3
Australia	1,572	Great Britain (1887)	13,054
New Zealand	787	Bosnia	4,000
Turkey	669	Holland	1,107

TIN.

Present outlook.—The condition of expectancy, which has been the burden of the reports concerning tin prospects in the United States, continued in 1888. No tin has been offered for sale from American mines and yet the frequent reports of negotiations for opening the mines in Dakota were sufficient to maintain interest in the subject, and this has been increased by the apparent intention to establish the manufacture of tin plates in the United States as one of the results of the consolidation of the steel interests at Chicago.

The Harney Peak Tin Mining, Milling, and Manufacturing Company has made the following statement as the condition of the company's property in June, 1889:

"In June, 1888, the capital stock of the company was increased from $10,000,000 to $15,000,000, and the additional shares were afterwards issued in payment for mining and other properties which were deemed essential to the business of the company. Since then the company has made further large acquisitions of property, comprising one hundred lodes and adjacent placer ground, water rights, a saw mill, mill sites, etc., all in Pennington and Custer counties, South Dakota, and encircling Harney Peak.

"Contracts have been made and purchases completed for drills, boilers, engines, compressors, and hoisting and other mining machinery, but not for new concentrating apparatus nor for a smelting outfit. As to the former, special attention is now being given to an investigation of the best methods of concentrating the various and greatly dissimilar ores on the properties of the company, with a view to the improvement of the company's present apparatus and its adjustment to the conditions of each variety, and also to the discovery by practical tests of how much of the old machinery which had been found necessary in Cornwall and elsewhere may be dispensed with here, owing to the greatly more favorable character of the rock containing the tin deposits in the Black Hills.

"During the period between the discovery of tin in Dakota and June, 1889, a number of shafts of large dimensions have been sunk to various depths, or are now in process of sinking; a number of heavy drifts, tunnels, etc., also have been or are now being driven, and extensive mining operations generally have been prosecuted on many of the lodes with uniform highly satisfactory results. These operations will be vigorously prosecuted, others on other rich lodes will be begun, and all will be pushed forward energetically during the current year, and we will employ several hundred men. Not so many are now engaged, but the force is being increased almost daily, as rapidly as the necessary machinery arrives on the ground and is put in place.

"At an early day a sampling mill will be erected at a central point on the company's properties for the purpose of studying and treating the varieties of ore from the different groups of mines and of ascertaining the specific method of dressing and of treating the ore generally which is best adapted to each, after which mills will be built at suitable intervals on the area of 30 miles over which our properties are distributed, projected in a line and on a scale with the experience thus derived.

"The company is unable to speak definitely as to the time when American tin will be first marketed in quantity from the mines, from the circumstance that it is the policy of the company to open its numerous mines and push them forward energetically before proceeding to manufacture. The time, however, will not be far distant. The company possesses abundant working capital, which will be employed from this time forward in the active development of the mines on an extensive scale with a view to early and practical business results. Early in 1888 a lot of 80,000 pounds of ore, taken from the various mines under the direction of gentlemen representing influential parties in England who had become interested in Dakota tin, and who were accompanied by Prof. M. C. Vincent, of London, as their scientific expert, was shipped to London, and in March, 1888, was submitted to Mr. F. Claudet, assayer to the Bank of England."

The samples dealt with were from a large number of claims, and would appear to show that the deposits are of considerable size, from the fact that the greater part of the shipment is made up of large masses of ore, in some instances weighing upwards of 2 tons in a single mass.

The ore from each claim bears its own special characteristics with respect to the gangue matter, which consists of mica, quartz, and feldspar; the tin being invariably in the state of black oxide. He selected first, second, and third classes of the ore, as set forth in the accompanying list of assays, and which he classified in the following manner: Class No. 1 is of the high grade ore, as the supplementary assays at the end of the report show. Class No. 2 appears to represent as near as could be ascertained by the method of sampling adopted, to be the medium class of the shipment. Class No. 3 was selected to represent the poorest quality. The weights of the samples taken by him and the results obtained, are fully set out below. He reported the tin as metal and black oxide in pounds, per ton of 2,240 pounds. The supplementary selections and assays were for the purpose of more fully ascertaining the relative values of the ores, the very highest grade being taken. The assays marked in the preliminary list were made in the first instance to serve as a guide in the subsequent selections in the extended sampling. The method of sampling, as described above, was adopted as the only one possible under the circumstances of arriving at an approximate yield of the ores. The tin was found to be of good quality.

Preliminary assays of Harney Peak tin ore.

[By Frederick Claudet, assayer to the Bank of England.]

Nos.	Box Nos.	Claims.	Metallic tin per ton.	Black tin per ton.
			Pounds.	*Pounds.*
1	3	Gertie	1,187.2	1,508.8
2	17	Excelsior	1,568.0	1,992.9
3	25	Darwin	1,523.2	1,935.8
4	26	....do	1,590.4	2,021.4
5	28	Ingersoll	1,568.0	1,992.9
6	29	....do	1,612.8	2,049.8
7	30	Cowboy	1,680.0	2,135.2
8	31	....do	1,724.8	2,192.1
8a	31	....do	1,680.0	2,135.2
9	45	G. W. Coates.	1,209.6	1,537.3
10	21	Czar	1,120.0	1,423.5
11	21	....do	Traces.	Traces.
12	22	....do	1,187.2	1,508.8
13	22	....do	Traces.	Traces.
14	....	Hatchet	None.	None.

Assays of classified tin ores from Harney Peak.

Nos.	Box Nos.	Claims.	Grades.	Sample weights.	Metallic tin per ton.	Black tin per ton.	Weight of contents of box.
			Class.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	1	Sarah	1	9	20.77	26.4	
2	1	....do	2	10	21.65	27.5	3,700
3	1	....do	3	7	15.90	20.2	
4	2	Gertie	1	9	36.28	46.1	
5	2	....do	2	11	7.79	9.9	1,806
6	2	....do	3	10	4.01	5.1	
7	3	....do	1	12	71.07	90.3	
8	3	....do	2	13	22.20	28.2	2,006
9	3	...do	3	11	10.07	12.8	
10	4	....do	1	10	15.90	20.2	
11	4	....do	2	9	16.77	21.3	1,330
12	4	....do	3	8	11.65	14.8	
13	5	Etta	1	9	248.77	316.1	
14	5	....do	2	10	81.29	103.3	665
15	5	....do	3	8	4.72	6.0	
16	6	Etta	1	12	62.02	78.8	
17	6	....do	2	8	40.38	51.3	830
18	6	....do	3	7	5.27	6.7	
19	7	Missing Link	1	8	143.00	181.7	
20	7	....do	2	9	62.80	79.8	470
21	7	....do	3	8	None.	None.	
22	8	Etta	1	12	54.61	69.4	
23	8	....do	2	10	42.11	53.5	685
24	8	....do	3	7	14.48	18.4	
25	9	Tin Reef	1	12	121.83	154.8	
26	9	....do	2	10	38.64	49.1	1,850
27	9	....do	3	9	29.66	50.4	
28	10	....do	1	10	52.34	66.5	
29	10	....do	2	9	21.33	27.1	1,391
30	10	....do	3	9	26.76	34.0	
31	11	....do	1	10	27.72	36.5	
32	11	....do	2	10	9.68	12.3	965
33	11	....do	3	9	13.38	17.0	
34	12	Mewonitoc	1	10	41.94	53.3	
35	12	....do	2	10	70.83	90.0	1,400
36	12	....do	3	9	54.85	69.7	
37	13	....do	1	10	85.47	108.6	
38	13	....do	2	9	29.83	37.9	1,426
39	13	....do	3	11	2.67	3.4	
40	14	....do	1	10	34.55	43.9	
41	14	....do	2	9	24.01	30.5	1,385
42	14	....do	3	9	5.98	7.6	
43	15	....do	1	11	79.49	101.0	
44	15	....do	2	11	40.54	51.5	1,035
45	15	...do	3	11	1.03	1.3	

Assays of classified tin ores from Harney Peak—Continued.

Nos.	Box Nos.	Claims.	Grades.	Sample weights.	Metallic tin per ton.	Black tin per ton.	Weight of contents of box.
			Class.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
46	16	Sarah	1	11	14.25	18.1	1,459
47	16	....do	2	12	14.64	18.6	
48	16	.. do	3	8	3.55	4.5	
49	17	Excelsior	1	14	92.71	117.8	1,381
50	17	....do	2	11	21.65	27.5	
51	17	....do	3	11	22.35	28.4	
52	18	Excelsior	1	11	17.24	21.9	1,339
53	18	....do	2	10	33.68	42.8	
54	18	....do	3	10	10.07	12.8	
55	19	....do	1	13	65.55	83.3	600
56	19	....do	2	9	47.46	60.3	
57	19	....do	3	9	29.59	37.6	
58	21	Czar	1	11	108.22	137.5	1,330
59	21	....do	2	9	2.28	2.9	
60	21	....do	3	9	None	None.	
61	22	....do	1	11	48.64	61.8	1,150
62	22	....do	2	11	11.80	15.0	
63	22	....do	3	11	8.66	11.6	
64	23	Addie	1	9	59.26	75.3	4,800
65	23	....do	2	12	8.97	11.4	
66	23	....do	3	11	5.67	7.2	
67	24	Excelsior	1	9	123.08	156.4	5,400
68	24	... do	2	9	36.28	46.1	
69	24	....do	3	9	21.49	27.3	

In addition to these 69 analyses, 84 additional ones were made from other boxes. They are simply cumulative evidence as to the quality of the ore.

Subsequently, in November, 1888, it was determined to make a "mill-run" of these ores; and to that end about ten tons, taken promiscuously so as to represent the various groups and an average of their ores, were taken to the melting and assay offices of Messrs. Johnson, Matthey & Co., Hatton Garden, London, E. C., for treatment by them. This ore consisted in many instances of solid blocks weighing from 100 pounds to 3,300 pounds each. The parcels were taken in the presence of the assayers from the original cases. Those gentlemen reported the following results after crushing, mixing, and carefully assaying 10 tons 3 hundred-weight of tin ore, which was part of the shipment of 40 tons by the steamer Erin.

The results of assays of 10 tons of Harney Peak tin ore, by Johnson, Matthey & Co.

Mark of group.	Number of mines.	Net weight.	Mark of group.	Number of mines.	Net weight.
		Pounds.			*Pounds.*
Addie	3	600	Excelsior	8	3,453
Campaign	9	1,830	Do	8	1,040
Coates	8	2,000	Gertie	5	1,480
Cow Boy	3	1,640	Mewonitoc	9	2,850
Custer	1	900	Mohawk	14	960
Czar	6	870	Sarah	7	530
Darwin	3	1,370	Tin Reef	10	2,586
Etta	2	800			

NOTE.—Analytical contents of pure metallic tin, 2.80 per cent., or 62.72 pounds per ton of ore. Product of pure metallic tin reduced from the black tin obtained from hand-washing, 2.51 per cent., equivalent to 71.46 pounds clean black tin (pure peroxide) per ton of 2,240 pounds of ore.

In this connection Mr. Arthur C. Claudet, of the office of Fred. Claudet, Assayer to the Bank of England, reported on the subject on the following day (November 27, 1888), as follows:

"An average sample drawn from the bulk after crushing and mixing (10 tons 3 cwt. 2 quarters 17 pounds) was carefully analyzed by us, and found to contain—metallic tin, 2.94 per cent., or 65.85 pounds metal per ton of 2,240 pounds of ore, equal to 83.7 pounds pure tin oxide, containing 78.67 per cent. of metal. Several experiments were made by concentrating the black tin, the yield being equal to 2.60 per cent. metal, against 2.94 per cent, as found by analysis."

In whatever light the prospect of immediate production may be viewed, the Harney's Peak enterprise has been the means of establishing many facts concerning the occurrence of tin and its associated minerals in the Black Hills. The chief natural conditions of the mining problem have been made clear, not only for this, but for possible future attempts to produce tin in that region. These conditions and in general what we may expect from Dakota tin ores have been summed up in an essay on the tin ore deposits of the Black Hills by Prof. F. R. Carpenter in the Transactions of the American Institute of Mining Engineers, which is given with slight condensations below.

General features.—The area of tin-bearing rocks has constantly been extended, and is now known to entirely surround Harney's Peak, and to extend into the smaller granite areas lying to the west and south of Custer City, as well as entirely throughout the small Archæan area, west of Deadwood, known as the Nigger Hill district, which extends into Wyoming. The granite rocks of each locality continue to be tin-bearing until they disappear beneath the yet unremoved Palæozoic rocks.

The Nigger Hill region differs from that of Harney's Peak, inasmuch as it contains both the igneous rocks of the Tertiary age and the granitic rocks common to the Harney Peak region. The tin veins are gold-bearing, the gold probably being carried in the pyrite which sometimes accompanies the cassiterite. This section has been worked continuously for placer gold since its discovery in 1875. The miners have always been troubled with a black sand, which filled the riffles of their sluice boxes to such an extent as to be a positive nuisance. It was commonly called "iron," and, notwithstanding the note of Mr. Pearce, its true nature seems to have been unsuspected by the miners until after the discovery of tin at the Etta mine. It was then found that the troublesome black sand was tin ore of good quality. Mr. S. F. Molitor, an assayer of Deadwood, and Mr. Mark Hydliff, of Bear Gulch, both early called attention to this locality. The tin-bearing rocks are partly in Dakota and partly in Wyoming. The whole section is easily reached from Spearfish.

From the manner in which the Potsdam rocks were laid down, there is every reason to suspect, not only that they are, in this area, gold-bearing, but that, since these tin veins are of Archæan age, the conglomerate forming the base of the Potsdam contains tin also. As the present streams have hardly begun to cut into the Archæan rocks of the section, the placer gold and the large quantities of stream tin found here can hardly have been freed from the veins by the action of the streams since the Cambrian beds were removed. It is not unlikely that both the gold and the stream tin, in part at least, were derived from the Potsdam rocks, which of course received both from the great Archæan veins, during the erosion of the slates that took place in Cambrian time.

But little gulch mining has been done in the Harney Peak region, and, perhaps for this reason, stream tin has not been found to the same extent as in other sections. Mr. McDermot, the only person engaged in placer mining in the district, so far as the writer knows, has found in his sluices considerable quantities of stream tin, a bag of which was taken to the School of Mines, and there run into bars.

Character of the veins.—These veins have been classed by Newton and Jenny (who, however, did not observe their stanniferous character), Blake, Vincent, and others as igneous or intrusive granites; but they seem to be true veins of the segregated type, parallel to the apparent bedding. Usually they are distinctly lens-shaped, but from a standpoint upon any one lens, a succession of such lenses can be observed upon the line of the strike. The same will doubtless prove true upon the dip. Many of them, however, are tabular in form, and can be traced for thousands of feet. This is true of the First Find, Champion, Tin Reef, Cleveland, and many others. The Margaret lode can be traced, with but few interruptions, from Battle creek to Iron creek, a distance of over 6,000 feet.

The line of demarkation between the granite vein matter and the inclosing schists is always sharp and well defined. There is never any shading or blending of the two. The deposits vary as much in breadth as in length. Some are only a few inches thick, while others exceed 100 feet. The amount of cassiterite also varies. It is never evenly distributed throughout the veins from wall to wall, but lies in zones or sheets. Except their usual parallelism to the bedding, these veins have all the characteristics of true fissures; and two have been observed which cut across the stratification.

The tin-bearing veins differ much among themselves; and even the same vein often completely changes its character in a short distance. Nearly always, when tin is present, one of the constituents of granite is wanting, and the vein matter is composed of quartz and mica alone, or of an aggregate of soda-feldspar and mica, which, for want of a better name, has been called albitic greisen. At other times the veins consist almost entirely of a massive pinkish feldspar, and again, not infrequently, of quartz alone.

The Etta vein shows some peculiarities. It is columnar, so to speak, in form. In cross-section it is roughly an oval, having respectively the diameters of 150 and 200 feet. The arrangement of minerals is somewhat concentric. The central portion or core is quartz and feldspar, around which is a zone of albite and mica, carrying tin stone in considerable quantities. Then comes a zone surrounding this, noted for its large and perfectly formed crystals of spodumene, 10, 20 and even 30 feet in length. The interstices between these crystals are filled with an aggregation of albite also carrying tin stone, but in a more massive form than the zone just within. Between the spodumene zone and the inclosing mica schist there is a micaceous aggregate composed of both muscovite and biotite, but barren of cassiterite.

The spodumenes, probably the largest and best formed crystals of this mineral species ever reported, are not peculiar to the Etta alone, but are found at the Tin Mountain mine, 6 miles west of Custer City, while smaller crystals are common at many other points in the section. Careful examination has discovered no rule concerning their position with regard to the walls of the lode and to each other. They stand in the midst of the tin-bearing rock, crossing each other in all directions. One was seen over 50 feet long, without a break; and, so far as exposed, perfect in form. In other veins, having a more tabular shape, there is usually near one wall a zone of mica, so arranged that the cleavage planes are either at right angles or parallel to the walls of the vein. The mica is generally quite fine near the walls, but rapidly becomes coarser until a zone of the largest crystals is passed. The tourmalines were frequently observed to have their vertical axes perpendicular to the wall, but the rule was far from general. Biotite is not common in the tin veins, and the writer has never observed it in association with the tin. The prevailing micas are of a light greenish-yellow color, passing into pure white, and are of the common or muscovite species. The feldspar is usually albite, and the variety known as clevelandite is common. Lithia mica has not been observed, notwithstanding lithia is found in such quantity, as is evidenced by the spodumenes.

It is, perhaps, worthy of remark that when the three elements of granite are together in anything like ordinary proportion, tin stone is very likely to be absent. When the aggregation consists mainly of mica and quartz or of mica and albite, tin is usually present also. If the vein consists of feldspar alone, the tin is wanting; but when it is composed of quartz alone, as is frequently the case, the quartz is always banded as in a fissure vein, and is usually tin-bearing; but the tin stone is quite different in appearance from that found in the greisens. It is light reddish-brown, and often occurs at the joints or planes indicating the banded structure. The crystals of cassiterite usually partake of the nature of the individual crystals composing the rock. If they are large, the tin crystals are large also, and *vice versa*. If the rock is quartz and mica, neither the crystals of quartz nor of mica inclose the crystals of cassiterite. They occupy interstices, so to speak, between these crystals; but in the albitic greisen they are frequently inclosed in feldspar. In the quartz-veins, the quartz frequently incloses the tin stone.

The abundance of phosphatic minerals present is an extraordinary feature of these veins. Apatite, triphylite, and heterosite are found in large quantities; autunite occurs sparingly, and other phosphatic minerals, perhaps new, but needing further examination, are also found.

Of other associated minerals columbite occurs in large quantities. Masses many pounds in weight are common. The Bob Ingersoll claim is reported by Prof. W. P. Blake to have yielded a mass weighing a ton. This mineral is here frequently called tantalite; but all analyses so far made for me at the Dakota School of Mines, as well as a great number of specific gravity tests, have invariably shown that it is columbite. Tantalic acid is always present in varying quantities, but never to such a degree as to be the predominating acid. The crystal form is always tabular, while the *habitus* of tantalite is prismatic. A sample, however, from the Etta mine, analyzed by Professor Schaeffer, was pronounced by him to be tantalite. It gave the following result:

Analysis of tantalite from the Etta tin mine, Dakota.

	Per cent.
Tantalic oxide	79.01
Stannic oxide	0.39
Ferrous oxide	8.33
Manganous oxide	12.13
Total	99.86
Specific gravity	7.72

Professor Schaeffer further declares that he was unable to find the least trace of columbic acid.

The following analysis of a sample taken from the Etta mine was made at the Dakota School of Mines by Dr. W. P. Headden, and gave:

Analysis of columbite from the Etta tin mine, Dakota.

	Per cent.
Tantalic acid	18.20
Columbic acid	64.09
Ferrous oxide	11.21
Manganous oxide	7.07
Stannic oxide	0.10
Calcic oxide	0.21
Total	100.88
Specific gravity	5.89

Five other samples from different sources, some from stream-tin, others from lodes, were examined, and all gave very decided tests for columbic acid, and ranged in specific gravity from 5.89 to 6.12. By these results we have been led to the conclusion that if tantalite, that is, a mineral composed mainly of tantalic acid, exists in the Hills, it is comparatively rare.

Graphite, both amorphous and crystalline, is common in these veins. It is sometimes very pure. Galena, carrying silver, is occasionally met with, while arsenopyrite, carrying gold, is not uncommon. Beryls are found in all the veins, and often of large size. Garnets exist in all mines so far worked. Two varieties were observed, the ordinary iron garnet and a honey-yellow garnet, quite common, but very small, supposed to be a lime garnet. Barytes is quite common. Ilmenite has been observed. Zircons and corundum have been reported by others. It is clear that the veins will form an interesting study for the mineralogist, as we have every reason to believe that new mineral species will be discovered here. The minerals so far observed by the writer in these veins contain the rare elements of boron, phosphorus, flourine, tin, lithium, glucinum, uranium, tantalum, and columbium, as well as the more common ones—gold, silver, lead, arsenic, iron, sulphur, etc.

The description of these veins has been thus explicit in order to show how perfectly they fall into the class of certain granitic veins of the Laurentian, described by Dr. Hunt. These are the endogenous veins which, he says, "have been deposited from solutions in fissures of strata, precisely like metalliferous lodes." This remark applies especially to those granitic veins, which include minerals containing the rarer elements. Among these are boron, calcium, rubidium, glucinum, zirconium, tin, and columbium. Much of the remaining evidence which Dr. Hunt cites in support of his theory of the aqueous origin of certain granites in the Laurentian, and of the distinction he draws between granitic dikes and granitic vein stones, is furnished here also; for example, the banded arrangement of minerals, the peculiar manner in which certain minerals incrust one another, and the rounded form of certain crystals.

The vein stones of these lodes vary but little in ultimate constituents from the surrounding schists, and were probably derived immediately from them by circulating waters. The proportion of alkalies in the vein stones is 15 per cent., while that in schists is 8 per cent. according to Newton; but this can hardly be correct, for solid feldspar would contain but 15 per cent. Many of the elements found in the veins are known to exist in the schists, viz, gold, silver, sulphur, iron, and graphite. The rarer elements, such as lithium, columbium, and tin, which, according to Dr. Hunt, probably exist in the great mass of sediments in the most minute quantities only, are found in these veins in surprisingly large amounts. This accumulation is best accounted for upon the supposition that they have been collected and deposited by percolating waters. As neither the veins nor the large bodies of granite seem to be either eruptive or metamorphic in origin, the writer concludes that such granites are not found in the limits of the Black Hills.

In the Cleveland vein, in Bear Gulch district, parts of the granite vein have been altered to a fine-grained, dark-green, almost black rock. Its boundaries in the vein are as sharply defined from the white-colored granite which they traverse as the granite is from the inclosing mica-schists. It carries a little fine-grained cassiterite, and is believed to resemble closely the "zwitter" of Altenberg. A further examination of it is now in progress.

Daubrée has stated that the presence of tin is intimately connected with quartz, and that, after quartz, certain minerals not common to ordinary lodes are habitually present. These are silicates into which fluorine and boron enter, among which are tourmaline, certain micas, lepidolite, topaz, with apatite and other phosphates. He supposes that the tin was introduced into the lodes originally as a fluoride or boride, or possibly in combination with chlorine or phosphorus.(*a*) In the Black Hills veins, lepidolite and topaz do not occur. Tin is often found remote from quartz. When tourmaline greatly predominates the tin is absent.(*b*) The greatest quantities of cassiterite occur in veins consisting of mica and quartz alone. The micas seem always to be ordinary muscovite. They have not been tested for fluorine. Fluorspar has not been found. No pseudo-morphs of cassiterite, as in Cornish veins, have been observed. Orthoclase occurs very sparingly; the variety microcline much more frequently. Albite is everywhere the predominating feldspar.

Analyses of cassiterite from the veins.—The following analyses of Black Hills cassiterite were made for the writer by Dr. W. P. Headden:

Analyses of cassiterite from veins in the Black Hills, Dakota.

Mines.	Stannic oxide.	Insoluble.	Specific gravity.
Occidental	96.42=75.86 tin.	3.58	6.923
Tin Mountain	97.5 =76.7 tin.	....	6.923
First Find	94.70=74.5 tin.	....	6.728

For the purpose of comparison, the following analyses of cassiterite from other sections are appended:

Analyses of cassiterite.

Localities.	Stannic oxide	Specific gravity.	Authority.
	Per cent.		
Finbo, Sweden	93.6	....	Berzelius.
Wicklow, Ireland	95.26	6.75	Mallet.
Xeres, Mexico	89.43	6.862	Bergemann.
Tipuani, Bolivia	91.80	7.021	Forbes.
Zinnwald	88.04	....	
California	76.15	....	Genth.
Cornwall	98.93	....	Klaproth.
Schlackenwald	99.28	....	Do.

a Doctor Hunt.

b That is, in the veins; but since the above was written we have found cassiterite in the schorlaceous schists themselves, which sometimes form the inclosing rocks of the veins. It was found, however, quite close to the veins.

The following is an analysis of Cornish black tin ready for the market, taken from Moissenet's "Preparation du Mineral d'étain dans le Cornwell:"

Analysis of Cornish tin ore.

	Per cent.
Stannic oxide	(*a*)92.00
Ferric oxide	4.32
Insoluble	1.66
Water	2.00
Total	99.98

a Equal 72.37 tin.

Analyses of stream tin.—A peculiar fact has been observed in regard to the stream tin. It is clearly derived from the disintegration of the tin veins, but it is not so pure as that which remains in the veins, as the following analyses by Dr. Headden will show:

Analyses of stream tin, Black Hills, Dakota.

	Stannic oxide.	Iron.	Insoluble.
	Per cent.		
Nigger Hill	92.60=72.84 tin.	....	....
Do	93.00=73.21 tin.	2.16	3.90
Southern Hills	92.80=73 tin.	......	....

Specific gravity 7 (average of several samples).

Is it possible that a part of the almost insoluble cassiterite has been dissolved out and replaced by some other mineral?

Percentage of black tin in the rock.—This question has been much discussed. If all the stuff broken at the mine were sent to the mill, the percentage of tin would be low. By close sorting it could be made very high, depending entirely upon the extent to which the lower grades of ore were rejected. Assays signify nothing. Hand samples containing from 25 to 50 per cent. of black tin can be readily selected at any mine. Prof. W. P. Blake suggests that it will probably be found advisable to send to the mill for treatment all rock carrying 10 pounds of cassiterite and upwards per ton. If this be done, 2 per cent. cassiterite is estimated as the probable average of the tin ores of the hills thus treated.

Treatment of the ore.—In the treatment of the tin ore, difficulties were anticipated which were not subsequently encountered. The first experimenters devised ingenious methods for ridding the ore of the large mica crystals before attempting to concentrate it. They also used either the Frue vanner or a shaking table of some sort for dressing the ore. It seemed to be taken for granted that ordinary jigs and buddles would not do the work. Investigation, however, showed that owing to the crystalline nature of the rock and the coarseness of the crystals of cassiterite good separation could be made with a coarse crushing, and that it made an ideal jig product. It was determined, therefore, to erect jigs for its treatment in the concentration plant at the School of Mines laboratory. The following is from the official report upon the first test made there, which was conducted by Prof. H. O. Hofman and the writer:

"The crushing and concentration plant at the School of Mines upon which the test was made consists of a small jaw crusher, one pair of 14-inch Cornish rolls, four trommels or revolving screens, and three Harz jigs with eccentric motion. It will be observed by engineers that there is no provision for either fine crushing or fine separation, and that the plant is imperfect to this extent. It was the intention of the management to have added an Evans buddle, but the funds were exhausted before this was reached. It is true the mill contains stamps and a Frue vanner, but they were not used in this test.

"The ore was greisen, but, unlike the typical greisen of Europe, extremely coarse-grained, and it could not be stamped on account of the large crystals of mica. It was crushed and carefully assayed, and gave a return of 2.7 per cent. black tin. It is believed that it represented just such material as a mill upon a commercial basis would have to treat in the tin section. It was first put through the crusher, and then through the rolls above mentioned. No attempt whatever was made to treat the jig tailings, which were quite coarse, by recrushing and further concentration in order to save such fine tin as they might yet carry. The screens upon the trommels were respectively fourteen, fifteen, and thirty mesh. That which did not pass through the first or coarse screen was returned to the rolls. Forty pounds of coarse stream tin were used to bed the first compartment of the first jig, and one jig only was used, as there were but 1,800 pounds of the material to be tested. The products from the screens were treated in the order of their coarseness, beginning with the coarsest and taking one grade after the other, but using always the same jig, which made 120 lifts of 1 inch per minute. The number of revolutions per minute could not be changed, but the lift was lessened to about one-half inch for the last product. The tailings were constantly sampled as they left the jig by many competent persons, and only occasionally was a trace of tin observed. This shows that so far as the tin had been separated from the gangue by crushing, just so far the separation was perfect.

"In a mill running with a commercial purpose these tailings would probably be crushed still finer, that a more perfect separation of fine tin might be had. It was supposed this would be necessary in this case, but a careful assay of the tailings disclosed the fact that 95.15 per cent. had been saved—a result as extraordinary as it was unexpected. It will be observed that there yet remain in the tailings 2.08 pounds per ton of black tin; but in Cornwall for every ton of tin stuff treated on the dressing-floors, discharging their waste into Red river, there are returned by the stream works upon the river never less than 3 pounds of tin. It has in some years reached 6 pounds for each ton treated. As heretofore stated, the cost in Cornwall, notwithstanding the cheap and skilled labor, is $1.25 per ton of tin stuff dressed or concentrated. It is probable this ore can be dressed at a cost not exceeding 50 cents per ton. This difference in cost is owing wholly to the different character of the ores, this ore being suitable for coarse concentration, while theirs must be stamped very fine, and hence cannot be jigged to any advantage, so that little or no concentrating machinery is used, nearly the entire work being done by hand. This necessitates the employment of nearly as many operatives in the dressing works as are employed in the mines. It is true that many of them are boys and girls, but their number is sufficient to raise the cost of dressing the tin rock to $1.25 per ton. (For detailed information see the paper of Mr. R. J. Frechville, extracts of which appeared in Mineral Resources of the United States, 1885.)

"The concentrates from this test returned 68 per cent. tin. A sample, however, made entirely free from gangue showed by analysis 74.50 per cent. tin. Other tests have been made since upon large lots, in which all the jigs, etc., were employed as in a working mill. One lot of several tons containing less than one-half per cent. black tin was so treated that the loss was even less than in the test given in detail above. The conclusion is that the ore can be crushed without difficulty. Less loss and a better separation would probably be had by doing the entire crushing by jaw crushers, multiple or otherwise, than by rolls. We found that the work might be expedited by screening out the coarsest of the mica, and used for this purpose a screen of two meshes to the linear inch. This, however, is not absolutely necessary; but as this product is found to be practically free from tin, often one-third of the waste may be thus removed without further trouble. In the above test the screened mica was afterward jigged, more to see its behavior in a jig than for the quantity of tin it might contain, and no difficulty whatever was found in its management.

"The writer unhesitatingly recommends jigs for the treatment of the Black Hills tin ores."

Yield of metallic tin.—It may be set down as a fact that the clean cassiterite of the Black Hills tin veins will not, by analysis, fall below 74 per cent. tin, and when perfectly clean it will yield a white tin of the grade known to the English tin trade as "superior refined" quality. This it does without the previous roasting that is required for most of the Cornish ore. It is of the utmost necessity, however, that the black tin be clean. There is a heavy brown garnet occurring with the tin, which can be separated by careful washing, and which must be removed in order to obtain good results. Strangers testing these ores for the first time are apt to leave it with the cassiterite, and hence bad results have sometimes been reported when good results would have been obtained by proper manipulation.

Imports and exports.—The following tables show that the quantity and value of the block tin and also tin plates were larger in the fiscal year 1888 than ever before. The exports of tin manufactures were also greater than usual.

Tin imported and entered for consumption in the United States, 1867 *to* 1888.

Fiscal years ending June 30—	In blocks, bars, or pigs, and grain tin.		In plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Cwts.		*Cwts.*		
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	13,770,741.04
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	12,043,308.87
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	2,487,007	10,248,720.34	12,550,664.34
1880	290,007	6,153,005.68	3,298,531	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
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

a Pounds in 1884 and following years.

Value of tin manufactures exported from the United States (*a*).

Fiscal years ending September 30 until 1843, and June 30 since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1826	$4,515	1847	$6,363	1868	$27,110
1827	2,967	1848	12,353	1869	18,994
1828	5,049	1849	13,143	1870	46,007
1829	1,757	1850	13,590	1871	70,366
1830	4,497	1851	27,823	1872	67,244
1831	3,909	1852	23,420	1873	69,865
1832	3,157	1853	22,988	1874	62,973
1833	2,928	1854	30,698	1875	48,194
1834	2,230	1855	14,279	1876	48,144
1835	2,545	1856	13,610	1877	87,057
1836	5,604	1857	5,622	1878	116,274
1837	10,892	1858	24,186	1879	103,467
1838	10,179	1859	39,289	1880	141,185
1839	19,981	1860	39,064	1881	498,524
1840	7,501	1861	30,229	1882	198,608
1841	3,751	1862	62,286	1883	191,947
1842	5,682	1863	41,558	1884	166,819
1843 (nine months)	5,026	1864	46,968	1885	162,304
1844	6,421	1865	106,241	1886	157,724
1845	10,114	1866	79,461	1887	137,551
1846	8,902	1867	40,642	1888	219,000

a Classed as "tin, and manufactures of," from 1851.

Prices.—The tin market was abandoned by the French syndicate early in the year, after a largely increased supply had shown the folly of the high price. The consequent decline to 17 cents per pound in New York was too great, and as the visible supply decreased the price became steadier at about £100 per ton in London or 23 cents per pound in New York. The *Iron Age* has published a detailed statement of the course of prices during 1888, from which the following is condensed. The extremes of value in both directions were even greater last year than they had been in 1887, when the great speculative advance was inaugurated. While the French syndicate operated in both copper and tin, and thought fit to maintain the latter at the high figure to which it had been raised, a sullen and monotonous state of affairs prevailed. The attacks by consumers, however persistent and justified by the general position of the metal, did not succeed in bringing down the price. The first four months of 1888 were featureless, consumers limiting their operations to the immediate requirements, while producers made the greatest effort to market their output as fast as possible while the high range lasted. The year opened in London at £167, closing the month of January at £170, while our own market opened the month at 37¼ cents and closed at 36.9. In February the price in London receded from £170 to £166, and in New York from 36.80 to 36.25. In March and April London remained steady at £166 till the close of April, when a sudden break occurred to £111, New York following to 24 cents.

A further rapid decline took place on May 10, to £79 12*s*. 6*d*., followed by a recovery to £87, closing the month at £85 15*s*. In New York, meanwhile, the metal gave way to 21 cents for two weeks and suddenly dropped to 19½. Towards the close of April the statistical position of the metal had become extremely precarious, the visible supply in Europe and America being 23,995 tons on May 1, against 11,332 on May 1, 1887. During the twelve months ending April 30, the Straits had shipped to London 22,479 tons, as compared with 12,685 tons the previous twelve months; to this country, 3,115 against 5,830; Australia to London, 6,900 against 6,019, and to the United States 825 against 1,250, the total being 33,319 against 25,784.

Simultaneously the deliveries in London, Holland, and the United States were 30,108 tons against 34,119. During the three preceding years they had been, respectively, 33,046, 34,739, and 35,963. While the shipment had increased 28 per cent., the deliveries showed a falling off of 12 per cent. With a visible supply of 11,332 tons, the price of tin was £102 15*s*. on May 1, 1887; it was £94 10*s*. on May 1, 1886, with a visible supply of 12,186 tons. When the French holders perceived that owing to the high price of £166 in London and 36½ cents in New York, consumers' demands were falling off at an alarming rate, they concluded that it would be better policy to abandon tin speculation and concentrate attention on copper; they first made some considerable sales in London at £130 for near forward delivery, and then declared their resolution of not putting in a bid at the Batavia Billiton sale of April 25th. This gave the signal for a break, but the syndicate covered, at £105, the sales made at £130 alluded to above.

Subsequently the market went as low as £79 12*s.* 6*d.*, which was altogether too great a drop, as the speedy rebound proved. Comparatively little of the actual stock of the syndicate seems to have been sold during the interval, it being estimated at the time that its holdings in England and Holland still aggregated some 16,000 tons on June 1. The syndicate evidently waited for a higher ruling and greater steadiness later on, in order to realize gradually, and this purpose appears to have been carried out.

While this great change occurred in April and May, the invisible supply, *i.e.*, the holdings in the hands of dealers and consumers, had run very low. Even at the lower range, between £79 12*s.* 6*d.* and £87, comparatively little had changed hands to go into actual consumption, because of the general demoralization still pervading the trade. Speculation was ready again, however, now that a basis of values had been reached, affording good opportunities for a rise. This appeared all the more plausible, as it became pretty certain that dealers and consumers would thenceforward take courage and replenish the exhausted supplies. Under this legitimate, though perhaps moderate, demand prices increased gradually to £100 and over, and a steadier trade resulted, in spite of the fact that the statistical position improved very slowly. Midsummer dullness in trade and a lingering hesitation on the part of consumers still caused irregularity and weakness in the latter part of June. Opening at £85 15*s.*, the closing price was £75 2*s.* 6*d.*, while in New York the price fell from 19.20 to 17 cents. In July the price advanced from £76 5*s.* to £89 7*s.* 6*d.*, and from 17.50 to 20.10 cents. The upward tendency made some further headway during August, there being an improvement from £88 15*s.* to £97 12*s.* 6*d.*, and from 19.60 to 22 cents. September advanced it again from £96 to £103 17*s.* 6*d.*, and here from 21.95 to 23.70 cents. The advance over £103 aroused speculative interest leading to continual, but at no time violent, fluctuations. Thus in October the opening figure was £103 10*s.*, and at the close £102, or in New York 23.20 to 23 cents. November saw a decline to £101 5*s.*, or from 22.90 to 22.15. Opening at £100 10*s.* in December, the year closed at £100 2*s.* 6*d.*, while New York declined from 22¼ to 22 cents—a return in fifteen months to practically the average value before the operations of the syndicate. In this period the visible supply was more than double and reduced again to the average amount.

ALUMINUM.

By R. L. Packard.

The report for 1887 stated that no evidence of the actual introduction of any new process of producing aluminum had been received at the time the article on aluminum was prepared. Since that report was written other processes have been patented, of which those invented by Mr. C. M. Hall have been put in operation by the Pittsburgh Reduction Company.

The Hall process reduces the metal from aluminum oxide by electrolysis, this alumina being held in solution by a molten bath of the fluorides of aluminum and sodium in a carbon-lined iron crucible. The fluorides are not decomposed by the electric current. The current is conveyed to the melted solution by means of carbon cylinders placed in the bath for positive electrodes, a carbon-lined pot forming the negative electrode. The oxygen of the alumina goes off at the positive electrode as carbonic acid, wearing away the carbon at the rate of nearly a pound of carbon to the pound of aluminum produced. The reduced metal settles to the bottom of the pot, from which it is easily tapped or ladled off, practically free from the electrolyte, a remelting entirely purifying from it. The fluorides of aluminum and calcium are also used as a bath, and to this also alumina is added. Another bath is described consisting of fluoride of aluminum, fluoride of sodium, fluoride of calcium, and chloride of calcium. When it is desired to produce alloys of aluminum with other metals the negative electrode is formed of the particular metal required. The production of aluminum by this process up to the end of May, 1889, was over 3,500 pounds, which was sold at $5 per pound in ingots and from $7 to $9 per pound in sheets, according to thickness.

The uses to which aluminum is now put do not appear to vary from those previously mentioned except in its growing metallurgical employment in treating molten iron. The uses referred to are for parts of mathematical, engineering, optical, chemical, surgical, and dental instruments, dental plates, and a host of small articles. Indeed, no use on a large scale can be expected with the price anything like $5 per pound.

Early in 1889 aluminum was offered, however, at $2 per pound in ingots, when sold in lots of 1,000 pounds or more, and at $3 per pound for 50-pound lots. A considerable effort to increase the uses of the metal was also made by the Pittsburgh Reduction Company. Cooking utensils, forks, spoons, clock cases, salvers, medallions, watches, and almost everything now made of plated ware and German silver, and many fancy articles, were made of it, and the effort to introduce them is meeting with favor.

Hitherto aluminum has been added to molten iron—as in the case of the "mitis" castings—in the form of an alloy, ferro-aluminum, containing about 7 to 8 per cent. of aluminum, so as to add about one-tenth of 1 per cent. of aluminum to the iron in the crucible. Metallic aluminum is now being used in the place of the iron alloy, and the product of the Pittsburgh Reduction Company is used largely for that purpose.

The former reports of this series mentioned the metallurgical uses of aluminum, especially its beneficial effect when added in the form of ferro-aluminum to melted wrought iron just before casting. This use of aluminum has been extended to cast iron, and Mr. W. J. Keep, of the Michigan Stove Company, of Detroit, read a paper at the August (1888) meeting of the American Association for the Advancement of Science, in which he described the results of a number of experiments which he made to ascertain the effect of aluminum on cast iron. Mr. Keep says that he and his co-experimenters had no expectation at the outset of the important results they finally obtained. These results may be summarized as follows:

In the experiment to determine the effect which the addition of aluminum has on the solidity of castings, a base of white metal of known composition was used with one-tenth of one per cent. of aluminum added. Sound castings of the white base alone resisted a weight of 379 pounds. With one-tenth of 1 per cent. of aluminum added it resisted 545 pounds. The "resistance to impact" of the white base alone was 239 pounds; with aluminum added it was 254 pounds. The castings appeared of finer grain, "but the secret of the strength lies in the closing of the spaces between the grains, or, in other words, in the increased solidity of the casting." It was found that the aluminum remained in the iron to which it was added so as to exert its solidifying and strengthening effects upon subsequent charges.

Mr. Keep states that aluminum allows most of the carbon to retain its natural combined form until the metal is too thick for the separated carbon to escape, but, at the instant of solidifying, aluminum causes the iron to "drop" a portion of its carbon from the combined state. This liberated carbon takes the graphitic form, and is imprisoned in the otherwise solid iron. All of the carbon thus liberated is imprisoned uniformly throughout the casting and is not accumulated in pockets, forming soft and hollow spots, as would be the case if the carbon were liberated while the casting was yet fluid. Aluminum not only changes white iron to gray, but seems at once to change the white character of the metal. The "drop" of the carbon seems to be instantaneous at the moment of crystallization, and therefore the time taken in cooling has little effect.

Owing to this action of aluminum in separating graphitic carbon, the tendency to chill is lessened because the carbon is separated uniformly throughout the casting, and not kept combined in the cooled portions while appearing as graphitic in the center. This action also lessens the thickness of sand scale because the separated carbon forms a "perfect plumbago facing, which opposes the sand and heat."

The other conclusions reached by Mr. Keep are that aluminum renders the cast iron easier to work; increases its strength, as shown both by its resistance to a load gradually applied, and to blows; increases its elasticity, and lessens its shrinkage.

It was expected that chemical and microscopical examinations would give interesting results supplementary of the physical tests made by Mr. Keep.

Notices appear from time to time of the success of the Castner process in England, but it has not appeared in this country as a competitor in the production of aluminum.

The following are the official statistics of the importation of aluminum:

Aluminum imported and entered for consumption in the United States from 1870 to 1888, inclusive.

Fiscal years ending June 30—	Quantity.	Value.	Calendar years ending December 31, from 1886 to 1888; previous years end June 30.	Quantity.	Value.
	Pounds.			*Pounds.*	
1870	....	$98	1880	340.75	$4,042
1871	....	341	1881	517.10	6,071
1873	2.00	2	1882	566.50	6,459
1874	683.00	2,125	1883	426.25	5,079
1875	434.00	1,355	1884	595.00	8,416
1876	139.00	1,412	1885	439.00	4,736
1877	131.00	1,551	1886	452.10	5,369
1878	251.00	2,978	1887	1,260.00	12,119
1879	284.44	3,423	1888	1,348.53	14,086

Alloys of aluminum.—The manufacture of aluminum bronze and brass as carried on by the Cowles Electric Smelting and Aluminum Company is extending, as a company affiliated with the Cowles Company has been organized to erect works at Bridgeport, Connecticut, for the purpose of working the Cowles alloys into sheets, rods, and wire. The mills were nearly ready to start running at the end of June, 1889. The aluminum bronze and brass industry has been hitherto retarded on account of the lack of facilities in this country to properly work the alloys into the various forms demanded by the trade, and the works at Bridgeport are intended to supply the wants of both manufacturers and dealers in this respect.

Unfortunately no statistics of the production of aluminum bronze and brass can be furnished, as the Cowles Company declines to make public the amount it manufactured for the year 1888.

In 1888 the price of the Cowles aluminum bronze and ferro-aluminum, was as follows:

Prices of aluminum bronze manufactured by the Cowles Electric Smelling and Aluminum Company during 1888.

BRONZE.

Aluminum.	Per pound.
Per cent.	*Cents.*
$2\frac{1}{2}$	25
5	33
$7\frac{1}{2}$	39
10	46

FERRO-ALUMINUM.

Aluminum.	Per pound.
Per cent.	*Cents.*
5	$16\frac{3}{10}$ to $26\frac{3}{10}$
10	$31\frac{3}{10}$ to $51\frac{3}{10}$

The uses of the aluminum bronze and brass and of ferro-aluminum are well known, and are noticed in the advertisements of those alloys and the numerous articles made from them in the trade journals. The Cowles process has been frequently described, and is now as well known as any technical process of similar merit and importance. It was the pioneer of this class of processes in the United States, and has created and established an industry. Close upon its heels comes the Heroult process, which should receive notice here, as it was patented in this country since the preparation of the last report, although, as at present advised, it has not yet been put into practical operation.

The process consists in reducing alumina in the presence of molten copper (or iron) by the current of a dynamo in a carbon crucible without the aid of external heat. Silica may be reduced in the same way. The operation is carried on in a carbon crucible containing the metal to be alloyed, which, when melted by the current, forms the negative pole, while a block of carborn forms the positive pole. Emphasis is laid upon the slow combustion of the carbon of the positive pole, which is attacked by the oxygen of the alumina as the latter is reduced, the heat thus generated contributing to the economy of the process.

An idea of the scale on which the process was carried on at Neuhausen, Switzerland, may be obtained from the following description of the large crucibles used there in 1888. The apparatus consisted of a wrought-iron box 6 feet square and 4 feet 6 inches deep. Within this was fitted the carbon crucible proper, with a packing of charcoal dust and molasses between, which becomes hardened by the heat conducted from the crucible. The carbon crucible was formed of slab-like blocks of carbon laid together like bricks, so that the interior of the crucible was rectangular. The bottom was extended out through the side of the iron box so as to afford electrical conduction for the return current to the dynamo. The positive pole or "anode" was made of carbon slabs like those forming the crucible, placed so as to break joints and bound together, forming a huge block about 8 feet long, 17 inches wide, and $9\frac{1}{2}$ inches thick. This "anode" was raised and lowered through a hole in the carbon cover of the crucible by chains. The molten alloy was tapped off through a hole in the carbon bottom and a chute was made in the cover at one side for feeding the crucible and allowing the gases of combustion to escape. Particles of alumina carried off mechanically through this chute were caught in a removable chimney or flue suspended above it and then returned. The apparatus may vary in size and shape. The main conductors for the large Neuhausen crucibles were naked copper cables, and the dynamos, which were constructed specially for this work, were rated at 6,000 amperes, but sometimes worked up to 9,000 with a tension varying from 20 to 30 volts. The operation was begun by placing copper (preferably in small pieces) in the crucible. The carbon "anode" was then brought close to the copper which was melted by the current. As soon as the bath of melted copper was formed the alumina was introduced through the chute. The alumina floats on the copper and the "anode" was made to dip into the alumina without touching the melted copper. As reduction takes place the aluminum alloys with the copper and the oxygen of the alumina combines with the carbon. The product is tapped off from time to time through the tap hole in the bottom, and the raw materials are fed through the chute in the top of the crucible in small quantities at a time, alumina and copper alternately. (*a*)

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a Compiled from reports of Mr. Franklin L. Pope and Dr. W. T. Barnard.

PLATINUM.

Sources.—Sources of the supply of platinum remain practically the same to-day as they have been for the last twenty-five years. The chief supply is from the Ural mountains in Russia. A great difficulty formerly experienced in regard to the transportation of the ore or platinum sand was due to the fact that it had to be hauled a distance of over 200 miles; that difficulty is now removed by the railway that has been brought near the mountains. The other sources of supply are not constant except that portion which is held by the French in La República de Colombia, South America, whence a small supply is regularly received.

Production.—The production of platinum in the United States was very slight during 1888, being limited to 500 ounces, valued at $2,000. This was the product from the occasional saving of small placer mines in California. It consisted principally of platiniridium, and also contained much iridosmine, some of which was separated for pen points, but the rest was melted in with the platinum. The Canadian product from the Similkameen division, British Columbia, is also still small. In 1886 it amounted to 1,400 ounces, valued at $5,600, and in 1887 to 1,500 ounces, worth $6,000. The product of Russian platinum for 1887 is stated at 113,724 troy ounces.

An interesting discovery of a compound of platinum was made at Sudbury, Ontario, Canada, by Mr. Sperry, chemist of the Canadian Copper Company. The material was found in a placer resulting from the breaking up of the copper pyrites which comprises the copper and nickel ore of the Canadian Copper Company. Knowing this, Prof. F. W. Clarke has examined some of the rich specimens of copper pyrites containing nickel obtained from the body of this ore, and in it has identified this same platinum compound, thus tracing platinum to its occurrence *in place.* The compound proves to be arsenide of platinum, $PtAs_2$, and is the first mineral yet found containing platinum as an important constituent, other than the natural alloys with various metals of the platinum group. A considerable quantity of the mineral, which takes the form of a heavy, brilliant sand composed of minute well-defined crystals, has been thoroughly investigated by Professor Wells, who names it "sperrylite," after the discoverer, and the crystals have also been measured and very completely examined by Professor Penfield. The sand is generally found to contain fragments of chalcopyrite, pyrrhotite, and silicates, which may be removed by treatment, first with aqua regia to remove sulphides, and afterward with hydrofluoric acid to remove silicates. After this treatment the sperrylite sand is seen to have increased remarkably in brilliancy, every grain showing extremely brilliant crystal faces. It has a tin white color, resembling that of metallic platinum itself. It is heavy, possessing at 20 degrees a specific gravity of 10.6. Although this is an interesting occurrence, no effort has been made to obtain platinum from this source.

Price.—The price of this metal has advanced at a rapid rate. In 1883 it was as low as $5.49 an ounce, but in July, 1889, had risen to $8. At the close of 1889 a large electrical firm in this country paid $20,000 for 2,000 ounces of platinum, probably in the form of wire, and during the first quarter of 1890 it is quoted at 2,000 francs per kilogram; this with the Russian export duty, freight, insurance, and custom-house charges added, makes the price in the United States about $14 an ounce. The effect of this price will undoubtedly be to stimulate the production of platinum in connection with placer gold mining in California and Canada. The belief has heretofore obtained that the increased use of electrical appliances which require platinum wire increased the demand for platinum and consequently the price. It is claimed by those who manufacture platinum vessels that this factor has been overweighted. The great demand for platinum vessels in new technical and scientific institutions in India, Australia, New Zealand, the United States, and even in China and Japan, probably influenced the rise in the price of platinum. The firm of Johnson, Matthey & Co., the leading dealers in platinum in the world, has recently had an order from China which, it is said, would alone take more platinum than an electric-lighting plant in a city of 100,000 inhabitants would use. Another factor, which bears somewhat directly upon this point, which has been overlooked in determining the price of platinum, is in the improved condition of Russian finances. The ruble has now increased to its standard value, and the contracts for platinum heretofore made at a certain number of rubles per ounce still hold, and, as the value of the unit has increased to the standard, the cost to the consumer has correspondingly increased. Another element in addition to this is that there has been a large draft upon the employés in the Ural mines for the building of the trans-Siberian railway by the Russian government, that has to a certain extent depleted the mines of their laborers, and this course has made it difficult to keep up the usual output.

Again, it is maintained by some that the price of platinum which has been quoted in the commercial world has been too low; that platinum has been regarded as a tailing or refuse from the gold mines, and therefore the cost of production has not been charged against it; that if platinum had been mined and worked out in the same way that gold and silver have and the cost of producing and refining it charged to the platinum, it would to-day cost as much as gold. In fact, Messrs. Johnson, Matthey & Co. say it will not be surprising if the price of the platinum does equal that of gold in the course of a year. The real feature in the quick rise in price is undoubtedly the purchase by the leading dealer in London of the supply of scrap. The domestic market is absolutely bare of this material. and hence its entire dependence upon the London price.

IMPORTS.

Platinum imported and entered for consumption in the United States, 1867 to 1888 inclusive.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Manufactured.	Unmanufactured.		Vases or retorts, etc.
		Quantity.	Value.	
		Pounds.		
1867	$456			
1868	290		$95,208	$20,274
1869	184		80,014	22,004
1870	648		99,981	16,294
1871	48		108,244	22,470
1872	310		91,472	21,816
1873	43		90,771	9
1874	143		123,293	59,698
1875	173		141,188	18,082
1876	6		141,207	7,421
1877	11		81,925	18,611
1878	241		120,121	50,133
1879	73		166,178	34,209
1880	964		217,144	41,827
1881	290		273,343	21,292
1882	1,731	3,125.60	285,731	48,452
1883	4	3,104.15	298,799	92,967
1884		2,846.00	289,898	83,112
1885	3	2,612.34	285,239	17,473
1886		3,422.00	373,941	71,864
1887		4,732.00	509,414	68,051
1888		5,226.00	558,920	58,355

Value of platinum exports.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Unmanufactured.	Manufactured.	Old platinum.
1880			$600
1881			4,222
1882		$19,244	
1883	$6,250	21,600	
1884		18,587	1,130
1885			7,000
1886		4,048	2,000
1887		2,200	17,500
1888			

Iridium imported and entered for consumption in the United States, 1873 to 1888, inclusive.

Fiscal years ending June 30—	Value.	Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Value.
1873	$429	1881	$1,730
1874	275	1882	7,307
1875	500	1883	495
1876	180	1884	(*a*)
1877	311	1885	5,852
1878	(*a*)	1886	(*a*)
1879	425	1887	3
1880	(*a*)	1888	2

a None reported.

COAL.

By Charles A. Ashburner.

INTRODUCTION.

The coal statistics of the United States for the year 1888 have been collected from various sources. For States where the mine inspectors or other State officials collect the production of the coal mines under the authority of State law, the statistics have been compiled in each case from their reports, when sufficiently prompt and reliable. In most cases these have been submitted to the Survey in manuscript in advance of publication by the State. Where such returns have been used credit has been given in the body of this report. In States and Territories where there are no mine inspectors, or where the law does not charge them or other officials with the collection of the coal statistics, the reports have been compiled from statistics and general information obtained by detailed returns made directly to the Survey, either at Pittsburgh, Pennsylvania, or Denver, Colorado, by individual coal operators, railroad agents, boards of trade, and special correspondents familiar with coal developments in their individual localities. The returns for Colorado, New Mexico, Wyoming, Montana, and Dakota were made to Denver, and the reports for this State and the Territories mentioned have been compiled by Mr. F. F. Chisolm, special agent of the Survey. In the compilation of the statistics of all other coal districts, which were reported to Pittsburgh, valuable assistance has been rendered by Mr. Baird Halberstadt, of the Geological Survey of Pennsylvania.

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 and Arkansas. In the New England basin the original coal beds have been metamorphosed into graphite and graphitic coal, which have special uses (see Rhode Island report), although not classified by the coal trade as anthracite.

The Bituminious 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 Territory, Oregon, and California. (See "Mineral Resources," 1886, for detailed descriptions.)

The following table contains the approximate areas of these coal fields, with the total product (exclusive of colliery consumption) of each during 1887 and 1888:

Classification of the coal fields of the United States.

	Area.	Production in 1887.	Production in 1888.
Anthracite.	*Square miles.*	*Short tons.*	*Short tons.*
New England (Rhode Island and Massachusetts)	500	6,000	4,000
Pennsylvania	470	39,506,255	43,922,897
Colorado	....	36,000	44,791
	970	39,548,255	43,971,688
Bituminous. (a)			
Triassic:			
Virginia	180	30,000	33,000
North Carolina	....	....	....
Appalachian:			
Pennsylvania	9,000	30,866,602	33,796,727
Ohio	10,000	10,301,708	10,910,946
Maryland	550	3,278,023	3,479,470
Virginia	185	795,263	1,040,000
West Virginia	16,000	4,836,820	5,498,800
Kentucky	9,000	950,903	1,193,000
Tennessee	5,100	1,900,000	1,967,297
Georgia	200	313,715	180,000
Alabama	8,660	1,950,000	2,900,000
	58,695	55,193,034	60,966,240
Northern:			
Michigan	6,700	71,461	81,407
Central:			
Indiana	6,450	3,217,711	3,140,979
Kentucky	4,000	982,282	1.377,000
Illinois	36,800	10,278,890	14,655,188
	47,250	14,478,883	19,173,167
Western:			
Iowa	18,000	4,473,828	4,952,440
Missouri	26,887	3,209,916	3,909,967
Nebraska	3,000	1,500	1,500
Kansas	17,000	1,596,879	1,850,000
Arkansas	9,043	150,000	276,871
Indian Territory	....	685,911	761,986
Texas	4,500	75,000	90,000
		10,193,034	11,842,764
Rocky Mountains, etc.:			
Dakota	....	21,470	34,000
Montana	....	10,202	41,467
Idaho	....	500	400
Wyoming	....	1,170,318	1,481,540
Utah	....	180,021	258,961
Colorado	....	1,755,735	2,140,686
New Mexico	....	508,034	626,665
		3,646,280	4,583,719

Classification of the coal fields of the United States—Continued.

	Area.	Production in 1887.	Production in 1888.
Bituminous—Continued.			
Pacific Coast:	*Square miles.*	*Short tons.*	*Short tons.*
Washington	....	772,612	1,215,750
Oregon	....	31,696	75,000
California	....	50,000	95,000
		854,308	1,385,750
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

a Including lignite, brown coal, and scattering lots of anthracite.

PRODUCT.

The total product of all kinds of commercial coal in 1888 was 142,037,735 short tons (increase over 1887, 18,022,480 short tons), valued at the mines at $204,222,790 (increase, $30,626,794). This may be divided into Pennsylvania anthracite, 43,922,897 short tons (increase, 4,416,642 short tons), or 39,216,873 long tons, including 38,145,718 long tons shipped by the railroads and canals, and reported by their statistician, Mr. John H. Jones; and 1,071,155 long tons sold to the local trade at the mines (increase, 3,943,431 long tons), valued at $85,649,649 (increase, $6,284,405); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 4,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 98,114,838 short tons (increase, 13,605,838 short tons), valued at $118,573,141 (increase, $24,342,389).

The colliery consumption at the individual mines varies from nothing to 8 per cent. of the total output of the mines, being greatest at special Pennsylvania anthracite mines, and lowest at those bituminous mines where the coal bed lies nearly horizontal, and where no steam power or ventilating furnaces are used. The averages for the different States vary from 2 to $6\frac{4}{10}$ per cent., the minimum average being in the Pennsylvania bituminous and the maximum average being in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was: Pennsylvania anthracite, 41,624,611 long tons (increase over 1887, 4,045,864 long tons), or 46,619,564 short tons (increase, 4,531,367 short tons); all other coals, 102,039,838 short tons (increase, 14,152,478 short tons), making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 148,659,402 short tons (increase, 18,683,845 short tons), valued as follows: Anthracite, $89,020,483 (increase, $4,468,302); bituminous, $122,498,141 (increase, $24,493,485); total value, $211,518,624 (increase, $28,961,787). The above figures show a notable increase in 1888 over 1887 in the aggregate output and value of both anthracite and bituminous coal, although not so great an increase as occurred in 1887 over 1886 in the value of the anthracite, or in the total tonnage of the bituminous coal.

On March 1, 1889, a brief preliminary report was published showing the total product of coal in each State and Territory with corresponding spot values. The provisional results were based upon estimates and incomplete returns received from a number of the mining districts. The complete returns, upon which the final report is based, have increased the total tonnages and values in a number of localities. In the preliminary report the total tonnage, including colliery consumption, was estimated at 145,363,744 short tons, valued at $208,129,806; in the final report these estimates have been increased, respectively, to 148,659,402 short tons and $211,518,624.

The total product, exclusive of colliery consumption, in each State and Territory, and corresponding spot values, are shown in the following table:

Product of coal in the United States in 1888.

States and Territories.	Total production, not including colliery consumption.	Value of coal at mines.	States and Territories.	Total production, not including colliery consumption.	Value of coal at mines.
	Short tons.			*Short tons.*	
Pennsylvania:			Utah	258,961	$543,818
Anthracite	43,922,897	$85,649,649	Georgia	180,000	270,000
Bituminous	33,796,727	32,106,891	California	95,000	380,000
Illinois	14,655,188	16,413,811	Texas	90,000	184,500
Ohio	10,910,946	10,147,180	Michigan	81,407	135,221
West Virginia	5,498,800	6,048,680	Oregon	75,000	225,000
Iowa	4,952,440	6,438,172	Montana	41,467	145,135
Missouri	3,909,967	(a)8,650,800	Dakota	34,000	119,000
Maryland	3,479,470	3,293,070	Rhode Island	4,000	11,000
Indiana	3,140,979	4,397,370	Nebraska	1,500	3,375
Alabama	2,900,000	3,335,000	Idaho	400	1,800
Kentucky	2,570,000	3,084,000			
Colorado	2,185,477	4,808,049	Total	142,037,735	204,222,790
Tennessee	1,967,297	2,164,026			
Kansas	1,850,000	2,775,000			
Wyoming	1,481,540	4,444,620	Colliery consumption, Pennsylvania anthracite	2,696,667	3,370,834
Washington	1,215,750	3,647,250			
Virginia	1,073,000	1,073,000			
Indian Territory	761,986	1,432,072	Bituminous in all States and Territories	3,925,000	3,925,000
New Mexico	626,665	1,879,995			
Arkansas	276,871	415,306	Grand total	148,659,402	211,518,624

a Mr. O. Kochtitzky, commissioner of labor statistics of Missouri, estimates that the average value of coal at mines was $2.21, but from the best statistics secured the writer does not think it exceeded $1.50 per ton.

IMPORTS AND EXPORTS.

The following tables, compiled from official returns of the Bureau of Statistics of the Treasury Department, show the imports and exports of coal for the past twenty years. The values given are much higher than the "spot" rates which have been used in computing the total annual value of the coal produced in each State and Territory.

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, 30 per cent. ad valorem; 1847 to 1861, 24 per cent. ad valorem; 1862 to 1864, $1 per ton; 1865, $1.10 per ton; 1866 to 1872, $1.25 per ton; since August, 1872, 75 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 anthracite being the greater. 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 1888, inclusive.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
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, 680
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	2, 013, 555
1884	1, 448	4, 404	748, 995	2, 494, 228
1885	4, 976	15, 848	768, 477	2, 548, 432
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

Coal of domestic production exported from the United States, 1867 to 1888, inclusive.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
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, 006, 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
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

COAL TRADE REVIEW.

Including the coal which is sold to the local trade around the mines and that used for mining, the increase in the total product of coal of all kinds during 1888 was 18,683,845 short tons, and the increased value was $28,961,787, as against 17,232,154 short tons and $27,956,661 spot value for the previous year.

The growth of the bituminous coal trade of the United States during 1888 was not generally so notable as during the previous year, either in the increased tonnage or the increased value, although the growth in special localities during the year was greater than has ever before been realized. During 1888 there were 13,605,838 short tons more coal shipped from the mines to market than during the previous year, as against 13,523,266 tons increase in 1887 over 1886; although the tonnage increase in 1887 and 1888 was practically the same, yet the percentage increase in 1887 was greater than in 1888.

The increase in the spot value of shipments during 1888 was $24,342,389, while in the previous year the increase in spot value was only $18,676,123.

The most notable increase anywhere in the United States took place in Pennsylvania, and especially was this the case in Allegheny county and in the bituminous region, and also in the anthracite region, where the increase in tonnage during the year over 1887 was 4,416,642 short tons, or 3,943,431 long tons, the total product of the anthracite region being sold at an increase of $6,284,405 over the value of the total sales for 1887. This increase in the anthracite region of Pennsylvania is all the more notable when it is remembered that one of the most disastrous strikes which has ever taken place in any of the mining districts of America occurred in the anthracite region during the early months of the year.

With the exception of the States of Georgia, Indiana, and Rhode Island, more coal was produced in each State and Territory during 1888 than during the previous year, and the value of the product was greater during the latter year in every district (*a*) except in Georgia and Tennessee.

The spot value of anthracite coal per ton at the mouth of the mines during 1888 is estimated to be 6 cents lower than during the previous year, while in the bituminous regions of Pennsylvania there was an increase of 5 cents in the value per ton. In most of the other districts the spot value of the coal during 1888 ranged from 3 to 11 cents per ton higher than during 1887. Special and more extended reference to prices is made under the reports for the several States on the condition of the local trade. The consumers of coal are becoming more discriminating as to the character of the coal which they purchase, and the market values are each year more directly influenced by the absolute

a No account is taken here of Rhode Island and Idaho.

amount of heat which may be made available from a unit of coal than by any other reputation which the coal may have obtained from imagined favorable peculiarities. The advantages of anthracite coal for domestic consumption are becoming every year more apparent, and the areas over which the Pennsylvania and Colorado anthracite coal is distributed are rapidly extending, while consumption in old areas is increasing from the natural growth in population. In no way is this fact better reflected than in the course of the capital stocks of the anthracite producing companies among conservative capitalists. The *Engineering and Mining Journal* in speaking of the anthracite stocks at the opening of 1889, said:

"On Wall street the term 'coal stocks' is usually applied to the leading anthracite stocks. During 1888 this group has been very prominent in the speculative arena, and holders of these stocks have more cause for congratulation than the holders of any other group of stock represented at the New York Stock Exchange. During 1887 the tendency of the prices of these stocks was downward, while in 1888 the tendency was upward, and in some cases higher prices were attained than have been recorded for years past. The improvement in the prices of these stocks was not evenly divided; Reading, Lehigh Valley, and Lehigh Coal and Navigation were adversely affected by a long strike at their mines, while the other stocks were favorably affected by the same cause. Owing to this strike, Delaware, Lackawanna and Western, Delaware and Hudson, New York, Susquehanna and Western, and Pennsylvania Coal Company were able to increase their business greatly, and to secure a much higher average of prices for their coal than they have been able to do for years past. This result might not have been attained had it not been for the extraordinary growth of the demand for anthracite coal. As the manufacturing industries of the country have not been over active this year, it is clear that the demand has been for household use, and is only proportionate to the enormous growth of the country and the steady cheapening of the cost of transportation, especially upon the western and southern railroads. Whether as good results will be secured in 1889 is an open question. Without strikes the competition will be greater, and it is quite probable that the openness of this winter will so greatly reduce the consumption of coal as to leave the markets crowded until next summer, reducing both the demand for and the prices of coal. However, this will have but a temporary influence, and it should not disturb the investor, for it is clear that the demand for anthracite coal is rapidly approaching the point where the companies will find difficulty in supplying it and at the same time keep within the lines of wisdom and economy. When this point is reached the natural tendency of the leading anthracite coal stocks will be to disappear from the field of active speculation and find their way to the strong boxes of investors. Of course the speculative managers will delay that day as much as possible."

The production of anthracite coal is controlled by an arrangement entered into between the large producing and transportation companies, by which it is sought to protect the interests of the producers and shippers, mutually to restrict the product of the mines to the demands of the market, and at the same time to obtain a fair and reasonable price for the product, which insures fair wages to the mining labor and a fair profit to operators and shippers. The details of the anthracite coal trade of Pennsylvania are referred to under the report of the Pennsylvania coal statistics.

The product of the seven prominent bituminous mining districts which send coal to the Atlantic sea-board is controlled by the Sea-Board Association. The allotment of the percentage of product of each district was agreed upon for 1889 in the early part of March. The output of the year, it is estimated, amounted to 5,500,000 tons.

The governing board is composed of nine members appointed by the operators in the different districts. The Clearfield and Cumberland districts each appoint two members and the other districts one each. Mr. Galloway C. Morris, of Philadelphia, has been elected chief officer or commissioner.

While there was this formal agreement between the eastern shippers of bituminous coal as to the selling prices, yet during the latter part of 1888 there was a lively canvass going on throughout the eastern sea-board States for bituminous coal contracts, and it is reported that a large number of new contracts were secured by Clearfield, Cumberland, and West Virginia operators, but it seems more than probable that none of them were placed without some concession in price from pool figures of 1888. The difficulties in the way of maintaining prices in the coal trade throughout the year are many. A correspondent who has been largely interested in the coal market for twenty-five years, in referring to some of these difficulties at the opening of the year, says: "Last year at the close of navigation in December, and continuing through the winter, I could have bought at lower prices than in April. The opening prices were such that the companies found it difficult to advance; had it not been for the recollection of the scarcity and high prices during the strike and blizzard of the season of 1887 and 1888 that had just closed, prices would no doubt not have held through the summer of 1888. The season just closing will leave the dealers and consumers with a different experience."

The situation of the coal trade in the Mississippi valley and generally throughout the West is more complex than on the Atlantic sea-board. Special reference is made in the report on the bituminous region of Pennsylvania to the output of the Pittsburgh mines as influencing the western coal trade. West of Pennsylvania the most important coal-mining districts influencing the coal trade are in Illinois. In 1887 the Indiana, Pennsylvania, Ohio, and West Virginia bituminous coals made large inroads into the soft-coal trade of Chicago and the Northwest, which the Illinois operators regard as belonging to them. During 1888 the Illinois operators determined to regain their position by means of extremely low prices to the trade and a reduction in wages, and this was in a large measure accomplished, the result being that the production of the Illinois mines during 1888 increased at a greater rate than the production of the Ohio mines, which enters the same territory and occasioned a falling off in the product of the mines of Indiana. The effect of the action of the Illinois operators upon the production of the Pennsylvania and West Virginia mines was not noticeable. The condition of the coal trade of the Northwest during the past year is fully exhibited by the reports of the Chicago Board of Trade and Coal Exchange, printed elsewhere.

The distribution of coal from Duluth harbor, Superior and Saint Louis bays in the Northwest is rapidly increasing. The editor of the *Pioneer Press*, in referring to the growth of Duluth's coal trade, says:

"More coal is now unloaded in Duluth harbor, Superior and Saint Louis bays than in any other port, if not in any other two ports, on the chain of great lakes. The great development of Duluth's coal trade is due to the great growth of the Northwest and the requirements of its people, railroads, and manufactures, and also to the increase of transportation facilities to the interior and the advantage of cheaper coal rates by lake than Lake Michigan ports enjoy. The first reason would not account for the large increase of this year's trade, which has been much greater than the growth of the Northwest country tributary to the head of the lake. This fact shows that Duluth is now supplying coal to considerable territory formerly dependent wholly on Chicago and Milwaukee or the Iowa coal fields. Her present territory for coal sales includes all of Minnesota and nearly all of Dakota, Montana as far as Livingston, and parts of Wisconsin, Iowa, and Nebraska. If there were fair rail rates for coal from Duluth to interior points, as compared with other ports, there is no question but that her coal business would be largely increased over its present size and at a much more rapid rate, until all the coal required in the Northwest west of central Wisconsin would come from the head of Lake Superior. As it is now the coal rates from Duluth to Fargo and other common points are as high as the rates from Milwaukee or Chicago. In other words, it costs as much to ship a car load from Duluth docks (285 miles) as from Chicago docks (700 miles). At times the cost of freight from Duluth is more than from Chicago. This is a discrimination which is too unfair to last. Though rail rates on coal are higher from Duluth than Lake Michigan ports, it is the reverse so far as lake freights are concerned. The past season's coal freights from Lake Erie points to Duluth ranged from 50 to 85 cents, with the average less than 70 cents, or from 25 to 40 cents less than the rates at the same time to Chicago, Milwaukee, and Green Bay."

In reference to the coal trade of the Southern States and the area between the Rocky mountains and the Mississippi valley little can be said other than that the consumption of coal is rapidly increasing, dependent upon the industrial development of the districts. More favorable prices are generally secured, due to the increased competition and increased shipping facilities.

Along the Pacific slope for the past two years the price of house coal has ruled high, the highest price being reached in 1888, when at a number of points Wellington coal sold at $16 per ton to the trade. This high price of a favorite coal caused consumers to take other and less expensive kinds; naturally the increased consumption of other coals caused the prices to be advanced. The high prices invited the importation by rail of house coal from Rocky mountain mines to San Francisco and to interior central cities, and of coals from New Mexico into the southern part of California. In addition it stimulated the output of older mines along the coast and the opening up of several new collieries. Although the product of the new California mines played no important rôle in the general coal trade of the Pacific slope, still California produced 95,000 tons of coal during 1888, against 50,000 tons during the previous year. On December 1, 1888, the price of Wellington coal was unexpectedly dropped to $12 a ton, compelling a corresponding reduction in prices by other companies mining coal on the coast, which was followed by a further drop in price in this month by the latter companies. This last decline shut off the importations of Rocky Mountain coals, owing to the latter costing $10 a ton delivered. The mild character of the winter and the use of more gas and oil stoves have had quite a decided effect on the consumption of house coal, which is much less compared with the same time in 1887, and this, too, in the face of a larger population. The consumption of steam coal on the Pacific slope has increased to large proportions, and to this, no doubt, is due the ease with which coal values were maintained in 1887 and 1888. The increase in the number of steam vessels, locomotives, and manufactories has been fully 50 per cent. during the past two years, creating a corresponding consumption of steam coals. Another important reason why, during 1888, the price of steam coals has been the more easily maintained was a three months' strike of miners in the Australian collieries.

The condition of the coal market can be appreciated by a statement of the ruling prices received for coal at the opening of 1889 at the principal coal markets of the United States and the general movement of coal between the prominent coal-producing districts and these principal markets. The following market reports have been compiled for this report from facts contributed by Mr. H. A. Bischoff, editor of the *Black Diamond*, from the reports of boards of trade in the prominent commercial centers, and from a limited number of facts taken from the market reports of the *Coal Trade Journal:*

Boston, Massachusetts.—Boston proper and the surrounding cities of Brookline, Cambridge, Somerville, and Malden are estimated to have 600,000 inhabitants; these people probably use 900,000 tons of coal in the year besides the factory consumption. The receipts of coal at the port of Boston have been as follows; the amount given includes coal not only for local use, but for the supply of points upon various lines of railway entering Boston:

Coal receipts at Boston.

Years.	Long tons.	Years.	Long tons.
1883	2, 273, 068	1886	2, 500, 000
1884	2, 225, 740	1887	2, 400, 000
1885	2, 221, 220	1888	2, 500, 000

The several qualities are not divided, and it is impossible to state the receipts with any accuracy. It may be said, however, that in 1888 the hard coal was 1,100,000 tons and the soft (Clearfield, Cumberland, Pocahontas, etc.) 1,400,000 tons. The returns collected by the Chamber of Commerce show 2,040,684 tons of anthracite and 985,742 tons of bituminous; but this is probably only based on the vessel clearance papers as dating from a port where it was supposed hard coal was loaded, when it really may have been soft coal. The tonnage is probably far too great, for one well informed local authority estimates 1,750,000 tons as the amount received in Boston last year.

The market was fairly steady; prices were based on $4.25 for stove at New York in the summer months, with freight at 80 to 85 cents from New York and 95 cents to $1.05 from Philadelphia. Bituminous was steady at $2.50 to $2.60 free on board, with freights $1 to $1.10 per ton. Retail prices were: Furnace, $5.75; egg, $6; range, $6.25; nut, $6.25; Franklin, $7.50, all sizes; Lehigh furnace, $6; Lehigh egg, $6.25; wharf prices 50 cents less than the foregoing; bituminous, $4.25 on the wharf. At the close of the year stove coal could be purchased from $4.60 to $4.35; egg from $4.30 to $3.90, and broken from $3.95 to $3.65 at New York, with freights $1.05 to $1.25; Philadelphia, $1.55 to $1.65. Soft coal was steady at $2.60, with freights $1.70 from Baltimore and $1.60 from Hampton Roads.

New York.—The following market quotations for anthracite ruled at New York City at the beginning of 1889: Soft coal pool prices were: North River points south of Fifty-seventh street and East River points below Hell Gate, $3.25 per ton free on board; alongside, $3.50 per ton.

Prices of anthracite coal in New York City at the beginning of 1889.

	Lump.	Broken.	Egg.	Stove.	Chestnut.
The Lehigh and Wilkes Barre Company:					
Honey-Brook Lehigh	$5.00	$4.50	$4.50	$4.65	$4.65
Wilkes Barre	....	3.95	4.30	4.65	4.65
Plymouth red ash	....	4.15	4.40	4.90	4.80
Philadelphia and Reading Coal and Iron Company prices at Elizabethport:					
Hard white ash	4.50	4.15	4.40	4.65	4.55
Free-burning white ash	....	3.95	4.30	4.65	4.55
Lyken's Valley	....	5.00	5.50	5.50	5.25
Lehigh (free on board at the loading ports)	4.10	4.10	4.10	4.40	4.30
Free-burning coal (free on board)	....	3.95	4.30	4.65	4.65

Retail exchange prices.

	Per short ton.
White ash stove and nut, delivered	$5.75
White ash egg and furnace, delivered	5.50
Red ash stove and nut, delivered	6.25
Red ash egg and furnace, delivered	6.00
Peddlers (any kind of coal), at yard	5.00
Grocers and coal sellers, delivered	5.50

The tolls from mines in the Beaver Meadow, Hazleton, and other regions to Perth and South Amboy are $1.80. From mines in the Wyoming region to same points, $1.90, 30 cents per ton less than on buckwheat and pea coal. From the Schuylkill region to Philadelphia, $1.80 per ton; from Lehigh, $1.85; from Wyoming, $1.90 by Pennsylvania railroad and $2 by other routes. New York Harbor from Schuylkill district, $1.85 per ton.

Schedule rates of freight, alongside, for New York Harbor and vicinity.

Shipping ports.	225 tons and over.	175 to 225 tons.	125 to 175 tons.	100 to 125 tons.
	Cents.	*Cents.*	*Cents.*	*Cents.*
South Amboy	25	27½	30	35
Perth Amboy	25	27½	30	35
Elizabethport	25	27½	30	35
Port Johnson	25	27½	30	35
Hoboken	20	22½	27½	32½
Weehawken	21	23½	28½	33½

Coal prices for points in Central New York, average quotations free on board cars.

	Reynoldsville and Fairmount.	Dagus.
	Per ton.	*Per ton.*
Screened lump	$2.30	$2.25
Lump and nut	2.25	2.10
Run of mines	2.05	2.00
Screened nut	2.00	....
Nut and slack	2.00	1.90
Slack	1.75	1.65

Anthracite.

	Rochester wholesale.	Oswego retail.	Syracuse retail.
	Per ton.	*Per ton.*	*Per ton.*
Grate	$4.70	$5.15	$4.65
Egg	4.70	5.15	4.65
Stove	4.95	5.40	4.90
Chestnut	4.95	5.40	4.90
No. 4			5.40

During 1888 there were shipped at Fair Haven 155,000 tons of anthracite, and at Sodus Point, both anthracite and bituminous, 81,291 tons.

Philadelphia, Pennsylvania.—The prices of anthracite at the mines in the Schuylkill region for line trade delivery at the opening of 1889 were as follows:

Anthracite coal prices.

		A.	B.	C.	
				1.	2.
Lump	$2.25	$3.00	$2.75		
Broken				$3.90	$3.70
Egg	2.65	3.00	2.65		
Stove				4.15	4.05
Small stove	2.90	3.15	2.90	4.40	4.40
Chestnut	2.65	3.00	2.75	4.30	4.30
Pea	1.10	2.00	1.10	2.00	2.00
Steam-boat			2.75		
Furnace lump		2.75			

A. Lehigh coal prices for delivery between Mauch Chunk and Phillipsburgh are prices at Mauch Chunk.
B. For deliveries to Philadelphia and other points where coal is sold at a price at the mines, the prices given are at the mines.
C. Philadelphia and Reading prices, free on board at Port Richmond.
1. Hard white ash.
2. Free-burning white ash.

The large coal companies worked in harmony, and will probably do so during 1889, having accrued such decided advantages from a united policy in 1888. The strike in the coal regions last year cost the Reading Company $1,600,000, according to President Corbin's report, and $1,110,000 was expended in extraordinary improvements to various portions of the company's coal and railroad property.

Rates of freight per ton on coal from Philadelphia, Pennsylvania, at the close of 1888.

To—	Rate.	To—	Rate.
Portland	$1.50 to $1.60 and dis.	New York	$0.90 alongside.
Portsmouth	1.60 and dis.	Washington	.85
Boston	1.50 to $1.60 and dis.	Norfolk	.70
New Bedford	1.20 and dis.	Richmond	.80
Fall River	1.20 and dis.	Charleston	.90
Providence	1.20 and dis.	Savannah	1.00

Director Wagner, on December 27, 1888, awarded contracts for supplying the city with gas coal during the year 1889. The following were the successful bidders. The prices paid for 1888 were $3.79, $3.83, and $3.84.

Contracts for supplying gas coal to Philadelphia in 1889.

	Tons.	Price per ton.
Manor Gas Coal Company	5,000	$3.81
Penn Gas Coal Company	57,720	3.82
Westmoreland Coal Company	57,720	3.82
Newburgh Orrel Coal and Coke Company	15,000	3.76
James Boyce	15,000	3.76
Despard Coal Company	10,000	3.76
J. & W. Wood	10,000	3.76
Chesapeake and Ohio	25,000	3.80

Baltimore, Maryland.—The coal received at Locust Point for the Baltimore market includes Cumberland, George's Creek, Meyersdale, 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, and it is estimated that 200,000 tons were received during 1888. Of anthracite coal received there were something like 250,000 tons by the Susquehanna canal and other water routes, besides 300,000 tons by the Northern Central railroad.

Rates for anthracite coal in cars at Baltimore, or via Canton pier.

	Hard white ash.	Shamokin.	Lykens Valley.	Bernice.
Broken	$4.40	....	$4.90	$4.80
Egg	4.55	$4.80	5.05	4.80
Stove	4.85	5.10	5.40	5.10
Chestnut	4.65	4.80	5.05	4.80
Pea	3.00	3.00	3.50	....
Buckwheat	2.60	2.60	3.00	....

Bituminous coal is quoted at $2.60 per long ton free on board at Locust Point or Canton piers. Hampton Roads quotations are the same.

Freight rates for coal from Baltimore.

To—	Rate.	To—	Rate.
Bath	$1.60	Galveston	$3.00
Portland	1.55	Savannah	1.35
Boston	1.50	Wilmington, N.C	1.00
Portsmouth	1.65	Georgetown	.70
New Haven	1.35	Richmond	.70
New York	1.05	Norfolk	.50

From the annual report of the Baltimore and Ohio Railroad Company for the year ending with September last, it appears that there was an increase of 623,047 tons in the coal tonnage of the company compared with previous years.

The Baltimore and Ohio and Northern Central railroads carried the following to Locust Point:

Coal receipts at Baltimore.

Years.	Via Baltimore and Ohio Railroad.	Via Northern Central Railroad.
	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
1888	2,300,000	680,962

Foreign shipments of coal from Baltimore.

Years.	Tons.	Years.	Tons.
1883	63,526	1886	64,477
1884	59,289	1887	54,455
1885	71,527	1888	33,386

There were 16,500 short tons of coal received over the Baltimore and Potomac railroad, as against 15,338 tons in the year 1887.

Pittsburgh, Pennsylvania.—The following prices are given:

Pittsburgh coal prices.

Coal.	Per bushel.
	Cents.
River, on board	4¾
Railroad	5¼
Coke.	**Per ton.**
Furnace	$1.25
To dealers	1.35
Foundry	1.50

Prices of Pittsburgh coal at the following places:

	Second pool.	Fourth pool.
	Cents per bushel.	*Cents per bushel.*
Cincinnati	6½	5½
Louisville	6½	6
New Orleans	8½	8

Coal shipments by Ohio river for the past six years.

Years.	Bushels.	Years.	Bushels.
1883	87,995,000	1886	91,664,000
1884	55,432,000	1887	56,743,000
1885	74,964,000	1888	109,572,000

At the annual meeting of the stockholders of the Monongahela Navigation Company, owning seven dams and locks on the Monongahela river, the president's report showed that the total number of bushels of coal passed over the improvement during the past winter was 112,460,900, an increase of 35,000,000 over 1887. The total tolls received by the company during the year amounted to $272,789.57, while the expenses were $111,390.82, leaving a net income of $161,497.40. A semi-annual dividend of 6 per cent. was declared, payable 4 per cent. in cash and 2 per cent. in stock.

River coal shipments from Pittsburgh in December, 1887 and 1888.

To—	1887.	1888.
	Bushels.	*Bushels.*
Cincinnati	165,000	1,986,000
Louisville	.....	2,775,000
Total	165,000	4,761,000
Increase for December, 1888	.....	4,596,000

River coal shipments in January and February, 1885 to 1889, inclusive.

	1885.	1886.	1887.	1888.	1889.
To Cincinnati:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
January	2,130,000	1,274,000	2,149,000	7,087,000	1,671,000
February	None.	3,632,000	2,250,000	5,634,000	812,000
Total	2,130,000	4,906,000	4,399,000	12,721,000	2,483,000
To Louisville:					
January	7,697,000	975,000	4,590,000	7,659,000	1,744,000
February	None.	7,410,000	4,696,000	8,476,000	2,174,000
Total	7,697,000	8,385,000	9,286,000	16,135,000	3,918,000

December (1888) coal and coke receipts, by slack water, at Pittsburgh.

Pools.	Coal.	Coke.
	Bushels.	*Bushels.*
No. 1	812,500	70,000
No. 2	1,075,000	119,000
No. 3	1,000,500	.....
No. 4	1,217,300	.....
Total	4,105,300	189,000
Grand total	.....	4,294,300
December, 1887	.....	8,430,600

The monthly shipments for the year 1888, and the daily averages compiled from the files of the *Courier*, were as follows:

Coal shipments from Pittsburgh in 1888, *by months.*

Months.	Pittsburgh.	West.	East.	Total.	Daily average.
	Cars.	*Cars.*	*Cars.*	*Cars.*	*Cars.*
January	4, 125	13, 600	2, 500	20, 225	778
February	3, 500	10, 500	4, 500	18, 500	740
March	2, 625	12, 000	4, 000	18, 625	689
April	2, 000	12, 600	3, 600	20, 200	808
May	4, 300	13, 800	6, 700	24, 800	918
June	4, 900	9, 460	4, 800	19, 160	766
July	4, 000	10, 700	5, 860	20, 560	790
August	5, 350	12, 450	6, 650	24, 450	905
September	5, 270	13, 916	6, 140	25, 326	1, 013
October	5, 900	17, 900	5, 925	29, 725	1, 100
November	6, 325	17, 685	6, 060	30, 070	1, 156
December	6, 800	17, 900	6, 100	30, 800	1, 174
Total	55, 095	162, 511	62, 835	282, 441	905

The total shipments for 1888, estimated at 18 tons per car, are as follows:

Total shipments of coal from Pittsburgh in 1888.

Destinations.	Tons.
Pittsburgh and other points	1, 001, 510
West of Pittsburgh	2, 925, 198
East of Connellsville	1, 167, 030
Total	5, 093, 738

Prices at the close of the first quarter of 1889 were as follows: Furnace coke, $1.15; to dealers, $1.25; foundry coke, $1.40; crushed coke, $1.50; all on board cars at ovens, per ton of 2,000 pounds. Freight rates from ovens to Pittsburgh, 70 cents per ton; to Shenango valley, $1.35; Cleveland, $2.80; Chicago, $2.75; East Saint Louis, $3.50. Foundry prices at western points were quoted as follows: Chicago, $4.25; Saint Louis, $4.70; Louisville, $4.70; Kansas City, $6.75; Toledo, $4; Detroit, $4.15; Milwaukee, $4.20; Buffalo, $4.

The following were the wages paid for and prices in cents per bushel of Monongahela coal during 1888:

Prices and wages paid for mining Monongahela coal in 1888.

Months.	Wages per bushel.	Cincinnati.		Louisville.		Pittsburgh, afloat.
		Fourth pool.	First and second pool.	Fourth pool.	First and second pool.	
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	3	7	8	7¼	8¼	4½
February	3	7	8	7	8	4¾
March	3	6¼	7¼	6¼	7¼	4¾
April	3	5½	6½	5½	6½	4¾
May	3	5½	6½	5½	6½	4¾
June	3	5¼	6¼	5⅜	6⅜	4¾
July	(*a*)	5	6	5¼	6¼	4¾
August	(*a*)	5	6	5¼	6¼	4¾
September	(*a*)	5¼	6¼	5¼	6¼	4¾
October	3	5¼	6¼	5¼	6¼	4¾
November	3	5¼	6¼	5½	6½	4¾
December	(*a*)	5⅜	6⅜	5½	6½	4¾

a Not mining.

On November 19, the river operators decided to close down the Monongahela mines for an indefinite period, beginning December 1.

Buffalo, New York.—The quotations ruling at Buffalo at the beginning of 1889 were as follows:

Prices for anthracite coal at Buffalo, New York.

Sizes.	Free on board vessel at Buffalo.	To dealers on cars at Buffalo.	To dealers on cars at bridges for shipment west.	Retail, screened, and delivered.
	Long ton.	*Long ton.*	*Long ton.*	*Short ton.*
Grate	$5.05	$4.75	$4.75	$5.25
Egg	5.05	4.75	4.75	5.25
Stove	5.30	5.00	5.00	5.50
Chestnut	5.30	5.00	5.00	5.50
Pea				3.75

The Buffalo Coal Exchange rules say that when coal is sold in the yard the price shall be 40 cents per ton less than delivered figures. Rates to steam-yachts and canal boats shall be same on deck per ton as the regular established retail quotations. Further, all coal shall be sold at regular established retail prices, and these prices are for coal delivered only during the month in which the order is taken.

Prices for bituminous coal at Buffalo, New York, on track (nominal).

	Reynoldsville region.	Allegheny Valley railroad and Mercer County region.	Pittsburgh region.	Low grade division of Allegheny Valley railroad.
	Short ton.	*Short ton.*	*Short ton.*	*Short ton.*
Screened lump	$2.20	$2.00	$2.40	$2.15
Lump and nut mixed	2.10	1.90	2.30	2.05
Run of mines	1.95	1.75	2.15	1.90
Screened nut	1.95			1.90
Nut and slack mixed	1.70	1.65		1.80
Slack	1.50	1.40		1.65
Ohio cannel			4.55	
Connellsville coke			4.00	
Reynoldsville coke			3.25	

The anthracite coal trade of 1888 closed very quiet. Stocks here, at interior adjacent points and elsewhere, were largely in excess of demand. Bituminous coal was less plentiful and business fair, although manufacturers did not press the capacity of their works, and when navigation closed vessels' requirements ceased. Quotations, as above printed, were nominal. Every variety of bituminous coal was on the market. The mild weather, of course, had little to do with the fluctuations in the quantity of soft coal sold. Except for the high grade in use for families but little was used for domestic purposes and none for furnaces. The large number of families now supplied with natural gas for fuel is necessarily a factor in explaining the lessened consumption of coal to quite a considerable extent even when taking the increase in population into consideration. Boring for gas has been commenced at the poorhouse, and if the venture proves satisfactory 2,000 tons of coal will be replaced. Natural gas has been successfully used at the city water works at a cost 10 per cent. less than that of bituminous coal. The following is the full text of the report made by Mr. T. Guilford Smith, the chairman of the coal committee of the Buffalo Merchants' Exchange, at the annual meeting held January 9, 1889:

"The coal committee reports very largely increased shipments of coal to Buffalo for re-shipment there by lake and rail. Lake shipments were as follows: 2,546,905 short tons, including 2,071 cargoes, distributed to fifty-five ports, an increase of about 600,000 tons over last year. The rail figures, when all in, will no doubt show a considerable increase. To move this large amount of increased traffic by lake increased facilities have become necessary. The Lehigh Valley interests have largely increased their shipping wharves at Tifft Farm during the past season. The New York, Lake Erie and Western Railroad has also increased its dock facilities and pocket-carrying capacity. At the present time the Delaware, Lackawanna and Western is also increasing its docks at the foot of Erie street, and will be able to ship more coal during the season of 1889 than ever should it be desired.

"During 1888 the Central Dock and Terminal Company was organized, and has acquired property for the shipment of Reading coal, and during 1889 its docks and pockets will no doubt be constructed and add largely to the shipping facilities of this port. In addition to the facilities already mentioned for the increased tonnage by lake very considerable contracts have been entered into by the New York, Lake Erie and Western Railroad for the storage of coal here during the winter and its trans-shipment into line cars. This coal trestle will be ready for use on the opening of spring trade. The New York Central and Hudson River Railroad has also appropriated very considerable land and put in tracks for the storage of large contracts of anthracite coal during the winter, which can be utilized in the same way. The consumption of coal in Buffalo does not seem to have been as largely affected by natural gas as was expected, probably owing to the lack of supply on the part of the Natural Gas Company and partly owing to the stringent measures which it has seen fit to adopt in reference to supplying its customers since the disastrous fire of last spring, which nearly consumed Saint Paul's church. There are no statistics, so far as known, of the arrivals of coke in Buffalo as separated from anthracite and bituminous coal, but the amount used here and in the vicinity and which passes through Buffalo is constantly on the increase. The leasing of the Niagara River Iron Company's blast-furnace will no doubt increase this consumption greatly, and it would seem desirable to have, if possible, separate statistics on this fuel."

The following table exhibits the shipments of anthracite by lake from Buffalo for the past six years.

Lake shipments of anthracite from Buffalo.

Years.	Tons.	Years.	Tons.
1883	1,467,778	1886	1,531,210
1884	1,431,081	1887	1,894,060
1885	1,428,086	1888	2,514,906

The clearances at and from Buffalo in the past season aggregated some 2,369,906 tons, as compiled from the daily returns; to which may be added 155,000 tons loaded into vessels which cleared at Tonawanda.

The eleven principal places are named below, with the figures in the preceding seasons:

Clearances of coal at Buffalo for three years.

Destination.	1888.	1887.	1886.
	Tons.	*Tons.*	*Tons.*
Chicago	1,023,619	784,462	642,135
Milwaukee	549,831	376,876	376,615
Duluth	282,106	165,798	157,420
Superior	120,000	96,746	65,090
Toledo	83,850	84,563	55,290
Detroit	35,330	40,003	31,090
Green Bay	26,345	29,446	23,870
Saginaw	27,075	19,196	11,660
Racine	29,695	16,565	25,263
Marquette	18,920	16,242	13,580
Washburn	19,360	15,200	10,290
Total	2,216,161	1,645,097	1,412,303
To all other places	133,855	93,382	118,907

Mr. E. L. Hedstrom, of Buffalo, has recently made a study of the development of the coal trade of the city, and has compiled the following figures:

Coal receipts at Buffalo.

Years.	Bituminous.		Anthracite.	
	By lake.	By rail.	By canal.	By rail.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1842	900	None.	900	None.
1852	34,665	None.	22,895	None.
1862	84,523	None.	73,793	58,578
1872	78,889	66,600	190,994	333,000
1882	7,880	1,089,907	223,001	1,400,000
1887	None.	1,801,217	59,439	3,378,325

Total tonnage, bituminous and anthracite coal, received at Buffalo.

Years.	Tons.	Years.	Tons.
1842	1,800	1872	790,876
1852	57,560	1882	3,021,791
1862	239,873	1887	5,298,490

The clearances of coal from Buffalo during 1888, as stated by the *Courier*, were 2,556,270 tons, against 1,902,580 for 1887.

Erie, Pennsylvania.—The shipments of coal from the city of Erie, Pennsylvania, during the past six years are reported as follows:

Coal shipments from Erie, Pennsylvania.

Years.	Tons.	Years.	Tons.
1883	204,755	1886	235,255
1884	193,969	1887	230,845
1885	188,860	1888	245,000

Cleveland, Ohio.—Average quotations, car lots, at the close of 1888, were as follows:

Prices of coal at Cleveland, Ohio.

	Per ton.		Per ton.
Bituminous:		Bituminous:	
Carbon Hill	$2.50 to $2.60	Sherodsville lump	$1.95
Monday Creek	2.50 to 2.60	Osnaburgh lump	2.00
Massillon	2.50 to 2.65	Coshocton	2.35
Palmyra lump	2.85 to 2.90	Hocking	2.25
Briar Hill	2.75 to 3.00	Anthracite:	
Pittsburgh	2.10 to 2.20	Grate	4.95
Kentucky cannel	4.90	Egg	4.95
Salineville	1.85 to 1.95	Stove	5.18
Goshen	2.00 to 2.10	Nut	5.18
Conotton lump	2.25		

Coal receipts and shipments at Cleveland, since January 1, 1888.

	Total receipts.	Total shipments.
	Tons.	*Tons.*
Anthracite	180,641	29,735
Bituminous	1,726,634	677,733
Coke	124,165	2,947

The collector of customs at Cleveland, Mr. W. J. McKinnie, in his annual report places the Cleveland shipments at 1,855,260 tons of bituminous, with the amount taken aboard vessels for fuel at 308,979 tons; Ashtabula, 462,125 tons and 57,603 tons fuel; Fairport, 138,660 tons and 7,061 tons fuel; Lorain, 287,808 tons and 19,500 tons fuel. The aggregate of these items is 3,136,996 tons. The increase over the previous year is certainly in the neighborhood of a million tons. When the immense movement of anthracite out of Buffalo is considered in connection with the foregoing figures, it will readily be seen that the business of shipping coal out of Lake Erie ports is no small matter.

Receipts of coal at Cleveland, Ohio, for the past six years.

Years.	Tons.	Years.	Tons.
1883	2,089,909	1886	1,557,361
1884	1,686,112	1887	1,631,513
1885	1,445,152	1888	1,919,332

Coal and coke receipts and shipments at Cleveland, Ohio, for the past three years.

	1886.	1887.	1888.
Receipts:	*Tons.*	*Tons.*	*Tons.*
Bituminous	1,412,535	1,454,744	1,737,781
Anthracite	144,826	176,769	181,551
Coke	117,372	114,924	124,827
Total	1,674,733	1,746,437	2,044,159
Shipments:			
Anthracite by rail	20,000	20,296	29,735
Bituminous by rail	120,000	294,453	677,733
Bituminous by lake	600,000	703,506	1,000,000
Total	740,000	1,018,255	1,707,468

Toledo, Ohio.—The following are the prices of coal by the car load in Toledo:

Coal prices at Toledo, Ohio.

	Per ton.
Bituminous.	
Hocking Valley or Shawnee:	
Lump	$2.70
Steam lump	2.60
Run-of-mine	2.45
Nut	2.20
Steam nut	2.00
Massillon:	
Lump	2.80
Nut	2.70
Jackson:	
Lump	2.80
Steam lump	2.70
Run-of-mine	2.50
Nut	2.25
Steam nut	2.20
Cumberland-Blossburg	3.10
Cannel	3.25
Anthracite.	
Chestnut and stove, free-burning coals	5.49
Grate and egg, free-burning coals	5.27
Lehigh:	
Egg, grate, chestnut, and stove	6.10
Lump	6.75
Anthracite—Continued.	
Cupola, broken	$3.25
Coke.	
Connellsville foundry	4.00
Gas-house	3.00
Connellsville crushed	4.50
Retail prices.	
Chestnut and stove	6.50
No. 4	6.75
Grate and egg	6.25
No. 2, chestnut or pea	5.00
Lehigh, all sizes	6.75
Blossburg, for blacksmiths	5.25
Cannel	5.00
Jackson:	
Lump	4.00
Nut	3.75
Massillon:	
Lump	3.75
Nut	3.50
Hocking Valley, Baltimore and Ohio, Cambridge and Ohio Central lump	3.50
Nut	3.25

The year 1888 started with the above schedule of prices adopted by the Coal Exchange. The year's trade was gratifying, and indications point to fully as good business in 1889. Prices in Toledo were remarkably steady for months, the only differences having been in the price of Massillon coal. During the season just closed the Columbus, Hocking and Toledo road brought about 3,300,000 tons of coal into and through Toledo; the Wheeling and Lake Erie, 750,000; the Ohio Central, 800,000; the Pennsylvania, 350,000; and the Cincinnati, Hamilton, and Dayton, Lake Shore, and some other roads large amounts. The total amount of anthracite in stock here was estimated at 25,000 tons at the close of 1888.

The following were the receipts and shipments for the month of January, 1889, reported by some of the railroads: (The Ohio Central and Cincinnati, and the Jackson and Mackinaw did not report.)

Receipts and shipments by some railroads at Toledo, Ohio.

Railroads.	Receipts.	Shipments.
	Tons.	*Tons.*
Columbus, Hocking Valley and Toledo	64,900	
Wheeling and Lake Erie	54,200	
Pennsylvania Company	25,600	1,900
Lake Shore and Michigan Southern	4,918	310
Toledo, Ann Arbor and Northern Michigan	96	18,730
Cincinnati, Hamilton and Dayton	3,634	255
Wabash, Saint Louis and Pacific	907	3,245
Michigan Central	473	
Toledo, Saint Louis and Kansas City	105	380
Total	154,833	24,820

Mr. D. B. Smith has compiled the following table showing the receipts of coal at Toledo, in short tons, during 1886, 1887, and 1888:

Receipts of coal at Toledo, Ohio, for three years.

Received by—	1886.	1887.	1888.
	Tons.	*Tons.*	*Tons.*
Wabash railway	12,598	9,634	10,375
Lake Shore and Michigan Southern railroad	165,382	206,099	101,064
Cincinnati, Hamilton and Dayton railroad	8,198	11,741	37,831
Pennsylvania Company's railroad	201,427	330,020	339,750
Michigan Central railroad	9,594	13,864	16,504
Columbus, Hocking Valley and Toledo railway	1,039,200	955,620	1,358,025
Toledo, Ann Arbor and North Michigan railway	1,910	552	24,700
Toledo, Saint Louis and Kansas City railroad	3,828		1,359
Toledo and Ohio Central railway	404,684	590,000	637,000
Lake boats	87,120	117,921	140,963
Wheeling and Lake Erie railway	391,086	454,813	755,155
Toledo, Columbus and Southern railway	15,832	5,446	1,014
Cincinnati, Jackson and Mackinaw railroad			45
Total	2,340,859	2,695,710	3,423,785

Detroit, Michigan.—The following rates are given:

Prices of coal at Detroit, Michigan.

	Per ton.		Per ton.
Anthracite:		Steam:	
Grate	$6.50	Lump	$2.75 to 3.00
Stove and chestnut	6.75	Nut	2.50 to 2.70
No. 4	7.00	Pea	2.25 to 2.40
No. 2 chestnut	5.75	Slack	1.90 to 2.00
Lehigh lump	7.75	Massillon:	
Bituminous:		Lump	4.50
Domestic lump	4.00	Nut	4.00
Nut	3.50		

There has been no change in these prices. The market was almost lifeless at the close of 1888, owing to the open winter. The conditions for coal handling were good. There were no freight blockades, there were plenty of cars, and the supply of coal was good, with no snows to delay shipments. The shipments were very small, and the soft-coal trade quiet. The coke trade was active, at $4.15 for Connellsville, the demand being quite uniform. The receipts of coal at this port for the month of December and for the year 1888 were as follows:

Receipts of coal at Detroit, Michigan, in 1888.

Via—	By rail. December.	By rail. Entire year.	From—	By lake. December.	By lake. Entire year.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Grand Trunk	2,605	43,738	Ashtabula	.....	5,349
Lake Shore	15,252	225,405	Buffalo	1,250	38,547
Michigan Central, east	5,047	83,078	Charlotte	.....	460
Michigan Central, south	31,132	291,646	Cleveland	6,700	51,372
Wabash Western	3,376	85,662	Sandusky	.....	5,387
Detroit, Grand Haven and Milwaukee	.....	136	Toledo	.....	7,038
			Erie	.....	6,244
			Lorain	.....	7,081
			Ogdensburgh	.....	2,700
			Other ports	.....	17,357
Total	57,412	729,665	Total	7,950	141,535

Chicago, Illinois.—The following statistics exhibit the amount of coal and coke received at, shipped from, and consumed in, Chicago, Illinois, during five years ending December 31, 1888, as compiled by the Board of Trade, and Coal Exchange.

Yearly receipts of coal at Chicago, Illinois.

Kinds of coal.	1884.	1885.	1886.	1887.	1888.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Anthracite by lake	820,002	741,886	768,164	853,158	1,242,044
Anthracite by rail	627,806	613,054	616,997	845,386	702,737
Eastern bituminous coal by lake	243,188	206,817	166,762	123,221	115,862
Eastern bituminous coal by rail	612,462	790,169	888,771	1,196,324	1,049,372
Illinois coal	1,467,989	1,287,995	1,175,001	1,375,759	1,809,210
Indiana coal	469,079	659,634	732,191	1,154,681	1,169,231
Coke	553,860	558,963	540,204	592,980	643,486
Total	4,794,386	4,858,518	4,888,090	6,141,509	6,731,942

The shipments, as shown in the following table, comprise coal and coke re billed from this market or passing beyond Chicago on through billing.

Shipment of coal from Chicago, Illinois, for three years.

	Anthracite.			Bituminous coal and coke.		
	1886.	1887.	1888.	1886.	1887.	1888.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
January	49,003	54,182	53,528	51,416	84,381	79,179
February	46,006	55,276	39,873	49,337	119,058	87,209
March	37,461	39,889	26,892	52,309	110,822	73,507
April	8,965	15,955	14,222	38,470	67,460	56,873
May	7,192	6,857	11,416	20,041	41,319	56,791
June	13,884	16,142	29,390	25,645	36,640	37,723
July	58,299	52,126	82,769	30,289	70,817	64,235
August	49,461	64,289	97,061	38,987	57,931	65,566
September	42,903	55,302	87,515	44,846	92,047	88,101
October	46,553	60,835	65,015	50,738	111,234	102,697
November	47,779	70,935	54,102	65,418	106,505	100,749
December	44,363	67,772	36,924	71,688	103,260	60,001
Total	451,869	559,560	598,707	539,184	1,001,477	872,631

The following statement shows for each year the receipts and consumption of anthracite coal at, and shipments from, Chicago since 1884:

Anthracite coal receipts and consumption at Chicago, Illinois, from 1884 to 1888.

	Receipts.				Distribution.			
	On hand in docks and yards Jan. 1.	Jan. 1, to Dec. 31. By vessel.	Jan. 1, to Dec. 31. By rail.	Total.	Jan. 1, to Dec. 31. Shipments to the country.	Jan. 1, to Dec. 31. Local consumption.	Jan. 1, to Dec. 31. Balance of stock carried over.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1884	265, 645	820, 002	627, 806	1, 713, 453	585, 753	803, 411	324, 289	1, 713, 453
1885	324, 289	741, 866	613, 054	1, 679, 209	632, 274	823, 417	223, 518	1, 679, 209
1886	223, 518	768, 164	616, 997	1, 608, 679	451, 869	1, 038, 751	118, 059	1, 608, 679
1887	118, 059	853, 158	845, 386	1, 816, 603	559, 560	1, 079, 443	177, 600	1, 816, 603
1888	177, 600	1, 242, 044	702, 737	2, 122, 381	598, 707	1, 062, 315	461, 359	2, 122, 381

Receipts of coal and coke at, and shipments from, Chicago, Illinois, for 1888 and 1887.

	December.		From January 1 to December 31.	
	1888.	1887.	1888.	1887.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Receipts:				
Anthracite, by lake	53, 541	36, 468	1, 242, 044	853, 158
Anthracite, by rail	20, 872	85, 869	702, 737	845, 386
Pennsylvania	20, 662	51, 872	438, 779	464, 754
Ohio	43, 831	112, 483	643, 227	775, 289
West Virginia	8, 908	8, 692	85, 228	70, 399
Illinois	154, 772	150, 894	1, 809, 210	1, 375, 759
Indiana	99, 344	118, 440	1, 169, 231	1, 154, 681
Coke	71, 495	68, 946	643, 486	592, 980
Total	473, 425	633, 664	6, 733, 942	6, 132, 406
Shipments:				
Anthracite	36, 924	67, 772	598, 707	559, 560
Bituminous and coke	60, 001	103, 260	872, 631	1, 002, 477
Total	96, 925	171, 032	1, 471, 338	1, 562, 037

Prices of Coal and Coke at Chicago, Illinois, at the close of 1888.

	Per ton.		Per ton.
Birdseye cannel	$6.00	Gartside block	$2.70
Brush Creek cannel	4.50	Washington	2.75
Buckeye cannel	4.25	Island semi-block	2.25
Brookfield, Briar Hill	4.25	Dugger	2.25
Erie	4.25	Peacock	2.25
Black band	4.25	Summit semi-block	2.25
Blossburg smithing	4.25	Wilmington	2.25
Sonman smithing	3.80	Mt. Olive	2.25
Mt. Vernon smithing	3.80	Norton creek	2.25
Cumberland smithing	3.80	Sangamon, No. 3	2.25
Raymond	3.65	Morris	2.10
Plymouth	3.65	Grape creek	2.25
Winifredo	3.65	Streator	2.25
Campbell's creek	3.65	Walston coke	4.25
Youghiogheny	3.40	Walston domestic coke, crushed	4.50
Pittsburgh	3.35	Connellsville coke	4.25
Peach orchard	3.60	New River coke	4.25
Hocking	3.25	Pocahontas coke	......
Shawnee	3.25	Pittsburgh coke	3.70
Sunday creek	3.25	North Bend lump coke	4.25
Wellston shaft	3.35	North Bend crushed coke	4.50
Jackson Hill	3.35	Pana coal	2.25
Indiana block	2.70	New Pittsburgh	2.35
ANTHRACITE.(*a*)			
Lehigh lump	$7.25	Stove	$6.50
Grate	6.25	Chestnut	6.50
Egg, small	6.50	Egg, large	6.25

a Free on board cars in Chicago.

Mr. H. A. Bischoff, in speaking of the coal trade at the opening of 1889, says: "The tonnage to the consuming Northwest has increased in 1888 to an extent not anticipated by even the most sanguine of operators, and it has but shown what will be demanded in the future. This field is referred to most especially here, because it is practically a new one, and so much added to an area where the consumption was already great and increasing rapidly. The fuel problem all over the country has assumed new magnitude of late, while in certain large districts recently settled it is just developing itself. With abundant demands, business in certain staples remains profitable even in hard times. With new markets clamoring for supplies, 1889 promises well for the coal trade in almost any contingency. There are other reasons than the existence of abundant markets which promise well to the coal industry. The transportation problem, still a most perplexing one, is receiving close attention, and there is reason to believe will be less vexatious than in the past."

Milwaukee, Wisconsin.—Following are the current quotations:

Prices of coal free on board cars at Milwaukee, Wisconsin, at the close of 1888.

Kind or grade.	Per short ton.	Kind or grade.	Per short ton
Anthracite:		Bituminous—Continued.	
Chestnut	$6.50	Youghiogheny	$3.75
Range or stove	6.50	Raymond	3.75
Grate	6.25	Pittsburgh	3.75
Egg	6.25	Hocking	3.50
Coke	4.35	Norton Creek	2.50
Blossburg	4.75	Mount Olive	2.50
Bituminous:		Wilmington	2.50
Cumberland smithing	4.75	Briar Hill	5.25
Cannel	5.25		

The following are the total receipts of coal at the port of Milwaukee for the season of navigation during 1888, as compiled by Mr. James F. Trowell, harbor-master at that port:

Coal receipts at Milwaukee in 1888.

	Anthracite.	Bituminous.	Totals.
	Short tons.	*Short tons.*	*Short tons.*
Northwestern Fuel Company	141,452	44,656	186,108
Coxe Bros. & Co	160,640	20,233	180,873
H. M. Benjamin	130,215	23,480	153,695
R. P. Elmore & Co	51,032	7,602	58,634
Pennsylvania Coal Company	37,525	2,812	40,337
Corrigan, Worrall & Co	31,874	12,205	44,079
T. Sundermann & Son	19,346	24,423	43,769
F. R. Buell & Co	29,031	1,525	30,559
The Hadfield Co	32,650	1,452	34,102
L. Henes, jr. & Co	11,496	11,119	22,615
Fetto & Meyer	14,860	4,585	19,445
Urigh & Davel	11,556	1,060	12,616
Gross & Sons	10,472	....	10,472
N. A. Nelson	9,613	792	10,405
Hambach & Jergensen	5,756	1,386	7,142
J. H. Pauly	5,910	2,780	8,690
Daniel Orth	6,504	....	6,504
Husse & Raloff	4,596	....	4,596
Callaway & Co	3,787	....	3,787
Whitnell & Rademaker	4,861	....	4,861
Joachim Christiensen	4,088	....	4,088
John Hannan	1,942	459	2,401

Coal receipts at Milwaukee in 1888—Continued.

	Anthracite.	Bituminous.	Totals.
	Short tons.	*Short tons.*	*Short tons.*
Milwaukee Gas Light Company	1,940	32,345	34,285
Krause & Co., Milwaukee		2,196	2,196
Milwaukee Ferry Boat Company		2,581	2,581
Leopold & Austrian		2,196	2,196
Plankington Packing House		5,014	5,014
Kerns' mill		3,137	3,137
Sandersons' mill		3,935	3,935
Daisy mill		1,076	1,076
Blatz Brewing Company		6,265	6,265
Schlitz Brewing Company		9,098	9,098
North Chicago Rolling Mill Co		9,993	9,993
	731,152	238,405	969,557
Summary:			
Anthracite			731,152
Bituminous			238,405
Total			969,557

In addition to the receipts noted above there were received at Milwaukee during the year 152,686 tons, whose distribution to individual consumers has not been reported, making the total receipts 1,122,243 tons.

The following tables have been compiled and reported to the Survey by Mr. William J. Langson, secretary of the Chamber of Commerce:

Receipts of coal at Milwaukee for four years

	1888.	1887.	1886.	1885.
By lake from—	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Buffalo	631,263	464,972	395,971	392,003
Erie	74,610	61,222	41,847	50,915
Oswego	1,348	1,153		10,043
Cleveland	98,631	78,259	91,997	126,741
Ashtabula	23,105	38,881	11,096	35,360
Black river				5,549
Lorain	13,533	11,757	12,417	19,452
Sandusky	19,733	36,606	57,412	19,307
Toledo	38,452	14,115	69,079	31,875
Charlotte	14,292	2,781	31,744	19,491
Fairport	30,253	10,517		
Ogdensburgh	7,700			
Huron, Ohio	8,244			
Other ports		4,331	2,679	
Total by lake	961,164	724,594	714,242	710,736
By railroad	161,079	118,385	45,439	65,014
Total receipts	1,122,243	842,979	759,681	775,750

Shipments of coal from Milwaukee for the past six years.

Shipped by—	1888.	1887.	1886.	1885.	1884.	1883.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago, Milwaukee and St. Paul Railway	283,269	166,120	177,286	179,883	140,630	146,295
Chicago and Northwestern Railway	107,193	79,258	70,420	56,591	37,314	41,746
Wisconsin Central Railroad	12,624	18,953	11,745	8,943	7,469	6,725
Milwaukee, Lake Shore and Western Railway	16,146	13,886	13,072	12,804	11,757	30,575
Milwaukee and Northern Railroad	34,480	15,627	12,011	10,872	7,556	10,075
Lake	125	1,595	269	184	335	355
Totals	453,837	295,439	284,803	269,277	205,061	235,771

Receipts of coal at Milwaukee by lake and rail annually for twenty-seven years, from 1862 to 1888, inclusive.

Years.	Tons.	Years.	Tons.
1862	21,860	1876	188,441
1863	43,215	1877	264,784
1864	44,503	1878	239,667
1865	36,369	1879	350,840
1866	66,616	1880	368,568
1867	74,568	1881	550,027
1868	92,992	1882	593,842
1869	87,690	1883	612,584
1870	122,865	1884	701,166
1871	175,526	1885	775,750
1872	210,194	1886	759,681
1873	229,784	1887	842,979
1874	177,655	1888	1,122,243
1875	228,674		

Duluth, Minnesota.—Previous to 1881 the Northwestern Fuel Company was the only one engaged in the coal business at Duluth. In 1881 the Lake Superior Coal and Iron Company put in coal docks, followed in 1882 by the Ohio Central Coal Company. In 1883 the Saint Paul and Pacific Coal Company succeeded the Lake Superior Company. In 1884 the Pioneer Coal Company was organized and received a small amount of coal, and in 1886 the Lehigh Coal Company was formed and built a dock at West Superior. Finding early in the season of 1888 that its vast dock at Duluth was insufficient for its rapidly increasing business, the Northwestern Fuel Company took possession of the fine dock of the Duluth Elevator Company at West Superior, and erected a large trestle work and machinery thereon, giving it a large additional capacity. Mr. Wm. C. Sargent added a capacity of 20,000 tons to his dock at the foot of Sixth avenue west, and the Pioneer Fuel Company has erected on Rice's Point, on what is known as the "old furnace" property, a dock having a capacity of 100,000 tons.

Coal receipts at Duluth, Minnesota, by the several coal companies for the season of 1888.

	Tons.
Duluth companies:	
Northwestern Fuel Company	575,000
Ohio Coal Company	335,000
Pioneer Fuel Co.	75,000
Superior companies:	
Lehigh Coal and Iron Company	350,000
Saint Paul and Pacific Company	200,000
Total	1,535,000

It is interesting to note the steady development of the coal trade at the head of the lakes, and the following figures give total receipts in tons each season for the past eight years. Every settler on the prairies of the Northwest makes a new customer for Duluth coal, and the increased traffic is evidence of the great development going on.

Coal receipts at Duluth, Minnesota.

Years.	Tons.	Years.	Tons.
1878	31,000	1885	595,000
1881	163,000	1886	736,000
1882	260,000	1887	912,000
1883	420,000	1888	1,535,000

The increase in 1887 over 1886 was 24 per cent.; that of 1888 over 1887, 68 per cent.—an extraordinary showing.

During 1888 the Lehigh Coal and Iron Company first made experiments at Superior in making coke from Pittsburgh coal to be crushed and offered to the trade, principally for domestic consumption. The experiment seems to have proved successful, since it is claimed that the company will build 150 more coke ovens during the coming year.

Saint Paul and Minneapolis, Minnesota.—Wholesale prices for coal were as follows in December, 1888:

Prices of coal at Saint Paul and Minneapolis, Minnesota, in December, 1888.

	Free on board cars at Duluth.	To dealers at Saint Paul and Minneapolis.
	Per ton.	*Per ton.*
Anthracite: (*a*)		
Grate and egg	$6.25	$8.00
Stove and nut	6.50	8.25
Bituminous:		
Pittsburgh	3.75	4.75
Youghiogheny	3.75	4.75
Willow bank	3.75	4.75
Mansfield	3.75	4.75
Hocking	3.50	4.50
Sunday creek	3.50	4.50
Briar Hill	4.75	6.00
Indiana block	....	4.75
Illinois	....	$3.10–3.45
Smithing:		
Piedmont	4.75	5.75
Cumberland	4.75	5.75
Blossburg	4.75	5.75

a Lehigh, all sizes, 50 cents additional.

Following are receipts at and shipments of coal from Saint Paul and Minneapolis by railroad for the month of January, 1889:

Coal receipts and shipments at Saint Paul and Minneapolis in January 1889.

Railroads.	Receipts.	Shipments.
	Cars.	*Cars.*
Manitoba railway	87	153
Saint Paul and Duluth	172	2
Chicago, Milwaukee and Saint Paul	112	1
Chicago, Saint Paul, Minneapolis and Omaha, east	424	0
Chicago, Saint Paul, Minneapolis and Omaha, west	72	85
Northern Pacific	68	1
Minneapolis and Saint Louis	2	6
Kansas City	126	110
Wisconsin Central	16	5
Chicago, Burlington and Quincy	720	17
Sault Ste. Marie and Southwestern	12	0

Cincinnati, Ohio.—Overproduction, natural gas, petroleum, and mild weather have all operated against the Ohio coal trade during the winter of 1888 and 1889. The producers and wholesalers all suffered from these influences. The rains at the opening of 1889 made "coal boat water" again, and the run that came down from Pittsburgh about exhausted all the loaded coal there. At the end of the year prices were 5½ cents for fourth pool and 6½ cents for second pool.

Prices of coal at Cincinnati, Ohio, at the close of 1888.

Anthracite coal.	Free on board car.	Delivered.	Bituminous coal.	Free on board car.	Afloat, per bushel.
	Short tons.	*Short tons.*		*Short tons.*	*Cents.*
Chestnut	$6.25	$7.25	Youghiogheny	$2.25	6½
Range, or stove	6.25	7.25	Kanawha river	2.10	6
Grate	6.00	7.25	Ohio river	1.80	5
Egg	6.00	7.25			

Col. S. D. Maxwell, secretary Board of Trade, reports the receipts of coal at this city to have been as below in the several years named ending with August 31:

Coal receipts at Cincinnati, Ohio.

Years.	Tons.	Years.	Tons.
1881	1,492,817	1885	2,008,850
1882	2,197,407	1886	2,130,354
1883	2,025,859	1887	2,350,026
1884	2,092,551	1888	2,500,000

Prices of coal at Louisville, Kentucky, at the close of 1888.

Bituminous coal (kind or grade).	Per bushel.	Bituminous coal (kind or grade).	Per bushel.
Pittsburgh:	*Cents.*	Kentucky:	*Cents.*
Lump	7½	Lump	6
Nut	6½	Nut	5
Nut and slack	4½		Per ton.
Winifrede:		New River smithing coal	$3.00
Lump	6½	New River coke	4.75
Nut	5½	Jellico cannel	5.75
Anthracite coal.	**Free on board car.**	**Anthracite coal.**	**Free on board car.**
	Short ton.		*Short ton.*
Chestnut	$7.00	Egg	$6.75
Range or stove	7.00	Connellsville coke	4.70
Grate	6.75		

The following table shows the consumption of coal in the vicinity of Louisville during the past four years. The figures do not include coal used by the railroads. The receipts of coke are partly estimated on account of incomplete returns:

Consumption of coal in the vicinity of Louisville, Kentucky, for four years.

	1885.	1886.	1887.	1888.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Pittsburgh by river	539, 628	575, 000	646, 000	750, 000
Ohio River and Kanawha	86, 348	90, 000	72, 800	95, 000
Total coal by river	625, 976	665, 000	718, 800	845, 000
Bituminous by rail	305, 960	200, 671	232, 107	341, 427
Anthracite	9, 300	4, 341	4, 241	13, 377
Coke	40, 306	50, 000	49, 688	65, 000
Aggregate	981, 542	920, 012	1, 004, 836	1, 264, 804

Prices of coal at Saint Louis, Missouri, at the close of 1888.

BITUMINOUS.

	Free on board East Saint Louis.	Free on board Saint Louis.	Delivered. Domestic consumption.
	Per ton.	*Per ton.*	*Per ton.*
Trenton	$1. 75	$2. 05	$2. 87½
Du Quoin	1. 50	1. 80	2. 62½
Brookside	1. 50	1. 80	2. 62½
Saint Barnard	1. 37½	1. 67½	2. 50
Mount Olive	1. 37½	1. 67½	2. 50
Troy	1. 37½	1. 67½	2. 50
Gillespie	1. 25	1. 55	2. 37½
Collinsville, Illinois	1. 25	1. 55	2. 37½
Dutch Hollow	1. 25	1. 55	2. 37½
Staunton	1. 25	1. 55	2. 37½
Nut coal	1. 00	1. 30	2. 12½
Big Muddy	1. 75	2. 05	2. 87½

ANTHRACITE.

	Per ton.
Grate and egg, 2½ tons and over, delivered	$8. 50
Stove and nut, 2½ tons and over, delivered	8. 75

At the opening of 1889, the market at Saint Louis was very much depressed, owing to the unusually mild season. This is apparent in the statement of receipts given below. The falling off in bituminous coal for December, as compared with 1887, was 20,000 tons, and the total decrease for the months of November and December was quite 60,000 tons, representing a loss, in these two months alone, of 2½ per cent. of the entire year's business. Nor is this condition changed with the new year, for, as compared with the first ten days of January, 1888, the receipts have fallen off 19,000 tons. The anthracite trade was worse than the bituminous. With a good supply in sheds and the mild season, the receipts almost ceased at the close of 1888. The shortage in receipts was 7,600 tons for December, and 2,500 tons for the first ten days in the following month. The coke trade shared the same depressing influence felt in the other lines. The shortage of 7,100 tons for December, and of 40,890 tons for the year, is indicative of the depression in this trade. The figures for the last three years are appended.

Receipts of coal at Saint Louis, Missouri, in 1886. 1887, *and* 1888.

BITUMINOUS COAL.

December.	Tons.	Years.	Tons.
1886	224, 545	1886	2, 082, 019
1887	222, 720	1887	2, 321, 814
1888	205, 685	1888	2, 357, 938
Decrease in December, 1887	1, 825	Increase in 1887	239, 795
Decrease in December, 1888	17, 035	Increase in 1888	36, 124

ANTHRACITE COAL.

December.	Tons.	Years.	Tons.
1886	16, 099	1886	96, 640
1887	13, 083	1887	131, 600
1888	5, 465	1888	136, 290
Decrease in December, 1887	3, 016	Increase in 1887	34, 960
Decrease in December, 1888	7, 618	Increase in 1888	4, 690

COKE.

December.	Tons.	Years.	Tons.
1886	21, 173	1886	104, 036
1887	16, 679	1887	175, 550
1888	9, 525	1888	134, 660
Decrease in December, 1887	4, 494	Increase in 1887	71, 514
Decrease in December, 1888	7, 154	Decrease in 1888	40, 890

Kansas City, Missouri.—Quotations for short tons on the cars, delivered here, were as follows:

Prices of coal at Kansas City, Missouri, at the close of 1888.

	Per ton.		Per ton.
Bituminous:		Bituminous—Continued.	
Farmers' lump	$3. 00	Foster lump	$2. 25
Weir City nut	2. 40	Wellington	2. 50
Oakdale nut	2. 40	Anthracite:	
Rich Hill nut	2. 00	Nut size	9. 25
Higginsville lump	2. 75	Egg size	9. 25
Clinton lump	2. 75	Stove size	9. 50
Deepwater lump	2. 75	Grate size	9. 50
Cannel	4. 75	Smithing coal:	
Illinois	2. 75, 4. 00	Piedmont	7. 20
Vernon	2. 50	Blossburg	7. 20
Weir City lump	2. 75	Coke:	
Oakdale lump	2. 75	Gas-house	5. 00
Rich Hill lump	2. 50	Native	4. 00
Lexington lump	2. 50	Connellsville	7. 25
Excelsior lump	3. 00		

Receipts and shipments of coal at Kansas City in 1888 from twenty-one railroads.

	Receipts.	Shipments.		Receipts.	Shipments.
	Tons.	*Tons.*		*Tons.*	*Tons.*
January	116, 195	26, 726	August	111, 853	14, 945
February	86, 930	13, 816	September	83, 742	13, 395
March	79, 865	15, 441	October	95, 678	14, 582
April	50, 908	11, 778	November	64, 390	16, 815
May	55, 930	8, 967	December	66, 230	17, 892
June	62, 264	7, 823			
July	57, 250	12, 017	Total	931, 235	174, 197

	Tons.
Received by water	4, 500
Total receipts by rail and water	935, 735

The receipts and shipments for the last four years have been as follows:

Coal receipts and shipments at Kansas City for four years.

	Receipts.	Shipments.		Receipts.	Shipments.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1885	533, 262	199, 476	1887	752, 354	131, 559
1886	562, 540	160, 233	1888	935, 735	174, 197

Prices of coal at Dubuque, Iowa.

Anthracite coal.	Retail.	Bituminous coal (kind or grade).	Free on board car.
	Short ton.		*Short ton.*
Chestnut	\$8. 25	La Salle	\$3. 10
Range or stove	8. 25	Oglesby	3. 10
Grate	8. 00	Wilmington	3. 10
Egg	8. 00	Breckenridge	2. 50
		Pana	2. 95
		Peoria	2. 60
		Mount Olive	2. 70

Prices of coal at Davenport, Iowa.

Anthracite coal.	Retail delivered.	Bituminous coal.	Retail delivered.
	Short ton.		*Short ton.*
Chestnut, Scranton	\$8. 00	Third vein, La Salle	\$3. 50
Range or stove	8. 00	Mercer county, lump	3. 25
Grate	7. 75	Mercer county, nut	3. 00
Egg	7. 75	Indiana block	4. 50
Lehigh, nut and range	8. 50		
Lehigh, egg	8. 25		

Prices of coal at Burlington, Iowa.

Anthracite coal.	Retail.	Bituminous coal.	Retail delivered.
	Short ton.		*Short ton.*
Chestnut	\$9. 00	Steam coal	\$2. 50
Range or stove	9. 00	Domestic coal	2. 75
Grate	8. 75	Soft nut	2. 25
Egg	8. 75		
No. 4	9. 50		

Mobile, Alabama.—The demand for Alabama coal was good in this section, as well as in other parts of the South, but there has been no material change in the local trade, which is divided among many dealers. New mines have been opened and the output of many of the old mines has been increased, but as this was done mainly with a view of supplying the new iron furnaces, manufactories, and railroads in the interior, and as no mines were opened especially for the tide-water business, the local trade has had to depend on the surplus on hand at the mines. There has been no material reduction in freights, and coal has ruled higher rather than the contrary. During the past year there was no improvement in the export trade, and no business in that line worth speaking of was done, owing to the fact that Alabama coal delivered in Mobile costs much more than bituminous coal is sold for in eastern ports. Mobile has much to hope for in the plans of the Tuscaloosa and Selma land companies, who propose building their own coal roads to the coal fields and bringing coal to the river to be floated to Mobile. Should these plans be carried out, Mobile would at once become a coal shipping port of importance. Prices were higher than last year and fluctuated a little, but the highest prices were during the winter months, when anthracite advanced from $8.50 early in the season to $12 in February, but declined when the warm weather commenced. Alabama steam coal, free on board, ranged from $3.25 to $3.75 per ton, but sold at $3.25 at the end of 1888. The range of prices for retail lots was as follows: Alabama, $4.50 to $7.50, and anthracite $7 to $12 per ton. Below will be found the receipts at Mobile for the past six years, ending September 1, 1888.

Receipts of coal at Mobile, Alabama.

Kinds.	1888.	1887.	1886.	1885.	1884.	1883.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Alabama	38,785	39,232	30,316	40,301	17,808	25,304
Pennsylvania and English	648	910	2,022	775	891	1,229
Total	39,433	40,142	32,338	41,076	18,699	26,533

This does not include the coal brought for use of the Louisville and Nashville or the Mobile and Ohio railroad companies; probably a total of 25,000 tons additional.

New Orleans, Louisiana.—A comparative statement of consumption of Pittsburgh coal is given below:

Consumption of Pittsburgh coal at New Orleans, Louisiana, from 1883 *to* 1888.

Years.	Barrels.	Years.	Barrels.
1883	3,759,250	1886	4,529,000
1884	3,864,300	1887	5,100,000
1885	3,995,650	1888	4,500,000

The coal sent to planters below the city is included in the consumption. The returns for 1886 and following are for calendar years; the preceding year ends on November 30. The Pittsburgh coal shippers have now an organization at New Orleans for handling their coal, known as the Pittsburgh and Southern Coal Company. A new rule for gauging the coal went into effect last year. A barrel of coal has been for many years rated at 180 pounds, as wheat is rated at 60 pounds to the bushel. In measuring coal in boats it has been customary at Pittsburgh to allow 4 cubic feet to the barrel, timbers of boat included; at Louisville the measurement has lately been 4 cubic feet net to the barrel—that is, not including timbers of boat. A coal boat fully loaded will contain 10,000 barrels, and heretofore a barrel of coal was $2\frac{4}{7}$ bushels, but under the new measurement a barrel of coal will consist of $2\frac{6}{10}$ bushels, making a difference of about 130 barrels to the boat load. In the latter part of August a great storm at New Orleans sank about 3,500,000 bushels of coal. The effect of this loss was seen in an advance in prices early in September, but as that month and also the succeeding one brought high water, the increasing stock brought prices down. Prices ranged at 26 to 28 cents per barrel until September; then 35 to 40 cents for September and October, while in November and December the price was 27 to 29 cents per barrel.

California.—The following table exhibits the various sources from which California has received its coal during 1888, and the tons imported from each locality:

Imports of coal at San Francisco.

	1888.
	Tons.
British Columbia (Wellington, Nanaimo, and East Wellington)	304, 916
Australian	272, 336
English and Welsh	107, 387
Scotch	10, 510
Eastern (Cumberland and anthracite)	30, 120
Franklin, Green river, and Cedar river	322, 711
Carbon Hill and South Prairie	241, 437
Mount Diablo and Coos Bay	81, 194
Japan	15, 852
Total	1, 386, 463

The arrivals at San Pedro and San Diego are not included in the above imports; the arrivals at San Diego this year were 101,368 tons; in 1887, 68,996 tons; in 1886, 20,986 tons.

In the receipts from British Columbia (Vancouver) are included 1,20? tons of anthracite mined in the Canadian Rocky mountains.

Foreign coal delivered during the year 1888 *at San Pedro and San Diego, California*

	San Pedro.	San Diego.
	Tons.	*Tons.*
British Columbia	42, 375	7, 129
Other foreign coal	123, 839	87, 360
Total	166, 214	94, 489

In speaking of the California coal trade for 1888, Mr. I. W. Harrison says:

"It was an exceptional fact to chronicle in 1887 that coal had fluctuated during the year fully $3 per ton; how much more singular that during the year 1888 it had advanced $3 per ton above the highest price of 1887—that is to say, the difference between minimum and maximum values on foreign coals in 1887–'88 reached $6 per ton. It is safe to predict that this will never be repeated. The principal causes of such marked fluctuations can be readily accounted for; early in the year outward grain freights were extremely low; hence coal carriers received very high rates to come to this port; then, again, the coast collieries were taxed to their utmost capacity to meet the demand, which so closely assimilated to their supplies, that extreme prices were strongly sustained. To add to this, labor troubles were threatened in Australia in June last, which finally culminated in August in a general strike in Newcastle, which again forced up values, and for a time it became a matter of serious comment whether, in the absence of Australian supplies, some of our manufactories would not be forced to close temporarily.

"A steam ship running from San Francisco to Australia requires from 1,500 to 2,000 tons of coal for fuel on its trip. This is about the usual cargo of steam colliers entering the Columbia, the largest on record being some 2,400 tons."

Total receipts of coal at San Francisco during the past six years.

Years.	Tons.	Years.	Tons.
1883	869,615	1886	1,011,867
1884	987,151	1887	1,154,993
1885	959,216	1888	1,386,463

The following tables show the highest and lowest prices of coal per cargo from Australia during the past year, as reported by Mr. Stewart:

Highest and lowest prices per ton for Australian coal in San Francisco, California.

Months.	Newcastle.		Sydney.	
	Highest.	Lowest.	Highest.	Lowest.
January	$9.25	$9.00	$8.00	$8.00
February	10.25	9.62½	9.25	9.25
March	10.25	9.87½	9.62½	9.62½
April	12.00	10.12½	9.62½	9.62½
May	9.50	9.12½	9.25	9.00
June	10.25	10.25	9.50	9.50
July	9.50	8.90	9.25	9.25
August	9.50	8.75	8.25	8.25
September	11.50	9.75	9.75	9.75
October	11.50	10.50	9.50	9.50
November	10.50	10.00	8.25	7.50
December	10.00	9.50	7.50	7.50

Highest and lowest prices for Australian Wallsend, or Greta coal at San Francisco for the past four years.

	1885.	1886.	1887.	1888.
Highest	$6.75	$6.45	$8.75	$12.00
Lowest	5.50	5.50	6.00	8.90

The following table of prices will show the monthly fluctuations of three foreign coals for "spot" cargoes. The average price is given for each month, reported by Mr. I. W. Harrison:

Cargo prices of foreign coal at San Francisco in 1888.

Months.	English steam.	Scotch splint.	West Hartley.	Months.	English steam.	Scotch splint.	West Hartley.
January	$9.50	$10.00	$10.00	July	$10.50	$12.50	$12.50
February	12.00	12.50	12.60	August	10.50	12.50	12.50
March	12.50	13.00	13.00	September	11.50	12.50	12.50
April	12.50	13.00	13.00	October	12.00	12.50	12.50
May	12.50	13.00	13.00	November	11.25	12.50	12.50
June	11.25	12.75	12.75	December	10.50	12.00	12.00

It would naturally be supposed that the extremely high figures ruling this year would have materially restricted consumption, yet we find that our imports of 1888 exceed those of 1887 by 272,585 tons, being an increase of about 25 per cent.—a very positive evidence of prosperity, as it is attributable only to increase of population and enlargement of manufactories. It may safely be anticipated that a further increased consumption may be looked for in 1889. This has been the most prosperous year for the coast collieries, both for amount shipped and prices realized; the net profit on 950,258 tons must have been quite large.

The imports of coke for the year foot up 25,763 tons, as against 22,657 tons in 1887; the stock on hand at the end of 1888 was very light and prices very high.

WAGES IN COAL MINING.

The wages paid for mining coal and for outside labor around coal mines and directly connected with the handling of wrought coal from the bottom of the mine shaft or the mouth of the mine drift to railroad cars on which the coal is shipped to market vary greatly throughout the United States, but are closely connected with peculiar and local conditions which characterize each mining district. These wages are the subject of almost constant dispute between the employer and the employé. Primarily they are based upon the market price received for the product of the mine, since only under very peculiar and purely local conditions, and then only for very limited periods, are mines kept in active operation at a direct loss to the operator. The actual wages paid to the laborer when the mines are kept in operation at any profit, however small to the operator, are determined in special cases by a co-operative action between individual employers and their employés, but more generally by co-operative action between all the operators and employés in districts where the mining is generally carried on under the same conditions. Frequently, however, the wages are the subject of demand by the employé upon the employer, and when these demands are not acceded to by the latter the refusal is often made the object of a strike by the former, resulting in all active mining operations being stopped for longer or shorter periods, entailing great pecuniary loss both to the operator and laborer. The inevitable result of such a strike is, that while the operator loses much money during those periods when there are legitimate demands for his coal, yet the actual personal suffering is at all times infinitely greater to the miner and his family, whose distress for the want of proper food and clothing, and even at times shelter from the weather, is frequently extreme.

A strike among miners often takes place, and is very foolishly instigated by the miner himself, at periods of temporary depression in the coal trade; and in these instances the opportunity afforded the operator of closing his mine is eagerly embraced as a means of preventing possible loss to him in the conduct of his business. A lack of proper understanding between the employer and his men and failure to co-operate in the mutual interests of each have led to the organization, in almost every district of local miners' labor unions or more wide-spread amalgamated associations which have endeavored to establish an absolute fixed price for all labor interested in mining without a due regard to the welfare of the operator. This has forced the operators to pool their interests, as a counter action, so that to-day in all the prominent mining districts of the country the determination of a scale of mining wages is a matter of very delicate adjustment between the individual and corporate operators and the labor employed in and about their mines. The scale of wages which was in force during 1888 varied considerably in the different States and Territories, and in most cases was dependent upon many conditions purely local to each mining district.

It is not proposed here to review the action of conventions which were held during the year by either the coal operators or the mining laborers, or to refer to the practical results brought about by conferences between the employers and employés, but merely to give the number of laborers employed in each State and Territory, the tons of coal they produced, the price which the coal commanded at the mouth of the mines, and the average wages paid the miners. These facts are exhibited in the following table:

Product, value per ton, laborers, and wages at coal mines of United States during 1888.

States and Territories.	Short tons produced.	Average value per ton at mines.	Inside and outside labor employed.	Wages paid for mining, noted in cents.
Pennsylvania:				
Anthracite	43,922,897	$1.95	101,000	85 per car of 2 gross tons subject to adjustment on sliding basis of price of coal.
Bituminous	33,796,727	.95	62,000	Pennsylvania Railroad mines, 69 net ton; Clearfield, 45 net ton; Allegheny Mountain, 40 net ton; Connellsville, 89 net ton; Meyersdale, 40 net ton; Monongahela, 3 bushels 76 pounds; Reynoldsville, 65 net ton.
Illinois	14,655,188	1.12	29,410	Mount Olive, 50 net ton; Peoria, 70 net ton; Spring Valley, 70 net ton; Wilmington, 80 net ton.
Ohio	10,910,916	.93	27,000	Hocking Valley, 60 net ton; generally, 45 to 65 net ton.
West Virginia	5,498,800	1.10	9,700	Fairmont and Baltimore and Ohio Railroad mines, 35 gross ton; Kanawha River, 2½ to 3 bushels 80 pounds; Elk Garden, 50 gross ton.
Iowa	4,952,440	1.30	9,600	Angus, 75 gross ton; Flagler, 65 to 75 gross ton; Fort Dodge, 4 bushels; Ottumwa, 75 gross ton; What Cheer, 75 gross ton.
Missouri	3,909,967	1.50	8,800	50 to 60 net ton.
Maryland	3,479,470	.95	5,950	50 gross ton.
Indiana	3,140,979	1.40	7,403	Block coal, 72½ net ton; bituminous, 57 net ton.
Alabama	2,900,000	1.15	6,900	Generally 40 to 65 net ton; Montevallo, 100 net ton, 2-foot bed.
Kentucky	2,570,000	1.20	6,343	Eastern mines, 75 net ton; western mines, 62½ net ton.
Colorado	2,185,477	2.23	5,575	Bowlder, 82½ net ton; Crested Butte bituminous, 75 gross ton; Baldwin, 100 net ton.
Tennessee	1,967,297	1.10	4,800	50 to 65 net ton.
Kansas	1,850,000	1.50	3,600	Average, 5½ bushels 80 pounds; Leavenworth, 4 bushels 80 pounds.
Wyoming	1,481,540	3.25	2,459	Lump coal, 60 net ton and 40 slack coal.
Washington	1,215,750	3.00	3,000	350 per day by measure and contract.
Virginia	1,073,000	1.00	2,400	Pocahontas, 40 net ton; eastern mines, 50 to 75 net ton, subject to local arrangement.
Indian Territory	761,986	1.95	1,700	80 net ton.
New Mexico	626,665	3.25	1,500	Average per day, 250 to 400, paid on ton basis.
Arkansas	276,871	1.50	650	80 to 125 net ton; average, 87 net ton.
Utah	258,961	2.10	500	Varies from 80 net ton to about 300 for miners to 200 for laborers per day.
Georgia	180,000	1.50	500	Convict miners, contracted.
California	95,000	4.00	(a)1,070	Adjusted on basis of about 250 daily earnings.
Texas	90,000	2.05		Varies greatly; ranges from 45 to 130 net ton; T. and P. C. Co., 125 net ton.
Michigan	81,407	1.60		125 to 250 per day basis; Bennett S. P. Co., 75 net ton.
Oregon	75,000	3.00		Coos Bay, 100 net ton.
Montana	41,467	3.75		Based on daily earnings, 300 to 450.
Dakota	34,000	1.75		Based on daily earnings, 250 net ton.
Rhode Island	4,000	2.75		Varies greatly; average earnings about 190 net ton.
Nebraska	1,500	2.25		Unknown.
Idaho	400	4.50		Prospecting labor exclusively.
Total, exclusive of colliery consumption.	142,037,735			
Colliery consumption:				
Pennsylvania anthracite.	2,696,667	....	(b)	Same wages paid in each coal field for mining colliery-consumed coal as for mining commercial coal.
Bituminous in all States and Territories.	3,925,000			
Grand total	148,659,402	....	301,860	

a Estimated. *b* Colliery-consumed coal mined by labor included above.

Mr. Kochtitzky, commissioner of labor statistics of Missouri, estimates that the average value of coal at mines was $2.21 per ton, but from the best statistics which can be secured it is not thought to have exceeded $1.50 per ton.

In the column headed "Inside and outside labor employed" is included only the number of miners and laborers engaged in removing the coal from the bed and placing it on railroad cars and wagons at the mouth of the mine for shipment to market. The number of laborers employed in the different districts for the removal of 10,000 tons of coal within the space of one year varies greatly. In the first place, it depends upon the number of days worked during the year. Most of the coal mines throughout the United States during 1888 worked more than two hundred and fifty days, while a large number of them worked practically every day except Sundays and holidays, and the number of inside and outside laborers employed embraces the average number employed for these days during the year when the average daily tonnage of coal was produced, this average being ascertained by dividing the total yearly product by the number of days worked. In very few instances were any mines worked for so short a time during the year that the miners were only temporarily located in the vicinity of their mines, but as a rule they were permanent residents during the year, so that the total of 301,860 men employed about the coal mines of the United States may be taken to represent the permanent population about the coal mines. In the second place, the number of miners employed depends upon local conditions peculiar to each mining district, such as the thickness of the coal bed, the hardness or softness of the coal, and the existence or absence of thin layers of slate or clay included within the body of the coal bed, which necessarily retards the mining; whether the coal bed is comparatively horizontal or dips at various angles, rendering the geological structure irregular and complex; whether the bed is mined from self-draining drifts and tunnels, or from the bottom of slopes and shafts, from which the coal has to be hauled, and the mine water-pumped; the necessary preparation which a coal has to undergo after it is taken from the mine and before it is in condition to ship to market; whether it has to be washed as some of the Pennsylvania anthracites and Southern bituminous coals are; whether it has to be broken down into commercial sizes, as is the case in all anthracites; the care which is necessary to remove the slate and bony coal in the market product, and the necessary handling of the coal between the mine mouth and the railroad shipping car. Many other conditions might be named which directly influence, but to a smaller degree, the number of laborers required for the mining of a definite quantity of coal.

Taking 10,000 tons of coal mined per year as a unit of product, it is found that the number of both inside and outside laborers employed about the mines varies from 17 as a minimum in Maryland to 26 as a maximum in California. In West Virginia it is 18; in the Pennsylvania bituminous region, 19; in Kansas and Indian Territory, 20; in Illinois, 20, and in the Pennsylvania anthracite region, 23. In all the other States and Territories in which coal is produced the number of men employed for the production of 10,000 tons of coal per annum varies from 22 to 25. The peculiarities already referred to in the character of the coal bed influence not only the numbers of miners employed in mining a unit of product, but the rate of wages paid, it being obviously just that where one man can mine twice as much coal in one district as another equally competent miner can mine in another district there should be a marked discrimination in the amount of wages paid to each. While it is of great interest to coal operators and to the mining labor to be informed as to the rate of wages paid in different districts, yet unless the local conditions peculiar to each district are fully understood no just appreciation can be formed as to the absolute daily profit realized by labor in each locality. In addition to the conditions which affect this question already noted, it is important to bear in mind the different purchasing value of a dollar in the different mining communities.

The following table shows the commercial coal produced by the principal countries of the world, as compiled by Mr. James M. Swank. English tons of 2,240 pounds are used in giving the statistics of Great Britain and the United States, and metric tons of 2,204 pounds are used for all the continental countries of Europe.

The world's product of coal.

Countries.	Quantity.	Countries.	Quantity.
	Tons.		*Tons.*
Great Britain (1888)	169, 935, 219	Sweden (1887)	300, 000
United States (1888)	126, 819, 406	Spain (1887))	977, 559
Germany and Luxemburg (1888)	81, 863, 811	Italy (1887)	327, 665
France (1888)	22, 951, 940	Other countries (1888)	10, 000, 000
Belgium (1888)	19, 185, 181		
Austria and Hungary (1886)	20, 779, 441	Total	457, 790, 222
Russia (1886)	4, 650, 000	Percentage of the United States.	27. 7

DETAILED STATISTICS BY STATES.

ALABAMA.

Total product in 1888, 2,900,000 short tons; spot value, $3,335,000.

Development of the Alabama coal fields.—The phenomenal development of the Alabama coal fields has been surprising.

In the early development of the coal resources of the State, special credit is due to Prof. Michael Tuomey, formerly professor of geology in the University of Alabama, and to Mr. William A. Gould, who is still living, at an extremely old age, near the town of Warrior. Professor Tuomey, during the early part of the last decade, traversed the mountains on foot and on horseback, through what was at that time a sparsely settled country; and from sketched maps which he made of the principal coal seams and ore deposits, the attention of the people of Alabama was first called to the great mineral wealth of the State. This led to the construction of the Alabama and Tennessee railroad, which is now a section of the East Tennessee, Virginia and Georgia railroad. In 1876, Mr. Gould discovered a coal bed in a forest some 6 miles from the present city of Birmingham. He entered 160 acres of Government land around his discovery, mined the bed which he had discovered, and sold the coal, which was hauled away in ox wagons. Probably the first coke oven in the State was erected by Gould himself. The subsequent development of the Alabama coal field, first by the Pratt Coal and Coke Company, in 1879, and later by other companies, has been referred to in the reports for 1886 and 1887.

In 1870 no coal was mined in the State except such as was taken out of country banks by farmers for local consumption. From reliable facts obtained from old residents it is believed that in 1872 the total amount of coal mined during the year did not exceed 10,000 tons. In 1873 the product had increased to 40,000 tons ; in 1876, to 100,000 tons ; in 1879, to 200,000 tons; in 1880, to 340,000 tons; while in 1887 the total production of the State had increased to 1,950,000 tons. Various claims have been made by the different coal trade journals and local authorities as to the product of coal during 1888, the greatest estimate stating the amount at 3,300,000 tons. During the early part of 1888 a very careful canvass was made of the coal mined in the State by both the United States and the State Geological Surveys, and from all the facts which could be obtained, and from a liberal estimate as to the amount of coal mined at country banks and from isolated mines of which no report could be obtained, it was ascertained that the total product for 1887 did not exceed at a maximum limit 1,950,000 tons, although a product during that year of 3,000,000 tons was claimed by different authorities.

During 1888 the attention of capitalists was attracted to the Alabama coal fields to a greater extent than in any previous year, and greater activity was manifested by old companies in extending their mines and increasing their production, and in the organization of new companies, some of which mined an extensive amount of coal during the year, while others merely accomplished their organization, purchased lands, and commenced the opening up of coal beds and the erection of coal-mining plants. The negotiations for the acquirement of coal lands have been carried on with great secrecy. This fact, in the absence of definite laws providing for the collection of statistics, has prevented the collection of complete returns from all the coal producers; but in many cases returns were obtained which, by agreement, are held confidential, and are only used in the compilation of total statements either for definite areas, or for the State. Most of these returns have been collected directly by the United States Geological Survey, but valuable assistance has been rendered by Professor Smith and Messrs. Philips and Claghorn, mining engineers of Birmingham, Alabama, who were appointed special collectors by both United States and the State surveys. The total product of the State, which has been determined in this way, is 2,900,000 tons, the total spot value of which is estimated to be $3,335,000; and it is confidently believed that the estimate of 3,300,000 tons is excessive. It is estimated, however, that during the coming year the production of the Alabama coal mines will increase at a rate never before attained.

The principal producing mines are confined to six counties, and the percentage of the total product which was mined in each county during 1888 has been estimated as follows: Jefferson county, 72 per cent.; Bibb county, 11 per cent.; Walker county, 10 per cent.; Saint Clair and Shelby counties each 2 per cent.; while less than half of 1 per cent. was produced in Tuscaloosa county, the remaining 2 to 3 per cent. being produced from adjoining counties. On account of the difficulties which have already been referred to in collecting statistics of the Alabama coal mines in detail for the year 1888, it has proved impracticable to prepare a table showing the details of the production at all mines. A general idea of the relative production by the principal companies can be had from the detailed statistics for 1887 which are contained in the following table:

Returns from individual coal mines in Alabama in 1887.

Names of companies.	Location.	Production.	Number of mines.
JEFFERSON COUNTY.			
		Short tons.	
Tennessee Coal, Iron and Railroad Company.	Pratt mines	711,606	4
Henry Ellen Coal Company	Henry Ellen	41,000	2
Sloss Iron and Steel Company	Coalburgh and Brookside	189,555	4
Watts Coal and Iron Company	Warrior	23,000	3
Warrior Coal and Coke Company	do	42,050	7
Mabel Mining Company	do	30,000	1
Pierce Warrior Coal Company	do	51,900	3
Hoeno Consolidated Coal Company	do	58,220	3
Milner Coal and Railroad Company	Newcastle	65,000	2
Woodward Iron Company	Woodward	60,676	1
J. S. Carr & Co	Morrow's mines	110,000	1
Total		1,383,007	31
BIBB COUNTY.			
Brierfield Coal and Coke Company	Brierfield	72,000	2
Cahaba Coal Mining Company	Blocton	157,821	6
Total		229,821	8
SAINT CLAIR COUNTY.			
Coosa Coal and Coke Company	Broken Arrow	None.	2
Saint Clair Coal Company	Ragland	52,141	1
Total		52,141	3
WALKER COUNTY.			
Wolf Creek Coal Company	Corona	530	1
Pennsylvania-Mobile Coal Company	do	44,000	1
O'Brien Coal Company	do	10,500	1

Returns from individual coal mines in Alabama in 1887—Continued.

Names of companies.	Location.	Production.	Number of mines.
WALKER COUNTY—cont'd.		*Short tons.*	
Virginia and Alabama Mining and Manufacturing Company.	Patton and Coal Valley	60,000	3
T. H. Dunn & Co.	York	18,750	1
Frief & Moore	Horse Creek mines	15,000	1
Kansas City Coal and Coke Company	Carbon Hill	2,000	1
B. M. Long & Company	Cordova	10,000	1
E. Donaldson & Company	Coal Valley	14,000	2
Black Diamond Coal Company	Patton	12,500	1
Norrell & Company	Day's Gap	13,758	1
Corona Coal and Coke Company	Corona	20,000	1
Total		221,058	15
TUSCALOOSA COUNTY.			
A. Durie and others	Tuscaloosa	5,250	1
Mines near Clement's Station, no returns			
Alabama Insane Hospital	Tuscaloosa	3,000	1
Total		8,250	2
SHELBY COUNTY.			
Montevallo Coal and Iron Company	Aldrich	36,555	1
Unreported	Stonestreet mines	15,000	
Total		51,555	1
Total for the State, 1887		1,945,812	60

During 1888 the producing capacity of most of the mines noted in the table above was largely increased, either by the opening up of new mines on coal tracts already owned, the extension of operating machinery and development of workings at old mines, or by the purchase of new tracts on which new mines have been started. The railroad location and the possible daily output of many of the operating companies noted, and of additional companies at the first of the year 1889, are set forth in the following table, compiled by Messrs. Philips and Claghorn:

List of coal mines in Alabama, with present daily output and prospective increase.

WARRIOR COAL FIELDS.

Names.	Location.	Daily output.	Remarks.
On Louisville and Nashville Railway.			
South and north Alabama division:		*Tons.*	
Warrior Coal and Coke Company	Warrior fields	200	
Pierce-Warrior Coal Company	do	350	
Hoeno Consolidated Coal Company, embracing Alabama, Brake and Jefferson mines.	do	175	
Mable Mining Company	do	100	
Watt's Coal and Iron Company	do	200	Just built 26 new coke ovens.
Milner Coal and Railroad Company.	Newcastle	200	
On Birmingham Mineral Railway.			
Woodward Iron Company	Woodward	400	
De Bardeleben Coal and Iron Company.	Bessemer Blue Creek mines.	850	Increasing output.

List of coal mines in Alabama, with present daily output, etc.—Continued.

WARRIOR COAL FIELDS—Continued.

Names.	Location.	Daily output.	Remarks.
On Birmingham Mineral Railway—Continued.			
Birmingham Furnace and Manufacturing Company.	Self Creek spur of Huntsville branch.	80	Building coke ovens.
Alabama Connellsville Coal and Coke Company.	Connellsville	100	Do.
On Alabama Great Southern Railway.			
William Gould	Coaling	....	Mines new.
Colonel Johnson	......do	....	Do.
On Georgia Pacific Railway.			
Corona coal and Coke Company	Corona	400	
Sloss Iron and Steel Company	Coalburgh, 1,000; Brookside, 350.	1,350	
Virginia and Alabama Coal Company, Patton and Coal Valley mines.	Patton	800	
On Kansas City, Memphis and Birmingham Railway.			
Horse Creek mines	Horse creek	400	
Coal Creek mines	Elliot	500	
Price mines	Near Birmingham	50	
Coal City Coal and Coke Company	......do	100	
On Sheffield and Birmingham Railway.			
Near Jasper		100	
Pratt mines		4,000	
Vulcan mines	Near North Birmingham	50	
Black Diamond Mining Company		200	In near future.
Total for Warrior coal fields		10,605	

CAHABA COAL FIELDS.

Names.	Location.	Daily output.	Remarks.
On Louisville and Nashville Railway.			
South and north Alabama division:			
Eureka Company	Helena	350	
Cahaba Coal Mining Company	......do	....	Not in operation.
Davis and Carr old mines	......do	....	To be re-opened.
On Birmingham Mineral Railway.			
Cahaba Coal Mining Company	Blocton	1,900	
On East Tennessee, Virginia and Georgia Railway.			
Selma, Rome and Dalton Railway:			
Montevallo Coal and Transportation Company.	Montevallo	200	
On Georgia Pacific Railway.			
Henry Ellen mines	Henry Ellen	800	
Total for Cahaba coal fields		3,250	

COOSA COAL FIELDS.

Names.	Location.	Daily output.	Remarks.
On East and West Alabama Railway.			
Saint Clair Coal Company	Ragland	200	10 coke ovens.
Eureka Coal and Mining Company	Broken Arrow	100	60 coke ovens.
Total for Coosa coal fields		300	

List of coal mines in Alabama, with present daily output, etc.—Continued.

RÉSUMÉ.

Fields.	Daily output.
	Tons.
Warrior coal fields	10,605
Cahaba coal fields	3,250
Coosa coal fields	300
Not included in returns, scattering, say	100
Total	14,255

This will cover the present output of the principal coal mines in Alabama. The daily consumption will not fall short of 17,000 tons. The deficit, which is almost wholly in coke, is made up by shipments from Pocahontas. There seems to be a disposition in Alabama to try washing coal for the manufacture of a better grade of coke, and at least one concern is now investigating the subject. For blast-furnace work some Alabama cokes do well enough, but that there is room for improvement even in this direction is not to be denied.

Change in the daily output of coal in Alabama since 1887.

Fields.	1887.	1888.
Warrior	6,800	10,605
Cahaba	2,900	3,250
Coosa	....	300

At the end of 1887 there was a daily shortage of about 6,430 tons. This is now reduced to about 3,500 tons. It is reported that the furnaces at Sheffield and Florence have contracted for a year's supply of coke from the Flat Top district, Virginia. Exactly how much coal and coke from other States is used in Alabama cannot now be determined.

Professor Smith, State geologist, has reported the following coal operators besides the individual coal operators and companies noted in the preceding list and extracted from the report for 1887:

Additional coal operators in Alabama.

H. E. Kelley, Warrior Coal and Coke Company, Coaldale.

Thomas A. Mack, Eureka Company, Helena.

Messrs. Davis & Carr, Sydenton.

L. W. Johns, De Bardeleben Coal and Iron Company, Bessemer.

R. Hogsett, Birmingham Furnace and Manufacturing Company, Trussville.

T. A. Evans, Alabama, Connellsville Coal and Coke Company, Connellsville.

R. M. Alverson, Eureka Coal and Mining Company, Broken Arrow.

William Gould, Coaling.

Col. N. D. Johnson, Coaling.

W. B. Lightfoot, Vulcan Mining Company, Birmingham.

A. P. Van Fleet, Sheffield and Birmingham Coal, Iron and Railroad Company, Elliot.

Mr. Price, Price Mining Company, Birmingham.

J. M. Searle, Coal City Coal and Coke Company, Birmingham.

W. J. Embry, Mary Ellen Coal and Mining Company, Birmingham.

Hiram Haines, New Orleans and Alabama Coal and Mining Company, Montgomery.

ALASKA.

No reliable reports have been received as to any production of commercial coal in Alaska during 1888 or previous years. Considerable interest has, however, been manifested in the possibility of opening up several coal beds known to exist in that Territory. Prospectors are already in the field, searching for valuable coal beds and locating coal mining claims, both under the impetus of individual gain, in either selling the coal claims to capitalists, or mining the coal themselves for sale to domestic consumers and to the Government and trading steamships.

In the report of 1885 special reference was made to a coal bed which had been found at Killisnoo, on Admiralty island, but the poor character of this coal, as determined from analyses by Dr. C. F. Chandler, which showed the coal to contain 14 per cent. ash and about 1 per cent. of sulphur, discouraged any work looking to the mining and sale of coal from this bed.

During the season of 1880 and 1881, Mr. Ivan Petroff, special agent of the Census Bureau, made explorations in Alaska, and in reference to the occurrence of coal reported as follows:

"Coal is found, chiefly of a lignite composition, at a great many points along the southern and western coasts of Alaska, and in the adjacent islands. A bed was opened in the Arctic, above Cape Lisburn, by Captain Hooper, of the Revenue Marine, who says that he mined it easily and used it with great satisfaction in making steam for his vessel. The oldest coal mine in the country is that on Cook's inlet, near its mouth, at a place still called on the map Coal Harbor. The Russians also took notice of coal at Unga, on the Shumacin islands, and several openings were made by them here and there in the Alexandria archipelago. Following the Russians, our people discovered and attempted to work one or two beds in the Sitkan archipelago, and several others further west.

"The quality of all this coal, located and worked for a brief period, was of so poor a character that in no case has it been pronounced fit for use on sea-going vessels, being so highly charged with sulphur and other deleterious materials. The value, however, of Captain Hooper's bed, in the Arctic, to opening enterprises of seal and whaling, and for the use of the Revenue Marine itself, must be of very striking moment. These experiments with Alaskan coal have been exceedingly thorough, particularly at Unga, where the most laudable, persistent, and even desperate determination has been manifested by the owners of certain ledges there to develop their holdings into mines of wealth. Steamers in the Territory bring their own coal with them, or have it sent up by tender from British Columbia to the Sound of California. The traders at the different posts where timber is scarce or entirely wanting use it now as their principal fuel, and it is the sole fuel on the seal islands."

Hon. A. P. Swineford, late governor of the Territory, writing of coal, in a communication referring to a trip taken to certain portions of the

Alaskan Territory, states that at Coal Harbor there was no difficulty in finding three distinct seams in a sandstone formation which dips to the northwest at an inclination of from 3 to 5 degrees from the horizontal. The exposures are in the face of a perpendicular bluff, and can be seen at a distance of 2 miles. The exposures made by the waves against the bluff are above high water at one point, but the dip carries the seams under the surface of the bay a short distance to the north, the principal one being visible for a considerable space under the water. The seams are separated apparently by fire clay. The lowest is at least 8 feet thick, the next 4 to 5 feet, and the upper not more than 3 feet. It seems to be cannel coal of good quality and the field of great extent. Some 200 or 300 pounds were taken on the vessel and burned satisfactorily in the cabin grate, sufficient heat being developed for welding purposes. It gave off some illuminating gas, and Chief Engineer Lowe showed it to contain 86 per cent. carbon, 6 per cent. ash, and a trace of sulphur.

The existence of these coal seams was well known to the Russians (Russian-American Company), but were not worked by them, owing to the fact that they opened upon the beach, and as they could only be successfully worked through perpendicular shafts of considerable depth they preferred to commence operations at some other point where so large an outlay of capital would not be required. They accordingly proceeded to open a mine on the shore of a small cove, known as Coal bay, in Graham's Harbor, which lies about 20 miles to the southwest of the entrance to Chugachik bay, and as near as can be learned for a number of years mined from a single shaft all the coal they required for use in their steamers. They made the mistake, however, of following the seam under the bay, and, having cut a stream of water, the mine was flooded beyond the hope of redemption. Subsequently, about the year 1851, a company was formed in San Francisco to which the Russian-American Company was a party, for the purpose of mining coal for the San Francisco market, and a new mine near the old one was opened under the local management of a German engineer named Haltern, and from that time till the transfer considerable coal was mined, though very little of it found its way to San Francisco. The American partnership of the firm or corporation, which was called the American-Russian Company, concluded that San Francisco needed more ice than coal, and the shipment of ice from Wood island was made its principal business. With the transfer of the country to the United States all efforts at coal mining ceased, and nothing has since been done looking to the practical development of the extensive coal measures on Cook's inlet and elsewhere in Alaska.

These coal seams not only crop out at the points mentioned, but they are exposed all along the eastern shore of the inlet from Anchor point at the northern entrance of Kachemack gulf to Kusilloff river, and at various points between Coal and Graham's harbors, covering a total distance of nearly 100 miles. At the point where the landing was made the natural conditions could not be more favorable for opening and practically operating a large number of mines. The ground back from the bay rises to an elevation of 100 feet or more, affording the best facilities for the construction of gravity roads upon which the products could be carried out upon piers and transferred to ships at a very trifling cost.

There is no portion of the United States territory where the working of coal beds will prove of so great local importance as in Alaska, and a Government survey, looking particularly to the exploration of possible workable coal beds, will prove a matter of greatest importance to the better development of the Territory.

ARKANSAS. (a)

Total product in 1888, 276,871 short tons; spot value, $415,306.

The coal beds of Arkansas are contained in the Carboniferous system, but the position of the beds in this system cannot at present be definitely stated. The beds are known to occur in some twelve different counties, but the distribution of workable coal has not yet been defined. It is mined on a commercial scale in Sebastian, Johnson, and Pope counties. The beds thus worked vary in thickness from 20 inches to nearly 7 feet. In composition the coal is mostly semi-bituminous, but much of it deserves, from its mode of burning, to be classed as semi-anthracite.

The development of coal in Arkansas on anything like a commercial scale is of recent date. A steam plant was in operation about the year 1870 at the old Spadra mine in Johnson county. Mining at Ouita, in Pope county, was carried on in the year 1873. Soon after the extension of the Little Rock and Fort Smith railway, about 1873, coal from the Coal Hill mines began to seek a market, but it was not until the year 1883 that this product began to assume commercial importance. The western or Sebastian county coal area remained comparatively unopened even up to this late date. Many small mines were worked, but the product was hauled in wagons, mostly to Fort Smith, and little reached a more distant market. Since the extension of the Saint Louis and San Francisco railway south from Fort Smith in 1887, large mining operations have been started in Sebastian county, at Huntington, Hackett City, and near Jenny Lind.

The principal mining districts in the State are: (1) the Western or Sebastian County district; (2) the Coal Hill district; (3) the Philpott district; (4) the Ouita district.

(1) *The Western or Sebastian County district* includes the Huntington, the Hackett City, and the Long Prairie or Jenny Lind coal mines.

The Huntington coal mine is in the southern part of the county, on an extension of the Saint Louis and San Francisco railway. It is

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a By Mr. Arthur Winslow, assistant geologist, in charge of the coal regions, with permission of Dr. John C. Branner, State geologist of Arkansas.

owned and operated by the Kansas and Texas Coal Company. The mine is opened by two slopes and one shaft, located near the southern outcrop of the coal, each provided with a separate hoisting plant. A large amount of coal has also been obtained by stripping, but this product is soft and slacks easily. The following is a section of the bed here:

Section at the Huntington coal mine, Arkansas.

	Ft.	In.
Good coal	4	
Shale	0	10–12
Coal	0	6–8
Shale	0	4–6
Coal	2	

The dip is about 5 degrees northward.

Numerous pits have been dug in this coal and other small openings made during past years, within a few miles of Huntington, for supplying local demands. The Gwyn drift is among them.

The Hackett City coal mine is about 15 miles south of Fort Smith, near the Indian Territory line. It is owned and operated by the Kansas and Texas Coal Company. The principal opening was a shaft, over 130 feet deep, which was provided with a good steam hoisting plant, a ventilating fan, and other surface improvements. This shaft was abandoned during the autumn of 1888, and an opening started in the outcrop of the coal. The thickness of the bed here averages about 3 feet. The same coal bed is opened at Greenwood, about 10 miles east of Hackett City, and the bed has there the following section:

Section of the coal bed at Greenwood, Arkansas.

	Ft.	In.
Coal	2	8
Shale with a little coal	0	4–14
Coal	3	3

The dip is about 10 degrees to the south.

The Long Prairie or Jenny Lind coal mines are located about 12 miles southeast of Fort Smith. The principal opening is a slope of the Western Coal and Mining Company, on the line of the Gurdon and Fort Smith branch of the Saint Louis, Iron Mountain and Southern railway. This slope was started late in the autumn of 1888, and will soon be equipped and sufficiently developed to furnish a large amount of coal for the market. It is in the same coal bed with, and closely adjoins, the Petty slope, which is one of the small openings supplying Fort Smith with coal. The following is a section of the bed:

Coal bed section at Jenny Lind mine, Arkansas.

	Ft.	In.
Coal	2	6
Shale	0	2
Coal	2	6
Black Jack (shale)	0	3

The bed dips about 9 degrees to the north.

The Coal Hill district.—This includes the mines in the immediate vicinity of Coal Hill, and also those about Spadra.

The Coal Hill mine, at the town of Coal Hill in Johnson county, is on the line of the Little Rock and Fort Smith railway. It is owned and operated by Stiewel & Co. The coal is reached by a shaft 172 feet deep. There is a 50 horse-power steam hoisting plant, also a 10-foot ventilating fan. The bed lies in a nearly horizontal position, with a good roof throughout the mine. The following is a section of the bed here:

Coal bed section at Coal Hill, Arkansas.

	Inches.
Coal	21-22
Shale with coal	4
Coal	24-25

The Allister or the Ouita Coal Company's mine in Johnson and Franklin counties is about two miles from the town of Coal Hill, at the end of a siding from the Little Rock and Fort Smith railway. The openings here consist of two slopes or main entries, which follow the coal downwards and north with the dip, which is about 2 degrees. There is a steam hoisting plant at one slope.

The limiting thicknesses of the bed are as follows:

Coal bed section at the Allister mine, Arkansas.

	Inches.
Coal	18-24
Shale	2-18
Coal	20-24

The steaming and other qualities of this coal are similar to those from Stiewel & Co.'s shaft, with the exception that some of the coal here is softer and slacks more readily on account of its being mined from near the outcrop.

The Felker mine is nearly a mile north of the Allister mine, in Franklin county, close to its east line. The coal is here only about 20 inches thick, and is interpreted to overlie the bed at the Allister slope. This coal is worked intermittently for special and local purposes, and is hauled to the railway in wagons, a distance of about a quarter of a mile. It is now handled in Little Rock by the Black Diamond Coal Company, and gives much satisfaction in domestic use.

The Eureka or Spadra coal mine is in Johnson county, about 6 miles southwest from Clarksville, on the Little Rock and Fort Smith railway, and is owned and operated by Stiewel & Co. The coal is opened by a shaft 56 feet deep. Hoisting is done with a small steam plant. The bed dips very slightly and has an excellent roof throughout. The thickness of the bed is as follows:

Section of the Spadra coal bed near Clarksville, Arkansas.

	Inches.
Coal	16-18
Shale	½-2
Coal	18-21

The Philpott district, in the central part of Johnson county, includes a number of small openings. The beds are thin and the coal production small; but, by reason of the quality of the coal and local facilities for mining, it is able to find a wider market than would be expected. It is hauled over 6 miles to the railway at a cost of $2 per ton.

The Philpott is the principal mine. It is owned and operated by Mr. L. S. Philpott. The coal is opened by a drift and by a shaft 25 feet deep. The dip is about 5 degrees. The thickness of the coal varies from 20 inches to 2 feet. Hoisting is done by horse and gin.

The Ouita district includes the openings at Ouita and those in the Shinn basin south of Russellville, in Pope county.

The Ouita coal mine is about 4 miles northwest of Russellville, on the Little Rock and Fort Smith railway. It is owned and the output is controlled by the Ouita Coal Company. The principal opening is a slope about 500 feet long, which enters the coal near the outcrop. It is provided with a steam hoisting plant. The dip of the bed is about 5 degrees. The following is an average section:

Section of the Ouita coal bed, near Russellville, Arkansas.

	Inches.
Clay ("mining")	3
Shale	4
Bony or "wild" coal	4
Coal	26

The Shinn mines include a number of small openings in a little isolated coal basin, situated about 2 miles south of Russellville. They are on a small branch railway, which extends from Russellville to Norristown. These mines are owned and operated through the Shinn Brothers. The coal has an aggregate thickness of about 18 or 20 inches, but has generally a shale parting from 4 to 8 inches thick. The dip is about 10 degrees. A small steam plant is at one mine. Work is carried on intermittently.

Production.—The production of coal on a commercial scale in Arkansas can hardly be considered to antedate the year 1883, and from that time to the latter part of 1887 the production was almost entirely confined to the mines of Johnson and Pope counties. In the fall of 1887 larger operations were started in Sebastian county, and the production from that county may be expected to increase rapidly during the next two years. No statistics are available prior to 1887. In "Mineral Resources of the United States, 1886," the production of coal for 1885 is given at 100,000 tons, and for 1886 at 125,000 tons. In the same report for the year 1887 the production is placed at 150,000 tons. The latter estimate is manifestly too high, as is seen by comparison with the figures given below. Those of the preceding years must be even more so.

The figures given in the following table are mostly from the returns of individual operators, and, though not all exact, they lay claim to being far more accurate than any results heretofore published. They give a fair, general idea of the present condition of the industry in the State.

Arkansas coal statistics.

Counties and collieries.	Operators.	Total production in 1887.	Statistics for 1888.	
			Total production in 1888.	Average daily production.
SEBASTIAN COUNTY.		*Short tons.*	*Short tons.*	*Short tons.*
Hackett City mine	Kansas and Texas Coal Company	24,000	38,991	125
Huntington mine	do	12,000	114,783	368
Gwyn drift	W. P. Gwyn	*a* 300	320	
Petty slope	E. B. Petty	*a* 3,200	6,500	20 to 30
JOHNSON COUNTY.				
Allister slope	Ouita Coal Company	49,000	56,237	183
Coal Hill shaft	Stiewel & Co	30,000	*a* 15,000	
Eureka shaft	do	*a* 1,500	3,200	
Felker slope (*b*)	Black Diamond Company	*a* 1,000	*a* 1,000	
Philpott shaft	L. J. Philpott	400	600	15
POPE COUNTY.				
Ouita slope	Ouita Coal Company	4,000	6,040	40
Shinn slope	J. L. Shinn	*a* 200	*a* 200	10
From about 25 small openings in different counties.		4,000	4,000	

Counties and collieries.	Operators.	Statistics for 1888.					
		Average number of hands.	Wages paid miners per ton.	Wages paid day hands per day.	Average cost of production per ton.	Average open price on cars at mine per ton.	Total value of product.
SEBASTIAN COUNTY.							
Hackett City mine	Kansas and Texas Coal Company.	104	$0.87	$1.50 to $2.50			
Huntington mine	do	504	.87	1.50 to 2.50			
Gwyn drift	W. P. Gwyn	5			$1.50	$3.25	
Petty slope	E. B. Petty	15	.75		1.37	2.00	$13,000
JOHNSON COUNTY.							
Allister slope	Ouita Coal Company.	130	.80 to .90	1.00 to 1.50	1.20	1.45	81,544
Coal Hill shaft	Stiewel & Co	*a*100	.80			2.00	
Eureka shaft	do	*a*25	.80			1.75 to $2.25	
Felker slope (*b*)	Black Diamond Company.	*a*10	1.10			2.50	2,500
Philpott shaft	L. S. Philpott	15	1.25	.75 to 1.00	1.50	2.50	1,500
POPE COUNTY.							
Ouita slope	Ouita Coal Company.	25	1.00	1.00 to 1.50	1.45	2.00	12,080
Shinn slope	J. L. Shinn	*a*5					
From about 25 small openings in different counties.		*a*40					

a Estimated. *b* Extends into Franklin county.

Total product in 1887	Short tons.. 129,600
Estimated spot value in 1887	$194,400
Total product in 1888	Short tons . 276,871
Estimated spot value in 1888	$415,306
Total number of employés in 1888	978

Distribution.—The following is a statement of the number of tons of Arkansas coal shipped from points on the Little Rock and Fort Smith railway during the years 1887 and 1888. The figures for the latter year were furnished by Mr. C. G. Warner, general auditor of the Missouri Pacific Railway Company:

Arkansas coal shipped by the Little Rock and Fort Smith railway.

From—	1887.	1888.
	Short tons.	*Short tons.*
Fort Smith	140	91
Coal Hill	45, 998	67, 963
Spadra	1, 309	3, 205
Ouita (Russellville)	2, 577	3, 885
Total	50, 024	75, 144
Amount of Arkansas coal consumed on the Little Rock and Fort Smith railway	....	17, 064
Total	....	92, 208

The last figure does not include the amount consumed on the Iron Mountain and Southern division of the Missouri Pacific railway.

The shipment of Arkansas coal over the Saint Louis and San Francisco railway during the year 1887 was 18,400 tons. The amount carried during the year 1888 could not be obtained.

Markets.—Those reached by the Hackett City and Huntington coals are in Texas, Kansas, and Arkansas, the greater portion going to Texas. They are used for steaming and domestic purposes. The Gwyn drift is worked merely for local blacksmithing and domestic uses. The Petty slope supplies coal to Fort Smith, Greenwood, Van Buren, and other places in the neighborhood, and is used for steaming and domestic purposes. About two-thirds of the product of the Allister slope is used by the Missouri Pacific railway, about two-ninths goes to Little Rock, and the balance is shipped to Hot Springs, Van Buren, Morrillton, Argenta, and other points in the State. About eight-ninths is used for steaming and about one-ninth for domestic purposes. The product of the Coal Hill shaft is distributed probably in about the same manner as that of the Allister slope.

The coal from the Eureka shaft is shipped mostly to Little Rock, but recently several car-load lots have been sent to a number of points in Texas, Missouri, Kansas, and even as far as Nebraska. It is used chiefly for domestic purposes, but also for special purposes where free burning, smokeless coal is desired. The Felker coal is shipped to Little Rock and other points along the railway and is used in about equal portions for domestic, blacksmithing, and forge purposes. The Philpott coal is distributed to different points along the Little Rock and Fort Smith railway, and is used chiefly for blacksmithing purposes. The coal from the Ouita slope, in Pope county, is shipped mostly to Little Rock, solely for domestic purposes. The remainder goes to Van Buren, Russellville, Hot Springs, and to Memphis. In Memphis it has been used on dummy lines. It has also been shipped to Saint Louis for railway car stoves. The small product of the Shinn mine is entirely consumed in the adjoining towns of Russellville and Dardanelle.

The geographic position of the Arkansas coal lands is often emphasized as favorable to the development of a large coal trade, because of their remoteness from the great coal-producing areas of the country, and, further, because they form geographically the nearest source of supply for the more southern States, in which marketable coal is scarce or entirely absent. This advantage is offset to a great extent in the East through the competition of the Mississippi river traffic, that great channel of trade making the Pittsburgh coal of Pennsylvania more accessible to New Orleans than is Arkansas coal. Railway rates also tend to block the extension of the Arkansas coal trade. Further, in the West the development of coal in the Indian Territory brings active competition into Texas markets. These conditions will be modified to a certain extent in the future as new lines of communication are opened out, but they will always exist to a great extent. A most promising line of growth of the Arkansas coal trade in the future will be through the increase of home consumption, with the general industrial development of the State, and also through a careful consideration of the special adaptabilities of the different coals.

Composition.—The following is a table of analyses of coals from the above-described localities, made by the Geological Survey of Arkansas, through Dr. R. N. Brackett and Mr. J. P. Smith.

Analyses of Arkansas coals. (*a*)

Names of mines.	Counties.	Thickness.		How sampled.	Specific gravity.
		Ft.	*In.*		
Hackett City shaft	Sebastian	3	0	From 5 market cars	1.341
Huntington slope	...do	6	6	From 2 market cars	1.293
Greenwood shaft	...do	6	0	From pile of fresh coal on dump.	1.300
Gwyn drift	...do	4	10	...do	1.315
Western Coal and Mining Company, Petty slope.	...do	5	0	...do	1.381
Philpott shaft	Johnson	1	9	...do	1.292
Felker slope	Franklin	1	8	From pile on dump, dug six months.	1.317
Ouita slope	Pope	2	6	From 1 market car	1.339
Eureka shaft	Johnson	3	0	...do	1.345
Coal Hill shaft	...do	3	10	...do	1.333
Allister slope	...do	3	7	From 2 market cars	1.320
Shinn slope	Pope	1	10	From fresh face of coal	1.346

a Arranged in the order of their fuel ratios.

Analyses of Arkansas coals—Continued.

Names of mines.	Counties.	Chemical composition.					Fuel Ratio.
		Water.	Sulphur.	Ash.	Fixed carbon.	Vol. hydro carbon.	C / V. H. C.
Hackett City shaft	Sebastian	0.853	1.324	9.038	73.869	14.916	4.95
Huntington slope	do	0.928	1.143	4.845	77.538	15.546	4.99
Greenwood shaft	do	0.818	2.522	5.973	75.821	14.866	5.10
Gwyn drift	do	0.892	1.193	6.245	77.092	14.577	5.29
Western Coal and Mining Company, Petty slope.	do	1.779	1.620	7.046	76.225	13.330	5.72
Philpott shaft	Johnson	0.869	0.993	3.090	80.915	14.133	5.73
Felker slope	Franklin	1.128	1.164	3.220	81.277	13.211	6.15
Ouita slope	Pope	0.980	1.829	8.174	76.817	12.200	6.29
Eureka shaft	Johnson	1.100	2.745	12.042	72.835	11.278	6.46
Coal Hill shaft	do	1.017	3.672	8.351	76.119	10.841	7.02
Allister slope	do	1.178	3.531	8.322	76.494	10.475	7.30
Shinn slope	Pope	1.058	3.346	11.750	75.434	8.410	8.96

Names of mines.	Counties.	Results of coking tests.	
		Appearance of product.	Per cent. of product.
Hackett City shaft	Sebastian	Product well fused and roughly took the shape of the crucible.	82.3
Huntington slope	do	Product well fused and took the shape of the crucible.	80.6
Greenwood shaft	do	Product very well fused and took the shape of the crucible.	83.6
Gwyn drift	do	do	82.2
Western Coal and Mining Company, Petty slope.	do	Product well fused and took roughly the shape of the crucible.	83.0
Philpott shaft	Johnson	Product well fused and took the shape of the crucible.	84.6
Felker slope	Franklin	Fragments partially fused, but retain somewhat the original shapes.	85.0
Ouita slope	Pope	Product not at all fused; fragments retain their original shapes.	87.6
Eureka shaft	Johnson	do	89.2
Coal Hill shaft	do	Product partially fused; fragments retain somewhat their original shapes.	87.2
Allister slope	do	Product partially fused; fragments little changed.	86.5
Shinn slope	Pope	Product not at all fused; fragments retain their original shapes.	88.4

On the basis of their fuel ratios, it is seen that the above coals are mostly semi-bituminous. The term "semi-anthracite" is often somewhat carelessly applied to all Arkansas coals. The physical appearance of the different varieties is similar, which, together with the fact that in composition they merge into each other by almost insensible gradations, has rendered confusion in nomenclature excusable. To the eye they all present more or less the appearance of soft bituminous coal with a cuboidal fracture. There seems to be no approach in any to the hard, compact, glistening anthracite, with the semi-conchoidal fracture. But despite these facts of proximate composition there are several coals of this list which from their mode of burning deserve to be classed as semi-anthracites. These are the coals from the Ouita, the Eureka, and the Shinn openings. The remaining coals are all of the nature of semi-bituminous coals. Even those termed bituminous in the table are so near the border line as not to have the characteristics of that coal at all pronounced; others, from the Coal Hill district—*i. e.*, from the Felker, Allister, and Coal Hill openings—approach nearer to being semi-anthracites.

Arkansas coals are all more or less soft and friable and not well adapted to long transportation. This characteristic is variable in different openings. Much of the coal shipped from Huntington during the past year has been stripped coal, which, being soft and stained, was calculated to injure the reputation of Arkansas coals.

Arkansas coals have all a high evaporating power, burn freely, and make little smoke or soot. For reaching the best results, however, a grate with small openings is necessary, as these coals are liable to decrepitate and to fall through the grate. Coal Hill coal makes an intensely hot fire, producing steam rapidly; but it clinkers and is severe in its action upon grate bars. It slacks a good deal on exposure, and in burning much fine coal is lost through ordinary grate bars. Sebastian county coal is easily ignited and quick burning, but does not produce quite so intense a heat as does the Coal Hill coal; it does not clinker, but leaves a loose ash. The Ouita and Eureka coals are not considered good for steaming purposes. The coking qualities of several of the coals have been tested on a commercial scale and these tests give little prospect that any will produce a merchantable coke. Arkansas coals are all suitable for domestic use, being more or less free burning, easily kindled, and burning with a slight draught. Those of Sebastian county swell and coke somewhat in the fire, but not objectionably so; they leave a loose pulverulent ash and do not burn out the grates. Coal Hill coal is not esteemed as a domestic fuel. In open grates it burns with an objectionably intense heat; with this the sulphur in the coal becomes very active and, as a result, grates and stoves are corroded. Some cinder or loose clinker is also formed. The Philpott and Felker coals have a much better reputation. The Ouita and Eureka coals are among the best for domestic purposes, and seem to satisfy all the chief requirements. They are especially adapted for use in self-feeding stoves and for kitchen use. They are easily kindled, burn slowly, and do not swell or coke. The Ouita coal leaves a loose reddish ash, but the Eureka coal forms a fusible clinker.

Arkansas coals have heretofore been sent to market without any preparation other than a rough sorting into slack, nut, and lump at the tipple. Operators are now looking towards crushing and screening the coal into various market sizes, and this will, without doubt, add much to the development of the trade.

CALIFORNIA.

Total product, 95,000 short tons; spot value, $380,000.

Mr. William A. Goodyear has made a special collection of statistics of coal mines of the State for 1888 and reports the aggregate amount between 90,000 and 95,000 short tons. The total product of the Mount Diablo mines was 58,795 long tons, or 65,850 short tons. Of this amount the Empire mine produced about 22,000 long tons, and the Pittsburgh and other mines in the vicinity of Somersville produced 36,795 long tons. The several mines in Ione valley, owned by the Southern Pacific Railroad Company, produced 24,404 short tons. The tonnage from the Diablo mines is reported in tons of 2,240 pounds, and from the Ione mines in tons of 2,000 pounds. The total product of these mines was 90,254 short tons. If to this should be added small lots produced at country banks through the State, the total product would be at least 95,000 tons, with a spot value estimated at $380,000.

Comparatively little development has been made in California coal fields during 1888. In the reports for 1886 and 1887 special attention was called to localities in which coal had been mined in the past either for local consumption or distant shipments. During the past year Prof. Henry G. Hanks, late State mineralogist, has collected special information from a number of mines in the State, and which will be found in the report of the State mineralogist for 1888.

The following table shows the receipt of coal at the California seaports during 1887 and 1888:

Receipts of coal at San Francisco, San Pedro, and San Diego in 1887 and 1888

Localities from which coal was brought.	1887.	1888.
	Short tons.	*Short tons.*
Australian	156,729	272,336
English and Welsh	94,028	107,387
Scotch	12,108	10,510
Eastern anthracite and Cumberland	21,709	30,120
British Columbia	252,810	304,916
Seattle, Franklin, Green River, Cedar River, Washington Territory	292,179	322,712
Carbon Hill, Washington Territory	181,267	241,437
South Prairie, Washington Territory	48,163	
Coos Bay, Oregon, and Mount Diablo, California	96,000	81,194
Japan	....	15,852
Total at San Francisco	1,154,993	1,386,464
British Columbia and other foreign	138,000	166,214
Washington Territory	10,000	....
Total at San Pedro	148,000	166,214
British Columbia and other foreign	50,099	94,489
Washington Territory	6,000	....
Total at San Diego	56,099	94,489
Total California	1,359,092	1,647,167

A review of the coal trade of California during 1888, with prices of coals, is given under the general review of the coal trade of the United States.

COLORADO.

Total product, 2,185,477 short tons; spot value, $4,808,049.

The year 1888 was marked by a great increase in coal production in Colorado, this increase being largely due to the opening of the great Glenwood field by the completion of the Colorado Midland and the Denver and Rio Grande railways into the valley of the Roaring Fork of Grand river.

The growing demand for fuel in the Missouri valley taxed the productive capacity of the Trinidad field to its utmost, and the demand will in all probability soon cause the opening of new mines in this field.

The Glenwood field is of especial economic importance in view of the varied character of its coal, which ranges from a first-class anthracite to low-grade bituminous coal.

NORTHERN DIVISION.

WELD COUNTY.

Product of Weld county from 1886 to 1888, inclusive.

Names of mines.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Mitchell	18,840	31,288	26,554	76,682
Eaton		1,600		1,600
Brown			500	500
Vernon		1,650		1,650
McKissic		740	1,000	1,740
Small mines	1,610	4,003		5,613
Totals	20,450	39,281	28,054	87,785

The Weld county mines are economically of small importance, the only mine worked regularly being the Mitchell, which, with the sale of the Denver, Utah and Pacific railway to the Burlington and Missouri River railway, passed into the possession of the Colorado Fuel Company. The coal is the characteristic northern Colorado lignite, and is largely used by the railway.

BOULDER COUNTY.

Product of Boulder county from 1886 to 1888, inclusive.

Names of mines.	1886.	1887.	1888.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Louisville	55,896	28,347	5,075	89,318
Marshall	64,934	130,000	110,000	304,934
Cleveland	6,100	11,548	11,244	28,892
Star	7,946	11,000	19,020	37 966
Jackson	21,000	29,273	30,200	80,473
Fox	24,652	26,566	38,517	89,735
Garfield	6,942	10,022	15,030	31,994
McGregor	5,657	7,516	11,200	24,373
Stewart	20,973	25,110	29,093	75,176
Baker	3,187	9,120	10,300	22,607
Standard			23,600	23,600
Simpson			11,126	11,126
Small mines	3,000	8,836	750	12,586
Total	220,287	297,338	315,155	832,780

Boulder county still maintains its position as third in the list of productive counties in Colorado. While the coal field is inferior to that in the southern and western sections, its proximity to Denver and ample railway facilities cause a great demand for the coal, which is generally used by all consumers in Denver. The Louisville mine, which is capable of a good product, remained practically idle in 1888.

The Marshall mine has, owing to stratigraphical difficulties, never yielded as largely as its owners expected, and the production decreased slightly in 1888. The product of the other mines remained about as usual, with a natural increase. The two new producers, the Standard and Simpson, will probably play an important part in the county's output.

The Simpson mine is opened on a 12-foot vein of good lignite, and has been thoroughly equipped with machinery for handling a very large daily product. The mine began production late in 1888; hence the small output. The capacity of the mine on January 1, 1889, was about 300 tons per day. A new shaft is sinking and more extensive openings are being made, which, when complete, will probably make the daily capacity 1,000 tons.

The Standard mine has been supplied with better facilities and is now capable of larger production.

The coal veins of Boulder county are six in number, of which three are economically valuable. A large area of known coal land is yet unopened, and the county will probably for a very long time be able to supply any and all demands fcr fuel.

JEFFERSON COUNTY.

Product of Jefferson county from 1886 *to* 1888, *inclusive.*

Name of mine.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
White Ash	9,928	12,000	9,000	30,928

In Jefferson county the only mines operated are at Golden. The coal vein is vertical, being raised by the uplift of the Colorado range after the deposition of the rocks of the coal-bearing series. The vein is expensive to work, and practically only enough coal is mined to supply the local demand. There are two or three small mines at Golden which are occasionally worked, but their small product is included with that of the White Ash mine.

ARAPAHOE COUNTY.

Product of Arapahoe county from 1886 *to* 1888, *inclusive.*

Name of mine.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Scranton	11,000	16,000	1,700	28,700

During the past year practically nothing was done at the Scranton mine. The coal is a soft, brown coal of very inferior quality, and contains much water and ash. When first put on the market in Denver its price, $2.75 per ton against $4 to $4.50 for northern Colorado coals, attracted quite a number of customers, but its use did not continue. The mine is reached by a railway about 17 miles in length, built specially to bring the coal to Denver.

CENTRAL DIVISION.

DOUGLAS COUNTY.

Product of Douglas county for 1887 and 1888.

Name of mine.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*
Douglas	3,500	400	3,900

The Douglas mine was opened in 1886, and a spur track built from the Denver and Rio Grande railroad to the mine from Sedalia; but the operation of the mine was not a financial success, and mining is carried on only upon a very small scale. The coal is used in the immediate neighborhood.

EL PASO COUNTY.

Product of El Paso county from 1886 to 1888, inclusive.

Names of mines.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Franceville	50,000	47,017	39,114	136,131
McFerran	3,000	500	5,000	8,500
Total	53,000	47,517	44,114	144,631

All the coal mined in El Paso county is a lignite of rather low grade. The Franceville mine has already been described in the following volumes of the Mineral Resources: 1882, page 45; 1883 and 1884, page 27; 1885, page 19; 1886, page 245.

The McFerran mine has been worked on a small scale for local demands, but in 1888 passed into the hands of the Western Coal and Mining Company, and is being extensively developed. A branch of the Chicago, Rock Island and Pacific railway has been built to the mine. The vein worked shows 6 feet of good coal.

These two mines are about 10 miles east of Colorado Springs.

PARK COUNTY.

Product of Park county from 1886 to 1888, inclusive.

Name of mine.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Como	23,823	23,421	46,588	93,832

The only mines operated in Park county are those owned by the Union Pacific Coal Company, the vein being known by the name of Lechner. The coal is semi-bituminous, and makes a good steam coal. The product of the mine is almost entirely consumed by the Denver, South Park and Pacific branch of the Union Pacific railway. The openings on the vein lie about 2 miles south of Como in the South Park and are five in number, only two of which, No. 1 and No. 5, are worked. The coal seam is badly faulted and disturbed near the openings, and three openings have on that account been abandoned. The vein in No. 1 and No. 5 averages about 7 feet in thickness. The mines are well equipped with steam-hoisting works and ventilating machinery. Attempts have been made in the past to coke this coal, but without success.

FREMONT COUNTY.

Product of coal in Fremont county, Colorado, from 1886 *to* 1888, *inclusive.*

Names of mines.	1886.	1887.	1888.	Totals.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Rockvale	205, 212	252, 564	276, 089	733, 865
Coal Creek	126, 812	154, 520	159, 000	440, 332
Small mines	....	10, 242	3, 700	13, 942
Totals	332, 024	417, 326	438, 789	1, 188, 139

During the year there was nothing unusual in coal mining in Fremont county. The Cañon City Coal and Coking Company actively developed its seven mines located at Rockvale and increased its product about 10 per cent. The Colorado Coal and Iron Company produced but little more than in 1887 from its two slopes at Coal creek.

SOUTHERN DIVISION.

HUERFANO COUNTY.

Product of coal in Huerfano county, Colorado, from 1886 *to* 1888, *inclusive.*

Names of mines.	1886.	1887.	1888.	Totals.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Walsen	89, 913	89, 100	57, 400	236, 413
Cameron	....	42, 710	29, 200	71, 910
Robinson	....	....	19, 400	19, 400
Rouse	....	....	49, 710	49, 710
Loma	....	....	3, 900	3, 900
Totals	89, 913	131, 810	159, 610	381, 333

Huerfano county has been very actively developed during 1888. The completion of the Missouri Pacific and Chicago, Rock Island and Pacific railways to Pueblo and Denver, and the consequent opening of large and prosperous markets in Kansas and Nebraska, together caused the purchase and development of many mines which previously had been undeveloped. The largest new product came from the Colorado Fuel Company, which bought and opened the Rouse mine. The vein worked here is 6 feet in thickness, and the coal is one of the best which reaches the Denver market. It is semi-coking, contains a low percentage of water, and burns freely and with great heat. The mine is being opened on a very large scale, and every preparation is being made for producing 1,000 tons of coal per day. The shipment of coal began on September 1, and at the end of the year 600 men were employed.

At Loma, 3 miles from Walsenburgh, the Southern Colorado Coal Company has opened the Loma mines. These mines will be operated in connection with the Chicago, Rock Island and Pacific railway. The vein worked is 7 feet in thickness, and in quality the coal very closely resembles that from the Rouse mine. The State inspector reports the two veins worked by this company to show the following sections:

Sections of two veins worked by the Southern Colorado Coal Company at the Loma mines.

	Ft. In.		*Ft. In.*
Number 1:		Number 1:	
Coal	1 4	Coal	1 8
Slate	2-4	Number 2:	
Coal	3 6	Clean coal	5 6 6 0
Soft clay	2		

The Colorado Coal and Iron Company produced considerably less than usual from its two mines, the Cameron and Walsen.

LAS ANIMAS COUNTY.

Product of coal in Las Animas county, Colorado, from 1886 to 1888, inclusive.

Names of mines.	1886.	1887.	1888.	Totals.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Starkville	143, 403	181, 270	143, 532	468, 205
El Moro	286, 303	303, 070	302, 000	891, 373
Chicosa			16, 966	16, 966
Sopris			134, 557	134, 557
Valley			91, 650	91, 650
Gray Creek			14, 000	14, 000
Small mines		22, 200	3, 750	25, 950
Totals	429, 706	506, 540	706, 455	1, 642, 701

In Las Animas county the large increase in 1888 over 1887 of 40 per cent. was due wholly to the opening of new mines. The properties owned by the Colorado Coal and Iron Company and the Trinidad Coal and Coking Company produced substantially the same tonnage in 1888 as in 1887.

The Chicosa mine has been opened by the Trinidad Fuel Company on Chicosa creek, about 12 miles west of Trinidad. The vein mined yields 6 feet of clean coal of the same general character as that of the district. The joint track of the Denver and Rio Grande and Denver, Texas and Fort Worth railways is about 2 miles from the mine and is connected by a spur track. The mine has been well opened and is easily worked. The dip of the vein is about six degrees, and the vein is entered on its out-cropping edge. The mine was primarily opened with a view to supplying the newly opened Texas markets with fuel.

The largest of the new mines is the Sopris, which is owned by the Denver Fuel Company. The openings are located about 6 miles south of Trinidad and show a 7-foot vein of clean coal, which makes a good coke. The dip of the vein is less than four degrees, and there is a heavy cover. The mine is connected with a spur track from the Denver, Texas, and Fort Worth railroad by a tail-rope tramway. The mine has been thoroughly equipped with the best modern machinery to insure a large output, and its capacity on January 1, 1889, was over 1,000 tons per day. The company operating it is connected with the Chicago, Burlington and Quincy Railway system, and has a large market already established in Kansas and Nebraska.

The Valley mine, operated by the Paton Coal and Coking Company, is south of the Sopris, and was opened fully in 1888. The State inspector reports the vein much faulted and broken, and the coal characterized by frequent seams of bone and slate.

The Gray Creek mine was opened in 1888, and is operated by the Colorado Coal and Iron Company, under lease. The mine will probably show a large product in 1889.

The coal veins of Las Animas county attracted much attention in 1888, and have good railway facilities. The coal is of good quality, the great Missouri Valley market is within easy reach, and the supply is always less than the demand. Almost all the coal mined near Trinidad makes a good coke.

LA PLATA COUNTY.

Product of coal in La Plata county, Colorado, from 1886 *to* 1888, *inclusive.*

Names of mines.	1886.	1887.	1888.	Totals.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
San Juan	14, 000	14, 000	26, 000	54, 000
Porter	1, 910	2, 880	2, 775	7, 565
Small mines	2, 256	6, 000	4, 850	13, 106
Totals	18, 166	22, 880	33, 625	74, 671

The coal mines of La Plata county are operated only for the local demand in Durango and Silverton, both small towns. Some of the coal is burned in locomotives by the Denver and Rio Grande railroad, and most of that from the Porter mine is coked for the use of the San Juan smelter at Durango.

DOLORES COUNTY.

Product of coal in Dolores county, Colorado, from 1886 *to* 1888, *inclusive.*

Name of mine.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Grand View	....	1, 000	200	1, 200

The Grand View mine is worked only to supply the needs of the Grand View Smelting Company at Rico. The coal occurs in a 16-inch seam, 8 miles from the smelter. The coke made from the coal is reported to be rusty and friable, and costs from $11 to $13 at Rico. The smelter was in blast only a short time during 1888, and but little coal was taken from the mine.

WESTERN DIVISION.

PITKIN COUNTY.

Product of coal in Pitkin county, Colorado, for 1887 *and* 1888.

Names of mines.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*
Spring Gulch	4,000	28,000	32,000
Thompson	....	113	113
Total	4,000	28,113	32,113

The only mine which produced any considerable amount of coal in Pitkin county in 1888 was the Spring Gulch, which is owned by the Grand River Coal and Coking Company. The mine is situated in Jerome Park, on the Roaring Fork, and at the terminus of the coal branch of the Colorado Midland railway. The mine is on the coking vein, which is here about 4½ feet in thickness. The coal produced is almost entirely consumed in making coke at Cardiff. Besides the two productive mines of this county, some of the best coal mines in the State are opened by the Colorado Coal and Iron Company and the Colorado Fuel Company. The latter company owns anthracite, coking, and bituminous veins on the slope of the Roaring Fork, but the mines of both companies are unproductive, owing to lack of railway communication with the markets.

The Coal Measures of this field are remarkable from the fact that they produce anthracite, coking, and non-coking coals. The alteration of the coal is due in part to the uplifting of the measures, but chiefly to the influence of the vast eruptions of porphyries, which built the Elk mountains. The nearer the eruptive range the more complete the metamorphism. The coal veins can be traced up the Roaring Fork, around the west side of Chair mountain, and across the head of Anthracite creek to Crested Butte and Baldwin almost continuously, but the portion of the coal field lying in Gunnison county only contains one or, perhaps, two economically valuable anthracite coal veins. The great obstacle to the development of the Grand River and Roaring Fork field is the necessarily great cost of carriage to market. Both the Denver and Rio Grande, and the Colorado Midland railways cross the Continental divide before reaching Leadville, and each road has one other watershed to cross before reaching Denver.

The same Coal Measures are traceable, with scarcely a break, up the divide between Rifle and Elk creeks to and across the White river, around the White River Plateau or Flat Top mountains, into Routt county, and north past the Elk Head range into Wyoming. The Flat Top range is volcanic, and where the coal is found near the eruptives it has generally been changed into anthracite and coking coal. On the north side of Mount Orno of this range occurs a small anthracite field and a small area of coking coal, but they are both at a great altitude, about 11,000 feet above the sea-level, and the Measures are broken and tilted. The location will probably remain inaccessible to railways. Where the Coal Measures cross the White river near Meeker, the coal is either lignitic or semi-bituminous in character. It is found in wide veins, and a little is mined to supply the local needs of the small town of Meeker. The coal field of Pitkin and Garfield counties is perhaps the best in the West, but it must from natural difficulties remain a comparatively small producer for many years.

GARFIELD COUNTY.

Product of coal in Garfield county, Colorado, for 1887 *and* 1888.

Names of mines.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*
Marion	20,000	60,000	80,000
Sunshine	10,000	40,000	50,000
Newcastle	....	15,000	15,000
Total	30,000	115,000	145,000

Garfield county was the scene of great activity in coal mining in 1888. The mines operated lie along the Roaring Fork of Grand river and along the Grand river. All the mines in the county are operated by the Grand River Coal and Coking Company of Glenwood Springs.

The Marion mine is situated about 2 miles northwest from the terminus of the Jerome Park branch of the Colorado Midland railroad. The vein operated is 5½ feet in thickness, and the dip is between 45 and 60 degrees west. The vein which is worked here and at the Spring Gulch mine is the coking seam, and has been already described in previous volumes of Mineral Resources. The company operated in 1888 one hundred coke ovens of the bee-hive style, and are constructing one hundred more. The coke is possibly the best made in the West, and is used largely by the Leadville lead smelters.

The Sunshine mine is located about 5 miles north of the Marion, and opens the thick non-coking seam of coal which is here 9 feet in thickness. The coal is bituminous and of very good quality. It is largely used by the Colorado Midland railway for fuel, and is sold in Glenwood, Leadville, and Aspen for domestic uses, some of it also finding its way to Denver.

The Newcastle mines are located at Newcastle, the western terminus of the Colorado Midland railway. Here the Grand river cuts the uplifted Coal Measures at almost a right angle, and the veins are opened by tunnels. Five openings have been made on the five valuable coal veins which occur in this field. The Colorado Midland railway was completed to Newcastle very late in 1888, and the product of the mine was consequently small. It is capable of supplying almost any demand.

GUNNISON COUNTY.

Product of coal in Gunnison county, Colorado, from 1886 to 1888, inclusive.

Names of mines.	1886.	1887.	1888.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Crested Butte	102, 918	161, 390	156, 000	420, 308
Anthracite Mesa	(a)19, 628	(a)36, 000	(a)44, 791	(a)100, 419
Baldwin	37, 405	42, 732	57, 583	137, 720
Small mines		3, 000		3, 000
Total	159, 951	243, 122	258, 374	661, 447

a Anthracite coal.

There has been practically no change in coal mining in Gunnison county in 1888. The annual product of anthracite coal from the Anthracite Mesa mine reached its highest point during the year. The coal is very largely consumed in Denver.

At the Crested Butte mine the hoisting facilities have been considerably improved and the capacity increased.

At the Baldwin mine there has been no change.

MESA COUNTY.

Product in 1888, 300 short tons.

A little coal is taken from lignite outcrops in Mesa county for ranch use, and it is proposed to build a railway for hauling coal from some of the veins, but nothing of importance has yet been done.

A large percentage of the total coal product of Colorado is mined by or in the interest of railways. The Colorado Coal and Iron Company is the oldest and largest producer in the State, and is connected with the Denver and Rio Grande by traffic agreements. Its product to January 1, 1889, has been as follows:

Production of coal by the Colorado Coal and Iron Company.

Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*
1873	12, 187	1882	511, 239
1874	18, 092	1883	602, 396
1875	15, 278	1884	450, 808
1876	20, 816	1885	562, 660
1877	44, 410	1886	605, 956
1878	82, 140	1887	750, 790
1879	120, 102	1888	737, 113
1880	221, 378		
1881	350, 944	Total production	5, 106, 309

The production of coal in 1888 by companies operated by, or in the interest of railways in Colorado was as follows:

Product of Colorado coal mines operated by or in the interest of railway companies in 1888.

Railways.	Quantity.
	Short tons.
Denver and Rio Grande	737,113
Union Pacific	104,171
Atchison, Topeka and Santa Fé	419,621
Burlington and Missouri River	203,107
Denver, Texas and Fort Worth	56,110
Colorado Midland	147,000
Total	1,667,122

The railway product was about 76 per cent. of that of the State. The product of anthracite coal was 44,791 short tons.

The product of coal in Colorado in 1888, by counties, was as follows:

Product of coal in Colorado, by counties, in 1888.

Counties.	Quantity.
	Short tons.
Las Animas	706,455
Fremont	438,789
Boulder	315,155
Gunnison	258,374
Huerfano	159,610
Garfield	115,000
La Plata	33,625
Pitkin	28,113
Weld	28,054
El Paso	44,114
Jefferson	9,000
Arapahoe	1,700
Park	46,588
Douglas	400
Mesa	300
Dolores	200
Total	2,185,477

Coal production of Colorado from 1864 to 1888, inclusive.

Years.	Localities.	Production.	
		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

Coal production of Colorado from 1864 *to* 1888, *inclusive*—Continued.

Years.	Localities.	Production.	
		Short tons.	
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	
	Northwestern division	1,064	
	Unreported mines	50,000	
			437,005
1881	Northern division	156,126	
	Central division	174,882	
	Southern division	269,045	
	Northwestern division	6,691	
	Unreported mines	100,000	
			706,744
1882	Northern division	300,000	
	Central division	243,694	
	Southern division	474,285	
	Northwestern division	43,500	
			1,061,479
1883	Northern division	243,903	
	Central division	396,401	
	Southern division	501,307	
	Northwestern division	87,982	
			1,229,593
1884	Northern division	253,282	
	Central division	296,188	
	Southern division	483,865	
	Northwestern division	96,689	
			1,130,024
1885	Northern division	242,846	
	Central division	416,373	
	Southern division	571,684	
	Southwestern division	125,159	
			1,356,062
1886	Northern division	260,145	
	Central division	408,857	
	Southern division	537,785	
	Southwestern 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

The increase in total production over 1887 was 393,742 tons, or 22 per cent. The average value of the coal on the cars at the mines was $2.20 per ton, making the value of the State's production in 1888 $4,808,049.40.

The average number of persons employed was 5,375, and the average price paid for mining and timbering is 70$\frac{1}{5}$ cents per ton of 2,000 pounds. The average cost of producing the coal on the cars, including royalties, was $1.80 per ton.

Product and character of Colorado mines in 1888, by John McNeil, State inspector of coal mines.

Names of mines.	Counties.	Operators.	Kind of opening.	Character of coal.	Thickness of coal seam.	Number of employés.	Production of lump coal.	Production of nut coal.	Production of slack coal.	Total production of all coal.	Remarks.
					Ft. In.		Short tons.	Short tons.	Short tons.	Short tons.	
El Moro	Las Animas	Colorado Coal and Iron Company.	Drift	Bituminous	7 6	500	....	....	....	302,000	Run of mine; coke made, 95,100 tons.
Starkville	do	Trinidad Coal and Coking Company.	do	do	5 0	409	99,867	....	43,665	143,532	Coke made, 19,634 tons.
Chicosa	do	Trinidad Fuel Company	do	do	7 0	80	11,337	1,868	3,761	16,966	
Mine A. Sopris	do	The Denver Fuel Company.	do	do	6 0	500	....	....	....	134,557	Run of mine; coke made, 6,000 tons.
Valley	do	Raton Coal and Coke Company.	do	do	4 6	100	....	....	....	91,650	Mine run.
Gray Creek	do	Colorado Coal and Iron Company (leased).	do	do	....	40	....	....	....	14,000	New mine.
Small mines not reported.	do	....	....	do	....	....	....	....	....	3,750	Estimated, small mines near Trinidad.
Fort Lewis	La Plata	United States Army	Drift	do	9 0	4	....	....	....	1,750	Estimated.
Rockvale No. 1	Fremont	Cañon City Coal Company	Shaft	Semi-bituminous	3 4	460	124,275	10,580	31	134,886	
Rockvale No. 4	do	do	do	do	3 5	270	96,638	16,959	....	113,597	
Rockvale No. 5	do	do	Slope	do	6 0	21	12,265	....	2,070	14,335	New mines.
Rockvale No. 7	do	do	do	do	6 0	120	12,403	366	502	13,271	
Coal Creek No. 1	do	Colorado Coal and Iron Company.	do	do	4 6	450	....	....	....	37,000	
Coal Creek No. 2	do	do	do	do	3 9		....	....	....	122,000	
Oak Creek	do	Mellor Brothers	Drift	do	3 5	14	....	....	....	2,500	Small opening.
Alkali Gap	do	Moore Brothers	Slope	do	3 0	10	1,200	....	....	1,200	Estimated, small mine near Cañon City.
Marshall No. 3	Boulder	Marshall Consolidated Coal Mining Company.	do	Lignite	8 0	130	85,000	....	25,000	110,000	
Marshall No. 5	do	do	Drift	do	8 0						
Fox	do	Fox & Patterson	Slope	do	9 0	57	28,667	7,700	2,150	38,517	
Standard	do	Standard Coal Company	Shaft	do	4 6	35	18,600	....	5,000	23,600	
Star	do	Star Coal Company	do	do	4 6	33	15,020	....	4,000	19,020	
McGregor	do	McGregor Coal Company	do	do	4 6	25	6,700	1,500	3,000	11,200	
Cleveland	do	Cleveland Coal Company	do	do	4 6	35	8,600	2,500	144	11,244	
Garfield	do	Garfield Coal Company	do	do	5 0	25	10,630	1,900	2,500	15,030	
Baker	do	Baker Coal Company	Slope	do	12 0	13	8,000	2,200	100	10,300	

Product and character of Colorado mines in 1888, by John McNeil, State inspector of coal mines—Continued.

Names of mines.	Counties.	Operators.	Kind of opening.	Character of coal.	Thickness of coal seam.	Number of employés.	Production of lump coal.	Production of nut coal.	Production of slack coal.	Total production of all coal.	Remarks.
					Ft. In.		*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
Davidson	do	Edwards and Lewis Coal Company.	Shaft	do	2 9	4	150	...	...	150	This company is just opening.
Cannon	do	Cannon Coal Company	do	do	14 8	40	600	...	...	600	New mine.
Stewart	do	Goodredge & Marfel	do	do	5 0	55	21,302	7,791	...	29,093	
Jackson	do	Jackson Coal Company	do	do	5 0	50	26,700	2,800	700	30,200	
Simpson	do	Simpson Coal Company	do	do	14 0	...	8,826	...	2,300	11,126	New mine, commenced September, 1888.
Louisville	do	Loch & Co	do	do	8 0	20	4,255	...	820	5,075	
Como No. 1	Park	Union Coal Company	Slope	Semi-bituminous	8 0	156	42,107	1,736	2,745	46,588	
Como No. 5	do	do	do	do	8 0						
Mesa	Mesa	Book Cliff Coal Company	Drift	Bituminous	4 6	13	300	...	...	300	New mines.
Grand View	Dolores	Grand View Mining and Smelting Company.	do	do	1 8	4	200	...	...	200	
Anthracite No. 1	Gunnison	Colorado Fuel Company	do	Anthracite	5 0	100	37,291	...	7,500	44,791	This coal is sized in three grades.
Crested Butte	do	Colorado Coal and Iron Company.	do	Bituminous	6 0	240	...	...	...	156,000	Coke made, 40,700 tons.
Baldwin	do	Union Coal Company	Shaft	Semi-bituminous	5 6	130	56,224	724	635	57,583	
Mitchell	Weld	Colorado Fuel Company	do	Lignite	5 0	60	21,558	4,996	...	26,554	
Brown	do	M. Brown	do	do	4 0	2	...	...	...	500	
Walsen	Huerfano	Colorado Coal and Iron Company.	Slope	Semi-bituminous	6 6	125	...	...	...	57,400	
Cameron	do	do	do	do	3 6	75	...	...	...	29,200	
Robinson	do	do	do	do	7 0	25	...	...	...	19,400	
Rouse	do	Colorado Fuel	do	Bituminous	6 0	600	37,828	9,907	1,975	49,710	Mine opened September 1, 1888.
Indian Creek	do	John F. Moore	Drift	Semi-bituminous	3 0	3	600	...	...	600	
Loma No. 1	do	Southern Colorado Coal Company.	Slope	do	7 0	100	3,300	...	...	3,300	These mines were opened during 1888, and began shipments on Dec. 1; they will be ventilated by a 20-inch diameter fan.
Loma No. 2	do	do	do	do	5 8						
Loma No. 3	do	do	do	do	5 8						

Franceville	El Paso	Denver, Texas and Fort Worth Coal Company.	...do	Lignite	8	0	75	30,096	6,002	3,016	39 114	
McFerran	...do	Western Coal and Mining Company.	...do	...do	6	0	38	4,000	600	400	5,000	New mine; first shipment November, 1888.
San Juan	La Plata	San Juan Coal Mining Company.	Drift	Bituminous	4	0	20	20,000	2,500	3,500	26,000	
Porter	...do	Porter Coal Company	...do	...do	3	4	4	2,200	75	500	2,775	
City Coal	...do	Robert Carter	...do	...do	3	0	2	1,000	....	....	1,000	
Champion	...do	Champion	...do	...do	4	6	3	900	....	200	1,100	
Black Diamond	...do	B. Whitehead	...do	...do	4	0	3	1,000	....	....	1,000	Estimated.
White Ash	Jefferson	Golden Fuel Company	Shaft	Lignite	7	0	20	9,000	....	....	9,000	
Scranton	Arapahoe	Denver Railroad Land and Coal Company.	Slope	...do	7	0	2	1,700	....	....	1,700	
McKissic	Weld	John McKissic	....	....	....		....	....	....	....	1,000	Estimated for McKissic and other small mines.
Pearl Ash	Douglas	W. T. Wells	Shaft	Lignite	9	0	20	400	....	....	400	Mine re-opened December 7, 1888.
Marion	Garfield	Grand River Coal and Coke Company.	Drift	Bituminous	5	6	40	....	....	....	60,000	Mine run.
Sunshine	...do	...do	...do	Semi-bituminous	8	6	55	25,990	8,010	6,000	40,000	
New Castle	...do	...do	...do	Bituminous	8	0	40	....	....	....	15,000	Mine run.
Spring Gulch	Pitkin	...do	...do	...do	4	6	40	....	....	....	28,000	Mine run; coke made, 15,000 tons.
Thompson	...do	Colorado Coal and Iron Company.	...do	...do	....		....	....	....	....	113	New mine.

DAKOTA. (a)

Product in 1888, 34,000 tons; spot value, $119,000.

The business of mining coal in Dakota still remains, as in the past, in an unsatisfactory condition. While there are many published statements of coal discoveries, the output of the mines is insignificant when compared with the total fuel consumption. The only systematic mining on a large scale is done at Sims, by the Northwestern Grain and Fuel Company. The Sims mine produces lignite of fair grade, and where the bed is opened there are about 7 feet of merchantable coal. All the bed is not mined out. The roof of the coal here is a talcose clay, which requires heavy timbering, rendering coal mining quite costly. The floor of the seam is fire clay, which is not utilized. During 1888 many additional openings were made, and the productive capacity of the mine was raised to about 100 tons per day. The price paid miners for coal is 75 cents per ton, run-of-mine. During 1888 this mine produced 18,000 tons, or more than half the entire product.

Many discoveries of coal are reported, but not many mines have been worked, the coal beds being generally of slight thickness and the quality of the coal poor. Near Mandan Mr. John Warn has opened a 3-foot vein of coal, which is said to be the best yet produced in Dakota, and has begun systematic work with a view of marketing the coal, which is reported clean and free from clinkers. This coal is sold in Mandan at $2.65 per ton.

At New Salem, Morton county, about 3,000 tons of lignite were mined in 1888, and at Dickinson, Stark county, about 8,000 tons. In addition to these amounts, farmers mined and brought into Mandan and other towns about 5,000 tons, making the total production 34,000 tons. The number of men regularly employed in mining coal is probably less than one hundred.

The report and analyses by Mr. George H. Eldridge, which were published in Mineral Resources for 1886, page 250, show the general character of the Dakota coals heretofore developed.

GEORGIA.

Total product in 1888, 180,000 short tons; spot value, $270,000.

The coal fields of Georgia are confined exclusively to a small area which has been estimated to contain about 200 square miles, in the extreme northwestern corner of the State. This coal area runs along the eastern boundary of the Appalachian coal field. The only commercial establishment is that of the Dade Coal Company, whose mines are located at Coal City. The total product by this company during the year was 178,800 short tons, of which 125,000 tons were manufactured into coke, 51,300 tons shipped to market, and 2,500 tons consumed at the mines. This company's product is shipped to railroads and iron furnaces in the immediate vicinity of Chattanooga. The average value

a Reported by Mr. F. F. Chisolm.

of the coal in 1888, at the mouth of the mine, was $1.50 per ton of lump coal. At the Dade mines the bushel is the unit of measurement; a ton of the coal is rated at 25 bushels. The average weight of the coke produced is 40 pounds per bushel. The average thickness of the coal bed worked is 3 feet 6 inches. This bed is estimated by Mr. C. B. Finley, the general manager of the company, to underlie 10 square miles of territory. The mine was worked 300 days during the year, and 500 convicts are employed at the mines and coke-ovens. The following is an analysis of coal reported by the company:

Analysis of Dade coal, Coal City, Georgia.

	Per cent.
Ash	9.36
Fixed carbon	74.83
Volatile matter	15.36
Sulphur	.45
Total	100.00

This coal is rated in the trade as a semi-bituminous coal. The production of this company during 1888 is much less than that reported for 1887 as published in the report for that year. No fair comparison can be made, however, with the figures for the two years, since an error was made in January, 1888, in filling out the blank form showing the total product of this company during 1887.

Although the establishment of the Dade Coal Company is the only one of any commercial importance in the State, it has been estimated that there were mined at country banks during the year 1,200 tons, making the total product for 1888, 180,000 short tons.

IDAHO.

Total product in 1888, 400 short tons; spot value, $1,800.

Numerous reports have been published as to the discovery of available coal beds in the Territory, but no reliable facts have been ascertained in regard to any accurate development in any special locality. That several coal beds have been found at different points and have been worked for local consumption at different times is well known, and has been referred to in numerous government reports and coal-trade journals; but all that can be learned about the coal is that it is of such inferior value as to prevent its development as a fuel either in competition with other coals, which can be brought into the Territory, or with wood, which can be cut in most localities in which the coal has been found.

Mr. F. F. Chisolm has visited a number of localities in which good coal has been reported to be found, and reports the coal in all of them to be worthless.

On the Wood river Mr. Chisolm reports the occurrence of a form of graphite. The product from the beds in all these localities is reported as worthless. Although no special information has been obtained as to the coal which has been produced, it is believed that several hundred tons of coal have been mined in different portions of the Territory for local consumption by prospectors and miners.

ILLINOIS.(a)

Total product in 1888, 14,655,188 short tons; spot value, $16,413,811.

The greater portion of what has been classified under the name of the Central field lies in the State of Illnois. The State contains one hundred and two counties, and out of these fifty produce coal. Macoupin, Saint Clair, and La Salle are reported among those which produce the largest amount of coal, and Brown and Coles among those which produce the smallest amount.

According to the late Prof. A. H. Worthen, State Geologist, the productive coal area of the State is about 37,000 square miles, although Dr. Theo. B. Comstock believes that the actual area underlaid by coal beds which can be profitably mined will not exceed more than from 10,000 to 25,000 square miles.

According to the reports of the State mine inspectors, the most prolific, accessible, and easily worked seam of coal in the State is found in the Belleville district, in the four or five counties east of the Mississippi river at Saint Louis. The seam is from 6 to 8 feet in thickness, and lies usually 100 feet under cover; seldom less than 50 and rarely more than 250 feet.

A summary of the general statistics for the past four years is shown in the following table:

Statistics of the Illinois coal field.

Years.	Counties producing coal.	Mines and openings of all kinds.	Employés of all kinds.	Mining machines employed.	Tons of lump coal mined.	Aggregate value of the same at the mines.	Average value per ton at the mines.	Average number of days in active operation.
1885	50	778	25,446	....	9,791,874	$11,456,493	$1.17	225
1886	50	789	25,846	235	9,246,435	10,263,543	1.11	206
1887	49	817	26,804	....	10,278,890	11,152,596	1.085	213.2
1888	50	833	29,410	272	11,855,188	13,309,030	1.123	220.6

Years.	Average price paid per ton for mining.	Kegs of powder used.	Mules employed underground.	Men killed.	Men injured so as to lose time.	Tons mined for each life lost.	Employés for each life lost.	New mines opened.	Mines abandoned.
1885	$0.725	140,382	....	39	176	251,073	652	....	....
1886	.616	127,099	1,344	52	169	177,816	497	....	....
1877	.727	152,627	1,474	41	180	244,735	409	....	.....
1888	.716	190,710	....	55	179	215,549	535	99	94

a The accompanying statistical report of lump, nut, and slack coal consumed during the calendar year from the Illinois coal mines has been prepared by Col. J. S. Lord, secretary of the State of Illinois Bureau of Labor Statistics, for the fiscal year ending July 1, 1888.

The figures showing the production of lump coal for 1888 exhibit an output greater by a million and a half tons than has ever before been attained in this State; a somewhat better average price for the same, and an increase in working force corresponding with the greater amount of work done. This indicates, however, not so much an increase in the number or capacity of the mines of the State, as an enlargement of opportunities to market the product; in other words, those favorable conditions which constitute a good season, and afford a fair chance for the mines already open. The capacity of existing mines in this State is in fact largely in excess of any demand which has yet been made upon them, and there is every present prospect that this disparity will be maintained, as the development of new mines quite keeps pace with, if it does not exceed, any increase which may be legitimately anticipated in the demand.

There has been a marked tendency during the year to enlarge the operations of existing companies and to organize new ones for the further development of such seams as are of established location and character. Something of this is observable in the northern fields adjacent to the recently acquired territory of the Spring Valley Company. In this field the Chicago, Wilmington and Vermilion Company has secured a foothold for operations auxiliary to their extensive enterprises at Streator and Braidwood; and a new company from a neighboring State, the Whitebreast Fuel Company, has also acquired property here and has encountered and overcome great obstacles in sinking to the superior lower seam of this region. Still greater activity in original enterprises has characterized some points in the central and southern portions of the State. Shafts have been sunk in McLean county, at Colfax, Saybrook, Maroa, and Lexington, and with notable success at Colfax, where a coal of good quality is found. The thickness and excellence of the seam at Pana, in Christian county, has especially stimulated operations at that point and in that vicinity. Two new companies have been organized and are advancing their works at Pana, and others are sinking or prospecting at the neighboring towns of Taylorville, Oconee, Ramsay, Coffeen, Moawequa, and Assumption. The coal in this field is probably from 500 to 800 feet below the surface, and is 7 or 8 feet in thickness. Operations are predicted upon its being substantially uniform and persistent throughout that region, though it has not been found in place at Assumption. In Marion county, some 50 miles or more south of this, there have been several very deep shafts sunk to coal recently, viz: at Odin, Salem, and Kinmundy, and the projectors of these enterprises are now ready to compete in the market with the older collieries at Centralia and Sandoval. Still farther south, in Perry and Jackson counties, notably in the vicinity of Elkville, desirable tracts of coal lands have been taken up during the year for the purpose of immediate development, and indications point to a material increase in the output of coal from that field.

There has been a revival of prospecting and of development at other points, as well as some exhaustion and abandonment of mines, the statistics of which are found in the inspectors' tables; but in general the tendency is towards an increased production. This may be ascribed to several causes, conspicuous among which, no doubt, is the degree of prosperity which has attended the business during the year, and the consequent impression that a coal mine is an unfailing source of wealth to its owners; beyond that is the broader view that this State, by its location and established wealth of mineral, must be the natural source of supply for an extended territory; that the coal of western States will prove a diminishing factor in the markets of the northwest, and that natural gas and crude oil will prove less formidable competitors as commercial fuel than had been supposed.

Number and character of mines.—In the foregoing summary the whole number of mines and openings of every kind is given as 833; of these, however, 11 are found to be so-called "strippings," where the coal, lying near the surface, is uncovered and quarried, and they are consequently dropped from the classification of mines proper, leaving a total of 822. This shows an increase of 21 over the number reported for 1887. Of these 21 mines, 8 are found to be mines of the first class, or those which produced more than 50,000 tons, and 13 to be of the second class, or those which produced from 10,000 to 50,000 tons. In mines of the third class there are 7 mines less, and in those of the fourth class 7 mines more than in the year preceding, which equalize the whole number in these two classes.

Following the classification in former reports, and including the tabulations made for former years, the following comparative statement is made of the relative number and relative product of the coal mines of the State for a series of six years:

Classification of the coal mines of Illinois.

Years.	Number of mines producing less than 1,000 tons.	Number of mines producing from 1,000 to 10,000 tons.	Number of mines producing from 10,000 to 50,000 tons.	Number of mines producing over 50,000 tons.	Total number of mines.
1883	209	233	135	62	639
1884	262	273	146	60	741
1885	286	290	139	63	778
1886	316	280	136	57	789
1887	320	278	139	64	801
1888	327	271	152	72	822

This shows a continual increase in the number of mines during a period of six years, and at present 183 more mines than in 1883. Ten of these are mines of the first class, 17 of the second class, 38 of the third class and 118 of the fourth class. This classification is not based on the capacity but upon the actual product, so that it is not exact as to what might be produced by the several establishments under favorable conditions. The same rule, however, has been applied to the separation of mines in each year, so that the relative showing is true.

That the mere enumeration of the places where mineral is found and taken for use signifies very little, unless some indication is given as to their relative capacity, is made apparent upon a comparison of the relative tonnage of the several groups of so-called mines in this table. Here are 598 mines of the two smaller classes whose total output is only about 8 per cent. of the whole; while the 72 mines of the first class produce over 60 per cent., and the 224 mines of the two larger classes produce 92 per cent. of all the coal mined in the State. Below is a statement of the relative product of the several classes of mines for the last two years:

Relative production by the several classes of mines.

Years.	Mines producing more than 50,000 tons.		Mines producing from 10,000 to 50,000 tons.		Mines producing less than 10,000 tons.		Total.	
	Number.	Short tons.	Number.	Short tons.	Number.	Short tons.	Number.	Short tons.
1887	64	5,949,894	139	3,270,681	598	1,058,315	801	10,278,890
1888	72	7,188,507	152	3,666,324	598	1,000,357	822	11,855,188

It is observed here that the gain both in mines and in tonnage is in the more important classes, while the output of the mines grouped in the lower classes is, in the aggregate, somewhat less than for the year preceding. But it is also true that a portion of the mines which produced less than 10,000 tons in that year would in a good season so increase their product as to gain position in a higher class. This doubtless explains the fact that there are fewer mines in the third class and more in the second than in the former year. The five mines from which were delivered the greatest number of tons of coal during the year are the following:

Five mines showing largest output for 1888.

Mines.	Towns.	Counties.	District.	Output.
			No.	*Short tons.*
Chicago, Milwaukee and St. Paul Coal Co. No. 2.	Braceville	Grundy	1	243,495
Chicago, Wilmington and Vermilion "J" .	Braidwood	Will	1	240,190
Chicago, Wilmington and Vermilion No. 3 .	Streator	Livingston ...	1	229,829
Spring Valley Coal Co. No. 1	Spring Valley ..	Bureau	2	203,700
Spring Valley Coal Co. No. 2	....do	....do	2	203,500
Total tons	....	....	......	1,120,714

These are the only mines from which were hoisted 200,000 tons or more during the year, and the first of these has been distinguished for a number of years as the greatest producer in the State.

Output for the year.—The whole number of tons of lump coal delivered from the mines of Illinois during the year ended July 1, 1888, was 11,855,188. This is 1,576,298 tons more than the output for the year preceding, and more than that of any other year in the history of the State. The following are the summaries for the total production of coal in Illinois, in tons of 2,000 pounds of lump coal, for a series of eight years:

Total product of coal in Illinois for eight years.

Years.	Short tons.	Years.	Short tons.
1880	6,115,377	1885	9,791,874
1882	9,115,653	1886	9,246,435
1883	10,030,991	1887	10,278,890
1884	10,101,005	1888	11,855,188

These totals have been compiled from exact data procured by this bureau for each of the foregoing years except 1880, for which year the total given was compiled by the United States census officials. This presentation is noteworthy not only as indicating the unusual activity in mining enterprises in 1888, but equally as showing the depression in this business during the years 1885 and 1886.

The foregoing totals represent, as indicated, the total tonnage in the commercial grade known as lump coal, but there is at every mine a product known as nut coal, which is obtained by dumping the coal as it comes from the mine over a screen in order to sift out the slack and small coal made in the mine, and prepare the lump coal better for market; underneath the first is a second screen which separates the slack from the nut coal, which is thus also prepared for market, and makes an excellent fuel. The proportion of nut coal thus obtained depends of course upon the dimensions of the screen, and varies widely in different parts of the country and of this State. Recent official statistics of coal production in Ohio give as the amount of screenings, nut, pea coal, and slack, "sold and shipped" in that State in 1887, a total tonnage equal to 30 per cent. of all the lump coal produced. If to this be added the portion of slack not sold and shipped, the total of screenings taken from the miners' output in Ohio would seem to be 35 or 40 per cent. of all the coal mined, of which 30 per cent. is sold and shipped. The screens of this State, however, do not permit any such portion of the total product to pass through them, and rarely admit of making pea coal at all. In fact the statistics of screen dimensions, as compiled and published in a recent report of this bureau, establish the fact that the proportion of nut coal made in this State is equal to 13 per cent. of the lump coal product. It is proper, therefore, that this increment should receive recognition, especially in making comparisons with other States, or in computing the total contribution of this State to the fuel supply of the country. Omitting the consideration of slack altogether, as an uncertain and inconsiderable element in the commercial product, and adding to the total tons of lump, as given, 13 per cent. for other forms of merchantable screenings, and the output of this State is increased from 11,855,188 tons to 13,396,362 tons (*a*), which is doubtless very nearly the true tonnage consumed. Formerly the proportion of screenings was larger in this State than now, and in future it is believed it will be less, as the tendency is towards a reduction in the size of screens. At present 65 per cent. of the coal mined in this State is screened over bars seven-eighths of an inch apart, which is regarded as a standard and legitimate screen.

The gain in the output in 1888 is found to have been made in the following amounts in the several districts: In the first district 190,965 tons; in the second district 224,160 tons; in the third district 410,726 tons; in the fourth district 286,249 tons. and in the fifth district 464,198 tons. The largest gain in any one county was in Bureau county, which produced 205,517 tons more than in the year preceding; there was a gain, however, of 166,430 tons in Saint Clair county; 162,622 tons in Macon county, and large gains in Vermilion, Fulton, Livingston, and other counties; while in La Salle county the product was 34,800 tons less than in 1887. Saint Clair county ranks as the greatest producer of coal in 1888. The ten foremost counties, with their respective tonnage, are as follows:

Product of coal in the ten principal counties of Illinois in 1888.

No.	County.	Tons.	No.	County.	Tons.
1	St. Clair	1, 184, 579	6	Bureau	635, 097
2	La Salle	1, 090, 435	7	Peoria	533, 817
3	Macoupin	1, 016, 624	8	Madison	512, 948
4	Grundy	862, 866	9	Vermilion	499, 076
5	Sangamon	764, 970	10	Livingston	495, 388

The output of each county for the two years, 1887 and 1888, and the gain or loss of each, and of the several districts, in the latter year, is given in detail in the following table:

Comparative coal product in 1887 *and* 1888, *in Illinois.*

Counties.	Output.		Counties.		District (net gain).
	1887.	1888.	Gain.	Loss.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
First district	2, 686, 829	2, 877, 794	240, 765	49, 800	190, 965
Counties:					
Grundy	792, 954	862, 866	69, 912		
Kankakee	97, 000	82, 000		15, 000	
La Salle	1, 125, 235	1, 090, 435		34, 800	
Livingston	387, 600	495, 388	107, 788		
Will	284, 040	347, 105	63, 065		

a It is estimated that the total production of all coal used, including lump, nut, and slack, for the calendar year 1888, was 14,655,188 short tons.

Comparative coal product in 1887 *and* 1888, *in Illinois*—Continued.

County.	Output.		Counties.		District (net gain)
	1887.	1878.	Gain.	Loss.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Second district	1, 069, 027	1, 293, 187	273, 382	49, 222	224, 160
Counties:					
Bureau	429, 580	635, 097	205, 517		
Hancock	6, 208	6, 515	307		
Henry	117, 533	108, 831		8, 702	
Knox	64, 324	57, 043		7, 281	
Marshall	73, 928	87, 013	13, 085		
McDonough	110, 103	104, 274		5, 829	
Mercer	127, 708	167, 931	40, 223		
Rock Island	85, 282	57, 872		27, 410	
Schuyler	22, 686	34, 403	11, 717		
Stark	17, 865	18, 690	825		
Warren	13, 810	15, 518	1, 708		
Third district	1, 781, 395	2, 192, 121	435, 316	24, 590	410, 726
Counties:					
Cass	2, 325	7, 300	4, 975		
Fulton	337, 215	461, 589	124, 374		
Logan	159, 000	174, 330	15, 330		
McLean	141, 700	117, 110		24, 590	
Menard	155, 621	181, 075	25, 454		
Peoria	452, 123	533, 817	81, 694		
Tazewell	51, 847	59, 324	7, 477		
Vermilion	359, 119	499, 076	139, 957		
Woodford	122, 445	158, 500	36, 055		
Fourth district	2, 568, 291	2, 854, 540	306, 218	19, 969	286, 249
Counties: (*a*)					
Bond	36, 076	38, 200	2, 124		
Calhoun		1, 036	1, 036		
Christian	149, 973	147, 030		2, 943	
Coles (*b*)	34, 612	27, 210		7, 402	
Greene	12, 578	14, 494	1, 916		
Jersey	2, 684	3, 949	1, 265		
Macon	118, 183	280, 805	162, 622		
Macoupin	926, 588	1, 016, 624	90, 036		
Madison	521, 705	512, 948		8, 757	
Montgomery	10, 220	14, 295	4, 075		
Morgan	6, 669	12, 545	5, 876		
Sangamon	730, 391	764, 970	34, 579		
Scott	9, 802	12, 491	2, 689		
Shelby	8, 810	7, 943		867	
Fifth district	2, 173, 348	2, 637, 546	477, 515	13, 317	464, 198
Counties:					
Clinton	55, 238	66, 463	11, 225		
Gallatin	31, 437	45, 374	13, 937		
Johnson	28, 000	28, 210	210		
Jackson	375, 718	445, 575	69, 857		
Marion	98, 915	156, 975	58, 060		
Perry	319, 552	306, 235		13, 317	
Randolph	74, 263	167, 321	93, 058		
Saline	19, 518	32, 550	13, 032		
St. Clair	1, 018, 149	1, 184, 579	166, 430		
Washington	40, 220	43, 600	3, 380		
Williamson	112, 338	160, 664	48, 326		
State totals	10, 278, 890	11, 855, 188			1, 576, 298

a Edgar and Jasper counties, each having one mine not operated, not included.
b The output of one mine which was abandoned in February, 1888.

Although, as has been shown, an exact enumeration gives eight hundred and thirty-three as the whole number of openings from which coal is taken, yet comparatively few of these can take rank as establishments of the first magnitude. An examination on this line shows that somewhat more than half the total product is mined by twenty-one of the great companies from eighty-five mines, situated in forty-five towns and villages in twenty-one counties, and is the result of an average of two hundred and twenty-seven and two-tenths days' operations. The details of this general statement are presented in the following table, showing the title, field of operations, and output of the more conspicuous producers:

Statistics of production of twenty-one leading coal companies in Illinois in 1888.

Names of companies, firms, or individuals owning mines.	Location. Town.	Location. County.	Number of mines.	Output.	Number of miners.	Number of other employés.	Average number days worked.
				Tons.			
Consolidated Coal Company	(*a*)	(*a*)	(*b*) 43	2,114,339	2,741	624	211
Chi., W. and V. Coal Company.	(*c*)	(*c*)	(*d*) 6	874,917	1,840	446	209
Spring Valley Coal Company.	Spring Valley ..	Bureau	3	545,800	1,300	400	250
Chicago, Milwaukee and Saint Paul Coal Company.	Braceville	Grundy.....	2	278,522	620	230	217
Saint Louis Ore and Steel Company.	Murphysborough.	Jackson	2	250,555	314	12	247
Taylor Williams	(*e*)	(*e*)	5	236,530	665	146	231
Star Coal Company	Kangley	La Salle.....	2	165,162	405	90	233
Wilmington C. M. and M. Company.	Diamond	Grundy.....	1	155,390	300	50	200
Wilmington Star Manufacturing Company.	Coal City	....do	(*f*) 2	153,725	415	96	176
Decatur Coal Company	Decatur	Macon	2	151,071	245	115	298
Pana Mining Company.....	Pana	Christian ...	2	146,605	90	54	144
City Coal Company	Niantic	Macon	1	129,734	194	38	209
Girard Coal Company......	Girard	Macoupin...	1	127,219	140	20	265
Chicago and Minouk Coal Company.	Minonk..........	Woodford..	1	127,000	200	60	265
La Salle County Carbon Coal Company.	La Salle	La Salle.....	2	125,682	353	125	181
McLean County Coal Company.	Bloomington....	McLean	1	116,260	300	60	280
Coal Valley Mining Company.	Cable...........	Mercer	2	105,630	306	139	176
Emmerson & Company.....	(*g*)	Fulton	2	104,172	185	28	185
Union Coal Company	Peru............	La Salle.....	1	102,835	263	115	300
Illinois Valley Coal Company.	Oglesby	....do	1	100,877	180	73	300
Grape Creek Coal and Coke Company.	Grape Creek....	Vermilion ..	3	100,550	288	44	194
Total..................	....	....	85	6,212,575	11,344	2,965	227

a Mines located as follows: Vermilion county, Danville, 3. Macoupin county, Staunton, 3; Mount Olive, 4; Gillespie, 1; Clyde, 1, and Carlinville, 1. Madison county, Collinsville, 2; Troy, 2, and Worden, 1. Clinton county, Trenton, 1. Randolph county, Coulterville, 1. Saint Clair county, Birkner, 2; Marissa 2; Ridge Prairie, 1; Collinsville, 1; Belleville, 13; Lebanon, 1; Lenzburg, 1, and Heinrich, 1. Washington county, Nashville, 1.

b Includes one mine abandoned in March, 1888. Output, 16,877 tons.

c Mines located as follows: Grundy county, Braidwood, 1. Will county, Braidwood, 2. La Salle county, Streator, 2. Livingston county, Streator, 1.

d Includes one mine abandoned permanently this year. Output, 73,418 tons.

e Mines located as follows: Grundy county, Gardner, 1. Kankakee county, Clark City, 1. Fulton county, Saint David, 1, and Norris, 1. Rock Island county, Rapids City, 1.

f Includes one mine abandoned this year. Output, 16,463 tons.

g One mine at Astoria and one at Dunfermline.

Value of coal at the mines.—The average value, at the mines, of the coal produced during the past year, as derived from the reports of operators, and computed for the total output of the State, is found to have been $1.123 per ton. For the year preceding the average value was $1.085 per ton, and for the year before that, 1886, it was $1.10 per ton;

the average for this year being somewhat better than for two years past. This is the first year since 1880 in which there has not been a decline from the average value of the former year. In fact, the tendency has been uniformly and not always gradually, downward for the last fifteen years, though the statistics of the subject do not go beyond 1880. From that date to 1887 the home value of coal, averaged for the State at large, declined from $1.51 per ton to $1.085 per ton; the tonnage meanwhile increased from 6,000,000 to 10,000,000. During the past year, however, with an output greatly in excess of that of any other year, there has also been some tendency to firmer prices, or at least a check to the continuous and long-sustained decline. This reaction has characterized all the districts except the second, in which the average value is reported 2½ cents a ton less than in 1887. In the first district, however, the gain in average value is 4.07 per cent.; in the third district, 3.96 per cent.; in the fourth, 6.76 per cent., and in the fifth, 4.19 per cent., making the average gain for the State 3.46 per cent. Below is given the result of similar computations for districts and the State for a series of seven years:

Average value of coal per short ton at the mines in Illinois.

Districts.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
First	$1.75	$1.59	$1.49	$1.41	$1.32	$1.316	$1.3696
Second	1.87	1.97	1.79	1.71	1.57	1.497	1.4725
Third	1.43	1.45	1.31	1.25	1.16	1.095	1.1384
Fourth	1.33	1.32	1.09	.985	.969	.887	.9470
Fifth	1.31	1.26	.961	.894	.862	.823	.8575
The State	1.51	1.48	1.26	1.17	1.10	1.085	1.1226

These averages have been computed similarly and from parallel data for each year, and although they can not be exact as to the prices actually received, are in general true as to prevailing values and the tendency of the market.

Prices paid to operatives for mining.—Heretofore all statistics on the subject of wages paid to miners in this industry have been confined to the prices paid per ton to hand miners as distinguished from those who work with and about machines. During the past year some facts have been taken concerning the labor cost of coal produced by machines, and the prices for mining are consequently considered now for the first time under both systems.

Hand mining.—The average rate per ton paid for mining coal with the common pick, including blasting, timbering, and loading, for the State at large, for 1888, as deduced from the specific amounts produced and prices paid in each locality is 71.7 cents, while the corresponding rate for the year preceding was 72.7 cents, a decline of 1 cent per ton. While this is true of the State, however, there are fractional gains in the prices of mining in the third, fourth, and fifth districts, which are somewhat more than offset by a slight decline in the first and second districts; all these variations, however, are so insignificant as to practically leave the prices unchanged from those of 1887. The following table shows the averages of prices paid for hand mining in each district and the State for a period of six years:

Average prices paid per ton in Illinois for hand mining, 1883 *to* 1888.

Districts.	1883.	1884.	1885.	1886.	1887.	1888.
First	$0.917	$0.906	$0.867	$0.859	$0.891	$0.8885
Second	.983	1.00	.941	.927	.927	.9181
Third	.875	.873	.814	.729	.688	.7055
Fourth	.71	.694	.62	.573	.576	.6136
Fifth	.619	.60	.511	.501	.537	.5536
The State	.802	.783	.725	.676	.727	.7171

This shows the lowest price to have been reached in 1886, the year in which, also, the smallest aggregate of coal was produced.

Following is a combination of the results shown in the foregoing tables of values and prices, in which the ratio is brought out between the principal factor in the cost of production and the value of the product.

Average value of coal and average prices for mining in Illinois from 1883 *to* 1888.

Districts.	1883.		1884.		1885.		1886.		1887.		1888.	
	Average value of coal.	Average price of mining.	Average value of coal.	Average price of mining.	Average value of coal.	Average price of mining.	Average value of coal.	Average price of mining.	Average value of coal.	Average price of mining.	Average value of coal.	Average price of mining.
First	$1.59	$0.917	$1.40	$0.906	$1.41	$0.867	$1.32	$0.859	$1.316	$0.891	$1.3696	$0.8885
Second	1.97	.983	1.79	1.00	1.71	.941	1.57	.927	1.497	.927	1.4725	.9181
Third	1.45	.875	1.31	.873	1.25	.814	1.16	.729	1.095	.688	1.1384	.7055
Fourth	1.32	.71	1.09	.694	.985	.62	.969	.573	.887	.576	.9470	.6136
Fifth	1.26	.619	.961	.60	.894	.511	.862	.501	.823	.537	.8575	.5536
The State	1.48	.802	1.26	.783	1.17	.725	1.11	.676	1.085	.727	1.1226	.7171
Ratio of price of mining to value of coal, per cent	54		62		62		61		67		64	

The foregoing deductions point to the general conclusion that as the value of the product and the price paid for mining decrease, the share of the total value which the miner receives increases. In the last year this share appears as 64 per cent. as against 67 per cent. the year preceding, because of the fact that the movement was not uniform in values and prices, the former having increased about 4 cents per ton, while the latter decreased 1 cent per ton. It should be borne in mind that these figures refer only to prices paid for mining with the hand pick and such labor as that system implies. Somewhat more than 80 per cent., however, of all the coal produced in this State is at present mined by hand.

Mining with machines.—The process of mining coal has from the earliest period been exclusively a hand process, and that of the ruder sort, requiring strength and endurance rather than a high order of skill; and the conditions under which it is necessarily performed have seemed until recently to defy the application of power machinery to this industry. In recent years, however, this process has been attempted, and in a measure successfully accomplished, by means of machines driven by compressed air, which perform the undercutting of the coal in a manner very similar to that of the miner with a pick, though with greater rapidity, and where the conditions are favorable at a less cost per ton to the operator of the mine. The most successful of these machines was invented in this State, and has been introduced and is now in use at so many of the principal mines that a special inquiry as to the present development of machine mining, and the peculiarities of employment which it involves has been made for this report. The statistics of the subject, briefly stated, are, that during the year 1888 there were 272 mining machines in use in this State, and that with them 3,088 men produced 2,243,210 tons of lump coal; in other words, nearly 20 per cent. of the whole output was mined by machines operated by 10 per cent. of all the men. Of these machines 245 are of the Harrison patent, 17 are the Legg or Lechner machines, and 10 are Yock machines. Distributed geographically, 218 machines are in use in the fourth and fifth districts, embracing the central and southern portions of the State, and with them 2,673 men produced 2,055,895 tons; that is to say, 80 per cent. of the machines, employing 86 per cent. of the men, and producing 92 per cent. of the coal mined by machines are in this territory. Tabulated in detail the distribution is as follows:

Statistics of machine coal mining in Illinois in 1888.

Districts.	Number and kinds of machines in use.			Total tons produced.	Number of men employed.
	Harrison.	Legg.	Yock.		
First district	30	3	....	151, 518	242
Second district	6	2	....	4, 735	79
Third district	8	5	....	31, 062	94
Fourth district	114	6	....	1, 112, 002	1, 220
Fifth district	87	1	10	943, 893	1, 453
The State	245	17	10	2, 243, 210	3, 088

In many places the use of mining machines has been largely experimental during the year, so that the reported results as summarized do not always afford a true index of their capacity at steady work. This is especially true of the second and third districts, in the former of which the machines reported have been used in driving entries and in other irregular or special work, while in the third the use of the machines has not been sufficiently uniform to make a fair showing for an entire year. In the first, fourth, and fifth districts the machines have had the most extended trial, and the results show more fully what may be expected of them under favorable conditions. Grouping the figures in these districts, it is found that 251 machines, operated by 2,915 men, have produced 2,207,413 tons, or 757 tons per man, and 8,795 tons per machine. But the coal in the first district is not much more than half the thickness of that in the other two, consequently the product per man and machine should be correspondingly less. Computed separately, the product in the first district is 626 tons per man and 4,591 tons per machine, while in the other two it is 761 tons per man and 9,431 tons per machine. An exact deduction as to the performance of these machines can only be made, however, upon a consideration of the actual number of days in the year in which they were operated. This does not appear definitely in the schedules, for the reason that the working time for the machines is not separated from that of men mining by hand. It is sufficiently established, however, that there are advantages in the use of machines under favorable conditions, but that they can not be uniformly applied with profit. The specific facts concerning the use of machines in the several districts may be learned from the reports of the inspectors.

The advantages derived from machinery in mines are very much the same as those which flow from the use of machinery everywhere. They consist not only in the greater execution of the machine, but in the subdivision of labor which it involves and the greater per capita efficiency of the force thus secured. The gain is consequently to the employer rather than to his men. The mining machine is in fact the natural enemy of the coal miner; it destroys the value of his skill and experience, obliterates his trade, and reduces him to the rank of a common laborer or machine driver if he remains where it is. The older miners can not readily adjust themselves to the change and seek other fields; if possible, those where the machine can not come. The younger men remain and adapt themselves to the peculiar forms of endurance which the machine demands, or devote themselves to the development of special skill in some of the new divisions of labor which it creates.

The mining machine not only revolutionizes the methods of work, but it equally changes the system of wages. The coal miner proper takes his own tools into the pit and undertakes to deliver from the wall of mineral before him certain tons of coal ready for market for a certain sum per ton. His earnings depend upon himself, and the better the man the better the pay. He mines and drills and blasts and loads his own coal, timbers his own roof, takes care of his own tools, and is responsible mainly to himself both for his personal safety and the amount of his output.

In the machine mine it takes seven or eight men to perform these various functions, and, in the mine as in the mill, the machine is the master and the men are its servitors. The operator of the mechanism simply directs its energies, when the motive power is given to it, and the coal is undercut or mined; the blaster follows with drills and explosives to loosen the mass; the loaders reduce it and shovel it into pit-cars; the timbermen follow and prop the roof which no longer has the mineral to rest upon; laborers assist in every process, and a machinist is retained for repairs. Each one does his certain portion of the work and no more, and doubtless does it better as well as faster by reason of his greater skill thus acquired; but this is only one small talent at the best, and chiefly consists in that sort of activity and hardness which is common to all good workmen, and which qualifies any good workman to take his place. Herein lies the chief value of the machine to the mine owner. It relieves him for the most part of skilled labor, and of all the restraints which that implies; it opens to him the whole labor market from which to recruit his forces, it enables him to concentrate the work of the mine at given points, and it admits of the graduation of wages to specific work and the payment of wages by the day. These conditions signify a more effective organization of the working force, and doubtless reduce the ultimate cost of production, even though the output be not materially increased.

Employés.—As should be expected from the greater output, the number of persons who have gained their livelihood through this industry during the year is materially larger than in the year preceding.

The statistics of employés for a series of years may be summarized as follows:

Employés in Illinois coal mines from 1882 *to* 1888.

Years.	Miners.	Others.	Total.
1882	....	....	20, 290
1883	20, 839	3, 100	23, 939
1884	20, 610	4, 965	25, 575
1885	20, 772	5, 174	25, 946
1886	20, 973	4, 873	25, 846
1887	21, 158	5, 646	26, 804
1888	23, 648	5, 762	29, 410

These are the numbers reported each year by the employers, as the average number employed during the winter or busy season, which comprises in general about eight months. Of course it can not be exact, as the number of men at work at each place fluctuates from week to week with the demand for coal, but the figures are doubtless substantially correct for the maximum of employés. The number at work during the summer months is materially less, though the unemployed are usually seeking other occupations in the vicinity, and are available at the mine, if required.

The increase in men over those employed in 1887 is nearly 10 per cent., but the increase in output is 15¼ per cent. The product per man for 1887 was 486 tons, and for 1888 was 501 tons.

Of the whole number of employés, 3,088, or practically 10 per cent., are engaged in machine mining. Dividing the tonnage cut by machines by this number of operatives, it is found that the per capita product under this system is 726 tons per man. This, however, is the deduction as to all machine work and all men engaged in it; a former deduction shows the specific performance of machines in selected localities where there has been the least hinderance to continuous and systematic work.

The number of days worked during 1888 at 282 mines throughout the State, which employed 88 per cent. of all the mining labor and which produced 93 per cent. of the total product, is shown in the following table:

Days worked during 1888 in Illinois coal mines

Inspection districts.	Average number of days.	Per cent. of total product.	Per cent. of total employés.
First	216	97	95
Second	219	82	71
Third	219	91	89
Fourth	230.7	95	91
Fifth	219	94	88
The State	220.6	93	88

These deductions are obtained from the experience of the industry as a whole. In a former table giving the experience of 85 of the largest mines, it is shown that they delivered 52.4 per cent. of the total product of the State, gave employment to 47.3 per cent. of all the men, and made an average of 227.2 days of running time.

The following statement shows by inspectors' districts the results of the year's operations in the 282 mines which produced 93 per cent. of the total output of the State:

Average tons raised, number of mines, etc., 1888.

Inspection districts.	No. of mines.	Average number of men per mine.	Average days worked.	Average tons per man per annum.	Average tons per day per mine.
First	37	221.5	216	340.2	363
Second	32	109	219	304.6	151.3
Third	80	58.3	219	428	114
Fourth	51	90.8	230.7	587	231
Fifth	82	59.3	219	506.9	137.3
The State	282	91.7	220.6	427	177.3

The statistics of casualties in and about the coal mines of Illinois have been taken now for six years, and the results of the inquiry, together with corresponding statistics of production, are herewith presented:

Casualties in coal mining in Illinois compared with the production.

Years.	Killed.	Injured	Total men employed.	Total tons of coal produced.	Fatal casualties.		Non-fatal casualties.	
					Employés to each life lost.	Tons of coal produced to each life lost.	Employés to each accident.	Tons of coal produced to each accident.
1883	134	231	23,939	10,030,991	179.6	74,858	103.6	43,424
1884	46	197	25,575	10,101,005	556.0	219,587	129.8	51,274
1885	39	176	25,446	9,791,874	652.4	251,074	144.6	55,634
1886	52	169	25,846	9,246,435	497.0	177,816	153.5	54,713
1887	41	180	26,804	10,278,890	654.0	244,735	149.0	57,105
1888	55	179	29,410	11,855,188	534.7	215,549	164.3	66,241
Total	367	1,132	157,020	61,304,383	....	....	....	....
Average	61.1	188.7	26,170	10,217,397	427.8	167,042	138.7	54,156

Mr. J. H. Decker, secretary of the American Water Works Association, Winfield, Kansas, made boiler tests some time ago at Hannibal, Missouri, of a number of Illinois coals and has reported the following results: The tests were with two boilers 60 inches by 16 feet, having eighty-four 3-inch tubes, set independently, ordinary plain setting, single return draught. The grate surface was 25 square feet, and common grate bars with three-eighths air space.

Boiler tests of Illinois coal.

Sources of coal.	Water evaporated per pound of coal.	
	Actual.	From 212°.
	Pounds.	*Pounds.*
Neelyville	7.179	8.509
Athens	6.49	7.83
Colchester and Springfield	5.80	6.46
Colchester	6.13	7.50
Dawson	5.17	6.25
Rich Hill, Missouri	6.574	8.56

Mr. D. C. Cregier, late commissioner of public works, Chicago, has reported the following as the average of twenty-nine similar tests made at the West Side pumping station:

Boiler tests of Illinois coal.

Sources of coal.	Water evaporated per pound of coal.	
	Actual.	From 212°.
	Pounds.	*Pounds.*
Vermilion	5.97	5.68
Minonk	6.71	7.50
Grape creek	6.82	7.23
Wilmington and Springfield	6.96	7.38
Streator	7.16	7.59
Wilmington, Streator	7.24	7.67
Briar Ridge, nut	7.33	7.77
Seneca	7.36	7.80
Shawnee	7.44	8.32
Streator, nut	8.09	....
Briar Ridge	8.16	8.65
Shawnee	8.18	8.67

INDIANA.

Total product in 1888, 3,140,979 short tons; spot value, $4,397,370.

The coal fields of Indiana are confined to the southwestern part of the State, and constitute the northeastern portion of what has been designated as the Central or Illinois coal field of the United States. The western part of this field lies in Illinois and the southern part in Kentucky. Less than 10 per cent. of the entire area of the central field is in Indiana, while nearly 80 per cent. of the same field is embraced in Illinois. On account of this fact the general field within the three

States is more frequently designated as the Illinois field of the United States than as the Central field.

Great difficulty has been experienced in making a thorough and reliable estimate as to the total product of the State. Mr. Thomas McQuade, State mine inspector, has estimated it at 3,140,979 short tons during 1888.

The production for 1888 was 76,732 tons less than during 1887. The principal cause for this decrease has been the amount of coal displaced by the introduction of natural gas into Indianapolis and other cities within the State, and by the consumption of crude oil for fuel in Chicago, which is transported by the Standard Oil Company in a pipe line extending from the Lima oil field in Ohio to that city. If the consumption of natural gas in the State, and of oil in Chicago materially increase, the production of the Indiana coal mines will proportionately decrease unless consumers are found by the trade in districts into which the Indiana coal is not at present shipped. Against this unpromising outlook it is claimed that between $200,000 and $300,000 have been invested in unworked coal tracts and new mines in the State during the past year.

The following table exhibits the number of mines which were worked during the year in each county, and the number of men employed both inside and outside the mines:

Coal mines, and men employed, in Indiana during 1888.

[Employing 10 men or more.]

Counties.	Mines.	Men employed inside.	Men employed outside.
Clay	45	3,110	213
Daviess	15	438	61
Dubois	10	60	12
Fountain	10	73	14
Greene	9	398	39
Gibson	3	6	3
Knox	3	65	7
Martin	3	15	3
Owen	5	30	5
Perry	12	114	20
Parke	17	639	70
Pike	18	291	50
Sullivan	13	439	70
Spencer	10	35	10
Vigo	17	563	65
Vermilion	5	220	30
Vanderburgh	5	197	32
Warrick	12	75	12
Warren	2	17	2
Total	214	6,785	718
Total employés	....	....	7,503

The coal beds are locally designated by the letters of the alphabet, extending from A up to N, although no commercial coal beds have yet been discovered to correspond to the letters C, D, and E. The remaining eleven coal beds have an aggregate thickness of between 25 and 30 feet, and are included in coal measures whose average aggregate thickness in any one locality does not exceed much more than from 250 to 300 feet.

Professor Cox, late State geologist of Indiana, claims a thickness of 650 feet for the coal measures within the State in a number of localities.

The coal beds which are mined by the largest operator in the State, the Brazil Block Coal Company, are beds I and J. These beds vary in thickness from 2 feet, to 4 feet 6 inches. The beds are found to lie in local basins and their extent is considered limited.

The following table exhibits the total product of Indiana coal during the past sixteen years:

Annual product of coal in Indiana for sixteen years.

Years.	Quantity.	Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1873	1,000,000	1879	1,196,490	1884	2,260,000
1874	812,000	1880	1,500,000	1885	2,375,000
1875	800,000	1881	1,771,536	1886	3,000,000
1876	950,000	1882	1,976,470	1887	3,217,711
1877	1,000,000	1883	2,560,000	1888	3,140,979
1878	1,000,000				

The following tables exhibit the names of the mines in each county where ten or more men are employed, the names of the operators, the kind of mines, the kind of coal produced, the notation of the coal seam worked and its thickness and the average depths of the coal bed beneath the surface. They are compiled from Mr. McQuade's report.

The coals are all bituminous, except a few mines of block coal in Parke, Fountain, and Clay counties, and cannel coal in Daviess county.

Statistics of coal mines in Indiana.

Names of mines.	Operators.	Kind of mine.	Seam worked.	Coal thickness		Depth from surface.
VIGO COUNTY.				*Ft.*	*In.*	*Feet.*
Fountain No. 1	Coal B. M. Company	Shaft	L	6	0	62
Fountain No. 2	do	do	L	6	0	60
South mine	do	do	L	5	6	60
Kay	do	Slope	L	6	0	45
Eppart	do	Drift	L	6	0	40
New Edgar	do	Shaft	L	5	6	25
Seelyville	P. Ehrlich & Co	do	L	7	0	96
Foleys	Otter Creek Coal Company	Drift	L	5	0	40
Grant	Grant Coal Company	do	L	4	0	35
VANDERBURGH COUNTY.						
Ingleside	J. Ingle & Co	Shaft	K	4	0	263
Sunnyside	Sunnyside Coal Company	do	K	4	0	266
Unity	do	do	K	4	0	257
First avenue	First Avenue Coal Company	do	K	4	0	260
Echo	Diamond Coal Company	do	K	4	0	257

Statistics of coal mines in Indiana—Continued.

Names of mines.	Operators.	Kind of mine.	Seam worked.	Coal thickness. Ft.	In.	Depth from surface. Feet.
SULLIVAN COUNTY.						
Pioneer	Crawford Coal Company	Shaft	L	5	6	248
Shelburn No. 2	Shelburn Coal Company	do	L	5	0	248
Hancock	Hancock & Konkle	do	L	4	4	50
Lyenton	Lyenton Coal Company	do	L	5	0	70
Dugger	Dugger & Neil	do	L	5	4	70
Superior	Superior Coal Company	do	L	5	0	100
New Pittsburgh	Pittsburgh Coal and Coke Company.	Drift	L	6	6	60
VERMILION COUNTY.						
Sharky	Sharky Coal Company	Drift	L	4	4	90
Brown's	Brown	do	L	4	4	70
Norton Creek Nos. 1, 2	Norton Creek Coal Company.	do	L	6	0	40
WARRICK COUNTY.						
Fuller	R. Lowder	Shaft	K	6	6	45
De Forest	B. Menden	do	K	6	6	95
No. 3	Gossly & Co	do	K	6	0	85
PIKE COUNTX.						
Ayrshire	D. Ingle	Slope	L	4	8	65
Whitman	C. Townsend	Shaft	L	4	0	50
Blackburn	S. Bettaman	Slope	L	6	0	40
RogerBros	Roger Bros	Shaft	L	7	0	80
KNOX COUNTY.						
Indian Creek	Indian Creek Coal Company	Shaft	K	4	4	95
PERRY COUNTY.						
Sioux No. 2	A. C. Coal Company	Drift	F	3	0	150
Bergenroth	Bergenroth Bros	Shaft	G	3	3	140
PARKE COUNTY.						
No. 4	Parke County Coal Company	Shaft	L	4	0	80
No. 5	do	do	L	5	6	80
No. 6	do	do	L	6	0	70
Black Diamond	Stevens Coal Company	Slope	I	3	10	38
Blaine Shaft	B. B. Coal Company	Shaft	J	3	6	40
Blaine Slopes, 2 and 3	do	Slope	I	4	0	30
Cox No. 1	do	Shaft	L	5	6	100
Cox No. 2	do	do	L	5	6	50
DAVIESS COUNTY.						
Sulphur Spring	Cable & Kaufman	do	L	4	0	60
Eureka	do	Slope	L	3	0	48
Maple Valley	do	Shaft	L	4	6	74
No. 4	do	do	L	4	0	70
No. 6	do	do	L	6	6	49
Buckeye	Cannel Coal Company	do	I	4	0	100
Wilsons	Wilson Coal Company	do	I	3	6	96
Wilsons No. 2	do	do	L	6	0	67
Mutual No. 2	Mutual Mining Company	do	I	5	0	100
DUBOIS COUNTY.						
Rosebank	J. C. Foote	Drift	L	4	0	50
Barronian	A. Barronian	Shaft	L	4	0	60
FOUNTAIN COUNTY.						
Harrison	Harrison B. Coal Company	Slope	I	3	4	30
GREENE COUNTY.						
Island City No. 1	Island Coal Company	Shaft	L	5	0	60
Island City No. 2	do	do	L	5	0	70
Summit	Dugger, Neil & Co	do	L	5	6	76

Statistics of coal mines in Indiana—Continued.

Names of mines.	Operators.	Kind of mine.	Seam worked.	Coal thickness.		Depth from surface.
CLAY COUNTY.				*Ft.*	*In.*	*Feet.*
Gart No. 1	B. B. Coal Company	Shaft	J	3	0	109
Gart No. 2	do	do	J	3	5	120
Gart No. 5	do	Slope	J	3	0	75
Gart No. 6	do	Shaft	J	3	6	90
Gart No. 7	do	do	I. & J.	3	6	70
Gart No. 8	do	do	I.	4	0	95
Gart No. 9	do	do	I. & J.	4	0	100
Gart No. 10	do	do	I. & J	4	2	167
Chicago	do	do	J	3	4	80
Campbell	do	do	I	3	7	106
Crawfords No. 1	Crawford Coal Company	do	I. & J.	4	0	107
Crawfords No. 2	do	do	J	3	3	82
Crawfords No. 3	do	Slope	I	3	6	25
Peanut mine	E. L. Winklepleck	Shaft	J	3	4	80
Star	do	do	I. & J.	3	10	70
Peanut No. 2	do	do	I	3	10	40
Nickel Plate	Jackson Coal and Mining Company.	do	I. & J.	3	4	102
Chicago	A. P. Coal Company	do	J	3	6	40
South slope	P. Ehrlich & Co	Slope	I	3	5	30
Newburg	do	Shaft	L	7	0	75
Eureka	do	do	I	3	5	80
Staunton	J. Summers	do	L	6	6	38
Brushville	Gart Coal and Mining Company.	do	L	6	6	60
Watson's	do	do	I	3	3	50
Vandalia	Ziller & Sigler	do	I. & J.	3	0	37
Diamond	do	do	J	3	10	69
Church Hill	Weaver, Todd & Co	do	J	3	3	37
Litchfield	Coal Bluff Mining Company	do	I. & J.	3	4	90
Jumbo	Watson, Little & Co	do	I. & J.	4	0	70
Harrison	C. & I. B. Coal Company	do	I	4	6	90
Morris	John Morris	do	I	4	0	72
Lancaster No. 2	Lancaster Coal Company	do	I	4	6	60

INDIAN TERRITORY.

Total product in 1888, 761,986 short tons; spot value, $1,432,072.

All the producing coal mines in the Territory are located along the line of the Missouri Pacific railway within the reservation of the Choctaw Nation, which occupies the southeastern part of the Territory. The total increase in the product during 1888 over that for 1887 was 76,075 tons, and the increase in spot value during the same year was $145,380. The Indian Territory mines are operated by the Osage Coal and Mining Company and by the Atoka Mining Company. The mines of the Osage company are located at McAlester, in Tobocksey county, of the Choctaw Nation. The producing mines during the year were Nos. 7, 9, 10, and 11, and the total product of all the mines worked was 425,735 tons, of which 10,000 tons were consumed at the mines and 415,735 tons were shipped to various points in Texas, Mexico, New Mexico, and Arizona. The average selling price of this coal for the year, delivered on cars at the mine mouth, was $1.95. During 1887, 37,818 tons of the product of these mines was manufactured into coke for shipment, but during 1888 the company reports that no coke was made at the McAlester mines.

The mines were worked 236 days during the year, and there were on an average 955 miners and laborers employed. The aggregate wages paid to these men during the year was $732,890.60. The average thickness of the coal bed which is worked is from 3 feet 6 inches to 4 feet. The bed has considerable dip and contains a good quality of coal. The following table exhibits the composition of the McAlester coal and coke as reported by the company.

Analyses of coal and coke from McAlester, Indian Territory.

	Coal.	Coke.
	Per cent.	*Per cent.*
Ash	5.52	10.975
Fixed carbon	62.67	87.140
Volatile matter	29.71	1.560
Water	2.10	0.325
Total	100.00	100.00

The Atoka Coal and Mining Company operated mines Nos. 4, 5, and 6 during 1888, situated at Lehigh, in Atoka county, in the Choctaw nation. The total product of all kinds of coal mined was 336,251 tons; of this amount 9,355 tons were consumed at the mines and manufactured into coke, and 326,896 tons were shipped to consuming points, principally in Texas. The average selling price of this coal delivered on cars at the mouth of the mine was $1.79 per ton. The coal bed worked at these mines varies from 3 feet 11 inches to 4 feet 2 inches in thickness, and the coal which it produces is reported to be especially adapted for general manufacturing and steam uses. During the year the mines were worked two hundred and eighteen days, and on an average 750 miners and laborers were employed. The aggregate amount of wages paid to miners and laborers during the year was $508,923.08.

The following table exhibits an analysis of Atoka coal, as reported by the company:

Analysis of coal from Atoka, Indian Territory.

	Per cent.
Ash	10.49
Fixed carbon	45.74
Volatile matter	39.16
Water	4.61
Total	100.00
Sulphur	0.370

In addition to the mines operated in the interest of the Missouri Pacific Railway Company there are several openings throughout the Territory which have been mined to a greater or less extent to supply a very limited local demand. The recent opening up of Oklahoma will no doubt increase the consumption of coal within the limits of the Territory during the coming year; and the development of new mines, and an increased product of those already established, can be expected.

IOWA.

Total product in 1888, 4,952,440 tons; spot value, $6,438,172.

The statistics of the Iowa coal fields for the calendar year 1888 have been compiled from returns from the mine inspectors and facts collected directly by the United States Survey. The statistics of the Iowa coal mines collected by the mine inspectors cover the fiscal year extending from July 1, 1887, to June 30, 1888. This fact, together with the great difficulty which has been experienced by the State inspectors in getting the individual coal operators and operating companies to report their production, has made it necessary to collect a large amount of information independent of the State department, in order to determine the production for the calendar year 1888.

The Iowa mines produced, during the year 1888, 478,612 tons more coal than during 1887. The fact that the production of the Iowa coal mines during the past year increased, is important, and is not generally appreciated in the State or by the coal trade generally. This results, no doubt, from the fact that the proportion of the total product taken by local consumers is greater in the State of Iowa than in any other coal producing State. The number of small mines is greater than in any other State, and the production in special districts varies more from year to year, due to the increase of railroad construction and the competition with more valuable coals mined in adjoining States.

The State is divided into three inspection districts known respectively as the Southern or First district, of which Mr. Thomas Binks is inspector; the Northeastern or Second district, of which Mr. James Gildroy is inspector, and the Northwestern or Third district, of which Mr. James E. Stout is inspector. The most notable decrease in the production of coal of commercial sizes, excluding nut coal during the past year, was in the Third or Northwestern district, the decrease for the calendar year 1888 being 6,321 tons. In the table which follows the nut coal is included in 1888. In speaking of the general condition of the coal trade in this district under date of January 26, 1889, Mr. Stout says:

"There has been no special development in the Third district during the year; in fact there has been rather a retrograde movement, quite a number of mines being worked out and abandoned, and very few new ones opened, although the output of coal is nearly as large as during the preceding fiscal year. The condition of the coal trade in Iowa at the close of 1888 was very discouraging, owing to the continued warm weather. The outlook was very bright in the early part of the season, in fact better than usual, and there is no doubt that, if the weather had been as cold as the Iowa winters generally are, it would have been a very prosperous year; but at that time the mines in this district did not average half time, while the prices for the railroad trade were demoralized. It will be found by comparison that the average selling price of coal in this district is considerably higher than in either of the other districts, both for railroad use and for local trade, but the location of the Third district easily explains the fact, since mines in the southern and southeastern part of the State have to compete with coal brought from Missouri and Illinois mines, while the Third district, being the farthest northeast, has greater advantages as to location, and consequently coal can and does command better prices. Then again it will be impossible for the majority of the operators in the Third district to mine coal as cheaply as it is done in the other two districts, for several reasons; the coal beds are not so thick, the roof is not so good, and the coal exists in smaller basins. For these reasons the mines are operated on a small scale, and the coal can not be handled on so small a margin of profit as at the larger mines in the other two districts."

The following table shows the production of coal in each district for the past six years:

Total production of coal in Iowa by districts from 1883 *to* 1888, *inclusive.*

Districts.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*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	1, 528, 967
Second...	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978	1, 974, 352
Third.....	1, 403, 419	1, 417, 585	1, 194, 469	900, 741	791, 671	*a* 918, 503
Total ..	3, 979, 946	3, 902, 291	3, 582, 656	3, 853, 374	3, 994, 490	4, 421, 822

a Including nut coal in 1888.

As will be observed from the above total, there has been a slight increase in the production of coal since 1885, but there was a slight progressive decrease in the production of the State during the years 1883, 1884, and 1885. The following table exhibits the production of coal in each county in the first district for the past six years:

Product of coal in the first inspection district of Iowa from 1883 *to* 1888, *inclusive.*

Counties.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Appanoose............	128, 896	158, 986	245, 896	150, 000	160, 351	210, 263
Adams................	3, 891	3, 981	3, 896	9, 581	19, 851	18, 817
Davis................	527	1, 207	33, 655	1, 000	1, 800	1, 800
Jefferson............	38, 887	8, 172	1, 116	1, 083	10, 397	9, 387
Lucas................	487, 821	410, 729	439, 956	530, 759	472, 998	364, 969
Marion	90, 985	97, 085	100, 011	141, 694	212, 695	230, 652
Monroe	93, 435	98, 427	101, 517	117, 700	183, 505	233, 896
Page.................	748	1, 009	1, 819	1, 550	1, 780	3, 430
Taylor...............	94	127	617	8, 585	12, 180	8, 002
Van Buren............	1, 678	1, 778	1, 193	8, 038	26, 331	25, 960
Wapello	237, 821	240, 720	187, 911	237, 111	272, 073	380, 395
Warren...............	12, 828	13, 727	12, 825	23, 332	24, 796	17, 103
Wayne................	1, 892	4, 947	25, 812	34, 000	28, 084	24, 293
Total............	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841	1, 528, 967

The largest production in this district in 1887 was in the county of Lucas, where the production during 1888 was 108,029 tons less than during the previous year. The county which ranks first of the production for 1888 was Wapello; the increase in the production of this latter county during 1888 being 108,322 tons, practically the same as the decrease in the former county. The following table exhibits special facts connected with the production of coal in the first district counties during the fiscal year 1888:

General statistics of coal mining in the first district of Iowa in 1888.

Counties.	Number of mines.	Production, 1888.	Average thickness of coal beds worked.			Number of miners.
			Upper.	Lower.	Middle.	
FIRST DISTRICT.		*Long tons.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	
Appanoose	34	210,263		3 0		770
Adams	12	18,817	1 6			107
Davis	5	1,800		3 6		20
Jefferson	7	9,387			3 0	57
Lucas	13	364,969	2 6		5 0	930
Marion	44	230,652			4 2	454
Monroe	18	233,896		3 0	4 6	404
Page	4	3,430	1 6			28
Taylor	8	8,002	1 6			65
Van Buren	15	25,960			3 8	71
Wapello	22	380,395			4 2	816
Warren	27	17,103	1 6	3 6		113
Wayne	7	24,293		2 7		78
Total	216	1,528,967				3,913
General average of thicknesses			1 8	3 2	4 0	

The average number of miners employed in Appanoose county during the year was 132 greater than during the previous year, while the number of coal mines operated, 34, was one more than during 1887. This county produced 49,912 tons more coal than during 1887.

Only 12 coal mines were worked in Adams county during the year 1888, as against 15 during 1887; and there was an average of 55 miners less, although the mines were worked more continuously during 1888 than during the previous year. The total product of the county fell off during the year 1,034 tons.

In Davis county 5 mines were operated. The product of the mines in this county was practically the same as during the previous year, although the average number of miners employed during the year was six less. The coal beds in this county are not mined so easily as those in the two counties already referred to, and in consequence more powder for breaking down the coal is used.

The mines in Jefferson county during 1888 produced about 1,000 tons less coal than during the previous year. The production of this county, although always small, has varied to a greater extent than the production of any other county in the district.

The production of coal in Lucas county during the five years previous to 1888 was greater than in any other county in the district, being about five-twelfths of the entire product of the district. During 1888, however, Wapello ranked first as the most important coal county. This fact is due both to better facilities for transportation and to more central location with regard to markets. The falling off in the production of Lucas county mines commenced during the winter of 1885 and 1886.

During 1888 Marion county produced 17,957 tons more coal than during the previous year. The growth in the production of the mines of this county has been progressive since 1881, when the production was about one-eighth of what it was in 1888. This steady growth in the mines of the county is due largely to the favorable thickness of the beds, which range from 3 feet 6 inches to 6 feet. Although there was a slight change in the producing mines, yet the number, 44, of mines worked during 1888 remained the same as the previous year.

In Monroe county the increase in the product of the mines in 1888 over the previous year was 50,391 tons. Most of the coal beds which are mined lie from 50 to 160 feet below the surface. The number of operating mines in this county remained the same as during the previous year. Although there was considerable increase in the total product, the average number of miners employed remains practically the same as during the previous year. This is a significant fact, and points to better mine management and more systematic and economical mining of coal. Most of the coal mined in this county is shipped over the railroad, and the coal from some of the mines which are not directly connected by rail will bear the expense of shipment to the railroad by wagons. Next to Davis county, there is less coal produced in Page county than in any other county in the district, although the production of this county, which, during 1888, was 3,430 tons, was nearly double the production of the previous year. The coal bed which is mined in Page county has only an average thickness of 1 foot 6 inches.

In Taylor county the production during 1888 was 4,178 tons less than during the previous year. The small product of this county, 8,002 tons, is due to the extreme thinness of the coal beds, which ranges from 16 to 18 inches. In Van Buren county the product during the year was practically the same as during the year 1887. The product of the mines of this county is sold almost exclusively to local consumers.

Wapello county produced more coal than any other county in the district, the increase in its product during 1888 over that for 1887 being 108,322 tons. The most important establishment in the county is that of the Wapello Coal Company, and the increase of the total product of the county is due, possibly, more to the extension of the operations of this company than to any other cause.

The production of the mines in Wayne county was 3,791 tons less in 1888 than the previous year. The most important establishment in the county, that of the Occidental Coal Company, is carried on in a bed which ranges from 2 feet to 2 feet 9 inches in thickness. It lies at a depth of 240 feet.

The total production of the mines in Warren county during 1888 was 17,103 tons, being 30 per cent. less than the production of the previous year.

The following table exhibits the production of coal in the second or northeastern district, by counties, for the past six years:

Product of coal in the second inspection district of Iowa, from 1883 to 1888, inclusive.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mahaska	927, 387	932, 714	762, 785	851, 362	1, 025, 548	835, 981
Keokuk	500, 040	430, 940	372, 816	545, 304	599, 007	541, 966
Jasper	45, 883	46, 336	90, 425	286, 034	142, 039	275, 179
Scott	3, 714	3, 821	5, 937	3, 000	8, 634	9, 080
Marshall	....	....	....	400	200	....
Hardin	....	....	....	2, 000	450	1, 000
Muscatine	....	....	....	100	100	....
Total	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978	*a* 1, 663, 206

a Not including 311, 146 tons of nut coal in this district.

The coal-producing counties in this district are more concentrated than in either of the other two districts. The counties of Jasper, Mahaska, and Keokuk, which lie in the valley of the Des Moines river, adjoin one another, while the two counties of Hardin and Scott are isolated, the former occurring in the valley of the Keokuk river, while the latter faces the Mississippi river.

The largest producing county in this district is Mahaska, which during 1888 produced 835,981 tons, or 189,567 tons less than during the previous year. This is the largest producing county in the State. The decrease in the production of the county in 1888 is doubtless due to the increase of shipping facilities which has been attained by other counties, whose production has gone to consumers formerly supplied by the mines of Mahaska county.

The mines of Keokuk county produced 57,041 tons less coal during 1888 than during the previous year; the falling off in the production of the mines of this county is without doubt attributable to the same cause as the decreased product of the mines of Mahaska county. The principal mines in the county occur in the What Cheer district, which has generally been reputed as the most important and best-developed coal basin in the State. Although a large proportion of the product of this county is shipped from 10 mines by railroad, yet the remaining 12 mines support a large local trade.

The total production of Jasper county during the year 1888 was 275,179 tons, being an increase in the production over the previous year of 133,140 tons and very nearly the same as the production during 1886. The mines in this county are probably affected more directly by the condition of the local weather than any mines in the State, since the largest proportion of the product of the county is sold to the local trade. In the report for 1887 special attention was called to the decreased production of the mines during that year. From facts gathered during the last few months it is probable that this decrease and subsequent growth in the product of the mines in this county is in a measure to be accounted for by the failure of certain mines to correctly report their product during the year 1887. The average thickness of the coal beds mined in this county is about five feet, the range in thickness being from 3 feet 6 inches to about 7 feet.

The product of the coal mines of Scott county during 1888 was 9,080 tons, a slight increase over the product of the same mines for 1887. Most of the coal mined in this county comes from country banks to supply a local trade. The nearness of the county to the Mississippi river places it in an unfavorable position to compete with better coals, which can be brought in both by river and railroad from other States. The coal beds in this county are thin and varying in thickness, which makes the mining operations more or less hazardous.

In Hardin county only 1,000 tons of coal were mined during 1888, and this amount was consumed entirely by local trade.

The total production of these counties during 1888, including nut coal was 198,374 tons greater than during 1887. It is probable, however, that there was really less coal produced in this district during the latter year, since in 1888 there were 311,146 tons of nut coal reported from the mines. For 1887 no account was taken of the nut coal sold. The following table exhibits special facts connected with the mining of coal in the Second or Northeastern district during 1888:

General statistics of coal mining in the second district of Iowa in 1888.

Counties.	Number of mines.	Production 1888.	Average thickness of coal beds worked. Upper.	Lower.		Middle.	Number of employés.
		Long tons.	*Ft. In.*	*Ft.*	*In.*	*Ft. In.*	
Hardin	2	1,000	....	4	0	....	4
Jasper	14	275,179	......	4	8	....	400
Keokuk	19	541,966	....	5	2	....	1,432
Mahaska	22	835,981	....	5	6	....	1,850
Marshall	......	....	....	4	0	......	....
Muscatine	......	....	....	2	0	......	....
Scott	6	9,080	....	2	8	......	72
Total	63	1,663,206	....	......		....	3,758
General average of thicknesses	......	....	....	4	0	....	

The following table exhibits the production of coal in the Third or Northwestern district for the past six years.

Product of coal in the third inspection district of Iowa from 1883 to 1888.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Boone	466,981	473,073	458,191	294,970	167,068	140,142
Dallas	38,208	37,185	32,986	21,986	40,420	48,622
Greene	88,851	96,327	89,587	117,538	105,894	109,042
Guthrie	....	5,187	4,596	17,194	18,305	18,680
Hamilton	1,998	1,878	918	3,312	6,669	6,480
Polk	558,821	619,921	462,895	337,964	305,094	300,669
Webster	248,560	214,014	145,296	107,777	146,221	159,715
Story	....	....	....	....	2,000	2,000
Total	1,403,419	1,447,585	1,194,469	900,741	791,671	(*a*) 785,350

a This district mined 133,153 tons of nut coal not in above account.

The total product mined during the year 1888 was practically the same as during 1887, the slight difference in favor of the latter year, 6,321 tons, being probably due to the fact that the reports for 1887, as far as can be ascertained, gave the lump coal product, while many of the reports received for 1888 classified the product of the mines into lump coal, and nut coal, of which latter there was an aggregate reported for the district of 133,153 tons. If, however, the reports received for 1887 included all lump and nut coal produced by the mines, there will be an increase in the total product of the district for 1888 of 126,832 tons, instead of a decrease, as already noted, of 6,321 tons.

The following table exhibits special statistics connected with the mines in the third district during 1888:

General statistics of coal mining in the third district of Iowa in 1888.

Counties.	Number of mines.	Production 1888.	Average thickness of coal beds worked. Upper.	Lower.	Middle.	Number of employés.
		Long ton.	*Ft. In.*	*Ft. In.*	*Ft. In.*	
Boone	21	140, 142	....	2 8	4 2	846
Dallas	9	48, 622	....	2 5	3 6	172
Greene	5	109, 042	4 2	4 0	4 0	323
Guthrie	24	18, 630	....	2 0	....	148
Hamilton	10	6, 480	....	....	....	50
Polk	18	300, 669	4 0	4 1	4 6	969
Webster	33	159, 715	4 4	3 9	....	709
Story	1	2, 000	....	....	3 0	25
Total	121	785, 350	....	....	....	3, 242
General average of thicknesses	......	....	4 2	3 1½	3 10	

Polk county produced more coal than any other county in the district. The greater production of the mines of this county is due to their favorable position as related to railroads and local consumers. The product during 1888, throwing out of consideration the nut coal produced, was 4,425 tons less than during the previous year.

The product of the coal mines of Dallas county during 1888 was nearly 20 per cent. greater than for the previous year. The total for 1888 was 48,622 tons. The coal from these beds is mined to supply a local trade, while the two mines worked in the coal bed in the lower coal group ship their product entirely by rail to more distant consumers.

The product of the mines of Green county was slightly greater during 1888 than during 1887. Most of the product of the Green county mines is consumed by the Chicago, Minneapolis and Saint Paul railway, and the Minneapolis and Saint Louis railroad, the Keystone and Standard Coal Companies being the most important producers. The coal mines of Boone county produced in the aggregate about 16 per cent. less coal during 1888 than during the previous year. The mines of this county are found principally in the vicinity of Angus, Moingona, and Boonesborough. In Webster county the mines produced 13,494 tons of coal more during 1888 than during 1887, or about 9 per cent. increase. Although there was a progressive falling off in the product of these mines during 1883, 1884, 1885, and 1886, this falling off was due to the fact that the beds are in small detached areas, which makes the aggregate cost of mining more expensive. The increase in the product during the past two years has been due to more favorable rates received from the railroad, which has insured a slightly greater profit to the operator. The total product of Guthrie county was practically the same as during 1887. The coal is a favorite one among domestic consumers, and the product of the mines is sold almost entirely to the local trade. The coal mines of Hamilton county are, as a rule, only worked during the winter months, and the product is sold to local consumers. The mines are small and the coal basins in which they are located are of uncertain extent.

In Story county only one mine is in operation. The product of this county was practically the same in 1888 as in 1887.

KANSAS.

Total product in 1888, 1,850,000 short tons; spot value, $2,775,000.

During the past year great activity has existed in the search for valuable coal beds, and the opening of new coal mines in many localities throughout the State has been contemplated. Various estimates of the total coal product of the State have been made, ranging between 1,700,000 tons of coal and 1,900,000 tons. It is confidently believed that the closest estimate which can be made from the facts in the possession of the Survey is that the total product did not vary more than 50,000 or 60,000 tons below the latter figure. The scarcity of fuel, both wood and coal, in many of the settled districts of the State, particularly those at any remote distance from railway lines, has encouraged a search for new coal openings on the part of all residents, particularly townsmen in the more thickly settled sections and among farmers in the isolated sections. A large amount of money has been thrown away in the State in looking for coal beds where the local geology prevents commercial coal beds being found sufficiently near the surface to be profitably mined.

The principal coal producing counties in the State, in the order named, are Cherokee, Osage, Crawford, and Leavenworth. Although there can be no definite boundaries named for any one specific coal field, yet, for convenience of description, Mr. Braidwood has divided the principal operating districts into the following coal fields:

Cherokee and Crawford county coal field.
Osage, Shawnee, and Coffey county coal fields.
Neosho county coal field.
Franklin county coal field.
Bourbon and Linn county coal fields.

The following is Mr. Braidwood's description of these respective coal fields:

Cherokee and Crawford county coal field.—The coal bed most extensively mined at present in these two counties is known by coal men as the Cherokee bed, and is the thickest and most valuable yet discovered in the State. It ranges in thickness from 3 feet 2 inches to 3 feet 9 inches, attaining its greatest thickness in the vicinity of Weir City and Scammonville, Cherokee county. In a few localities in this vicinity it has attained a uniform thickness of 4 feet, and in a few exceptional places it has been found to measure 5 feet. This coal seems to possess superior quality over most other bituminous coals coming into the same market, and is sold at a higher price. It is a coal having good coking qualities, and is a good gas coal. As evidence of this fact it is being used very generally by the gas companies of the State. The outcrop of the eastern edge of this coal bed can be traced along a line in a southwestern direction from Mulberry, Kansas, and Morerod, Missouri, passing through Litchfield, Pittsburgh, and Weir City, to Columbus, a distance of 30 miles; the outcrop running to the east or west in conformity with the undulations of the surface. The bed is being mined by shaft, slope, drift, and strip-bank openings at intervals at and between these points. This coal bed is probably the same as that which is found at Walnut, Macon county, Missouri, but the most valuable areas of the bed so far discovered seem to be in Kansas. Beyond the vicinity of Columbus, to the southwest into the Neosho River basin, the trace of this bed has been lost. It has probably been cut out by the low lands of the river, and will come to view again southwest from Columbus, in the Indian Territory. The general dip or declivity is found bearing to the north and west. As evidence of this fact, so far as this coal bed has been developed, it is found deeper and deeper the further we get in that direction, so that the extent of the area of the bed is much greater than was surmised a few years ago. It seems to dip towards the interior of the State, varying with the undulations of the surface, at the rate of 15 to 30 feet to the mile.

In Pittsburgh there is a shaft, 30 feet in depth, located about three-fourths of a mile west from the outcrop line. Three miles due northwest of this shaft, at a place called Lone Oak, in ground having comparatively the same elevation, will be found a shaft working the same coal bed 116 feet beneath the surface. At Weir City, Cherokee county, there are 45-foot shafts also within 1½ miles from the outcrop. Four miles north and west of these shafts, near the city of Cherokee, will be found a shaft working the same bed, 140 feet in depth, and on ground having comparatively the same surface elevation. There are also other small beds of coal which run beneath the surface successively between the outcrop of this larger bed and where it is now being mined in these deep openings. One of these beds has attained a thickness of 26 inches. This bed can be found cropping out between the deep shaft at Cherokee and the other, not so deep, at Weir City, and between the shaft at Lone Oak and the one not so deep at Pittsburgh. The same bed is being stripped at Coalville, northwest of Mulberry, and is being mined from a shaft opening at Arcadia. It is also being mined at Mr. J. M. Baird's shaft at Cherokee, in Crawford county; it is being stripped and drifted on Cherry creek, northwest of Columbus, and is being mined from two shaft openings near Hallowell, due west of Columbus. This bed will no doubt make a valuable seam for long-wall work in the near future. In the hands of a good company, having managers who understand this system of work, this bed could be mined with profit and compete in the market with other coals, as there seem to be no other troubles or faults in it.

Other smaller beds, evidently above this latter coal bed, are being mined near Oswego, in Labette county. There is no scarcity of coal in this part of the country; the coal beds are very extensive. It is only a question of sinking the shafts a few feet deeper when the shallower areas are worked out.

Osage, Shawnee, and Coffey county coal fields.—The outcropping of a coal bed can be seen in this field in a similar manner to that found in Cherokee and Crawford counties, the eastern edge of the outcrop varying to the east and west owing to the undulations of the surface. The outcrop comes to view at intervals on the surface on a line in a southwestern direction from a point 3 miles west of Topeka, passing through Carbondale and east of Scranton, Burlingame, Dragoon, Peterton, Osage City, Barclay, and Avonia, through Lebo, in Coffey county, and to a point near Neosho Rapids, in Lyon county, showing an extent of country 65 miles long, between the Kansas and Neosho rivers, where coal is being mined at frequent intervals. The breadth of this coal area is not known. This coal bed ranges in thickness from 12 to 20 inches, having attained its greatest thickness at Scranton, and from here gradually thinning down to the northeast as it approaches the Kansas river, and to the southwest as it approaches the Neosho river.

A few years ago coal was mined in Shawnee county by the stripping process, but it is now being mined from shaft openings. At Carbondale, in Osage county, it is being mined from both strip-banks and shafts. Mining operations are going on, on high land, above the town called Carbon Hill. At Scranton it is found deeper, being farther to the northwest. There it has been stripped only in a few places on low land, the mining operations now going on being shaft openings. At Burlingame, which is farthest to the northwest of all the other localities, it is found, and is being mined from shaft openings ranging from 85 to 103 feet in depth. It is also mined from shafts at Dragoon, Peterton, and Osage City, but the shafts are not quite so deep, as those places are not so far to the northwest as Burlingame. It is being mined by shafts east of Barclay; from strip-works and drifts at Arvonia; from strip-works, drifts, and shaft openings at Lebo; and from strip-works near Neosho Rapids. There is no scarcity of coal in this coal field, as a practically inexhaustible supply will be only a question of sinking shafts a little deeper for the coal as the shallow parts of the bed are worked out.

Neosho county coal field.—The coal beds within profitable mining reach are confined to a very small portion of the county. Two miles south of Thayer, where mining operations are going on, there is a very small amount of coal shipped, the most of it being sold to the country trade. This coal bed is 14 inches in thickness and is found on low land, drawing to the Neosho river. It is being mined in the winter months by the drifting process, with from one to six men employed in each drift. In the summer season very little coal is mined or sold. A few miners work the whole year round, stacking the coal in summer and selling it in winter. The coal being found at greater depths about 10 miles west of the Neosho river probably accounts for the bed being seen only in one place. It is very probable that it extends over a great deal more country to the north and west than it gets credit for. The extent of country so far developed, by easy reach, covers about 4 square miles and is dotted here and there by one-man drifts.

Franklin county coal field.—The coal in this county is found cropping out at Ransomville, and to the southwest at Williamsburg. A shaft at Sibley, in Douglas county, is probably sunk to the same coal. The thickness of the coal bed ranges from 16 to 18 inches; it has a good roof, but generally a hard fire-clay bottom. The best mining operations are where the coal is found at shallow depths. The conditions are favorable for long-wall work, which is the prevailing system and is successfully practiced.

Bourbon and Linn county coal fields.—The coal bed mined in Bourbon county, by the drifting and stripping process, is probably the same bed which is being mined in Linn county by deep shafts. At LaCygne, Pleasanton, Mound City and Orchard this coal bed ranges from 18 inches to 2 feet, and in certain localities it is 3 feet in thickness. It is said that a coal bed has been found at Paola, Miami county, at a depth of 150 feet from the surface. This is probably the same coal bed, and it might be said that it is this or some bed near to it that is found in Leavenworth and Lansing, in Leavenworth county.

Coal fields of the central counties of Kansas.—In the center of the State, in the counties of Russell, Ellsworth, Lincoln, Mitchell, Cloud, Republic, and Jewell, there is found an inferior bed of lignite or brown coal, which burns very much like wood, has a white smoke, and makes no soot but much ash. This bed is being mined by the drifts on the south side of the Smoky Hill river, south of Wilson, in Ellsworth county. The drifts follow the coal bed into the side of the bluffs about 100 or 150 feet above the level of the river. The coal bed is next found in Ellsworth county, on the high land in the northeastern part, near Ben's ranch and Delight post office, where it is also being mined by drifts. The bed is found to average 22 inches in thickness, with local thicknesses as low as 8 inches and as high as 3 feet. It is next found in shaft openings in Lincoln county, on low lands near Denmark, Pottenburgh, Ingalls, and Beacon post offices. Next it is found at Minersville, on the division line of Cloud and Republic counties, where it is mined from slope and shaft openings, 45 feet from the surface; on very low land the same bed has been stripped. At Omio, Jewell county, this same coal bed has been discovered at a depth of 150 feet beneath the surface. Before the Omio shaft was sunk the bed was reported by the drillers to be 3 feet in thickness, and of a fine bituminous quality, but since the shaft has been sunk the bed is found to contain the same quality of coal, and it only measures 16 to 18 inches in thickness.

At Homer, in Russell county, the coal bed is found in a shaft over 100 feet in depth, and of about the same thickness and quality as at Omio, Jewell county. This coal bed, like all others of the State, will be found deeper the farther one goes to the north and west of where it is found cropping out, as on the hills in Ellsworth and other counties. It has no value as a competitor with coals from Colorado or those of the eastern part of the State, but off from railroad points, as is the case at almost all the above places, it is being mined with profit, and will no doubt continue to be mined with profit until railroad facilities will lay other coals down for less money with due regard to quality, etc.

The total product of the State during 1888 is estimated to have been 46,250,000 bushels or 1,850,000 short tons, a gain over 1887 of 253,361 short tons or 6,334,025 bushels. This gain is greater than that estimated by Mr. Findlay, who, from the incomplete returns he has received, regards the product of 1888 to be approximately the same as during 1887. The facts obtained directly by the Survey for 1888 show a material increase in the production of the mines in many parts of the State, particularly in the most eastern counties. The facts at hand are not sufficiently complete, however, to make a definite statement as to the total product of each county. The percentage of the total product which came from the mines in each county during 1888 varied but slightly from that produced in each county during 1887.

Coal produced by counties in Kansas, 1887.

[Bushels of 80 pounds.]

Counties.	Stripped.	Mined.
Bourbon	750,000	250,000
Cherokee	600,000	9,831,553
Coffey	150,000	17,000
Crawford	1,700,000	8,041,225
Ellsworth		75,000
Franklin		552,000
Leavenworth		4,352,018
Labette	150,000	
Linn	25,000	385,000
Lincoln		73,000
Neosho		750,000
Osage	600,000	9,840,189
Republic and Cloud		200,000
Russell		3,000
Shawnee		107,000
Other counties	800,000	
Colliery consumption		663,990
Total (*a*)	4,775,000	35,140,975

a Total production of all coals, 39,915,975 bushels; 1,596,639 short tons.

Osage county produces more coal than any other. The largest mines are in the vicinity of Scranton, Peterton, and Osage City, the Osage Carbon Company being one of the largest producers, selling its product largely to the Atchison, Topeka and Santa Fé railroad. The wages paid miners in this county range from 5⅝ to 7 cents per bushel. Cherokee county produces about the same amount of coal as Osage. The largest individual establishment in this county is that of the Keith and Perry Coal Company in the vicinity of Scammonville and Weir City, these mines, together with other smaller ones in the neighborhood of Columbus and Cherokee, making almost the entire product of the county. Wages here range from 3¼ to 3¾ cents per bushel, the coal beds being much more easily mined than those in Osage county. The Crawford county mines are situated principally in the vicinity of Pittsburgh, Litchfield, Fleming, and Frontenac; the mines of the Western Coal and Mining Company, the largest one operator in the county, being in the vicinity of Fleming. There are large areas in the county under which workable coal beds exist at very shallow depths, so that more coal is stripped here than anywhere else in the State. In Leavenworth county, which is the fourth coal county in the size of its production, there are practically but three independent operators, the Leavenworth Coal Company, which mines more than half of the total product of the county, the Riverside Coal Company, both companies in the vicinity of Leavenworth, and the State Penitentiary shaft at Lansing. A new shaft has recently been sunk between Leavenworth and Lansing (distance 5 miles), and the same bed of coal which is mined at both of these localities has been cut. All the other coal-producing counties in the State yield less than 30,000 tons in each county and call for no special comment.

The following table exhibits the number of operating coal mines, both those which are worked either by drift or by shafts, and the number of surface strippings in the State, together with the thickness of the coal beds and the designation of the character of the coal as generally classified by the coal trade:

Number of mines and strippings and thickness of coal beds worked in Kansas, 1888.

Counties.	Number of operators.	Number of mines.	Average thickness of coal beds.		Character of coal.	Coal mined by stripping.	
			Ft.	*In.*		*Operators.*	*Strippings.*
Crawford	14	23	3	4	Bituminous	38	38
Cherokee	20	25	3	3	....do	2	2
Osage	4	24	1	4	....do	24	24
Shawnee	7	7	1	0	....do		
Coffey	2	2	1	1	....do	19	19
Franklin	6	7	1	6	....do		
Douglas	1	1	1	3	....do		
Cloud	6	6	2	0	Lignite		
Republic	4	5	2	0	....do		
Ellsworth	8	8	1	7	....do		
Lincoln	7	7	1	8	....do		
Russell	4	4	1	1	....do		
Neosho	5	5	1	2	Bituminous		
Linn	6	6	2	5	....do		
Leavenworth	3	3	1	10	....do		
Bourbon	6	6	1	6	Poor bituminous.	17	17
Labette	3	3	1	6	Bituminous		
Jewell	1	1	1	5	Lignite		
Total	107	143				100	100

Professors Blake and Bailey, of the State University, have recently prepared for the State Board of Agriculture a report showing the composition of the coal mined in Cherokee, Fort Scott, Leavenworth, Linn, Osage, Franklin, and Cloud counties. Their results are embodied in the following table:

Analyses of Kansas coals.

Nos. of samples.	Water.	Volatile matter.	Fixed carbon.	Ash.
Cherokee measures:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	1.54	38.06	53.44	6.96
2	1.26	35.60	52.20	10.94
3	1.37	37.19	50.23	11.21
4	2.59	39.14	51.54	6.75
5	1.35	36.11	59.94	11.60
6	2.49	34.59	54.11	8.81
7	2.76	36.21	54.91	6.12
8	2.75	36.76	53.08	7.41
9	1.33	37.33	51.59	9.75
Cherokee (upper vein):				
1	2.25	34.17	49.51	14.07
2	2.07	34.37	50.21	13.35
3	1.91	37.44	46.19	14.46
Fort Scott:				
1	2.35	42.79	45.00	9.86
2	2.21	43.89	45.15	8.75
3	4.27	38.61	52.39	4.63
Leavenworth:				
1	3.22	41.55	49.32	5.99
2	2.25	36.49	47.27	13.99
3	2.61	39.58	45.65	12.16
Linn county:				
1	1.62	38.25	48.76	11.38
2	2.36	40.14	48.88	8.62
3	2.39	42.19	42.05	13.37
4	1.92	37.11	47.87	13.10
Osage county:				
1	7.19	40.03	41.13	11.65
2	7.71	41.56	39.92	10.81
3	9.29	42.05	40.89	7.77
4	4.70	44.86	42.11	8.33
5	6.75	42.79	40.97	9.49
6	7.27	41.45	41.35	9.93
7	5.56	42.79	39.32	12.33
8	5.83	43.26	41.75	9.16
9	7.36	38.33	38.54	15.77
10	4.91	39.58	43.17	12.34
11	7.77	40.85	40.29	11.03
Franklin county:				
1	7.55	44.40	37.78	10.37
Cloud county:				
1	13.70	46.14	28.52	11.64
Average:				
Cherokee	1.94	36.77	52.45	8.84
Cherokee, upper vein	2.08	35.32	48.64	13.96
Fort Scott	2.94	41.76	47.55	7.75
Leavenworth	2.69	39.21	47.41	10.69
Linn county	2.07	39.42	46.89	11.62
Osage county	6.76	44.59	40.86	10.79
Franklin county	7.55	44.46	37.68	10.37
Cloud county	13.70	46.14	28.52	11.64

An examination of these results shows that the lower or Cherokee coals contain the most fixed carbon, and that there is a gradual decline in the percentage of fixed carbon towards the upper veins, with a corresponding increase in the amount of volatile matter contained. On this account the Osage coals and those immediately allied to them give the greater quantity of gaseous products. The coals occurring in the central and northern part of the State are often very impure and contain large quantities of water and ash, the latter constituent being the great enemy standing in the way of commercial value of the Kansas coals generally.

The rapid growth in railway systems of the State which afford greater facilities for the importation of purer coals from surrounding States, particularly those in the East, will always menace the development of the poorer coals in Kansas.

KENTUCKY.

Total product in 1888, 2,570,000 short tons; spot value, $3,084,000.

The statistics of the coal mines in Kentucky, together with the special facts relating to the distribution of coal, have been contributed largely by Mr. C. J. Norwood, State Inspector of Mines. The returns made to the State Department of the production of the coal mines are for fiscal years commencing July 1 and ending June 30. Most of the statistics below refer to the fiscal year extending from July 1, 1887, to June 30, 1888; but the summary tables show the product for the calendar year 1888. The latter tables have been compiled from special facts received from Mr. Norwood and others. The State returns are all made in bushels, which, according to the State statute, contain 80 pounds each.

For convenience of description, the coal mines of the State are grouped into three districts, the Northeastern, the Southeastern, and the Western districts.

The following is an exhibit of the amount of coal produced in each district for the last six months of 1888, and also for the calendar year. In the case of the Western district the details of the production for the first six months of the calendar year are also given. This additional information for the Western district is supplied in order to replace the returns covering the same length of time in the Mine Inspector's report, in which an error was discovered by him after the publication of his report by the State Department.

Product of the Western district for first six months of 1888.

[33 mines.]

	Bushels.
All kinds	15, 730, 612
Lump	8, 543, 725
Nut	2, 423, 382
Slack	293, 775
Miscellaneous	4, 469, 730

Three of the mines which contributed to the above are not included in the list of producers of commercial coal during the six months ending December 31, 1888. They are the Clifton (idle), which contributed 12,000 bushels to the total for the first six months, and those of Messrs. C. L. Nall and John Tate (the output of which was small), which have fallen into the list of local mines. The output in bushels for the last half of 1888 was as follows:

Product of the Western district for the last six months of 1888.

[35 mines.]

	Bushels.
All kinds	16,185,651
Lump	8,344,861
Nut	2,318,476
Slack	573,392
Run of mines	3,990,365
Miscellaneous (*a*)	958,557

a "Miscellaneous" includes mixed lump and nut, pea, and perhaps a little slack. Of the total, 512,661 bushels, chiefly lump and nut (no slack), were contributed by five new mines.

In order to obtain the output for the calendar year, it is necessary to throw the run of mines of the above table into the class known as "miscellaneous." This makes the output for the year as follows:

Total output of the Western district for the calendar year 1888.

[38 mines.]

	Bushels.
All kinds	31,916,263
Lump	16,888,586
Nut	4,741,858
Slack	867,167
Miscellaneous	9,418,652

The output of the Northeastern district in bushels for the six months ending December 31, 1888, was as follows:

Product of the Northeastern district for the last six months of 1888.

[11 mines.]

	Bushels.
All kinds	4,838,023
Lump	3,146,634
Nut	687,093
Run of mines	906,196
Miscellaneous (*a*)	98,100

a "Miscellaneous" includes pea and mixed.

Total output of the Northeastern district for the calendar year 1888.

[11 mines.]

	Bushels.
All kinds	9,410,624
Lump	3,347,197
Nut	1,252,655
Miscellaneous	4,810,772

Of the total, 16,125 bushels, consisting of mixed lump and nut, were contributed by a mine which has hitherto produced cannel only.

The output of one of the mines in the Southeastern district (in Pulaski county) is estimated at 400,000 bushels of lump and 200,000 of nut; that of the others is computed from actual returns. Of the mines that were producing during the first half of the year, the Woods Creek (output 2,000 bushels) is idle. The product during the six months ending December 31, 1888, was as follows:

Product of the Southeastern district for the last six months of 1888.

[24 mines.]

	Bushels.
All kinds	9, 364, 250
Lump	3, 951, 706
Nut	1, 535, 078
Run of mines	3, 874, 186
Miscellaneous (*a*)	3, 280

a "Miscellaneous" consists of mixed nut and slack. Of the total, 297,745 bushels, chiefly lump, were contributed by the new mine Lily.

Total output of the Southeastern district for the calendar year 1888.

[25 mines.]

	Bushels.
All kinds	18, 706, 190
Lump	6, 911, 040
Nut	2, 785, 499
Slack	139, 100
Miscellaneous	8, 870, 551

In the following table is given the total product of the entire State (by districts) for the calendar year 1888. The total product for the State, as reported by the State inspector for the calendar year, was 2,401,323 tons. A careful review of all the facts obtained relating to coal mines throughout the State has led to the conclusion that there is a considerable amount of coal produced by country banks and consumed by farmers which was not regularly reported to the mine inspector's department, and would not, under the classification adopted by the mine inspector, be classed as coal coming from commercial mines. It has been estimated that the total product of this unclassified coal would aggregate, during 1888, nearly 170,000 tons; so that in the table given below there have been included 168,677 tons as the yearly product of country banks.

Production of coal in Kentucky in 1888.

Districts.	Mines.	Lump.	Nut.	Slack.	Miscellaneous.	Total.	Total.
		Bushels, 80 pounds.	*Bushels, 80 pounds.*	*Bushels, 80 pounds.*	*Bushels, 80 pounds.*	*Bushels, 80 pounds.*	*Short tons.*
Western	38	16, 888, 586	4, 741, 858	867, 167	9, 418, 652	31, 916, 263	1, 276, 650
Northeastern	11	3, 347, 197	1, 252, 655		4, 810, 772	9, 410, 624	376, 425
Southeastern	25	6, 911, 040	2, 785, 499	139, 100	8, 870, 551	18, 706, 190	748, 248
Country banks and uncommercial mines (*a*)						4, 216, 923	168, 677
Total	74	27, 146, 823	8, 780, 012	1, 006, 267	23, 099, 975	64, 250, 000	2, 570, 000

a Not included in inspector's report.

The average selling price of the coal at the mines varies greatly throughout the coal region, according to the local demand, the facilities for shipment to both near and distant consumers, and the competition with coal from the Pittsburgh region, from Ohio, from West Virginia, and in a very small degree from Tennessee. As far as it is possible to estimate it on account of these varying conditions, it would seem safe to place the average spot value at the mines at $1.20 per ton, or an aggregate for the entire product of the State at $3,084,000.

In compiling tables of production the State inspector reports that great difficulty is always experienced in knowing whether to classify special tonnages reported under the head "slack," "nut," and "lump," so that the classification under the head of "miscellaneous" includes "pea," "mixed," "run-of-mines," or "block," "run-of-mines with slack out," etc. These terms do not signify the same class of coal at all mines. For instance, "run-of-mines" in one place may be what is properly designated as "mixed" at another. The same coal at one place will be "mixed," "lump," and "nut," while at another place it will be "run-of-mines with slack out," and so on. The two following tables, compiled by the State inspector, give some interesting and valuable statistics relating to the employés of the Kentucky coal mines, the number of days worked, the powder consumed, and the live stock employed.

Employés at Kentucky coal mines during the fiscal year ended June 30, 1888.

Districts.	Average. Under ground.	Average. Outside.	Average. Total.	Total engaged when working at full capacity.	Population represented by workers at the mines.
Western	1,930	442	2,372	3,005	10,217
Northeastern	644	133	777	1,050	3,570
Southeastern	1,499	402	1,901	2,131	7,243
Total	4,073	977	5,050	6,186	21,030

Days worked, powder used, and live stock at Kentucky mines during the fiscal year ended June 30, 1888.

Districts.	Number of days worked.		Powder consumed		Live stock.	
	Total.	Average.	Kegs.	Cost at $3 per keg.	Principally mules under ground.	Value at average cash rates. (*a*)
Western	(*b*) 4,554	$162\frac{3}{5}$	14,974	$44,922	334	$23,099
Northeastern	(*c*) 1,740	$193\frac{3}{5}$	1,310	3,930	105	7,274
Southeastern	(*d*) 3,433	$163\frac{10}{21}$	2,778	8,334	138	9,432
Total	9,727	167.5	19,062	57,186	577	39,805

a Report of State Board of Equalization.
b For 28 mines and 2,191 employés. No statement on this point from Empire, People's, David, and Alves mines.
c For 9 mines and 717 employés. "Mary" mine could not state.
d For 21 mines and 1,803 employés. No statement on this point from Laurel and Woods Creek.

The figures for the number of kegs of powder consumed are not complete. No report was received from a few mines at which powder is known to be used in small quantities.

During the six months ending June 30, 1888, there were 7,205,126 bushels of coal shipped from the Western district to points outside of the State. Most of this coal was carried over the Chesapeake, Ohio and Southwestern, and the Louisville and Nashville Railroads, besides 600,000 bushels in boats down the Green river and 433,100 bushels by the Ohio river. From the Northeastern district there were shipped out of the State 1,016,973 bushels, principally over the Ashland Coal and Iron railroad and the Chattaroi railroad. From the Southeastern district there were shipped out of the State, over the Louisville and Nashville, the East Tennessee, Virginia and Georgia, and the Cincinnati Southern railroads, 2,162,835 bushels. This does not include 19,163 tons of cannel coal, which were shipped out of the State during the same six months from White House, Sandy River, and Broken Ridge mines. The coal from the latter mines, which aggregated 16,000 tons, was shipped entirely via the Ohio river. Acknowledgments are due to Mr. N. R. Knott, of the Louisville and Nashville railway, and to Mr. J. L. Frazier, of the Chesapeake, Ohio and Southwestern railroad, for valuable information regarding the shipments from Kentucky coal fields.

MARYLAND.

Total product in 1888, 3,479,470 short tons; spot value, $3,293,070.

The statistics of the Maryland coal field have been communicated to the Survey by Mr. C. H. Hamill, late mine inspector, and by Mr. R. T. Browning, present mine inspector. These statistics, contained in the following tables, are reported in long tons of 2,240 pounds each.

Product of coal in Maryland for six years.

Companies.	1883.	1884.	1885.	1886.	1887.	1888.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	456, 238	689, 212	710, 064	675, 652	936, 799	1, 023, 349
New Central Coal Company	210, 850	210, 140	203, 814	149, 561	181, 906	169, 484
George's Creek Coal and Iron Co.	257, 490	266, 042	257, 343	265, 942	394, 012	437, 992
Maryland Union Coal Company	137, 105	117, 180	98, 095	116, 771	148, 523	106, 620
Borden Mining Company	151, 665	162, 057	179, 537	137, 747	192, 636	212, 520
Maryland Coal Company	235, 854	295, 736	365, 319	288, 742	316, 518	340, 866
American Coal Company	190, 055	194, 230	220, 339	211, 305	259, 632	287, 058
Potomac Coal Company	139, 723	169, 463	196, 280	156, 757	209, 793	208, 777
Hampshire and Baltimore Coal Company	194, 534	36, 416	....	....	....	....
Atlantic and George's Creek Coal Company (Pekin mine)	69, 000	75, 467	64, 938	7, 321	....	6, 375
Swanton Mining Company	34, 905	28, 620	52, 862	42, 688	61, 610	58, 383
Blæn Avon Coal Company	84, 721	100, 961	69, 192	65, 830	11, 934	....
Piedmont Coal and Iron Co.	4, 619	1, 250	32	1, 678	....	....
Union Mining Company	5, 024	5, 310	5, 641	6, 824	7, 500	6, 396
National Coal Company	38, 998	42, 680	48, 307	62, 637	117, 775	76, 592
Davis & Elkins mine	....	74, 437	58, 002	58, 382	82, 667	98, 443
James Ryan	....	....	....	....	3, 608	....
George M. Hänsel	....	....	....	....	1, 989	3, 559
Barton and George's Creek Valley Company	....	....	....	....	....	69, 857
Enterprise mine	....	....	....	....	....	399
Total	2, 210, 781	2, 469, 301	2, 529, 765	2, 247, 837	2, 926, 902	3, 106, 670

Statistical analysis of the operations of the mines of Alleghany and Garrett counties, Maryland, for the year, 1888.

Companies.	Output of each company.	Miners.		
		Number.	Amount paid.	Amount paid per capita.
	Long tons.			
Consolidation	1,023,349	882	$524,446.33	$594.75
George's Creek Coal and Iron	437,992	282	225,469.90	799.53
Maryland	340,866	292	174,938.82	598.26
American	287,058	200	147,117.22	735.58
Borden Mining	212,520	200	108,916.50	544.58
Potomac Coal	208,777	166	104,784.35	631.23
New Central Coal	169,484	165	86,860.55	526.44
Maryland Union Coal	106,620	155	54,642.75	352.53
Davis & Elkins	98,443	75	49,220.00	656.96
National Coal	76,592	78	39,253.40	503.25
Barton and George's Creek Valley (*a*)	69,857	112	35,801.71	319.75
Swanton Mining	58,383	50	29,921.28	598.42
Union Mining (*b*)	6,396	......	3,272.71	....
Atlantic and George's Creek (*b*)	6,375	......	3,187.50	....
George M. Hansel (*b*)	3,559	......	1,779.50	....
Enterprise Mine (*b*)	399	......	199.50	....
Aggregate	3,106,670	2,657	1,589,812.02	

Companies.	Other employés.			Paid for supplies.	Total paid by each company.
	Number.	Amount paid.	Amount paid pr. capita.		
Consolidation	333	$151,501.68	$454.96	$44,771.47	$720,719.48
George's Creek Coal and Iron	99	52,411.00	529.04	19,105.00	296,985.90
Maryland	67	29,291.73	437.19	14,912.88	219,143.43
American	45	21,656.25	481.25	12,558.78	181,332.25
Borden Mining	44	19,250.00	437.50	9,197.75	137,364.25
Potomac Coal	54	25,813.45	478.03	9,133.99	139,731.79
New Central Coal	60	18,810.00	313.50	7,714.92	113,385.47
Maryland Union Coal	49	19,201.63	391.87	4,131.53	77,975.91
Davis & Elkins	35	12,686.19	333.89	2,461.41	64,367.60
National Coal	14	5,598.18	399.87	3,350.90	48,202.48
Barton and George's Creek Valley (*a*)	16	5,936.00	371.00	3,073.68	44,811.39
Swanton Mining	13	5,304.97	480.00	2,627.23	37,853.48
Union Mining (*b*)	.....	....	....	....	4,229.48
Atlantic and George's Creek (*b*)	.....	....	....	....	3,661.25
George M. Hansel (*b*)	.....	....	....	....	2,028.68
Enterprise Mine (*b*)	.....	....	....	....	243.00
Aggregate	829	367,461.08	....	133,039.54	2,092,035.84

a This company commenced operations with the beginning of the current year with about ten miners, to which number they added as working space was developed.
b Local. No return made.

Total shipments from the Cumberland coal field in

Years.	Frostburgh 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	128,534	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	64,522	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	289,884	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
Total	24,325,959	10,849,486	2,366,084	37,541,529	2,807,545	2,428,573	5,236,118

a Of this amount 35,149 long tons were shipped to the Chesapeake and Ohio Canal via Piedmont,
b Includes 78,045 long tons used on line of Cumberland and Pennsylvania railroad and its branches, pany in locomotives, rolling-mills, etc.
c The total shipments of the Cumberland coal field reported by the railroads is 63 long tons greater company.

Maryland and West Virginia for forty-six years.

Frostburgh region. George's Creek and Cumberland railroad. By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Local and Baltimore and Ohio.	Total.	Piedmont region. George's Creek railroad.	Hampshire Railroad, by Baltimore and Ohio railroad.	Total. 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
				(*a*)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, 191	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, 459	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	......	(*b*)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	*c* 3, 375, 796
584, 764	1, 044, 259	1, 455, 486	3, 084, 509	2, 938, 989	1, 475, 969	37, 172, 000	15, 110, 380	3, 470, 461	55, 752, 841

Baltimore and Ohio railroad, to Cumberland.
by Cumberland and Piedmont; also 280,850 long tons used by the Baltimore and Ohio Railroad Com-

than the total shipments shown in the table already given exhibiting the shipments of each coal

MICHIGAN.

Total product in 1888, 81,407 short tons; spot value, $135,221.

The coal field of Michigan is the most northern of the central field of the United States, and is detached from the coal fields in any other State, and in the general classification is known as the northern field. It is contained principally within the thirteen counties of Saginaw, Shiawassee, Clinton, Ionia, Montcalm, Gratiot, Isabella, Midland, Tuscola, Genesee, Ingham, Eaton, and Bay. In addition, small areas are found in Livingston and Jackson counties, and possibly in several others further north. Although the Michigan coal field has been estimated to have an aggregate area of 6,700 square miles, a very small portion underlies the surface of Jackson county, which is the most important producing county in the State. The following table exhibits the production of coal in the State by producing companies during the past ten years:

Product of coal in Michigan.

	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Williamston mine	......	....	....	10,454	884	....	....	500	....	....
Jackson mine	65,000	....	....	....	....	....	....	....	....	....
Corunna Coal Co	16,215	12,252	7,000	8,624	9,000	8,000	10,000	15,976	18,000	22,400
Other mines	800	....	....	....	....	....	....	1,500	....	....
Jackson Coal Co	....	66,780	61,666	60,103	40,412	13,712	15,553	21,368	....	....
Eureka Coal Co	....	30,000	37,477	25,000	....	....	....	....	....	800
Michigan Coal Co	....	20,021	23,987	25,000	....	....	....	....	....	....
Porter Coal Co	....	....	....	6,158	21,000	15,000	13,000	....	....	......
Star Coal Co	....	....	....	....	....	....	5,125	5,820	6,000	400
Standard Coal Co	....	....	....	....	....	....	1,500	15,270	27,792	18,284
R. H. Emerson	....	....	....	....	......	....	....	....	13,230	34,000
Spring Arbor Coal Co	....	....	....	....	....	....	....	....	500	....
Bennett Sewer Pipe Co	....	....	....	....	....	....	....	....	3,939	5,223
Grand Ledge	....	....	....	....	....	....	....	....	2,000	300
Total (*a*)	82,015	129,053	130,130	135,339	71,296	36,712	45,178	60,434	71,461	81,407

a In years previous to 1879 the total product was 504,519 short tons.

Although the total product of the State during 1888 was 9,946 tons greater than during 1887, still competition of Michigan coal with the better coals from other States renders the outlook for the greater development of the Michigan mines very discouraging. The greatest production by any one operator was that of Messrs. R. H. Emerson & Co., whose mines are located in the vicinity of Trumbull station, Jackson county. The total product of these mines for 1888 was 34,000 tons. The average selling price of this coal delivered on cars at mouth of mine during the year was $1.75. Almost the entire product is consumed in the town of Jackson. The coal bed averages about 3 feet in thickness, and is claimed to be especially suitable for steam purposes. About 100 miners are employed at these mines when in operation, who are paid 28 cents per car; the laborers are paid from $1.50 to $1.75 per day.

The Corunna Coal Company produced during the year 14,735 long tons of coal in sizes larger than nut, and 5,264 long tons of slack coal and nut coal mixed. The average selling price of this coal for 1888, delivered on cars at mouth of mine, was $1.99, and the product was consumed almost entirely by the Detroit and Milwaukee Railroad Company. The mines are in the vicinity of Corunna, in Shiawassee county. The bed ranges from 2½ to 3½ feet in thickness, and the coal is claimed to be especially suitable for steam purposes. From 50 to 100 miners and laborers are employed when the mines are in operation, and they receive from $1.25 to $2.50 per day in wages.

The Standard Coal Company produced during the year 18,283 short tons; 5,029 tons in sizes larger than nut; 7,469 short tons in nut coal and run-of-mine, not including slack, and 5,785 short tons of slack coal. The product of the mines is shipped principally to Jackson, and the average selling price during the year, delivered on cars at the mouth of mine was $1,80. The coal bed ranges from 3 to 3½ feet thick. From 50 to 60 miners and laborers are employed; the miners receive $2 a day and the laborers $1.50.

MISSOURI.

Total product in 1888, 3,909,967 short tons; spot value, $5,864,950.(*a*)

The most productive coal areas in Missouri are found in the northern and western parts of the State, north of the Missouri river and west of the La Mine and Osage rivers. A small area underlaid by the lower strata of the Coal Measures is, however, found south of the Missouri river in the immediate vicinity of the city of Saint Louis, in Saint Louis county, and it is in this area that the valuable fire-clay bed is found which supplies the Saint Louis fire-brick and clay manufacturing establishments. There are thirty-five counties which produce coal.

The total product of all the mines in the State during 1888 was 3,909,967 short tons, a gain over the product of 1887 of 700,051 short tons.

The largest producing county in the State is Bates, containing ten producing mines. The most important coal fields in Bates county are those at Rich Hill, in the southern part of the county. These fields are considered the most valuable and extensive in the State. The roof over this coal is a solid slate. The coal is excellent for steam and heating purposes, being but little inferior to Pittsburgh or McAlester coal. Two large companies are operating in the district, and a number of private operators are also working mines in this district and shipping from one to fifteen cars per day. This coal deposit extends over the entire

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a Hon. Oscar Kochtitzky, commissioner of labor statistics, estimates the total spot value of the 1888 product at $8,650,000, or an average of $2.21 per ton; but from the detailed facts obtained from coal operators and coal tradesmen throughout the State it is not thought that it exceeded an average of $1.50 per ton, or an aggregate spot value of $5,864,950.

southern portion of Bates county and the northern portion of Vernon county.

The second largest producing county in the State is Macon. There are ten mines shipping coal. The average thickness of the coal bed worked is 4 feet. Of the other counties in the State the following are the most important: Audrain, Barton, Henry, La Fayette, Putnam, Randolph, and Ray.

In Putnam county the coal field is found in the eastern part, extending over several thousands of acres. There are three coal beds found in this region. The first is 18 inches thick and lies close to the surface. It is largely mined by stripping. The second bed averages about 3 feet 9 inches in thickness and is usually mined by drifts. It yields an excellent bituminous coal and is largely used for smithing purposes. The third bed is found at depths varying from 50 to 100 feet below the surface and must be mined by shafts. It is said to be the most valuable coal of the three. In several of the counties in the central part of the State large deposits of cannel coal are found. In Moniteau county, about 125 miles from Saint Louis, a cannel coal bed has been found which varies from 12 to 72 feet in thickness. In some localities this coal may be mined by stripping. Cannel coal is also mined in Cooper county, where the bed has been entered for a depth of 35 feet without passing through it; 8,400 tons of this coal were produced in 1888. These cannel coal deposits are usually enlargements of the coal bed in the form of pockets.

The product of the coal companies of Saint Louis for 1887 and 1888, as reported by Mr. R. M. McDowell, general manager and mining engineer, is as follows:

Product of coal companies, Saint Louis, Missouri, from which the Survey has received returns.

Names of companies.	Mines.	Production, 1887.	Production, 1888.
		Short tons.	*Short tons.*
Lexington Coal and Mining Company	6	130, 165	153, 921
Western Coal and Mining Company	4	143, 470	224, 602
Johnson County Coal Mining Company	2	7, 105	....
Rich Hill Coal Mining Company	8	556, 353	460, 450
Osage Coal and Mining Company	1	48, 632	52, 373
Total	21	885, 725	891, 346
Western Coal and Mining Company, in Kansas	2	....	127, 747
Grand total all coal companies' mines	23	....	1, 019, 093

These companies, with the exception of the Osage, shipped their product principally to points in Missouri, Kansas, and Nebraska, the coal from the Osage mines being taken almost entirely by the railroads. Of the coal produced by the mines of the Western Coal and Mining Company 140,000 tons were taken by consumers in Kansas, and 212,349 tons by consumers in Missouri. The following table contains analyses of the commercial product from a number of the mines reported by Mr. McDowell:

Analyses of Missouri coals reported to the Survey.

Names of companies.	Ash.	Fixed carbon.	Volatile matter.	Water.	Total.	Sulphur.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Osage Coal and Mining Company, Elliott	2.34	47.54	41.90	8.22	100.00	1.81
Rich Hill Coal Mining Company, Rich Hill	13.70	41.14	42.62	2.54	100.00	4.51
Johnson County Coal Mining Company, Montserrat	26.90	34.69	32.25	6.16	100.00	14.71
Lexington Coal Mining Company	7.71	45.32	36.34	10.63	100.00	2.93

The annual report of the Missouri Pacific Railway Company for 1888 contains important facts relating to the statistics of the coal mines along the company's lines in Missouri, Kansas, Arkansas, and the Indian Territory. The following statement has been compiled from this report:

Coal purchased for and consumed by Missouri Pacific Railway Company.

Years.	Purchased.			Consumed.		
	Tons.	Cost.	Cost per ton.	Tons.	Cost.	Cost per ton.
1888	840,440	$1,365,991	$1.62	813,531	$1,435,642	$1.76
1887	758,113	1,155,082	1.52	725,480	1,198,944	1.65
Increase	82,327	210,909	.10	88,051	236,698	.11

The increased expenditure for coal was due to the added mileage of road requiring additional fuel for station use, the increased mileage of engines, and increased cost per ton, the latter due principally to the high rates paid for coal in Colorado, the advanced price of coal in Illinois, and the additional cost of freight in transportation of coal to system points. The opening of new mines at Jenny Lind, Arkansas, and reductions obtained in prices of coal in Colorado and elsewhere, are expected to reduce the average cost of coal during the coming year. The amount of freight included in cost of coal purchased was $238,777.18. The mines of the Osage Coal and Mining Company, situated at McAlester, Indian Territory, and Elliott, Missouri, produced an output of 425,735 tons of coal and 7,502 tons of coke, an increase in coal product of 18,086 tons and a decrease in coke product of 2,559 tons. Important improvements were made to properties of this company, principally in equipment and side tracks. The operations of the Western Coal and Mining Company were greatly extended during the past year. The tonnage of coal mined in 1888 was 251,092 tons, an increase of 79,790 tons; tonnage of coal purchased, 117,954, an increase of 44,750 tons. Two hundred and forty acres of additional coal lands were purchased in the Jenny Lind district, Arkansas, and 1,244 acres in Barton county, Missouri.

Acreage of coal lands owned by Missouri Pacific Railway Company.

Stations.	Counties.	States.	Acres.
Minden	Barton	Missouri	1, 538
Fleming	Crawford	Kansas	4, 551
Folsom	Cherokee	do	2, 670
Foster	Bates	Missouri	40
Jenny Lind	Sebastian	Arkansas	5, 071
Total			13, 870

The development of the Jenny Lind district, in Sebastian county, Arkansas, was actively prosecuted, and the stage of production nearly reached at the close of the year. The completion of the Fort Smith branch to this coal field affords the necessary transportation facilities to place the coal from these mines in use as company fuel and for commercial purposes. The tonnage of coal mined by the Lexington Coal Mining Company amounted to 154,164 tons, an increase of 24,475 tons. Additional coal lands, miners' houses, and side tracks were acquired and constructed during the year, and a new mine (No. 3) opened. The mines of the Rich Hill Coal and Mining Company produced an output during the year of 460,451 tons, a decrease of 71,105 tons. The coal lands of this company, comprising 1,918 acres, are estimated to contain an undeveloped product of 1,200,000 tons. The principal expenditures made, in addition to operating expenses, were for new equipment and side tracks.

Total product of coal in 1888 by five Missouri companies.

Companies.	1888.	1887.	Increase.	Decrease.
Atoka Coal and Mining Company	326, 896	288, 274	38, 622	
Osage Coal and Mining Company	425, 735	407, 649	18, 086	
Western Coal and Mining Company	369, 046	244, 506	124, 540	
Lexington Coal Mining Company	154, 164	129, 689	24, 475	
Rich Hill Coal Mining Company	460, 451	531, 556		71, 105
Total coal	1, 736, 292	1, 601, 674	134, 618	
Osage Coal and Mining Company—coke	7, 502	10, 061		2, 559
Total coal and coke	1, 743, 794	1, 611, 735	132, 059	

In making comparisons between the statistics reported by the Missouri Pacific Railway Company and those found elsewhere in this report, it must be borne in mind that the railway in almost all cases only records shipment figures. In some cases they will be found to agree with the production figures of this report. In cases where they are less all the coal produced has not been shipped over the Missouri Pacific railway; and in cases where they are greater the railway has included under the head of "individual mining companies" not only the coal which these individual companies have produced from their own mines and lands, but coal gotten from leased mines and lands, and in some instances coal which has been purchased for shipment from small adjoining mines.

The following table exhibits special statistics of the coal mines in Missouri during 1888:

Partial statistics of Missouri coal mines, 1888.

Counties.	Number of mines reported on.	Average price of coal at mines per ton.	Average wages of miners, per ton.	Number of employés.	Average thickness of coal seam worked.	
					Feet.	*Inch.*
Audrain	10	$1.50	$1.00	238	2	10
Barton	4	1.40	.65	360	3	4
Bates	10	1.25	.51½	2,177	3-5	....
Caldwell	2	....	.87½	140	2	4
Carroll	10	....	....	44	....	....
Cooper	1	....	....	35	a35+	....
Grundy	2	2.06	1.18¾	200	1	6
Henry	13	1.50	.87½	666	3	6
Johnson	7	1.25	....	49	2	6
La Fayette	21	1.75	1.12½	1,206	1	8
Linn	3	2.00	1.50	10	2	3
Macon	10	1.45	.70	1,506	4	....
Putnam	1	1.40	.80	760	2	10
Randolph	15	1.45	.94	734	4	....
Ray	7	1.60	1.00	611	2	....
Vernon	5	1.15	.75	64	2-8	....
	121	1.50	.87½	8,800	....	....

a Pocket of cannel coal.

MONTANA.

Total product in 1888, 41,467 short tons; spot value, $145,135.

In 1888 the Montana Central railway was built, connecting the mining sections of the Territory with the coal fields near Fort Benton and Great Falls, but too late to increase the product of the Territory in that year.

Mr. O. C. Mortson, of Great Falls, Montana, has kindly furnished for this report the following admirable description of the coal operations in north central Montana in 1888:

Sand Coulee.—In this section the largest working company is the Sand Coulee Company, operating on about 2,000 acres of coal land. In 1888 the mines of this company were connected with Great Falls by railroad and telegraph. The railroad (Saint Paul, Minneapolis and Manitoba) has completed its tracks to the mouth of the main entry, and all modern appliances are used to handle the output of coal. The coal is now mined by machinery, which is worked by compressed air. The operations of this company were not commenced on an extensive scale until September, but about 3 miles of main and side entries are now developed and in operation.

The coal from these mines is used exclusively by the Montana Central railway between Great Falls and Butte, Montana Territory. Aside from the home market, which includes Sand Coulee and Great Falls, with the Montana Smelting Company, it is coming into use in other places, and the supply is now equal to the demand. The total output for October, November, and December may be estimated at 12,000 short tons. On December 31, 1888, the number of men employed was 250. Machinery is ordered, and has already arrived, which will make the daily movement of coal 2,000 short tons and give employment to 1,500 men in a very short time. Dean's mine, which borders on the north side of the property already described, is developed by main entry and rooms. The total output for 1888 was about 2,600 short tons. The principal market was Great Falls. Humphrey's mine was worked about two months during the past year. The principal market for coal was Great Falls. The capacity of output at present is 80 short tons per day. Culberson's and Wrenn's mines have been idle during the past year, though the main entry in the latter is now in 550 feet.

Belt creek.—This coal field is situated about 10 miles from, and is identical with, the Sand Coulee formation. Six openings are now developed, showing an average thickness of 8½ feet of coal. Castner's mine is the most developed, the main entry being 950 feet in length, besides rooms and side entries. Millard's and Brown's mines, about one-half mile east, have very good showings. Several new openings are being made on the eastern boundary with so far very satisfactory results. The output of coal on Belt creek for 1888 is estimated at 2,000 tons, and the output would have been greater but for costly transportation. This district is at present able to make a daily movement of 250 short tons of coal. Besides the area of taken lands in Belt, a large area of land south and east is known to contain good coal, though little prospecting or development has yet been made. These remarks refer to Upper Belt creek and also to Otter creek.

Judith basin.—So far as known by prospecting the outcrop, thickness of vein, and character of coal, the western portion of the Judith basin adjacent to the Belt mountains is underlaid by the same vein of coal as Sand Coulee and Belt. On Arrow and Surprise creeks it is 4 feet in thickness; on Running Wolf, Willow, and Sage creeks it is 7 feet in thickness. Several locations have been made between Willow and Sage creeks during the past fall, which are now undergoing development. A limited home market has already been found for the coal produced; but in the future the proximity of the coal field to the silver mines of Wolf creek gives a promise of making this a valuable deposit.

Smith river.—The coal mines in this section were not worked in 1888.

Birch creek.—This coal field, situated about 90 miles northwest of Great Falls, has had a large area of land taken up under the coal act during the past season. The coal vein averages 3 feet in thickness. It is understood that the mines are now being developed, but the home market is limited.

Dearborn river.—Coal similar to the Birch creek is found on Dearborn river, lying about a similar distance from the Rocky Mountain range. Two or three mines are at present being developed with very satisfactory results.

Twelve-Mile Coulee.—Coal similar to the Birch creek and Dearborn river is found at the Twelve-Mile Coulee, about 24 miles east of Fort Benton. One location is being developed.

Milk river.—This is a very large coal field just beginning to develop. The character of the coal is, however, essentially lignitic. Some openings are being made north of Fort Assinaboine.

Analyses of Sand Coulee coals.

	Steam coal.	Coking coal.	Coking coal.	Coking coal.	Coking coal.
Water	3	4	....	....	2.97
Fixed carbon	76	60.07	64.33	50.64	54.84
Ash	17.05	10.05	11.41	7.11	7.98
Volatile matter	....	....	18.40	28.16	34.24
Sulphur	....	....	.43	1.14	....
Moisture	....	....	5.53	3.74	....

Timberline.—At the Timberline mines, near Bozeman, the Northern Pacific Coal Company continued operations for the first five months of 1888, producing in that period 9,867 tons of coal. On the 1st of June the mines were leased to Mr. C. W. Hoffman, of Bozeman, from whom a report could not be obtained. Estimates of his product vary from 15,000 tons to 7,800 tons. The highest estimate is taken, and includes all the coal produced by other small mines near Bozeman, and also the insignificant local production near Cinnabar. Coal was not mined at any of the properties owned by the Union Pacific railway in Montana. At Cinnabar the old Horr mines are again to be worked, and the owners claim that coking will be attempted. The Clark's Fork coal fields will be developed and become productive in case the proposed railway to Helena is built. Throughout the Territory coal mining remained in a very unsatisfactory condition; but with the recent developments of the railway interests in northern Montana it is probable that this state of affairs will be changed.

Coal product of Montana.

Years.	Timberline.	Bozeman and Maxey.	Sand Coulee.	Belt Creek.	Lignite.	Other mines.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1883	10,489	9,306	....	....	....	....	19,795
1884	55,664	8,006	....	....	16,221	485	80,376
1885	83,156	100	700	1,200	....	1,284	86,440
1886	45,446	....	800	600	....	3,000	49,846
1887	7,802	....	2,200	....	....	200	10,202
1888	24,867	....	14,600	2,000	....	....	41,467
Total	227,424	17,412	18,300	3,800	16,221	4,969	288,126

More detailed reports of individual mines and mining fields in Montana have been made in previous volumes of Mineral Resources, and to them the following reference is made:

Mines or localities.	Volumes.	
	Years.	Page.
Bozeman field	1883 and 1884	53
Do	1885	36
Do	1886	283
Gardiner mine	1883 and 1884	53
Do	1886	285
Rock Creek field	1883 and 1884	54
Do	1886	284
Medicine Lodge field	1885	39
Sand Coulee field	1883 and 1884	54
Do	1885	38
Do	1886	284
Belt Creek field	1885	38
Do	1886	284
Judith field	1883 and 1884	55
Do	1886	284
Bull Mountain field	1883 and 1884	54
Anaconda mine	1885	38

Economically, coal mining is still of little importance to the Territory. The number of men employed cannot be satisfactorily stated. The value of the output in 1888, at $3.50 per ton, is $145,135.

NEBRASKA.

Total product in 1888, 1,500 short tons; spot value, $3,375.

No special report of coal produced during 1888 throughout the State of Nebraska has been received. The figures stated above have been estimated from the best information which could be obtained.

Some coal or lignite occurs in each of the three principal formations in this State, the Carboniferous, the Cretaceous, and the Tertiary. Carboniferous rocks underlie 3,200 square miles of southeastern Nebraska, including the counties of Richardson, Pawnee, Johnston, Nebraska, Otoe, most of Cass, and portions of Gage, Lancaster, Sarpy, and Douglas. Thin seams of coal have been observed in nearly all of these counties, none of them exceeding 2 feet in thickness. The only one which is regularly mined is near Du Bois, in Pawnee county. Mining in this county is mostly done by farmers at odd times when they would otherwise be idle. None of the product is shipped away from the county. It is probable that similar operations are carried on in some of the other counties, but no authentic information is at hand of the fact or the amount of the product. The total product for 1888 has been estimated at 1,500 tons.

NEW MEXICO.

Total product in 1888, 626,665 short tons; spot value, $1,879,995.

The production of coal in New Mexico in 1888 was marked by no special features except the great increase at Gallup and the opening and working of several mines in the Cerrillos field. All the mines of the Territory reported production, and for the first time the output of coal is given without any estimates made away from the mine. The largest producer in the Territory is now the Gallup field, where in 1888 the output was 300,000 short tons from three companies, the Gallup Coal Company, the Black Diamond Coal Company, and the Aztec Coal Company. The coal from these mines is largely used by the Atlantic and Pacific railway. The coal is also used for fuel in Arizona, southern California, and New Mexico. The production of the mines here is subject to great variations, and the coal veins are characterized by changes in value due largely to the slight amount of cover over the coal. There are two veins worked, one 6 feet in thickness and the other 4 feet 9 inches. The loss from slack in mining is very heavy; on a daily product of 550 tons of merchantable coal the amount of slack made is about 80 tons. The prices paid for mining are 60 cents per ton, run-of-mine in the 6-foot vein, and 70 cents per ton in the small vein. About 6,500 tons of Gallup coal are sold yearly in Albuquerque at $6.50 per ton. The coal is a lignite.

At Cerrillos there are several companies operating and producing both anthracite and bituminous coal. The field has already been described in Mineral Resources, 1883 and 1884, page 57.

The following is the list of producers in 1888:

Coal produced in the Cerrillos field, New Mexico, in 1888.

Mines.	Kinds of coal.	Short tons.
Black Diamond	Bituminous	12, 600
Keystone	do	3, 024
Keesee	do	5, 040
Calamity No. 2	do	2, 016
Sterling	do	1, 764
Calamity No. 1	Anthracite	504
Eagle	do	252
Total		25, 200

The Cerillos bituminous sells in Albuquerque at $7 per ton, and the anthracite at $10 per ton. All the mines are worked on a very small scale.

At Carthage the San Pedro Coal and Coking Company produced 62,038 tons of coal and made 8,540 tons of coke in 1888. The coal from this mine is shipped as far as the City of Mexico for commercial use, and the coke goes to smelters in New Mexico and Texas.

At Raton 227,427 tons of coal were mined in 1888 from the mines in Bloss cañon. This coal is used by the Atchison, Topeka and Santa Fé railway for fuel, and is also sold by the company for commercial purposes.

At Monero 12,000 tons of coal were mined in 1888. The coal from the Monero mines is used altogether in Colorado. Durangó and local points on the San Juan branch of the Denver and Rio Grande railroad furnish the market. In case the proposed Albuquerque and Durango railway is built, the extensive coal fields of northwestern New Mexico will reach a market.

The product of the Territory to date has been as follows:

Coal product of New Mexico from 1882 to 1888.

Years.	Raton district.	Gallup district.	San Pedro.	Los Cerrillos.	Monero.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1882	91, 798	33, 373	16, 321	3, 600	12, 000	157, 092
1883	112, 089	42, 000	37, 018	3, 000	17, 240	211, 347
1884	102, 513	62, 802	41, 039	3, 000	11, 203	220, 557
1885	135, 833	97, 755	56, 656	1, 000	14, 958	306, 202
1886	87, 708	106, 530	69, 047	1, 000	7, 000	271, 285
1887	154, 875	275, 952	58, 707	7, 500	11, 000	508, 034
1888	227, 427	300, 000	62, 038	25, 200	12, 000	626, 665
Total	912, 243	918, 412	340, 826	44, 300	85, 401	2, 301, 182

The number of men regularly employed in coal mining in New Mexico is about 850.

The number of tons of coal consumed at the mines is estimated to be 1 per cent., or, for 1888, 6,266 short tons.

The value of the product of the Territory in 1888, at $3 per ton, is $1,879,995.

The various coal mines of the Territory have been more fully described in past volumes of Mineral Resources, and the following index will give the pages and volumes:

Description of New Mexico coal fields in previous reports.

[Years and pages of Mineral Resources.]

Localities.	1882.	1883-84.	1885.	1886.	1887.
	Page.	*Page.*	*Page.*	*Page.*	*Page.*
Raton	62	57-58			278
Cerrillos	63				279
Gallup	63				279
Monero	63				279
San Pedro	64	170			278

OHIO.

Total product in 1888, 10,910,946 short tons; spot value, $10,147,180.

The following table exhibits the product of the State by counties for the years 1886, 1887, and 1888. The product for the latter two years is given in lump, nut, pea, and slack coal, as reported by Mr. Thomas B. Bancroft, for 1887, and by Mr. R. M. Haseltine, State mine inspector, for 1888:

Coal produced in Ohio, by counties, in 1886, 1887, and 1888.

Counties.	1886. Lump.	1886. Nut.	1886. Total.	1887. Lump.	1887. Nut.	1887. Pea and slack.	1887. Total.	1888. Lump.	1888. Nut.	1888. Pea and slack.	1888. Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	766, 411	132, 635	899, 046	884, 622	141, 900	57, 021	1, 083, 543	1, 081, 559	167, 181	87, 958	1, 336, 698
Belmont	462, 252	111, 527	573, 779	494, 974	108, 363	118, 430	721, 767	735, 054	182, 264	190, 788	1, 108, 106
Columbiana	268, 465	67, 598	336, 063	393, 617	74, 985	47, 455	516, 057	314, 034	90, 575	61, 582	466, 191
Coshocton	43, 361	9, 573	52, 934	88, 367	17, 412	19, 012	124, 791	114, 051	24, 476	29, 376	167, 903
Carroll	184, 095	32, 535	216, 630	186, 624	39, 137	67, 567	293, 328	217, 541	74, 558	62, 998	355, 097
Guernsey	349, 503	84, 297	433, 800	360, 340	100, 475	92, 798	553, 613	259, 552	61, 984	59, 192	383, 728
Gallia	14, 862	2, 562	17, 424	13, 000	....	2, 365	15, 365	13, 571	....	3, 151	16, 722
Holmes	10, 491	2, 179	12, 670	7, 407	2, 283	836	10, 526	5, 500	1, 562	1, 059	8, 121
Hocking	637, 224	104, 347	741, 571	693, 097	116, 914	43, 052	853, 063	881, 706	162, 050	42, 782	1, 086, 538
Harrison	5, 132	377	5, 509	3, 643	72	317	4, 032	2, 465	200	200	2, 865
Jackson	717, 516	139, 224	856, 740	863, 047	194, 888	76, 770	1, 134, 705	827, 854	174, 726	86, 181	1, 088, 761
Jefferson	442, 051	33, 615	475, 666	222, 277	40, 328	31, 270	293, 875	171, 138	31, 605	40, 435	243, 178
Lawrence	139, 173	27, 760	166, 933	113, 790	22, 272	7, 497	143, 559	114, 757	21, 243	1, 806	137, 806
Medina	223, 747	28, 664	252, 411	178, 772	30, 425	16, 290	225, 487	143, 781	18, 976	35, 695	198, 452
Meigs	165, 627	26, 636	192, 263	153, 444	23, 051	8, 710	185, 205	170, 280	48, 773	23, 430	242, 483
Muskingum	85, 011	11, 590	96, 601	127, 353	9, 442	35, 133	171, 928	148, 782	17, 890	45, 189	211, 861
Mahoning	251, 515	61, 525	313, 040	210, 294	18, 999	43, 056	272, 349	177, 477	11, 775	41, 783	231, 035
Morgan	4, 370	....	4, 370	3, 500	....	600	4, 100	....	....	....	....
Noble	3, 342	....	3, 342	4, 000	1, 320	1, 000	6, 320	4, 000	1, 200	1, 000	6, 200
Perry	1, 346, 131	261, 535	1, 607, 666	1, 535, 911	179, 414	155, 515	1, 870, 840	1, 430, 268	229, 933	76, 604	1, 736, 805
Portage	61, 273	9, 066	70, 339	48, 649	4, 442	12, 072	65, 163	52, 488	8, 246	10, 189	70, 923
Sciote	....	....	....	....	....	....	....	....	....	....	....
Stark	519, 992	73, 430	593, 422	586, 014	81, 973	116, 177	784, 164	590, 009	74, 782	128, 436	793, 227
Summit	70, 221	12, 004	82, 225	76, 110	5, 700	14, 005	95, 815	90, 050	4, 373	17, 601	112, 024
Tuscarawas	212, 362	55, 304	267, 666	363, 094	81, 554	61, 818	506, 466	418, 860	112, 314	14, 943	546, 117
Trumbull	162, 331	26, 200	188, 531	132, 829	27, 058	8, 102	167, 989	120, 375	12, 707	24, 744	157, 826
Vinton	49, 392	10, 621	60, 013	69, 043	11, 702	8, 982	89, 727	84, 706	12, 701	11, 288	108, 695
Wayne	99, 174	9, 883	109, 057	84, 906	8, 436	11, 808	105, 150	69, 825	9, 498	11, 834	91, 157
Washington	4, 000	1, 500	5, 500	1, 480	400	....	1, 880	1, 462	115	855	2, 432
Total	7, 299, 024	1, 336, 187	8, 635, 211	7, 900, 204	1, 342, 945	1, 057, 658	10, 300, 807	8, 241, 145	1, 558, 707	1, 111, 099	10, 910, 951

The following table exhibits special facts relating to the mines in the State for the years 1886, 1887, and 1888:

Comparative statistics for 1886, 1887, and 1888.

Counties.	1887 compared with 1886.						1888 compared with 1887.	
	Tonnage.		Weeks worked.		Miners employed.		Tonnage.	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
Athens	184,497				276		253,155	
Belmont	147,988		8		143		386,339	
Columbiana	179,994		8		355			49,866
Coshocton	71,857		27		73		43,112	
Carroll	76,698		7		118		61,784	
Guernsey	119,813			6	10			169,885
Gallia		2,059	4			5	1,357	
Holmes		2,144	6			25		2,405
Harrison		1,477				20		1,167
Hocking	111,492			5	224		233,475	
Jackson	278,865		1		218			45,944
Jefferson	18,209				42			50,697
Lawrence		23,374		3		140		5,753
Medina		26,924	4			180		27,035
Meigs		7,058				108	57,278	
Muskingum	75,327			2	98		39,933	
Mahoning		40,691	5			339		41,314
Morgan		270				4		4,100
Noble	2,978					4		120
Perry	263,175			1	405			134,035
Portage		5,176	3			27	5,760	
Stark	190,742		2		151		9,063	
Summit	13,590		17			155	16,209	
Tuscarawas	238,800		6		237		39,651	
Trumbull		20,542	2			53		10,163
Vinton	29,714		9			20	18,968	
Wayne		3,907	1			119		13,993
Washington		3,620				9	552	
Total	2,003,739	137,242	110	17	2,350	1,208	1,166,636	556,477

There are twenty-seven counties in the State which produced coal during 1888. The total increase of coal for the entire State for 1888 over 1887 was 610,159 tons. The product of the following fourteen counties, Athens, Belmont, Carroll, Coshocton, Gallia, Hocking, Meigs, Muskingum, Portage, Stark, Summit, Tuscarawas, Vinton, and Washington, was greater during 1888 than during 1887, while the product of the following fourteen counties, Columbiana, Guernsey, Holmes, Harrison, Jackson, Jefferson, Lawrence, Mahoning, Medina, Morgan, Noble, Perry, Trumbull, and Wayne, was less during 1888 than 1887. The most notable increase was that in Belmont county, the total of which was 386,339 tons. During 1887, the only counties which showed a decided decrease in their tonnage from that for 1886 were Mahoning, Trumbull, Medina, and Lawrence.

The development of new coal fields within the State and the increased consumption of natural gas have had a more marked effect upon the Ohio coal trade than the development of the natural gas resources of Pennsylvania during 1888 has had upon the production of coal mines in that State. This is to be accounted for by the fact that Ohio does not supply so distant a trade as Pennsylvania, its coal not being able to meet competition so successfully in distant markets with cheaper local coals. One of the principal new establishments which increased the product of Athens county during 1888 was that of the Federal valley mines.

During the past year considerable interest has been excited in what is known as the Waterloo coal field, which is situated 18 miles from Gallipolis and 25 miles from Trenton, and on the eastern extension of the Cincinnati and Northwestern railroad, which is now completed to Portsmouth, and the Trenton branch of the Cincinnati, Hamilton and Dayton railroad, which passes within 8 or 9 miles of this field. This coal field is at present practically undeveloped, but active plans are reported for its development.

In order to inform the coal producers of Ohio in regard to special facts, a circular was prepared and distributed among themselves during the fall of 1888 which contained a number of valuable references to the Ohio coal trade. From this circular the following quotations are made:

"In this State the different districts are supplied from different sources; the Ohio valley with coal from Pennsylvania, the Kanawha valley, and the Ohio mines located on the river, by river, at prices with which no railroad mines can compete; northeastern and eastern Ohio, partly by coal from Pennsylvania. Pennsylvania coal also finds a market to some extent through the balance of the State by rail.

"The coal produced on the Cleveland, Lorain and Wheeling railroad goes chiefly to the Northwest by lake, northern Ohio, Michigan, and Canada; that produced on the Wheeling and Lake Erie road does the same, the majority of the output going to supply railroads. Of the output on the Wheeling and Lake Erie railroad in 1887 but 15.06 per cent. was used in Ohio for domestic or manufacturing purposes; in 1888, 21.24 per cent.; the balance either went out of the State or into railroad use.

"In the Hocking district, which includes Shawnee and Sunday creek, out of a product in 1887 of 3,198,340 tons, there were used by the railroads 959,623 tons; there were shipped out by lake 571,014 tons, and by railroads to points out of the State 931,547 tons, leaving but 736,156 tons, or 23 per cent., for consumption in this State for domestic and manufacturing purposes. In 1888, out of a production of 3,382,236 tons, there were used by the railroad companies 1,212,711 tons; there were shipped out by lake 756,675 tons, and there were shipped out of the State by railroads 746,596 tons, leaving for consumption in the State for domestic and manufacturing purposes 666,254 tons, or 19.07 per cent. of the production. Of the amount used by the railroads, most of it went out of the State. With the exception of a small amount to Zanesville, Akron, and Cleveland, the Hocking district finds its markets in the territory west of the Cleveland, Akron and Columbus railway, and north of the Cincinnati and Muskingum valley railroads. In this territory it meets the competition of the coal from Jackson county, Cincinnati and Muskingum valley, Columbus and Eastern, the Wheeling creek and Guernsey county mines, to say nothing of what comes from Pennsylvania. The shipments to the head of Lake Superior are accomplished by an investment in docks for storage purposes, and an advance of about $3 per ton on the coal by the operator desiring to reach that market. There are no statistics in regard to the other districts; but no doubt they would also show a small percentage sold in the State. The interests in bituminous coal are numerous, and competition sharp. Competition with other districts in the State and in the West—with Indiana and Illinois coal, which is of a poorer grade, costs much less to mine in some districts, and has less freight to pay to reach a market—controls and depresses prices here. It is a well known fact that those who have to buy coal in very small quantities are, like purchasers of everything in small quantities, compelled to pay high prices. The price of coal by the car load does not help them. The majority of coal used for manufacturing purposes is of the small grades, and is sold at low prices. If the percentage holds good on shipments to Ohio as on the total, the amount of Hocking lump used in Ohio in 1887 was 331,270 tons; in 1888, 299,814 tons."

Shipments of coal in the Hocking valley during 1888.

	Tons.
Columbus, Hocking Valley and Toledo railroad	1,983,067
Baltimore and Ohio railroad	606,057
Ohio Central railroad	895,230

The total product of the Hocking valley during 1888 was 3,484,354 tons. Of this amount the Columbus and Hocking Coal and Iron Company, which is the largest individual coal company in the State, produced 738,907 tons. The total product of the Hocking valley for the past seven years is shown in the following table:

Product of the Hocking valley, Ohio, for seven years.

Years.	Short tons.	Years.	Short tons.
1882	1,812,833	1886	2,960,000
1883	1,916,355	1887	3,348,547
1884	2,725,000	1888	3,484,354
1885	2,894,660		
		Total	19,141,749

The following table exhibits the coal forwarded by the Columbus, Hocking Valley and Toledo Railway Company from the coal-shipping stations along the line of the road during 1888, together with the revenue derived:

Distribution of coal over the Columbus, Hocking Valley and Toledo railway in 1888.

Stations.	Pounds.	Revenue.
Hocking Valley district:		
Union Furnace	1,826,900	$393.08
Starr	89,490,700	39,891.49
Pomeroy	5,929,800	1,180.16
Haydenville	52,553,600	17,214.44
Lick Run	43,374,400	21,059.20
Gore	4,226,300	1,636.30
New Straitsville	520,934,400	216,409.49
Greendale	661,700	238.53
Sand Run	246,847,500	90,228.00
Carbon Hill	6,847,700	2,157.37
Longstreth	304,049,700	140,553.82
Monday	217,771,300	92,111.72
Jobs	731,527,400	258,126.29
Brashears	230,748,000	95,837.91
Buchtel	511,346,000	224,212.85
Nelsonville	793,972,800	321,220.32
Floodwood	57,789,400	25,727.67
Glen Ebon	85,057,400	36,701.58
Hamley Run	29,019,900	13,368.53
Outlying districts:		
Radcliff	36,000	7.20
Hawks	11,641,800	4,076.72
Minerton	10,944,600	3,335.38
Cheshire	9,536,400	1,603.14
Total (1,983,067 short tons)	3,966,133,700	1,607,291.19

The total product of coal mines in the Mahoning valley for the past seven years is shown in the following table:

Product of Mahoning valley, Ohio, for seven years.

Years.	Short tons.	Years.	Short tons.
1882	1,000,000	1886	1,200,000
1883	1,200,000	1887	1,350,000
1884	925,000	1888	1,500,000
1885	1,000,000		
		Total	8,175,000

From a preliminary report of the mine inspector there were 235 accidents in the State during the year, of which 29 were with fatal results. Sixty-two of the most serious accidents were occasioned by falls from the roof of the mines. The accidents were distributed throughout the State as follows:

Accidents in coal mining in Ohio during 1888.

Counties.	Accidents.	Counties.	Accidents.
Stark	44	Jefferson	6
Perry	25	Medina	4
Jackson	22	Wayne	4
Athens	20	Coshocton	4
Tuscarawas	19	Summit	2
Carroll	17	Vinton	2
Belmont	16	Muskingum	2
Hocking	11	Mahoning	2
Columbiana	9	Lawrence	1
Meigs	9	Portage	1
Guernsey	7	Gallia	1
Trumbull	7		
		Total	235

The *Coal Trade Journal*, in speaking of the Ohio trade for 1888, says: "The shipments from the numerous large and small collieries throughout the Hocking valley were quite brisk during the early spring lake trade, but during the month of June there was a decrease in the output, the majority of the mines only working from one-fourth to one-half time. This, however, is generally expected at that season of the year, as vessels become scarce and a blockade of loaded cars at the lake docks follows. After August 1, the regular fall lake trade set in, and a good run at the collieries was generally had, hindered by a scarcity of cars at times. There were some very great changes in the distribution of the coal produced in the Mahoning valley last year; the net result was a gain of 240,000 tons. The Chicago trade fell off 170,000 tons; but the lake shipments showed an increase of 185,000 tons. The railway supply coal was in round numbers 1,200,000 tons, an increase of about 250,000 tons. Ohio points took something like 666,000 tons, a decrease of 67,000 tons as compared with the preceding year; Michigan points took 248,000 tons, a decrease of 22,000 tons; Indiana points took 58,000 tons, an increase of 1,500 tons; Canadian points took 53,000 tons, a gain of 9,000 tons."

Special facts connected with the coal trade in the prominent centers of Ohio have already been given in the general review of the coal trade. The steady and continuous growth (except during 1883 and 1884) in the coal production of the State since 1872 is exhibited by the following table:

Annual coal product of Ohio from 1872 *to* 1888.

Years.	Short tons.	Years.	Short tons.
1872	5, 315, 294	1881	8, 225, 000
1873	4, 550, 028	1882	9, 450, 000
1874	3, 267, 585	1883	8, 229, 429
1875	4, 864, 259	1884	7, 640, 062
1876	3, 500, 000	1885	7, 816, 179
1877	5, 250, 000	1886	8, 435, 211
1878	5, 500, 000	1887	10, 301, 708
1879	6, 000, 000	1888	10, 147, 180
1880	7, 000, 000		

The following tables, compiled by Mr. Sidney D. Maxwell, secretary of the Cincinnati Chamber of Commerce, exhibit interesting statistics of the coal trade of southern Ohio for a number of years:

Receipts of coal at Cincinnati for sixteen years.

Years.	Pittsburgh (Youghiogheny).	Kanawha.	Ohio river.	Cannel.	Anthracite.	Other kinds.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
1871-'72	19, 254, 716	....	a10, 359, 906	1, 104, 003	72, 171	....	30, 790, 796
1872-'73	24, 962, 373	....	a11, 075, 072	1, 162, 052	75, 000	....	37, 274, 497
1873-'74	24, 014, 681	....	a10, 398, 153	710, 000	112, 000	....	35, 234, 834
1874-'75	24, 225, 002	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, 759, 968	8, 912, 801	4, 268, 214	202, 489	712, 075	2, 351, 699	48, 198, 246
1880-'81	23, 202, 081	10, 715, 459	3, 151, 934	67, 684	770, 525	3, 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

a Including Kanawha coal.

OREGON.

Total product in 1888, 75,000 short tons; spot value, $225,000.

The principal coal establishment in the State is that of the Oregon Coal and Navigation Company, whose mines are located at Marshfield, in Coos county, on Coos bay, the mine being known as the Newport mine. The total production of this mine for 1888 was 62,272 tons, of which 47,712 tons were in sizes larger than nut and 12,320 tons were in nut coal and smaller sizes; 2,240 short tons were consumed at the mines and sold locally. Of the 60,032 tons shipped to outside markets, the bulk was sent to San Francisco, the average selling price at the mouth of the mines being $3 per ton.

During 1888 the Newport mine was worked two hundred and forty-five days, and there were employed on an average one hundred and sixty miners and laborers, the average wages received by each being $1.12. Next in size to the Newport mine is the Caledonia, situated on Isthmus slough, in Coos county, about 4 miles from Marshfield. The product of this county for 1888 was not reported. The Coos county basin, in which the above operations are confined, is claimed to cover several hundred square miles, extending from the Umpqua river north into Douglas county and south to the Coquille river and back from the Pacific slope from a distance of 15 to 20 miles.

During the past year attention has been attracted to what is known as the Nehalen coal tract, situated principally in township 4 north, of range 4 west, in Columbia county, about 25 miles from the city of Portland.

PENNSYLVANIA.

The total commercial product in 1888 was 77,719,624 short tons; spot value, $117,756,540.

Anthracite: Total shipments, 43,922,897 short tons, or 39,216,873 long tons; spot value, $85,649,649.

Bituminous: Total shipments, 33,796,727 short tons; spot value, $32,106,891.

ANTHRACITE.

The total product of coal in the anthracite regions of Pennsylvania during 1888 amounted to 46,619,564 short tons, or 41,624,611 long tons, which may certainly be considered a phenomenal amount when the statistical history of these coal fields for the past fifteen years is reviewed, and far exceeded the most sanguine expectations entertained by the best informed operators and shippers. The year 1888 may be said to have closed the most successful year in the history of Pennsylvania anthracite mining, which has now become the greatest coal-mining district in the United States. This phenomenal development may be ascribed to the compactness of the region in which these coal beds are mined (an area not greater than 325 square miles, and the area of the entire region containing coal being only 470 square miles) and to its nearness to the principal coal markets and most densely populated district in the State, containing the largest and most profitable manufactories.

The region is confined to the northeastern part of the State, in the counties of Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, Sullivan, and Susquehanna. It is divided into five principal and well-defined areas, the products of which were as follows:

Area and total product of individual anthracite coal fields.

Fields.	Square miles (approximated).	1885.		1886.	
		Long tons.	*Per cent.*	*Long tons.*	*Per cent.*
Northern	200	17,215,066	50.29	18,247,875	52.36
Eastern Middle	40	5,329,607	15.57	4,993,361	14.33
Western Middle	90	8,152,937	23.82	8,122,639	23.30
Southern	140	3,455,927	10.10	3,427,435	9.83
Loyalsock	Unknown.	75,011	0.22	61,767	0.18
Total	470 +	34,228,548	100.00	34,853,077	100.00
Fields.	**Square miles (approximated).**	**1887.**		**1888.**	
		Long tons.	*Per cent.*	*Long tons.*	*Per cent.*
Northern		21,006,337	55.90	23,917,574	57.46
Eastern Middle		3,831,335	10.19	4,852,267	11.66
Western Middle		9,382,422	24.97	9,503,440	22.83
Southern		3,265,974	8.69	3,267,299	7.85
Loyalsock		92,679	.25	84,030	.20
Total		37,578,747	100.00	41,624,611	100.00

Total product of Pennsylvania anthracite coal fields, by counties, for four years.

Counties.	1885.		1886.		1887.		1888.	
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*
Susquehanna	84,459	0.24	97,072	0.28	176,422	0.47	213,595	0.52
Lackawanna	7,174,294	20.96	7,275,853	20.88	8,772,510	23.34	10,120,011	24.29
Luzerne	14,329,645	41.86	14,928,206	42.83	15,003,722	39.92	17,462,905	41.96
Sullivan	75,011	.22	61,767	.17	92,679	.26	84,031	.20
Carbon	1,210,284	3.53	1,304,114	3.74	1,332,027	3.54	1,279,481	3.08
Schuylkill	7,700,005	22.49	7,915,650	22.71	7,994,462	21.27	8,229,407	19.77
Columbia	610,552	1.81	601,729	1.73	741,845	1.97	712,821	1.72
Northumberland	2,482,644	7.25	2,260,822	6.49	2,839,372	7.56	2,942,419	7.07
Dauphin	561,654	1.64	407,864	1.17	625,708	1.67	579,941	1.39
Total	34,228,548	100.00	34,853,077	100.00	37,578,747	100.00	41,624,611	100.00

Total products of and shipments by the inspectors' districts for the years 1885, 1886, 1887, and 1888, with the colliery and local consumption.

Districts (under law of June 30, 1885).	Inspectors.	Shipment.	Colliery and local consumption.	Total production.
		1885.		
		Long tons.	*Long tons.*	*Long tons.*
First	Patrick Blewett	6, 829, 977	428, 776	7, 258, 753
Second	Hugh McDonald	3, 686, 695	161, 854	3, 848, 549
Third	G. M. Williams	6, 036, 884	145, 891	6, 182, 775
Fourth	James E. Roderick	5, 055, 407	528, 209	5, 583, 616
Fifth	William Stein	4, 493, 075	276, 005	4, 769, 080
Sixth	James Ryan	3, 965, 959	238, 663	4, 204, 622
Seventh	Samuel Gay	2, 197, 424	183, 729	2, 381, 153
Total production of all anthracites		32, 265, 421	1, 963, 127	34, 228, 548
		1886.		
First	Patrick Blewett	6, 631, 226	481, 033	7, 112, 259
Second	Hugh McDonald	4, 143, 575	116, 498	4, 260, 073
Third	G. M. Williams	6, 692, 552	244, 758	6, 937, 310
Fourth	James E. Roderick	4, 916, 310	441, 060	5, 357, 370
Fifth	William Stein	4, 570, 145	402, 356	4, 972 501
Sixth	James Ryan	3, 463, 265	261, 252	3, 724, 517
Seventh	Samuel Gay	2, 347, 637	141, 410	2, 489, 047
Total production of all anthracites		32, 764, 710	2, 088, 367	34, 853, 077
		1887.		
First	Patrick Blewett	7, 855, 987	606, 626	8, 462, 613
Second	Hugh McDonald	4, 882, 527	160, 989	5, 043, 516
Third	G. M. Williams	7, 334, 139	206, 615	7, 540, 754
Fourth	James E. Roderick	3, 537, 192	424, 402	3, 961, 594
Fifth	William Stein	5, 005, 858	390, 587	5, 396, 445
Sixth	James Ryan	4, 359, 230	378, 392	4, 737, 622
Seventh	Samuel Gay	2, 298, 509	137, 694	2, 436, 203
Total production of all anthracites		35, 273, 442	2, 305, 305	37, 578, 747
		1888.		
First	Patrick Blewett	9, 207, 600	673, 972	9, 881, 572
Second	Hugh McDonald	5, 230, 858	204, 682	5, 435, 540
Third	G. M. Williams	8, 432, 868	251, 625	8, 684, 493
Fourth	James E. Roderick	4, 426, 018	426, 249	4, 852, 267
Fifth	William Stein	4, 930. 135	445, 050	5, 375, 185
Sixth	William McMurtrie	4, 454, 980	253, 216	4, 708, 196
Seventh	Samuel Gay	2, 534, 414	152, 944	2, 687, 358
Total production of all anthracites		39, 216, 873	2, 407, 738	41, 624, 611

The shipment of coal from the three prominent districts into which the region has been divided by the transportation companies, from the commencement of mining in 1820, has been carefully recorded by Mr. P. W. Sheafer, and subsequently by Mr. John H. Jones. From these records the following table has been compiled, and is interesting as showing the history of the development of the region:

Annual shipments of anthracite coal in Pennsylvania since 1820, with the number of tons and percentage shipped from each region.

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
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	38.52	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	15,699,721
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	6,282,226	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	30.01	5,898,634	18.65	(*a*)16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	(*a*)17,031,826	52.82	32,136,362
1887	9,431,621	26.95	6,019,162	17.20	(*a*)19,546,624	55.85	34,997,407
1888	11,464,163	29.23	4,881,384	12.45	(*a*)22,871,326	58.32	39,216,873
Total	242,642,329	36.31	123,118,912	18.43	302,424,741	45.26	668,185,982

a Includes Loyalsock field.

The total shipments reported in this table for each year cover the shipments made by the railroads and canals, and are less than the total shipments reported by the mine inspectors, which cover the shipments by wagon to near points.

Under the head of "Lehigh region" in the above table is included the eastern end of the southern or Pottsville coal basin, between Tamaqua and Mauch Chunk. In this district, which is known as the Panther Creek coal basin, the development of the region first commenced, and until 1828 more than one-half of the anthracite production of the entire region came from this basin.

From 1828 to 1857, inclusive, the Schuylkill region, including the southern coal field west of Tamaqua and the Western Middle coal field, produced more than one-half of all the coal mined, and until 1867 this same region produced more than either one of the other two regions. In 1868 the Wyoming region took its rank as the greatest producer of the three regions, and has maintained it until the present time.

Since 1883 the Wyoming region, which in the above table is made to include the Lackawanna district, has produced more than one-half of the total anthracite mined in the State.

The shipment and production (including colliery consumption) of coal for each colliery during 1886 and 1887, as reported to the Survey by the seven anthracite mine inspectors, are shown in the following tables. The numbers in the first column designate the character of the coal produced by each colliery according to an arbitrary trade classification. The following table gives the significance of the numbers, the character of the coals having been more fully explained in the report for 1886. (See Mineral Resources.)

Explanation of numbers used to designate the character of the coal.

1. Hard white ash.
2. Free-burning white ash.
3. Schuylkill red ash.
4. Shamokin.
5. Lorberry red ash.
6. Lykens Valley red ash.
7. Trevorton.
8. Wyoming red ash.
9. Lehigh red ash.

NORTHERN COAL FIELDS.

1. *Carbondale district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
2	1	Olyphant, No. 2, shaft	Olyphant borough
2	1	Eddy Creek	do
2	1	Grassy Island	do
2	1	White Oak	Archbald
2	1	Jermyn slope	Jermyn
2	1	Jermyn shaft	do
2	1	Racket Brook	Carbondale
2	1	Coalbrook	do
2	1	No. 1	do
2	1	No. 3	do
2	1	Erie shaft	Glenwood
2	1	Glenwood	do
2	1	Keystone	do
2	1	Forest City	Clifford township, Susquehanna county.
2	1	Clifford	do
2	1	Jermyn, No. 4	Priceville
2	1	Filer slope	Winton borough
2	1	Grassy Island	do
2	1	Powderly	Carbondale
2	1	Edgarton	Archbald borough
2	1	Eaton	do
2	1	Pierce	do
2	1	Lackawanna	Blakely borough
2	1	Dolph	Winton borough
2	1	Belmont	Carbondale
2	1	Blanc'd (Simpson)	Fell township
2	1	Brennan	do
1	1	Buffalo	do
2	1	Marshwood	Olyphant borough
2	1	S. V. White	Winton borough

2. *Scranton district.*

2	2	Sibley	Old Forge township, Lackawanna county.
2	2	Greenwood shaft and tunnel	Lackawanna township
2	2	Dunn shaft and slope	Old Forge township
2	1	Meadow Brook	Scranton, Twentieth ward
2	1	National shaft and slope, and Meadow Brook tunnel.	Lackawanna township
2	1	Bridge	Scranton, Fourteenth ward
2	1	Mount Pleasant	do
2	1	Green Ridge	Dunmore borough
2	1	Church	Scranton, Second ward
2	1	Archbald shaft	Lackawanna township
2	1	Sloan	do
2	1	Pyne	do
2	1	Taylor	do
2	1	Oxford	Scranton, Fifth ward
2	1	Dodge	Lackawanna township
2	1	Bellevue shaft	do
2	1	Bellevue slope	do
2	1	Hampton shaft	do
2	1	Continental	do
2	1	Central shaft	Scranton, Fifth ward
2	1	Hyde Park	Scranton, Fifteenth ward
		Diamond:	
2	1	Shaft No. 2	Scranton, Twenty-first ward
2	1	Slope No. 2	do
2	1	Tripp slope	do
2	1	Tripp shaft	do
2	1	Brisbin	Scranton, Third ward
2	1	Cayuga	do
2	1	Dunmore shaft, No. 1	Dunmore borough
2	1	Dunmore shaft, No. 2	do
2	1	Gypsy Grove shaft, No. 3	do
2	1	Gypsy Grove shaft, No. 4	do
2	1	Dunmore shaft, No. 5	do

NORTHERN COAL FIELDS.

1. *Carbondale district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	107, 741	115, 254	137, 819	146, 269
......do	174, 505	185, 944	163, 449	173, 888
......do	35, 587	45, 627	169, 269	183, 132
......do	123, 170	129, 365	127, 567	135, 150
......do	....	....	....	....
......do	197, 387	217, 811	200, 041	219, 771
......do	204, 725	206, 916	201, 764	203, 955
......do	279, 628	283, 010	291, 068	294, 240
......do	51, 759	54, 889	47, 567	50, 697
......do	4, 113	8, 808	10, 362	15, 057
Hillside Coal and Iron Company	121, 816	123, 389	164, 671	182, 056
......do	....	....	107, 362	112, 996
......do	173, 085	176, 421	141, 529	144, 295
......do	173, 085	176, 421	197, 665	211, 267
......do	....	....	....	2, 328
John Jermyn	171, 568	173, 304	179, 464	198, 022
Griffiths, Thomas & Co	34, 094	43, 996	63, 291	73, 017
Grassy Island Coal Company (limited)	67, 861	70, 049	75, 227	90, 539
Delaware and Hudson Canal Company	86, 265	91, 586	89, 568	95, 828
Edgarton Coal Company (limited)	160, 142	160, 547	139, 481	143, 098
Jones, Simpson & Co	126, 625	127, 105	118, 588	125, 196
Pierce Coal Company (limited)	148, 846	151, 657	115, 002	120, 402
Lackawanna Coal Company (limited)	170, 705	173, 212	211, 205	222, 650
Dolph Coal Company (limited)	67, 934	68, 433	66, 681	69, 759
Andrew Langdon	28, 444	29, 689	49, 748	51, 637
Northwestern Coal Company	105, 087	105, 782	126, 762	132, 444
Frisbie & Co	....	20, 857	15, 993	16, 422
A. J. Hoole & Co	....	....	21, 189	23, 774
Moosic Mountain Coal Company	....	220	22, 587	28, 447
Winton Coal Company	58, 698	60, 609	68, 743	75, 028
Total	2, 872, 870	3, 000, 901	3, 323, 662	3, 541, 364

2. *Scranton district.*

Elliott, McClure & Co	122, 000	132, 875	122, 839	135, 225
Pennsylvania Anthracite Coal Company	101, 900	103, 386	96, 731	104, 373
......do	74, 467	79, 828	63, 808	63, 882
William Connell & Co	132, 647	182, 254	232, 970	256, 649
......do	167, 505	167, 505	183, 658	196, 433
Bridge Coal Company (limited)	79, 551	107, 291	18, 692	33, 323
William T. Smith	137, 031	146, 017	128, 968	150, 345
O. S. Johnson & Co	136, 186	141, 357	104, 875	115, 259
Church Coal Company (limited)	6, 000	16, 500	4, 486	16, 496
Delaware, Lackawanna and Western Railroad Company.	166, 720	172, 808	189, 051	197, 426
......do	207, 776	207, 949	196, 890	206, 397
......do	197, 346	206, 477	185, 059	193, 928
......do	183, 241	190, 119	208, 863	221, 009
......do	122, 140	124, 182	149, 646	159, 230
......do	148, 931	154, 057	159, 266	167, 261
......do	184, 203	199, 229	180, 762	195, 337
......do				
......do	174, 646	181, 836	139, 992	146, 442
......do	26, 066	30, 236	245, 384	253, 635
......do	263, 632	287, 742	255, 127	278, 682
......do	112, 071	116, 700	143, 686	149, 851
......do	221, 017	241, 899	226, 790	248, 474
......do				
......do				
......do				
......do	46, 585	57, 252	192, 686	205, 952
......do	161, 225	172, 918	180, 552	194, 459
......do	....	1, 055	10, 222	11, 722
Pennsylvania Coal Company	58, 589	58, 980	21, 453	21, 690
......do	....	65, 586	63, 444	66, 120
......do	70, 112	70, 112	65, 756	66, 157
......do	....	114, 280	142, 714	145, 322

NORTHERN COAL FIELDS—Continued.

Scranton district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
2	1	Legitt's Creek shaft	Scranton, First ward
2	1	Marvine	do
2	1	Von Storch	Scranton, Second ward
2	1	Capouse	Scranton, Twenty-first ward
2	1	Pine Brook shaft	Scranton, Seventh ward
2	1	Fairlawn	do
2	1	Manville	Scranton, Thirteenth ward
2	2	Holstead	Marcy township
2	1	Pancoast shaft	Dickson City borough
2	1	Dickson shaft	Scranton, Second ward
2	1	Holden	Taylorville, Lackawanna township
2	2	Glendale	Lackawanna township
2	1	Richmond shaft	Scranton, Twenty-first ward
2	1	Spencer	Dunmore
......	1	Stafford	Lackawanna township
......	1	Storr's shaft	
......	1	Watkins	
......	1	Tripp's	
......	1	Peckville tunnel	
......	1	Clark's tunnel	
2	1	Local sales mines	

3. *Pittston district.*

2	2	Exeter	West Pittston
2	2	Heidelberg shaft	Pittston township
2	2	Everhart	Jenkins township
2	2	Tompkins shaft	Pittston borough
2	2	Spring Brook	Lackawanna township
2	2	Ravine	Pittston borough
2	2	Twin shaft	do
2	2	Beaver slope	do
2	2	Columbia	Marcy township
2	2	Fairmount	Pittston township
2	2	Butler	do
2	2	Mosier	Hughestown borough
2	2	Schooley	Wyoming
......	......	Maltby	do
2	2	Consolidated	Pleasant Valley
		Central:	
2	2	Shaft No. 12	do
2	2	Shaft No. 13	Old Forge township
2	2	Law shaft	Pittston township
2	2	Barnum	Marcy township
2	2	Stark	Lackawanna township
......	2	Boston	Jenkins township
		Breaker No. 6:	
2	2	Shaft No. 5	do
2	2	Shaft No. 6	do
2	2	Shaft No. 11	do
		Breaker No. 8: (*a*)	
2	2	Shaft No. 1	Hughestown borough
2	2	Shaft No. 8	do
2	2	Shaft No. 14	do
		Breaker No. 10:	
2	2	Shaft No. 9	Pittston borough
2	2	Shaft No. 10	Hughestown borough
2	2	Shaft No. 7	Jenkins township
2	2	Slope No. 4 Ewen breaker	do
2	2	Shaft No. 4	do
2	2	Tunnel No. 1	Pittston township
2	2	Old Forge	Old Forge township, Lackawanna county.
2	2	Eagle	Jenkins township
2	2	Elmwood	Pittston township

a Closed 1887; coal from shafts goes to Ewen breaker.

NORTHERN COAL FIELDS—Continued.

Scranton district—Continued.

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	179, 105	193, 041	160, 702	173, 126
......do	189, 555	202, 075	190, 788	203, 563
......do	246, 065	268, 182	264, 793	288, 329
Lackawanna Iron and Coal Company	318, 831	327, 791	328, 236	335, 536
......do	138, 861	145, 904	260, 938	280, 693
Fairlawn Coal Company (limited)	47, 191	57, 846	37, 382	45, 487
Delaware, Lackawanna and Western Railroad Company and Delaware and Hudson Canal Company.	217, 095	231, 174	201, 768	216, 286
Delaware, Lackawanna and Western Railroad Company.	203, 583	215, 157	194, 024	207, 835
Pancoast Coal Company	164, 268	178, 436	176, 292	188, 061
Delaware and Hudson Canal Company	202, 271	213, 169	257, 762	270, 208
Amity Coal Company (limited)	146, 371	150, 741	173, 000	181, 316
Glendale Coal Company	....	....	....	....
Elk Hill Coal and Iron Company	18, 469	19, 419	14, 403	16, 630
Spencer Coal Company	110, 437	117, 510	138, 558	147, 796
Wm. Connell & Co	....	....	30, 234	31, 329
Delaware, Lackawanna and Western Railroad Company.	....	3, 000	....	3, 000
Watkins & Son	219	427	17, 690	23, 000
Tripp & Co	319	10, 642	400	12, 000
Peckville Coal Company	802	1, 802	....	....
Clark Tunnel Coal Company	....	5, 965	....	6, 769
....	....	15, 600	....	19, 480
Total	5, 485, 929	6, 088, 311	6, 361, 340	6, 851, 523

3. *Pittston district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Lehigh Valley Coal Company	9, 968	10, 033	126, 279	128, 226
......do	113, 786	114, 007	71, 500	71, 500
Dininny & Cowan	....	....	....	....
A. Tompkins	....	....	....	....
W. E. Colburn	....	....	....	....
Dininny & Co	....	....	59, 338	62, 898
......do	47, 615	51, 129	15, 448	16, 834
Waterman & Beaver	....	....	....	....
Old Forge Coal Company	56, 942	58, 540	134, 425	137, 387
H. W. Harris & Co	23, 896	25, 577	28, 000	33, 208
Butler Colliery Company	29, 000	30, 150	51, 896	55, 001
......do	95, 838	98, 130	92, 101	94, 542
Dininny & Cowan	96, 203	103, 138	108, 314	116, 360
Lehigh Valley Coal Company	....	....	1, 743	1, 926
Hillside Coal and Iron Company	117, 912	118, 823	140, 352	142, 464
Pennsylvania Coal Company	....	....	....	....
......do	85, 052	85, 052	85, 738	85, 738
......do	86, 643	86, 643	90, 179	90, 179
......do	189, 067	189, 067	190, 702	190, 701
......do	....	....	....	....
N. Cowan	....	....	53, 562	56, 615
Pennsylvania Coal Company	....	....	....	....
......do	139, 726	139, 726	157, 146	157, 146
......do	....	....	....	....
......do				
......do	75, 404	75, 404	146, 946	146, 946
......do				
......do	188, 843	188, 843	160, 252	160, 252
......do	....	....	....	....
......do				
......do				
......do	290, 010	290, 010	272, 431	272, 431
......do				
......do	160, 241	160, 241	148, 554	148, 554
......do	....	....	....	....
Florence Coal Company (limited)	161, 637	169, 024	156, 022	164, 494

NORTHERN COAL FIELDS—Continued.

Pittston district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
2	2	Clearspring	West Pittston
2	2	Hunt	Wyoming
2	2	Katydid (*a*)	Moosic
2	2	Keystone	Plains township

4. *Wilkes Barre district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
		Susquehanna Coal Company:	
2	3	Colliery No. 1	Nanticoke
2	3	Colliery No. 2	do
2	3	Colliery No. 5	do
2	3	Newport, No. 6	Glen Lyon
8	3	Maffet	Sugar Notch
2	3	Alden	Alden
2	3	Warrior Run	Warrior Run
2	3	Franklin	Wilkes Barre
2	2	Hillman	Plains township
2	3	Hillman Vein	Wilkes Barre
2	2	Enterprise	Plains township
2	2	Henry	do
2	2	Midvale (*b*)	do
2	2	Mineral Spring	do
2	2	Prospect	do
2	3	Dorrance	Wilkes Barre
2	2	Wyoming Colliery	Plains township
2	2	Bennett	do
......	2	Delaware	do
2	2	Mill Creek	do
2	2	Pine Ridge	do
2	2	Laurel Run	do
2	3	Baltimore slope and shaft	Wilkes Barre township
2	3	Baltimore tunnel	do
2	3	Conyngham	Wilkes Barre
8	3	Red Ash, No. 1	Wilkes Barre township
8	3	Red Ash, No. 2	do
2	3	Diamond, No. 1	Wilkes Barre
2	3	Hollenback, No. 2	do
8	3	Empire, No. 4	do
2	3	Jersey, No. 6	Ashley
2	3	Stanton, No. 7	Wilkes Barre
2	3	Sugar Notch, No. 9	Sugar Notch
......	3	South Wilkes Barre	Wilkes Barre
2	3	Wanamie, No. 18	Newport township
8	3	West End, No. 1	Conyngham township
2	3	West End, No. 2	do

5. *Plymouth district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
......	3	Salem	Salem township
2	3	Susquehanna, No. 3	West Nanticoke
......	3	Avondale	Plymouth township
......	3	Chauncey	do
......	3	Gaylord	Plymouth
......	3	Dodson	do
......	3	Parrish	do
......	3	Lance, No. 11	do
......	3	Nottingham, No. 15	do
......	3	Reynolds, No. 16	do
......	3	Plymouth, No. 2	do
......	3	Plymouth, No. 3	Plymouth township
......	3	Plymouth, No. 4	Plymouth

a Included in Consolidated Colliery. *b* Coal goes to Prospect Breaker.

NORTHERN COAL FIELDS—Continued.

Pittston district—Continued.

Operators.	1887.		1888.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Clearspring Coal Company	149, 171	159, 426	165, 807	180, 625
Delaware, Lackawanna and Western Railroad Company.	52, 812	59, 151	42, 990	59, 552
	11, 459	13, 032		
Keystone Coal Company	89, 600	89, 786	118, 470	119, 018
Total	2, 270, 825	2, 314, 932	2, 618, 195	2, 692, 597

4. *Wilkes Barre district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Susquehanna Coal Company		188, 454		243, 272
......do	1, 444, 591	460, 403	1, 769, 059	523, 769
......do		514, 805		622, 028
......do		279, 983		395, 389
Hanover Coal Company	136, 068	136, 658	152, 339	153, 639
Alden Coal Company	255, 444	263, 074	304, 286	313, 456
A. J. Davis	80, 855	92, 389	83, 881	96, 081
Franklin Coal Company	156, 862	169, 337	143, 081	155, 026
H. Baker Hillman	60, 000	60, 000	46, 786	49, 886
Hillman Vein Coal Company	75, 032	97, 407	98, 544	118, 098
A. Langdon	106, 126	112, 418	130, 521	137, 918
Lehigh Valley Coal Company	175, 818	186, 259	174, 884	185, 466
......do				
......do	84, 536	90, 306	61, 613	66, 330
......do	317, 707	317, 853	289, 504	289, 640
......do	40, 017	51, 650	67, 972	78, 094
......do	135, 187	143, 187	132, 350	140, 350
Waddell & Walter	107, 823	112, 362	107, 557	114, 303
Delaware and Hudson Canal Company			58, 108	59, 608
......do	102, 814	102, 814	128, 699	128, 699
......do	198, 591	202, 016	192, 193	196, 130
......do	130, 125	130, 125	155, 585	155, 584
......do	69, 645	69, 645	103, 507	103, 507
......do	130, 419	132, 854	141, 822	144, 187
......do	83, 150	84, 657	101, 903	105, 538
Red Ash Coal Company	145, 781	145, 781	165, 195	165, 195
......do	175, 120	177, 712	196, 243	199, 480
Lehigh and Wilkes Barre Coal Company	94, 144	94, 526	82, 358	82, 917
......do	232, 037	254, 566	264, 483	285, 901
......do	246, 792	249, 373	293, 472	296, 331
......do	119, 039	123, 119	127, 873	138, 579
......do	266, 476	273, 473	220, 642	229, 596
......do	182, 723	184, 840	175, 832	178, 169
......do	5, 870	5, 870	180	180
......do	149, 215	151, 051	151, 343	153, 356
West End Coal Company	152, 861	172, 260	182, 479	198, 567
......do				
Total	5, 660, 868	5, 831, 237	6, 304, 294	6, 499, 269

5. *Plymouth district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Salem Coal Company				
Susquehanna Coal Company	117, 855	117, 885	103, 731	110, 353
Delaware, Lackawanna and Western Railroad Company.	166, 168	172, 589	184, 447	191, 502
T. P. Macfarlane				
Gaylord Coal Company	239, 726	248, 277	294, 421	303, 319
Plymouth Coal Company	139, 091	154, 041	134, 961	150, 140
Parrish Coal Company	185, 744	187, 957	345, 721	349, 895
Lehigh and Wilkes Barre Coal Company	193, 623	193, 689	209, 620	211, 351
......do	489, 480	498, 015	521, 522	529, 393
......do	149, 468	149, 631	159, 126	159, 126
Delaware and Hudson Canal Company	177, 307	177, 307	131, 166	131, 166
......do	222, 092	223, 939	227, 018	228, 837
......do	173, 802	173, 802	174, 812	174, 812

NORTHERN COAL FIELDS—Continued.

Plymouth district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
......	3	Plymouth, No. 5	Plymouth
......	3	Boston	Plymouth township
......	3	Kingston, Nos. 1 and 4	Edwardsville borough
......	3	Kingston, Nos. 2 and 3	......do
......	2	East Boston	Kingston township
......	2	Black Diamond	......do
......	2	Raubville	Luzerne borough
......	2	Harry E	Kingston township
......	2	Forty Fort	......do
......	3	Woodward, No. 1	Plymouth township

EASTERN MIDDLE COAL FIELD.

6. *Green Mountain district.*

9	4	Upper Lehigh, Nos. 2, 5, and 6	Upper Lehigh
9	4	Upper Lehigh, No. 4	......do
9	4	Pond Creek	Pond Creek

7. *Black Creek district.*

9	4	Sandy Run	Sandy Run
9	4	Cross Creek, No. 1	Drifton
9	4	Cross Creek, No. 2	......do
9	4	Cross Creek, No. 3	......do
1	4	Tomhicken	Tomhicken
1	4	Derringer	Derringer
1	4	Gowen	Gowen
9	4	Highland, No. 1	Highland
9	4	Highland, No. 2	......do
1	4	Oakdale, No. 1	Jeddo
1	4	Oakdale, No. 2	......do
9	4	Council Ridge, No. 10	Eckley
9	4	Council Ridge, No. 5	......do
1	4	Ebervale	Ebervale
1	4	Black Ridge	Conyngham
1	4	Harleigh	Harleigh
1	4	Lattimer, No. 1	Lattimer
1	4	Lattimer, No. 2	......do
1	4	Lattimer, No. 3	......do
1	4	Milnesville, Nos. 6 and 7	Milnesville
1	4	Hollywood	Hollywood

8. *Hazleton district.*

1	4	East Sugar Loaf, No. 1	Stockton
1	4	East Sugar Loaf, No. 2	......do
1	4	East Sugar Loaf, No. 3	......do
1	4	East Sugar Loaf, No. 5	......do
1	4	Humboldt	Humboldt
1	4	Hazlebrook	Lumber Yard
1	4	South Sugar Loaf	Hazleton
1	4	Laurel Hill	......do
1	4	Hazleton, No. 1	......do
1	4	Hazleton, No. 3	......do
1	4	Hazleton, No. 6	......do
1	4	Stockton	Stockton

NORTHERN COAL FIELDS—Continued.

Plymouth district—Continued.

Operators.	1887.		1888.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	200, 129	203, 732	210, 600	214, 616
......do	39, 609	40, 209	199, 644	202, 924
Kingston Coal Company	234, 387	249, 763	329, 727	349, 384
......do	363, 507	371, 559	344, 445	352, 445
W. G. Payne & Co	152, 092	154, 124	173, 880	175, 861
Haddock & Steel	120, 448	135, 450	120, 319	135, 169
Thomas Waddell & Co	57, 750	62, 913	60, 841	66, 158
Wyoming Valley Coal Company	128, 700	140, 850	127, 102	138, 783
......do	100, 600	110, 750	94, 031	107, 712
Delaware, Lackawanna and Western Railroad Company.	....	4, 464	35, 413	49, 875
Total	3, 651, 578	3, 770, 946	4, 182, 547	4, 332, 821

EASTERN MIDDLE COAL FIELD.

6. *Green Mountain district.*

Upper Lehigh Coal Company	145, 056	163, 683	181, 559	206, 647
......do	119, 828	124, 935	138, 973	146, 987
M. S. Kemmerer	....	....	....	....
Total	264, 884	288, 618	320, 532	353, 634

7. *Black Creek district.*

M. S. Kemmerer & Co	109, 965	118, 561	142, 102	153, 360
Coxe Bros. & Co				
......do	308, 706	345, 329	325, 500	361, 253
......do				
......do	67, 184	77, 823	54, 450	60, 407
......do	252, 074	273, 894	257, 537	381, 163
......do				
G. B. Markle & Co	83, 925	92, 217	108, 230	118, 140
......do	85, 790	94, 367	121, 442	131, 157
......do	62, 870	79, 155	74, 592	80, 558
......do	85, 668	93, 168	107, 644	116, 254
Coxe Bros. & Co	74, 031	84, 836	110, 389	125, 434
......do	73, 874	89, 155	97, 278	105, 559
Ebervale Coal Company	....	....	....	....
J. S. Wentz & Co	28, 981	31, 879	17, 850	19, 286
Kemmerer & Co	....	....	....	....
Pardee Bros. & Co	58, 090	69, 164	45, 572	57, 700
......do				
......do	30, 117	84, 749	97, 077	106, 337
Stout Coal Company	70, 061	75, 043	113, 849	122, 956
C. Pardee & Co	86, 258	93, 528	108, 924	119, 924
Total	1, 527, 594	1, 702, 868	1, 782, 436	2, 059, 488

8. *Hazleton district.*

Linderman, Skeer & Co	24, 743	27, 227	64, 618	69, 846
......do	60, 323	66, 342	66, 607	70, 603
......do	....	....	79, 284	86, 039
......do	71, 144	77, 043		
......do	52, 827	56, 886	76, 905	83, 057
J. S. Wentz & Co	33, 886	37, 185	66, 696	72, 031
A. Pardee & Co	33, 446	36, 686	51, 512	54, 752
......do	48, 882	55, 794	98, 608	106, 496
......do	87, 976	93, 241	114, 062	123, 209
......do	39, 877	45, 811	49, 672	55, 506
......do	50, 168	51, 515	54, 087	57, 437
Coxe Bros. & Co	....	....	36, 395	44, 344

EASTERN MIDDLE COAL FIELD—Continued.

8. *Hazleton district*—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
1	4	Sugar Loaf	Hazleton
1	4	Cranberry	do
1	4	Crystal Ridge	do
1	4	Mount Pleasant	Mount Pleasant

9. *Beaver Meadow district.*

1	4	Beaver Meadow	Beaver Meadow
1	4	Coleraine, Nos. 1 and 2	do
1	4	Spring Mountain, Nos. 1 and 2	Jeansville
1	4	Spring Mountain, Nos 4 and 7	do
1	4	Beaver Brook, Nos. 1 and 2	Frenchtown
1	4	Spring Brook, No. 5	Yorktown
1	4	Spring Brook, No. 6	do
1	4	Honey Brook, No. 1	Audenried
1	4	Audenried, No. 2	Tresckow
1	4	Audenried, No. 4	Audenried
1	4	Audenried, No. 5	do
1	4	Silver Brook	do

WESTERN MIDDLE COAL FIELD.

10. *East Mahanoy district.*

1	5	Ellangowan	Maple Dale
1	5	Knickerbocker	Yatesville
1	5	St. Nicholas	Saint Nicholas
1	5	Tunnel Ridge	Mahanoy City
1	5	Elmwood	do
1	5	Mahanoy City	do
1	5	North Mahanoy	do
1	5	Schuylkill	do
2	5	Suffolk	Saint Nicholas
1	5	Glendon	Mahanoy City
1	5	Primrose	do
1	5	Park, No. 1	do
1	5	Park, No. 2	do
1	7	Middle Lehigh	New Boston
1	5	Buck Mountain	Mahanoy City

11. *West Mahanoy district.*

2	6	Alaska shaft	Alaska Station
2	6	Reliance	Mount Carmel
2	6	Locust Spring	Locust Gap
2	6	Merriam	Locust Summit
2	6	Potts	Locust Dale
2	6	Keystone	do
1	6	Tunnel	Ashland
1	6	Bast	Big Mine Run
1	6	North Ashland	Dark Corner
1	6	Preston, Nos. 1 and 2	Girardville
1	6	Preston, No. 3	do
1	5	Girard	do
1	5	Hammond	do
1	5	Connor	do
1	5	Girard Mammoth	Raven Run
1	5	Turkey Run	Shenandoah
1	5	West Shenandoah	do
......	6	Small collieries	

EASTERN MIDDLE COAL FIELD—Continued.

8. *Hazleton district*—Continued.

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
A. Pardee & Co				
......do	85, 302	94, 548	124, 515	133, 761
......do				
Pardee Sons & Co	89, 352	104, 150	89, 218	96, 567
Total	677, 926	746, 428	972, 179	1, 053, 648

9. *Beaver Meadow district.*

Coxe Bros. & Co	116, 894	129, 292	150, 773	165, 660
W. T. Carter & Co	72, 428	77, 031	87, 791	99, 471
Lehigh Valley Coal Company	81, 612	94, 108	111, 240	121, 695
......do	82, 124	94, 827	120, 872	138, 472
Charles M. Dodson & Co	115, 095	126, 540	139, 935	152, 000
George H. Meyers & Co	28, 509	35, 406	99, 337	106, 700
......do	83, 130	92, 157		
Lehigh & Wilkes-Barre Coal Company	....	....	....	....
......do	58, 729	71, 360	92, 704	110, 460
......do	106, 689	116, 193	135, 427	148, 681
......do	145, 111	161, 690	175, 341	193, 143
Silver Brook Coal Company	90, 317	94, 817	137, 451	149, 215
Total	980, 638	1, 093, 421	1, 250, 871	1, 385, 497

WESTERN MIDDLE COAL FIELD.

10. *East Mahanoy district.*

Philadelphia and Reading Coal and Iron Co	435, 336	459, 336	407, 545	438, 545
......do	230, 157	242, 157	229, 041	241, 637
......do	....	....	....	....
......do	24, 585	26, 585	132, 174	141, 174
......do	105, 244	111, 244	119, 803	130, 803
......do	153, 827	163, 827	152, 057	177, 354
......do	161, 898	169, 898	133, 871	143, 871
......do	96, 180	102, 180	107, 007	112, 007
......do	154, 181	163, 181	165, 068	179, 068
J. C. Hayden & Co	69, 099	76, 979	105, 124	119, 343
Nevills & Co	97, 343	104, 883	122, 361	130, 361
Lentz, Lilly & Co	....	....	....	....
......do	228, 856	246, 372	281, 374	298, 711
Mill Creek Coal Company	231, 000	244, 860	234, 718	234, 718
Buck Mountain Coal Company	83, 746	89, 534	71, 669	77, 391
Total	2, 071, 452	2, 201, 036	2, 261, 812	2, 424, 983

11. *West Mahanoy district.*

Philadelphia and Reading Coal and Iron Company	192, 109	202, 636	196, 102	207, 868
......do	116, 691	123, 693	88, 368	93, 670
......do	125, 032	132, 534	168, 244	179, 185
......do	171, 052	181, 315	146, 669	155, 469
......do	....	....	....	....
......do	87, 987	93, 266	90, 763	96, 209
......do	74, 438	78, 904	88, 290	94, 587
......do	85, 409	90, 534	70, 080	74, 285
......do	152, 940	162, 116	163, 256	173, 051
......do	....	....	....	....
......do	101, 001	107, 061	72, 286	76, 613
......do	....	....	894	1, 094
......do	163, 731	183, 731	158, 404	179, 404
......do				
......do	61, 667	68, 667	71, 261	77, 264
......do	160, 743	170, 743	173, 937	187, 845
......do	140, 032	149, 032	156, 038	166, 203
......do	....	....	....	5, 000

WESTERN MIDDLE COAL FIELD—Continued.

11. *West Mahanoy district*—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
1	5	Shenandoah City	Shenandoah
1	5	Plank Ridge	do
1	5	Indian Ridge	do
1	5	Gilberton	Gilberton
1	5	Boston Run	Saint Nicholas
1	5	Bear Run	do
2	6	Locust Gap	Locust Gap
2	6	Monitor	do
1	5	Kohinoor	Shenandoah
1	5	East Bear Ridge	Mahanoy Plane
1	5	West Bear Ridge	do
1	5	Stanton	Maizeville
2	6	Mount Carmel	Mount Carmel
2	6	Black Diamond	do
2	6	Morris Ridge	Centralia
2	6	Bellmore	Mount Carmel
2	6	Big Mine Run	Big Mine Run
2	6	Hazel Dell	Centralia
2	6	Centralia	do
1	6	Logan	do
2	6	Continental	do
1	5	Packer, No. 1	Colorado
1	5	Packer, No. 2	Lost Creek
1	5	Packer, No. 3	Brownsville
1	5	Packer, No. 4	Lost Creek
1	5	Packer, No. 5	Rapahannock
1	5	William Penn	Shaft post-office
2	5	Springdale	
1	5	Kehley Run	Shenandoah
	5	Cambridge	do
1	5	North Laurel Ridge	Gilberton
1	5	South Laurel Ridge	do
1	5	Lawrence	Mahanoy Plane
1	5	Draper	Gilberton
	5	South Shenandoah	
	5	Furnace	

12. *Shamokin district.*

7	6	North Franklin, No. 1, Red Ash	Trevorton
7	6	North Franklin, No. 2, White Ash	do
4	6	Bear Valley	Shamokin
4	6	Burnside	Carbon Run
4	6	Peerless	Shamokin
4	6	Buck Ridge	do
4	6	Greenback	Greenback
4	6	Cameron	Shamokin
4	6	Luke Fidler	do
4	6	Hickory Ridge	Coal Run
4	6	Hickory Swamp	Green Ridge
4	6	Pennsylvania	do
4	6	Lancaster	Coal Run
4	6	Royal Oak	Shamokin
4	6	Sterling	Carbon Run
4	6	Henry Clay, No. 1	Shamokin
4	6	Big Mountain	do
4	6	Excelsior	Excelsior
4	6	Enterprise	do
4	6	Garfield	Shamokin
	6	Big Mountain, No. 2	Centralia
	6	Pioneer	Ashland
	6	Neilson Shaft	Shamokin

WESTERN MIDDLE COAL FIELD—Continued.

11. *West Mahanoy district*—Continued.

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Philadelphia and Reading Coal and Iron Company.	259, 321	274, 321	224, 425	236, 630
......do	....	....	....	....
......do	227, 823	217, 823	230, 327	245, 327
......do	100, 924	112, 924	126, 219	140, 219
......do	120, 716	127, 716	107, 617	117, 617
......do	156, 229	166, 229	123, 762	134, 845
......do	139, 611	147, 988	115, 256	122, 170
......do	132, 440	140, 286	113, 609	120, 423
......do	240, 587	252, 587	220, 592	235, 731
......do	....	....	....	....
......do	....	....	30, 158	36, 158
......do	73, 473	73, 473	1, 140	1, 640
T. M. Righter & Co	145, 971	153, 269	124, 718	130, 953
Schwenk, Robertson & Co	....	....	....	....
Isaac May & Co	87, 906	90, 906	82, 093	85, 693
S. S. Bickel & Co	92, 306	93, 482	104, 152	105, 135
Jeremiah Taylor	156, 781	160, 933	127, 543	131, 321
L. A. Riley & Co ......do	175, 949	189, 425	168, 340	179, 720
......do	194, 607	205, 916	154, 899	169, 222
Lehigh Valley Coal Company	....	....	....	....
......do	....	....	....	....
......do	....	245	67, 596	81, 408
......do	102, 068	109, 186	161, 247	169, 530
......do	124, 575	138, 645	148, 751	164, 229
......do	61, 097	71, 424	120, 514	145, 111
William Penn Coal Company	310, 000	340, 000	290, 000	320, 000
Lentz, Lilly & Co	67, 825	76, 212	21, 851	24, 290
Thomas Coal Company	132, 889	136, 190	119, 993	124, 134
Cambridge Coal Company	9, 949	10, 039	9, 557	9, 557
S. H. Barrett	33, 031	33, 048	18, 743	18, 931
......do	19, 721	19, 721	21, 687	21, 881
Lawrence & Brown	119, 982	149, 182	132, 044	162, 044
Oliver Ditson	132, 655	146, 621	154, 470	170, 785
Harry Reese	1, 388	1, 388	....	496
O. Zerbe & Co	2, 425	2, 425	11, 815	12, 547
Total	5, 055, 081	5, 415, 836	4, 977, 710	5, 385, 494

12. *Shamokin district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Philadelphia and Reading Coal and Iron Company.	....	....	....	....
......do	95, 104	100, 810	88, 952	94, 289
......do	135, 995	143, 759	117, 624	124, 682
......do	108, 583	115, 098	100, 842	106, 893
......do	(*a*)			
......do	....	....	19, 925	21, 120
......do	....	....	....	....
Mineral Railroad and Mining Company	104, 681	116, 909	128, 989	145, 924
......do	113, 701	122, 951	193, 755	207, 355
......do	44, 549	48, 944	99, 038	105, 476
W. L. Scott & Co	81, 623	87, 544	93, 270	99, 255
......do	291, 127	386, 127	227, 535	237, 291
Smith & Keiser	21, 118	21, 968	21, 795	22, 633
Tillet & Brother	147	246	157	157
Philadelphia and Reading Coal and Iron Company. ......do ......do	258, 620	275, 461	317, 127	336, 156
Excelsior Coal Mining Company	177, 467	177, 467	181, 833	181, 833
Baumgardner & Co	116, 349	124, 520	123, 972	127, 027
Garfield Coal Company	26, 101	26, 491	30, 332	30, 701
John Q. Williams	....	....	....	....
David Vaughan	....	....	....	....
J. Langdon & Co	15, 316	19, 255	71, 289	86, 889
Total	1, 590, 481	1, 765, 550	1, 816, 435	1, 927, 681

a The production of Peerless is included in that of Sterling, Henry Clay, and Big Mountain.

SOUTHERN COAL FIELD.

13. *Panther Creek district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
1	7	Colliery, No. 3	Nesquehoning
1	7	Colliery, No. 4	Jamestown
1	7	Colliery, No 5	Andrewsville
1	7	Colliery, No. 6	......do
......	7	Colliery, No. 8	Coaldale
......	7	Colliery, No. 9	......do
......	7	Colliery, No. 10	Bull Run
......	7	Colliery, No. 11	......do
......	7	Colliery, No. 12	Coaldale
......	7	Colliery, No. 13	Tamaqua
......	7	Leased mines	......do

14. *East Schuylkill district.*

2	7	Beechwood	Mount Laffeo
2	7	Wadesville shaft	Wadesville
2, 3	7	Pottsville	Pottsville
1	7	Eagle Hill shaft	New Philadelphia
......	7	Eagle	Saint Clair
1	7	Schuylkill Valley	New Castle
......	7	Monitor	Wadesville
3	7	Cumdee	......do
......	7	Hooker	Saint Clair
3	7	Palmer vein	New Philadelphia
......	7	Kaska William	Middleport
......	7	Coal Hill	Blythe township
1	7	East Lehigh	Tamaqua
......	7	West Lehigh	......do
3	7	Pine Dale	Middleport
1	7	Ebony	New Castle
3	7	Peach Orchard	Saint Clair
......	7	Sharp Mountain	Pottsville
......	7	Oak Hill	Mount Laffee
......	7	Flowery Field	Wadesville
......	7	Tamaqua	Tamaqua
......	7	Shelly	......
......	7	Chamberlain	Saint Clair
......	7	Milford	Middleport

15. *West Schuylkill district.*

2	7	Ctto	Branchdale
3	7	Phœnix Park, No. 3	Phœnix Park
2	7	Forestville	Forestville
2	7	Glendower	Glen Carbon
2	7	Richardson	......do
2	7	Thomaston	Heckschersville
2	7	Wood	Swatara
2	7	Peach Mountain	Wolf creek
2	7	Herbine	......do
3	7	Wolf Creek Big Diamond	......do
2	7	Little Diamond	Minersville
2	7	Ellsworth	New Castle
2	7	Black Valley	Minersville
......	7	Jugular	New Castle
2	7	Crystal	......do
2	7	Kirkline	Thomaston
3	7	Fegar Ridge	Newtown
......	7	Mine Hill Gap	Minersville

SOUTHERN COAL FIELD.

13. *Panther Creek district.*

Operators.	1887.		1888.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons*	*Long tons.*
Lehigh Coal and Navigation Company	73, 149	117, 905	151, 984	151, 984
......do	120, 929	130, 602	110, 330	110, 330
......do ......do	80, 863	87, 332	49, 172	49, 172
......do	93, 413	99, 018	115, 197	115, 197
......do	119, 554	127, 941	143, 880	143, 880
......do	121, 029	128, 289	142, 521	142, 521
......do	70, 834	75, 084	85, 650	85, 650
......do	62, 736	66, 500	83, 447	83, 447
......do	22, 135	23, 463	29, 199	29, 199
......do				
Total	764, 642	856, 134	911, 380	911, 380

14. *East Schuylkill district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Philadelphia and Reading Coal and Iron Company.	70, 986	75, 245	46, 489	46, 489
......do				
......do				
......do	203, 861	216, 093	174, 334	174, 334
......do	40, 662	43, 102	26, 634	26, 634
Quinn & Winnons	3, 706	3, 928	4, 014	4, 014
John Denning & Bro	4, 471	4, 739	5, 198	5, 198
John Mullin & Co				
Maurey & Co	13, 646	14, 465	20, 066	20, 066
Alliance Coal Mining Company	5, 408	5, 732	13, 313	13, 313
......do	122, 072	129, 396	122, 380	122, 380
William Basler				
Mitchell & Shepp	4, 157	4, 406	6, 685	6, 685
Peter Young			25, 637	25, 637
Slemmer & Co				
Bowman & Co				
Evans & Geisweit				
Thomas Wren				
......do				
Flowery Field Coal Company	10, 026	10, 628	16, 285	16, 285
Draper & Wittich				
Shelly & Confair				
Thompson & Co	7, 793	8, 261	16, 394	16, 394
Docker & Bowman				
Total	486, 788	515, 995	477, 429	477, 429

15. *West Schuylkill district.*

Operators.	1887. Shipment.	1887. Production.	1888. Shipment.	1888. Production.
Philadelphia and Reading Coal and Iron Company.	53, 718	56, 941	53, 316	53, 316
......do	59, 860	63, 452	61, 335	61, 335
......do				
......do	78, 819	83, 548	34, 565	34, 565
......do	111, 490	118, 179	53, 766	53, 766
......do	140, 396	148, 820	118, 395	118, 395
C. Wood				
W. H. Harris				
J. K. Seigfried	38, 943	41, 280	43, 743	43, 743
J. F. Donahue				
J. A. Lawrence	3, 600	3, 816	1, 435	1, 435
John R. Davis	12, 282	13, 019	9, 243	9, 243
Edward Hoskins				
J. S. Hepner				
Joseph Brady & Co	9, 596	10, 172	7, 730	7, 730
P. O'Connor	2, 225	2, 359	3, 640	3, 640
F. P. Kendrick & Co			6, 265	6, 265
Philadelphia and Reading Coal and Iron Company.				

SOUTHERN COAL FIELD—Continued.

15. *West Schuylkill district*—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
......	7	Swatara, No. 2	Swatara
......	7	....	....

16. *Lorberry district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
5	7	Colket	Donaldson
5	7	East Franklin	Upper Rausch creek
5	7	Middle Creek shaft	Middle creek
5	7	Rausch Creek	Tremont township

17. *Lykens Valley district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
6	7	Brookside	Porter township
6	7	Kalmia	Orwin
6	7	Lincoln	Tremont township
6	7	New Lincoln	......do
6	6	Williamstown	Williamstown
6	6	Short Mountain	Lykenstown
6	6	Lykens Valley	......do
6	6	Big Run Gap	Williams valley
		Total	....
......	7	Local sales and colliery consumption in seventh district.	....

LOYALSOCK FIELD.

18. *Loyalsock district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Locations.
......	2	Bernice	Bernice, Sullivan county

SOUTHERN COAL FIELD—Continued.

15 *West Schuylkill district*—Continued.

Operators.	1887.		1888.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
John D. Felty				
Dix & Edwards				
Total	510, 929	541, 586	393, 433	393, 433

16. *Lorberry district.*

Philadelphia and Reading Coal and Iron Company.				
......do			1, 290	1, 290
......do	109, 154	115, 703	95, 077	95, 077
......do				
Total	109, 154	115, 703	96, 367	96, 367

17. *Lykens Valley district.*

Philadelphia and Reading Coal and Iron Company.	312, 817	331, 586	235, 652	235, 652
......do	2, 423	2, 568	500	500
......do	112, 754	119, 519	111, 306	111, 306
Levi Miller & Co	148, 268	157, 175	73, 629	73, 629
Summit Branch Railroad Company	338, 927	388, 291	327, 748	334, 680
Lykens Valley Coal Company ......do	197, 494	237, 417	236, 129	245, 261
James Fennell				
	1, 112, 683	1, 236, 556	984, 964	1, 001, 028
				152, 944
Total				1, 153, 972

LOYALSOCK FIELD.

18. *Loyalsock district.*

State Line and Sullivan Railroad Company	59, 331	61, 767	81, 288	84, 031

The following table exhibits the percentage of the total product in each field which was mined during 1888 by the large mining corporations and by individual operators:

Distribution of product among mining companies by individual fields.

	Per cent.
Northern coal field:	
Delaware, Lackawanna and Western	13.32
Delaware and Hudson Canal Company	17.88
Delaware and Hudson, and Delaware Lackawanna and Western	1.11
Lehigh and Wilkes Barre Coal Company	10.36
Susquehanna Coal Company	7.43
Lehigh Valley Coal Company	4.35
Pennsylvania Coal Company	7.26
Hillside Coal and Iron Company	2.83
Individual operators	35.46
Total	100.00
Eastern middle coal field:	
Lehigh and Wilkes Barre Coal Company	9.12
Individual operators	90.88
Total	100.00
Western middle coal field:	
Philadelphia and Reading Coal and Iron Company	57.14
Lehigh Valley Coal Company	3.40
Mineral Railroad and Mining Company	3.08
Individual operators	36.38
Total	100.00
Southern coal field:	
Philadelphia and Reading Coal and Iron Company	42.09
Lehigh Coal and Navigation Company	26.21
Summit Branch Railroad Company	10.36
Lykens Valley Coal Company	7.27
Individual operators	14.07
Total	100.00

The mines in the western northern coal field are all operated by the State Line and Sullivan Railroad Company in the interests of the Lehigh Valley Railroad Company.

The percentage of the total product shipped by the different transportation companies individually, and by two or more companies combined, were shown in the report for 1887, to which the reader is referred.

The statistics of the shipment of anthracite coal are regularly collected by Mr. John H. Jones, in charge of the Bureau of Anthracite Coal Statistics, which he conducts under the direction of the anthracite transportation companies. The Survey is indebted to Mr. Jones for the statistics which are published in the following tables:

Shipments of anthracite, first quarter, 1888.

JANUARY.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	94, 471	13	500, 390	12	Dec..	405, 918	19
Central R. R. of New Jersey	329, 863	05	237, 632	15	Inc ..	92, 230	10
Lehigh Valley R. R	298, 035	05	409, 633	02	Dec..	111, 597	17
Delaware, Lackawanna and Western R. R	633, 884	05	350, 235	14	Inc ..	283, 648	11
Delaware and Hudson Canal Company	391, 885	01	355, 640	11	Inc ..	36, 244	10
Pennsylvania R. R	316, 862	03	253, 505	01	Inc ..	63, 357	02
Pennsylvania Coal Company	123, 525	12	79, 233	05	Inc ..	44, 292	07
New York, Lake Erie and Western R. R	67, 165	01	57, 041	10	Inc ..	10, 123	11
Total	2, 255, 692	05	2, 243, 312	10	Inc ..	12, 379	15
From Wyoming region	1, 908, 297	00	1, 200, 115	00	Inc ..	708, 182	00
From Lehigh region	48, 022	00	347, 023	00	Dec..	299, 001	00
From Schuylkill region	299, 373	00	696, 175	00	Dec..	396, 802	00

FEBRUARY.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	214, 314	03	502, 043	00	Dec..	287, 728	17
Central R. R. of New Jersey	361, 064	08	352, 625	17	Inc ..	8, 438	11
Lehigh Valley R. R	334, 316	03	480, 615	11	Dec..	146, 299	08
Delaware, Lackawanna and Western R. R	624, 301	11	482, 483	06	Inc ..	141, 818	05
Delaware and Hudson Canal Company	419, 102	08	344, 361	00	Inc ..	74, 741	08
Pennsylvania R. R	348, 434	08	225, 105	19	Inc ..	123, 328	09
Pennsylvania Coal Company	157, 380	14	97, 604	02	Inc ..	59, 776	12
New York, Lake Erie and Western R. R	69, 408	15	66, 164	15	Inc ..	3, 244	00
Total	2, 528, 322	10	2, 551, 003	10	Dec..	22. 681	00
From Wyoming region	2, 021, 973	07	1, 434, 854	12	Inc ..	587, 118	15
From Lehigh region	52, 250	05	409, 349	02	Dec..	357, 098	17
From Schuylkill region	454, 098	18	706, 799	16	Dec..	252, 700	18

MARCH.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	550, 949	16	603, 868	17	Dec..	52, 919	01
Central R. R. of New Jersey	361, 055	04	453, 722	07	Dec..	92, 667	03
Lehigh Valley R. R	448, 507	06	618, 766	16	Dec..	170, 259	10
Delaware, Lackawanna and Western R. R	498, 651	15	452, 181	00	Inc ..	46, 470	15
Delaware and Hudson Canal Company	371, 290	01	291, 908	13	Inc ..	79, 381	08
Pennsylvania R. R	303, 932	18	284, 632	10	Inc ..	19, 300	08
Pennsylvania Coal Company	80, 422	15	138, 191	16	Dec..	57, 769	01
New York, Lake Erie and Western R. R	70, 918	19	68, 000	00	Inc ..	2, 918	19
Total	2, 685, 728	14	2, 911, 271	19	Dec..	225, 543	05
From Wyoming region	1, 661, 833	02	1, 481, 243	15	Inc ..	180, 589	07
From Lehigh region	216, 326	11	549, 283	19	Dec..	332, 957	08
From Schuylkill region	807, 569	01	880, 744	05	Dec..	73, 175	04

TOTAL, FIRST QUARTER.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	859, 735	12	1, 606, 302	09	Dec.	746, 566	17
Central R. R. of New Jersey	1, 051, 982	17	1, 043, 980	19	Inc .	8, 001	18
Lehigh Valley R. R	1, 080, 858	14	1, 509, 015	09	Dec.	428, 156	15
Delaware, Lackawanna and Western R. R	1, 756, 837	11	1, 284, 900	00	Inc	471, 937	11
Delaware and Hudson Canal Company	1, 182, 277	10	991, 910	04	Inc .	190, 367	06
Pennsylvania R. R	969, 229	09	763, 243	10	Inc .	205, 985	19
Pennsylvania Coal Company	361, 329	01	315, 029	03	Inc .	46, 299	18
New York, Lake Erie and Western R. R	207, 492	15	191, 206	05	Inc .	16, 286	10
Total	7, 469, 743	09	7, 705, 587	19	Dec.	235, 844	10
From Wyoming region	5, 592, 103	14	4, 116, 212	17	Inc .	1, 475, 890	17
From Lehigh region	316, 598	16	1, 305, 656	01	Dec.	989, 057	05
From Schuylkill region	1, 561, 040	19	2, 283, 719	01	Dec.	722, 678	02

Shipments of anthracite, second quarter, 1888.

APRIL.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R.	636, 309	01	604, 475	04	Inc..	31, 833	17
Central R. R. of New Jersey	455, 248	04	484, 940	04	Dec..	29, 692	00
Lehigh Valley R. R	496, 533	07	607, 319	12	Dec..	110, 786	05
Delaware, Lackawanna and Western R. R	438, 210	03	372, 007	08	Inc..	66, 202	15
Delaware and Hudson Canal Company	296, 263	11	240, 407	02	Inc..	55, 856	09
Pennsylvania R. R	351, 351	16	294, 213	14	Inc..	57, 138	02
Pennsylvania Coal Company	103, 055	08	115, 433	12	Dec..	12, 378	04
New York, Lake Erie and Western R. R	79, 621	12	68, 000	00	Inc..	11, 621	12
Total	2, 856, 593	02	2, 786, 796	16	Inc..	69, 796	06
From Wyoming region	1, 502, 186	13	1, 341, 361	06	Inc..	160, 825	07
From Lehigh region	465, 564	00	571, 674	11	Dec..	106, 110	11
From Schuylkill region	888, 842	09	873, 760	19	Inc..	15, 081	10

MAY.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	568, 117	09	547, 507	07	Inc..	20, 610	02
Central R. R. of New Jersey	583, 579	18	541, 061	12	Inc..	42, 518	06
Lehigh Valley R. R	444, 219	11	396, 156	00	Inc..	48, 063	11
Delaware, Lackawanna and Western R. R	393, 122	11	441, 686	18	Dec..	48, 564	07
Delaware and Hudson Canal Company	264, 953	05	266, 401	18	Dec..	1, 448	13
Pennsylvania R. R	391, 873	05	313, 511	18	Inc..	78, 361	07
Pennsylvania Coal Company	122, 887	15	127, 158	14	Dec..	4, 270	19
New York, Lake Erie and Western R. R	82, 716	07	66, 868	18	Inc..	15, 847	09
Total	2, 851, 470	01	2, 700, 353	05	Inc..	151, 116	16
From Wyoming region	1, 447, 601	11	1, 417, 313	04	Inc..	30, 288	07
From Lehigh region	548, 367	09	507, 934	04	Inc..	40, 433	05
From Schuylkill region	855, 501	01	775, 105	17	Inc..	80, 395	04

JUNE.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	573, 595	14	560, 299	05	Inc..	13, 296	09
Central R. R. of New Jersey	502, 536	14	481, 127	03	Inc..	21, 409	11
Lehigh Valley R. R	432, 715	19	408, 548	07	Inc..	24, 167	12
Delaware, Lackawanna and Western R. R	488, 283	01	455, 315	16	Inc..	32, 967	05
Delaware and Hudson Canal Company	291, 652	03	266, 330	16	Inc..	25, 321	07
Pennsylvania R. R	456, 161	01	355, 182	04	Inc..	100, 978	17
Pennsylvania Coal Company	155, 558	05	117, 699	17	Inc..	37, 858	08
New York, Lake Erie and Western R. R	77, 145	15	66, 204	15	Inc..	10, 941	00
Total	2, 977, 648	12	2, 710, 708	03	Inc..	266, 940	09
From Wyoming region	1, 611, 271	13	1, 390, 254	04	Inc..	221, 017	09
From Lehigh region	488, 592	18	503, 740	11	Dec..	15, 147	13
From Schuylkill region	877, 784	01	816, 713	08	Inc..	61, 070	13

TOTAL, SECOND QUARTER.

	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R	2, 637, 757	16	3, 318, 584	05	Dec.	680, 826	09
Central R. R. of New Jersey	2, 663, 508	13	3, 138, 523	16	Dec.	475, 015	03
Lehigh Valley R. R	2, 384, 166	11	2, 333, 625	10	Inc.	50, 541	01
Delaware, Lackawanna and Western R. R	3, 076, 453	06	2, 553, 910	02	Inc.	522, 543	04
Delaware and Hudson Canal Company	2, 035, 146	09	1, 765, 050	00	Inc.	270, 096	09
Pennsylvania R. R	2, 168, 615	11	1, 726, 151	06	Inc.	442, 464	05
Pennsylvania Coal Company	742, 830	09	675, 321	06	Inc.	67, 509	03
New York, Lake Erie and Western R. R	446, 976	09	392, 279	18	Inc.	54, 696	11
Total	16, 155, 455	04	15, 903, 446	03	Inc.	252, 009	01
From Wyoming region	10, 153, 163	11	8, 265, 141	11	Inc.	1, 888, 022	00
From Lehigh region	1, 819, 123	03	2, 889, 005	07	Dec.	1, 069, 882	04
From Schuylkill region	4, 183, 168	10	4, 749, 299	05	Dec.	566, 130	15

Shipments of anthracite, third quarter, 1888.

JULY.

	1888. Tons.	Cwt.	1887. Tons.	Cwt.	Difference.	Tons.	Cwt.
Philadelphia and Reading R. R.	606,950	04	608,137	15	Dec..	1,187	11
Lehigh Valley R. R	697,090	18	516,454	06	Inc..	180,636	12
Central R. R. of New Jersey	517,107	15	435,753	09	Inc..	81,354	06
Delaware, Lackawanna and Western R. R.	523,391	05	407,023	13	Inc..	116,367	12
Delaware and Hudson Canal Company	355,521	12	277,044	19	Inc..	78,476	13
Pennsylvania R. R	430,226	19	335,856	10	Inc..	94,370	09
Pennsylvania Coal Company	167,136	14	125,148	11	Inc..	41,988	03
New York, Lake Erie and Western R. R	68,847	12	56,204	15	Inc..	12,642	17
Total	3,366,272	19	2,761,623	18	Inc..	604,649	01
From Wyoming region	1,717,686	03	1,379,699	08	Inc..	337,986	15
From Lehigh region	705,313	02	531,498	08	Inc..	173,814	14
From Schuylkill region	943,273	14	850,426	02	Inc..	92,847	12

AUGUST.

	Tons.	Cwt.	Tons.	Cwt.		Tons.	Cwt.
Philadelphia and Reading R. R.	876,017	16	703,232	14	Inc..	172,785	02
Lehigh Valley R. R	706,428	04	574,876	09	Inc..	131,551	15
Central R. R. of New Jersey	623,816	14	491,125	14	Inc..	132,691	00
Delaware, Lackawanna and Western R. R	726,659	12	520,978	08	Inc..	205,681	04
Delaware and Hudson Canal Company	456,311	00	346,722	00	Inc..	109,589	00
Pennsylvania R. R	459,741	05	354,978	08	Inc..	104,762	17
Pennsylvania Coal Company	187,325	06	147,388	09	Inc..	39,936	17
New York, Lake Erie and Western R. R	61,262	16	59,423	13	Inc..	1,839	03
Total	4,097,562	13	3,198,725	15	Inc..	898,836	18
From Wyoming region	2,153,804	03	1,612,367	14	Inc..	541,436	09
From Lehigh region	691,893	05	590,763	03	Inc..	101,130	02
From Schuylkill region	1,251,865	05	995,594	18	Inc..	256,270	07

SEPTEMBER.

	Tons.	Cwt.	Tons.	Cwt.		Tons.	Cwt.
Philadelphia and Reading R. R.	830,951	04	736,302	05	Inc..	94,648	19
Lehigh Valley R. R	668,473	01	471,820	17	Inc..	196,652	04
Central R. R. of New Jersey	595,430	08	391,543	10	Inc..	203,886	18
Delaware, Lackawanna and Western R. R.	699,311	04	596,613	18	Inc..	102,697	06
Delaware and Hudson Canal Company	442,357	04	404,778	08	Inc..	37,578	16
Pennsylvania R. R	415,492	05	331,038	17	Inc..	84,453	08
Pennsylvania Coal Company	145,846	03	148,950	17	Dec..	3,104	14
New York, Lake Erie and Western R. R.	118,464	02	56,605	16	Inc..	61,858	06
Total	3,916,325	11	3,137,654	08	Inc..	778,671	03
From Wyoming region	2,116,797	11	1,921 513	06	Inc..	195,284	05
From Lehigh region	628,248	01	244,362	02	Inc..	383,885	19
From Schuylkill region	1,171,279	19	971,779	00	Inc..	199,500	19

TOTAL, THIRD QUARTER.

	Tons.	Cwt.	Tons.	Cwt.		Tons.	Cwt.
Philadelphia and Reading R. R.	4,951,677	00	5,366,256	19	Dec.	414,579	19
Lehigh Valley R. R.	4,735,500	16	4,701,675	08	Inc.	33,825	08
Central R. R. of New Jersey	4,120,521	08	3,652,048	03	Inc.	468,473	05
Delaware, Lackawanna and Western R. R.	5,025,815	07	4,078,526	01	Inc.	947,289	06
Delaware and Hudson Canal Company	3,289,336	05	2,793,595	07	Inc.	495,740	18
Pennsylvania R. R	3,474,076	00	2,748,025	01	Inc.	726,050	19
Pennsylvania Coal Company	1,243,138	12	1,096,809	03	Inc.	146,329	09
New York, Lake Erie and Western R. R	695,550	19	564,514	02	Inc.	131,036	17
Total	27,535,616	07	25,001,450	04	Inc.	2,534,166	03
From Wyoming region	16,141,451	08	13,178,721	19	Inc.	2,962,728	14
From Lehigh region	3,844,577	11	4,255,629	00	Dec.	411,051	09
From Schuylkill region	7,549,587	08	7,567,099	05	Dec.	17,511	17

Shipments of anthracite, fourth quarter, 1888.

OCTOBER.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R.	910,353	16	782,081	13	Inc..	128,272	03
Lehigh Valley R. R	714,852	01	328,602	10	Inc..	386,249	11
Central R. R. of New Jersey	639,715	07	390,891	09	Inc..	248,823	18
Delaware, Lackawanna and Western R. R.	774,093	15	699,039	15	Inc..	75,054	00
Delaware and Hudson Canal Company	439,932	04	392,347	06	Inc..	47,584	18
Pennsylvania R. R	442,282	02	350,376	16	Inc..	91,905	06
Pennsylvania Coal Company	173,638	01	177,538	02	Dec..	3,900	01
New York, Lake Erie and Western R. R	92,659	10	64,421	07	Inc..	28,238	03
Total	4,187,526	16	3,185,298	18	Inc	1,002,227	18
From Wyoming region	2,234,306	02	2,124,051	04	Inc..	110,254	18
From Lehigh region	673,590	15	26,986	00	Inc..	646,604	15
From Schuylkill region	1,279,629	19	1,034,261	14	Inc..	245,368	05

NOVEMBER.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R.	845,065	07	788,608	02	Inc..	56,457	05
Lehigh Valley R. R.	660,263	14	397,526	00	Inc..	262,737	14
Central R. R. of New Jersey	535,455	12	427,472	19	Inc..	107,982	13
Delaware, Lackawanna and Western R. R.	663,846	15	717,541	12	Dec..	53,694	17
Delaware and Hudson Canal Company	410,424	17	444,586	11	Dec..	34,161	14
Pennsylvania R. R	371,001	11	366,528	10	Inc..	4,473	01
Pennsylvania Coal Company	134,821	07	177,374	12	Dec..	42,553	05
New York, Lake Erie and Western R. R	97,772	16	66,551	15	Inc..	31,221	01
Total	3,718,651	19	3,386,190	01	Inc..	332,461	18
From Wyoming region	1,952,029	07	2,236,927	14	Dec..	284,898	07
From Lehigh region	601,893	10	27,935	19	Inc..	573,957	11
From Schuylkill region	1,164,729	02	1,121,326	08	Inc..	43,402	14

DECEMBER.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R.	467,998	19	618,304	19	Dec..	150,306	00
Lehigh Valley R. R.	482,099	03	356,646	13	Inc..	125,452	10
Central R. R. of New Jersey	446,587	01	382,446	10	Inc..	64,140	11
Delaware, Lackawanna and Western R. R.	532,436	12	725,685	04	Dec..	193,248	12
Delaware and Hudson Canal Company	346,494	19	417,701	04	Dec..	71,206	05
Pennsylvania R. R.	267,080	17	351,212	18	Dec..	84,132	01
Pennsylvania Coal Company	72,835	06	151,733	16	Dec..	78,898	10
New York, Lake Erie and Western R. R.	88,390	05	64,347	08	Inc..	24,042	17
Total	2,703,923	02	3,068,078	12	Dec..	364,155	10
From Wyoming region	1,524,578	15	2,145,227	18	Dec..	620,049	03
From Lehigh region	519,174	14	36,510	15	Inc..	482,663	19
From Schuylkill region	660,169	13	886,339	19	Dec..	226,170	06

TOTAL, FOURTH QUARTER.

	1888.		1887.		Difference.		
	Tons.	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
Philadelphia and Reading R. R.	7,175,095	02	7,555,251	13	Dec..	380,156	11
Lehigh Valley R. R	6,592,715	14	5,784,450	11	Inc..	808,265	03
Central R. R. of New Jersey	5,742,279	08	4,852,859	01	Inc..	889,420	07
Delaware, Lackawanna and Western R. R.	6,996,192	09	6,220,792	12	Inc..	775,399	17
Delaware and Hudson Canal Company	4,486,188	05	4,048,230	08	Inc..	437,957	17
Pennsylvania R. R	4,554,440	10	3,816,143	05	Inc..	738,297	05
Pennsylvania Coal Company	1,624,433	06	1,603,455	13	Inc..	20,977	13
New York, Lake Erie and Western R. R	974,373	10	759,834	12	Inc..	214,538	18
Total	38,145,718	04	34,641,017	15	Inc.	3,504,700	09
From Wyoming region	21,852,365	12	19,684,928	15	Inc.	2,167,436	17
From Lehigh region	5,639,236	10	4,347,061	14	Inc.	1,292,174	16
From Schuylkill region	10,654,116	02	10,609,027	06	Inc.	45,088	16

All the anthracite transportation companies, with the exception of the Philadelphia and Reading Railroad Company, shipped more coal to market than during the previous year, the aggregate increase in shipments amounting to 3,504,700 tons. Nearly 70 per cent. of this increase was from the northern coal field, which is contained in the Wyoming and Lackawanna valleys and known to the coal trade generally as the Wyoming region. The greatest increase in the shipments of any one company was by the Central Railroad of New Jersey, the aggregate for the year being 889,420 tons. The only decrease for the year was in shipments of the Philadelphia and Reading Coal and Iron Company, which amounted in the aggregate to 380,156 tons. The stocks of coal on hand at tide-water shipping points at the beginning of the year, amounted to 130,977 tons. During the month of January there were 12,379 tons produced more than during the same month in the previous year, and there was a falling off in stocks of coal during the same month of 35,809 tons. These facts show an exceptional condition in the coal trade at the beginning of 1888, in view of labor troubles which existed, especially in the Lehigh region, by which the total product of the Lehigh Valley railroad during the month was decreased 111,597 tons below the product of the same month in the previous year; and also in view of the fact of the exceptional decrease in the shipments during the month by the Philadelphia and Reading Company, which amounted to 405,918 tons, a decrease due also to labor troubles.

One notable fact took place at the opening of the year, and that was the closure of the receivership of the Philadelphia and Reading Railroad Company and of the Philadelphia and Reading Coal and Iron Company, which had been in force from June, 1884; and the placing of the Philadelphia and Reading companies in strong hands opened a better basis for the advancement of their business than had existed since the acquirement by the Coal and Iron Company of its vast coal estates. The receivership of these companies was one of the most notable and ably conducted which has probably ever been organized. During the term of its existence the cash receipts of the receivers amounted to about $175,000,000 and its disbursements to about $172,000,000. The railroads and coal and iron properties of these companies were kept intact by the receivers, and were returned to the stockholders with the debts of the company ably provided for (although not to the satisfaction of all stockholders), and with the earning capacity of the companies undiminished. During the existence of this receivership the Coal and Iron Company mined and sold upwards of 22,000,000 tons of coal, while the railroad company transported nearly 90,000,000 tons of freight, merchandise, etc., and 75,000,000 passengers. The receivership of these companies was beset with so great difficulties, growing out of the numerous and conflicting interests involved, that it is remarkable that the properties of the companies were kept intact.

During the first quarter of the year the total shipments from the anthracite region were about 250,000 tons less than during the first quarter of the previous year. During the succeeding quarter the increased shipments were a little over double the decreased shipments during the first quarter, so that at the end of the first six months of the year the total increase over 1887 was 252,009 tons. Although this increase during the six months was accounted for largely by the increased accumulation of coal placed in stocks at tide-water shipping points, yet the increased demand during the six months by the trade was rightly interpreted by the operators as legitimate, and warranting more vigorous mining. The stocks on June 30, at tide-water shipping points, were 741,958 tons.

During the last six months of the year the amount of coal shipped by each one of the anthracite companies was very much greater than during the same six months of the previous year. The shipments of the Philadelphia and Reading railroad on July 1, were 680,826 tons behind those for the first six months of the previous year, while on December 31, the amount had diminished to 380,156 tons. The settlement of all the principal labor difficulties in the region prior to the latter half of the year, the increased demand by the early trade, and the ruling of better prices all tended to make the last six months of 1888 the most notable which have ever existed in the anthracite coal trade.

Out of the increase in shipments during the year, which, as stated above, amounted to 3,504,700 tons, the shipments during the last six months of the year 1888 increased 3,252,691 tons. Of this amount the increase during the month of October took the greatest proportion of any one month, the amount of shipments during this month exceeding that of the same month of 1887 by 1,002,227 tons. The increased demand for anthracite coal continued active until about the middle of November, when, on account of the mildness of the season up to the end of the year, there was a decrease in consumption of fuel as compared with the previous year, and the tonnage and prices both began to fall, although there was a steadiness in the values up to the beginning of 1889 which warranted the entertainment by the coal trade of great hopes for the latter year, which during the first six months had not been realized.

Prices.—The average price received by the operators for their coal during 1888 was remunerative, and higher than during the previous year. At the beginning of 1888 there were strikes and other labor disturbances in the Lehigh and Schuylkill mining regions, which were protracted into the month of March, and caused much suffering to the miners and great loss of wages to them, as well as a large loss of tonnage to the railroads carrying coal from these two regions. The year 1889 opened with peace existing between miners and operators throughout all the anthracite mining districts. Both the miners and the mine operators, and the railways which transport the coal to market, were enjoying the profits of their labors during the year which closed under such auspicious circumstances, and with a reasonable hope of equally good trade during 1889. These hopes up to June of the latter year have not been realized, and the condition of the coal trade during the first six months of 1889 may be said to have been in a demoralized condition. It has been conducted with loss of money to many of the operators, with decreased tonnages and profits to the railways, and with great suffering to many miners, who have been idle a large proportion of their time.

For the market prices which ruled during 1888 for the different classes of anthracite coal reference should be made to the reports of the Philadelphia and New York markets already given.

Cost of anthracite mining.—The thickness of the anthracite coal beds (varying from 5 to 70 feet in beds which are worked), the character of the coal itself, and the peculiar geological conditions under which beds are found have attracted the attention of mining engineers all over the world to the Pennsylvania anthracite mines, and many important professional papers on the anthracite region and on anthracite mining have been published by prominent engineers not only in America but abroad, principally in England, France, and Germany. The mining methods employed have been frequently adversely criticised, especially in the foreign papers. The engineers by whom these criticisms have been made have failed to appreciate all the trade and mining conditions under which the anthracite mines are operated. When these are taken into consideration in all their bearings it can be asserted that the mining of anthracite coal is as systematically and economically conducted as the mining of any coal in any region of the world.

Great interest is manifested by the public generally as to the cost of mining coal everywhere in the States, and especially is this so as regards the cost of producing a ton of coal in the anthracite mining region of Pennsylvania. The system necessary for profitable mining and preparation of anthracite is unavoidably such a complex one, owing not only to the peculiar hardness of the coal, but also to the complicated geological structure of the coal beds themselves, that most people, among whom may be included many practical miners in the bituminous coal fields, have little conception of the intricacies of anthracite mining.

The account given below does not show the average cost of production throughout the whole region at that time, nor the cost of production at the same colliery during 1888, yet it will give a very intelligent idea of the general classification of costs for most of the anthracite collieries. It will be seen that it costs about $1.39 per ton to place the coal on the cars for transportation, as against $1.95, the average cost per ton for the entire region during 1888. These two amounts are hardly comparable, however, since the estimate of $1.95 for all coals produced during 1888 includes general expenses not included in the account itemized below.

Account of cost per ton of mining anthracite at a selected mine.

[Capacity of mine, from 480 to 500 tons per day of ten hours.]

WAGES ACCOUNT.

	Men and boys.	Wages.
Miners, 6 cars, each 1½ tons per car, 66 cents } 99 cents per car { Miners	55	$217.80
Laborers, 6 cars as above, 33 cents } 99 cents per car { Laborers	55	108.90
Boys and old men, slate-pickers, per day, 40, 50, 60, and 70 cents; average, 55 cents	45	24.75
Engineers, averaging $2 per day	3	6.00
Firemen, at $1.65	5	8.25
Pumpmen, at $2	4	8.00
Footmen and topmen, at slope or shaft, at $1.50	4	6.00
Inside mule drivers, at $1.80	8	14.40
Inside door boys, at $1	2	2.00
Inside counter chute ticket boss and footman, at $2	2	4.00
Men driving gangways, contract pay, estimated at $1.80	8	14.40
Inside carpenters (chute, brattice, stables, track layers, etc.), $2.20	3	6.60
Inside carpenters' helpers, $2	2	4.00
Tunnel or slope drivers or sinkers, contract pay, estimated at $2	6	12.00
Outside and inside superintendents or bosses, $3	2	6.00
Breaker boss	1	2.50
Blacksmith (sometimes 2 and helper)	1	2.00
Outside carpenters, car builders, repairers, etc., $2	2	4.00
Men slate-pickers' boss, roller feeder, counter roller, and screen, $1.50	4	6.00
Ticket boss at tip of breaker	1	2.25
On platform below tip, $1.50	3	4.50
On tip with ticket boss, $1.40	2	2.80
Sprag boy near tip	1	1.00
Mule drivers outside, $1 and $1.50	3	3.50
On dirt dumps and ash dumps (sometimes 4), $1.50	2	3.00
Man at pea-coal supply to fireman	1	1.25
Inside stable boss and outside stable boss, $1.50	2	3.00
Mason (sometimes 2), $2.25	1	2.25
1 fire boss and 1 driver boss inside, $2.25	2	4.50
Car loaders at bottom of breaker, $1.50	2	3.00
Bookkeeper and paymaster	1	2.50
Total	233	491.15

GENERAL EXPENSE.

	Amount.
Iron rails for gangways and tunnels, per day, 72 pounds	$1.44
Ties, 4 at 20 cents; spikes, 8 cents	.88
19 props in 55 breasts per day, at 30 cents	5.70
11 mules, fodder and feed, at 18 cents each	1.98
Iron used by blacksmith, car irons, horse and mule shoes, nails, etc	2.00
Lumber used in chutes, brattice, doors, cross-heads, inside 200 feet	2.80
Lumber, oak, for cars, new and patching, 200 feet	5.60
Lumber for patching breaker, engine houses, etc., outside	1.50
Turning new breasts (the company's part) 2 men	4.00
Wear, tear, and loss of company's tools—hammers, picks, shovels, saws, augers, etc	1.00
Oil, tallow, packing-waste, wicks, lamps, lanterns, belting, rivets, new horses, mules, harness, wagons, car wheels	2.00
Breaker repairs, repairs to engines, pumps, pipes, new pumps, ropes, books, paper, ink, pens, way bills and bills of lading, blanks, envelopes, postage, printing, telegraphing, telephoning, etc	1.00
Loss by bad debts (2 per cent. on 490 tons at $3, delivered)	29.40
Royalty, average 25 cents per ton on 490 tons	122.50
Total general expense	181.80

The cost for wages would be 100.2 cents per ton on 490 tons output and 37.102 cents per ton for general expenses. Total cost in cars, $671.95. On 490 tons output = 100.2 cents + 37.102 cents = $1.37 per ton.

In the above account no allowance is made for accidents, cavings-in, drownings-out, gas explosions, broken ropes, smashed cars, broken water reservoirs, burst pipes, culverts, dams, etc., nor is any allowance made for interest on capital.

The following tables contain some interesting facts and figures compiled from the annual report of the Lehigh Coal and Navigation Company for 1888. From these figures a general idea can be formed of the number of days worked and the average daily production of what may be considered fairly average anthracite collieries; also, about the average proportion of different sizes of coal produced by the average anthracite breakers:

Production of anthracite by the Lehigh Coal and Navigation Company, in 1888.

Collieries.	Working time.	Coal.	
		Production.	Per day.
	Days.	*Tons. Cwt.*	*Tons. Cwt.*
No. 1	239.9	151, 984 02	633 11
No. 4	200.8	110. 330 15	551 09
No. 5	116.3	49, 172 09	422 16
No. 8	212.05	115, 197 05	543 05
No. 9	219.2	143, 880 10	656 08
No. 10	187.65	142, 521 04	759 10
No. 11	210.95	85, 650 00	403 00
No. 12	196.5	83, 847 15	426 14
No. 13	212.9	24, 552 07	115 06
Total	....	907, 136 07	4, 514 19

Distribution of the product of the Lehigh Coal and Navigation Company according to sizes, 1888.

Sizes.	Tonnage.	Per cent.
Lump and steamer	85, 122.03	9.38
Broken	171, 015.03	18.85
Egg	142, 028.07	15.66
Stove	122, 232.01	13.47
Chestnut	147, 454.10	16.26
Pea	121, 523.16	13.40
Small coals	117, 760.07	12.98
Total	907, 136.07	100.00

PENNSYLVANIA BITUMINOUS COAL.

Total product in 1888, 33,796,727 short tons; spot value, $32,106,891. The bituminous coal fields of Pennsylvania form the northeastern end of the Appalachian field. The total area underlaid by workable coal beds is about 900 square miles. The coal mines of the State are confined to twenty-seven counties, later enumerated. The largest coal area is contained in the western and southwestern parts of the State, extending west from the crest of the Allegheny mountains to the Ohio line, and southwest of a line drawn from New Castle, in Lawrence county, northeast to Kane, in McKean county, and thence southeast in the direction of Bellefonte, in Centre county. Ragged edges of broken Coal Measures extend beyond these lines. In addition, isolated areas are found in the Wellersburgh basin, in Somerset county; in the Broad Top coal field, in Huntington, Blair, and Fulton counties; in the Tipton field, west of Altoona, in Blair county, and in the fields in Bradford and Tioga counties. The characteristics of the Coal Measures in which these beds occur have been described in former reports.

PRODUCTION.

Comparative statistics of the Pennsylvania bituminous mines for 1886, 1887, *and* 1888.

OPERATING MINES.

Counties.	1886.	1887.	Increase 1887.	Decrease 1887.	1888.	Increase 1888.	Decrease 1888.
Allegheny	85	93	8	....	94	1	....
Armstrong	7	8	1	....	8	....	....
Beaver	6	5	....	1	5	....	....
Bedford	5	8	3	....	10	2	....
Blair	11	9	....	2	9	....	....
Bradford	6	3	....	3	3	....	....
Butler	8	10	2	....	10	....	....
Cambria	28	33	5	....	39	6	....
Cameron	1	1	....	....	1	....	....
Centre	9	13	4	....	16	3	....
Clarion	14	13	....	1	16	3	....
Clearfield	61	94	33	....	104	10	....
Clinton	....	....	....	....	1	1	....
Elk	6	23	17	....	24	1	....
Fayette	61	78	17	....	82	4	....
Greene	2	1	....	1	3	2	....
Huntingdon	8	9	1	....	9	....	....
Indiana	3	4	1	....	5	1	....
Jefferson	10	18	8	....	22	4	....
Lawrence	4	3	....	1	3	....	....
McKean	1	2	1	....	1	....	1
Mercer	17	17	....	....	15	....	2
Somerset	14	16	2	....	17	1	....
Tioga	7	13	6	....	13	....	....
Venango	1	1	....	....	1	....	....
Washington	35	37	2	....	42	5	....
Westmoreland	66	84	18	....	87	3	....
Unreported mines and country banks employing less than 10 miners (estimated)	....	....	....	....	....	....	....
Total	476	596	120	....	640	44	....

Comparative statistics of the Pennsylvania bituminous mines, etc.—Continued.

PRODUCT BY COUNTIES.

Counties.	1886.	1887.	1887.		1888.	1888.	
			Increase over 1886.	Decrease from 1886.		Increase over 1887.	Decrease from 1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	4,202,086	4,680,924	478,838		5,575,505	894,581	
Armstrong	210,856	235,221	24,365		226,093		9,128
Beaver	208,820	197,863		10,957	63,900		133,963
Bedford	173,372	311,452	138,080		248,159		63,293
Blair	305,695	287,367		18,328	314,013	26,646	
Bradford	206,998	167,416		39,582	163,851		3,565
Butler	162,306	161,764		542	194,715	32,951	
Cambria	1,222,028	1,421,980	199,952		1,540,460	118,480	
Cameron	3,200	3,000		200	700		2,300
Centre	313,383	508,255	194,872		382,770		125,485
Clarion	429,544	593,758	164,214		535,192		58,566
Clearfield	3,753,986	5,180,311	1,426,325		5,398,981	218,670	
Clinton					32,000	32,000	
Elk	526,036	609,757	83,721		555,960		53,797
Fayette	4,494,613	4,540,322	45,709		5,208,993	668,671	
Greene	5,600	3,002		2,598	5,323	2,321	
Huntingdon	313,581	265,479		48,102	281,823	16,344	
Indiana	103,615	207,597	103,982		157,285		50,312
Jefferson	1,023,186	1,693.492	670,306		2,275,349	581,857	
Lawrence	101,154	125,361	24.207		106,921		18,440
McKean	617	9,214	8,597		10,443	1,229	
Mercer	537,712	539,721	2,009		487,122		52,599
Somerset	349,926	416,240	66,314		370,228		46,012
Tioga	1,384,800	1,328,963		55,837	1,106,146		222,817
Venango	2,500	2,296		204	2,000		296
Washington	1,612,407	1,751,615	139,208		1,793,022	41,407	
Westmoreland	5,446,480	6,074,486	628,006		6,519,773	445,287	
Unreported mines and country banks employing less than 10 miners (estimated)		200,000	200,000		240,000	40,000	
Total	27,094,501	31,516,856	4,598,705	176,350	33,796,727	3,120,444	840,573
			176,350			840,573	
Net increase			4,422,355			2,279,871	

The bituminous coal trade of Pennsylvania during 1888 was an exceptional one in many respects, and requires special comment. Although the increase in the total product of the mines in 1888 compared with 1887 was 2,279,871 short tons, this was only a little over one-half of the increase in the product of the mines in 1887 over 1886, which was 4,422,355 short tons. The details of these respective increases are exhibited in the foregoing tables, showing the comparative statistics for 1886, 1887, and 1888. The disproportion in the increase in the latter two years is probably not so great as the figures at our command would seem to indicate, for these reasons: Personal acquaintance made by the writer with most of the bituminous operators during the ten years preceding 1886 in making examinations for the State Geological Survey, warranted an attempt in the early part of 1887 to ascertain, independently of the inspectors, the amount of coal produced by each mine during 1886. In order to accomplish this an arrangement was made with all the operators that if they would return to the United States Survey the total product of each mine during 1886 the facts so obtained would be confidential, and would only be used in making up a summary table of the total production of coal in each county. This plan proved successful, and with the exception of about 50 mines in the State, complete and reliable returns were received. Of the 50 mines for which no returns were received, out of a total of 476, an estimate of product was made, and the total product of the State was reported at 27,094,501 short tons. From more complete facts obtained during the past 2 years it is believed that the estimate of the product of the 50 unreported mines was too low, and that the total product of the State for 1886 was probably 500,000 tons greater than that reported.

During the early part of 1888 one of the State survey assistants visited all the more important mines, principally those having an annual production of over 5,000 tons, and explained to each operator the character of the work and the advantages which would accrue to the operators themselves from the publication by the United States Geological Survey of a list of all the mines, giving the annual product for each for 1887. This plan proved very successful, and resulted in permission being obtained from the operators to publish the production of individual mines.

During the past few years a revolution may be said to have occurred among the large coal consumers, which has resulted in their purchasing coal not from any possibly unfounded reputation which special coals may have attained as desirable fuel, but from actual tests which have been made by consumers themselves as to the relative efficiency of the coals for domestic consumption in furnaces, stoves, and grates, and for manufacturing purposes, for generating steam, and for the manufacture of gas, the selling price of each coal being considered in conjunction with its actual efficiency, and preference given to coals which would give the consumer a unit of efficiency at the lowest price. This has been more particularly the case since the extensive introduction of natural gas throughout western Pennsylvania, which has very materially affected the local consumption of coal, the Pennsylvania operators being forced to seek new markets for their product. It is now estimated that the natural gas companies of Pittsburgh are supplying about 26,000 domestic consumers and 1,100 manufacturing consumers from 400,000,000 to 600,000,000 cubic feet of natural gas per day, varying not only with the condition of the weather, which affects all consumers, but also with the activity of manufacture. It is estimated that in the vicinity of Pittsburgh alone there was consumed during 1888 an amount of natural gas which, if the consumers had to depend exclusively upon coal, would have required during the year about 8,500,000 tons. If to this should be added the amount of coal which would be taken by consumers in other parts of the State who now depend upon natural gas as a fuel, the amount would be increased to at least 10,000,000 tons. It must be remembered that this tonnage does not represent the actual amount of coal which has been displaced, since a large number of new enterprises have been started in western Pennsylvania subsequent to the general introduction of natural gas, and householders are keeping their houses more generally heated and at a very much higher temperature than formerly, when coal had to be depended upon. At the same time the amount of coal which has actually been displaced by the use of natural gas has been very great, and the coal producers, forced out of the local markets, have been compelled to seek more distant consumers. Greater distribution of Pennsylvania coal has been made, and to more distant points, than has been known before in the history of the United States coal trade.

During 1884 and 1885, when the Pennsylvania coal operators were forced into outside markets, the situation was viewed with great alarm by the coal trade; and, in order to open up new markets, the Pennsylvania coal had to be sold at very much lower prices at the mines than it had formerly commanded when so largely taken by local consumers. In consequence, the price of Pennsylvania coal in 1885 and 1886 fell. The average price of coal at the mines in the Pittsburgh region during 1886 ranged from 88 to 92½ cents per ton at the mines, and the average price at the mines throughout the State was only 80 cents per ton. As soon, however, as the distant consumers began to appreciate the greater efficacy of the Pennsylvania coals, as compared with others, the Pennsylvania operators were enabled to receive a better price for their product, so that during 1887 the average price which the Pennsylvania coal commanded at the mines was 10 cents per ton more than during the previous year, and 5 cents per ton more during 1888 than that received during 1887. Part of this increase in price was due to the general improvement in business, and with it came an improvement in the coal trade.

The increased popularity among the distant consumers of the Pennsylvania coals, particularly that of the Pittsburgh region, is more noticeable in the increased tonnage of the mines than in the increased average price. As an illustration of this fact, in Allegheny county, surrounding Pittsburgh, where more natural gas is consumed than in any other one locality in the State, the local consumption of coal from the surrounding mines has been, of course, directly affected; still, the growth in the product of the Allegheny county mines has been greater than in any other district.

During 1887 the mines of this county produced 4,680,924 tons, an increase over the previous year of 478,838 tons. During 1888 practically the same mines (only one new operator started in Allegheny county during 1888) produced 5,575,505 tons, an aggregate increase over 1887 of 894,581 tons. The most notable increase in other counties for 1888 was that in Westmoreland county, 445,287 tons; in Fayette county, 668,671 tons; in Jefferson county, 581,857 tons; in Clearfield county, 218,670 tons, and in Cambria county 118,480 tons. The increase in Allegheny county is largely to be attributed to the reasons already assigned, the increased product being taken largely by consumers at distant points. In Westmoreland county the same cause accounts, in a measure, for the increased product, although a large proportion of the increase of the Westmoreland mines was due to the extension of the illuminating gas interests generally throughout the country and the increased consumption of coal for this purpose, the Westmoreland coal being rated as the best and cheapest illuminating gas coal which can be obtained. While this latter fact is notably true of the Westmoreland mines, it also applies, in a measure, to the mines in Allegheny, Fayette, and Washington counties, the mines of all of which ship more or less coal to gas companies.

In Fayette county the large increase is to be attributed principally to the development of the coke industry. The superior value of the Connellsville coke over others and the low prices which it has commanded during the year have largely extended the coke trade.

The increased product in Clearfield and Jefferson counties is largely due to the opening up of new mines and to increased railroad facilities for shipment. There were more new mines opened in Clearfield county during the year than in any other county in the State. Of an aggregate of forty-five new mines in the State opened during 1888 ten were located in Clearfield county. In Jefferson county, where the increased tonnage during the year was more than twice as great as in Clearfield county, there were only four new coal mines opened. This disproportion in these two counties of new mines to the increased product is to be accounted for by the fact that a number of Clearfield county mines, which have been in operation for several years, produced less coal during 1888 than during 1887, while in Jefferson county the contrary ruled. Clearfield county is a very much older coal-producing county than Jefferson county, and its total product is more than twice as large as Jefferson's. Many of the areas in which the older mines in Clearfield county are located are being rapidly worked out, while the operations which have so far been carried on in Jefferson county have exhausted a comparatively small territory. In Cambria county the increase in the tonnage is a notable one in view of the great consumption of natural gas, which is brought into the county by the Westmoreland and Cambria Natural Gas Company from the Grapeville gas field, situated north of the line of the Pennsylvania railroad, about 40 miles west of Johnstown. The increase of the coal tonnage in Cambria is largely due to the opening up of new mines in new fields, there having been six new mines opened in the county in 1888, and also to the increase in railroad facilities, which has permitted a wider distribution of the coal to distant points, particularly on the sea-board.

Although there has been such a noted increase in the product of the Pennsylvania mines during 1888, it must not be inferred that this increase was general throughout the State. Out of the twenty-seven producing counties, twelve increased their product to an aggregate of 3,120,444 tons. They were Allegheny, Blair, Butler, Cambria, Clearfield, Clinton, Fayette, Greene, Huntingdon, Jefferson, McKean, Washington, and Westmoreland; while the fourteen remaining counties—

namely, Armstrong, Beaver, Bedford, Bradford, Cameron, Centre, Clarion, Elk, Indiana, Lawrence, Mercer, Somerset, Tioga, and Venango—produced in the aggregate 840,573 tons less coal during 1888 than during the previous year. If an analysis of these facts should be made, it would be found that the increase has taken place in counties where the coal deposits are the most extensive. This has encouraged the investment of capital in railroad construction in localities where the coal beds are the best and the coal can necessarily command a ready market, and where the beds can be most cheaply and economically mined, thus encouraging the investment of new capital in extending old mining plants and starting new operations.

Special facts have already been given under the general review of the coal trade as to the prices which the different Pennsylvania coals have commanded at the principal markets in the United States.

Wages in the bituminous region.—An investigation has recently been made by the Miners and Laborers' Amalgamated Association as to the wages and store prices paid at some of the leading coke works in the Connellsville region. The following figures have been made public. Although these are presumably accurate, no effort has been made on the part of the Survey to confirm them. Under what is known as the Frick scale, the price of mining is 30.6 cents per wagon of 34 bushels, and 45 cents per wagon of 50 bushels, equivalent to 90 cents per 100 bushels; for drawing coke from the oven, 64 to 66 cents for small ovens, and 76 to 79 cents for large ovens; haulers, per day of 9 hours, $1.85 to $1.95; general laborers, $1.35 per day. The J. M. Schoonmaker Coke Company pays for mining 35-bushel wagons 28.07½ cents to 28⅓ cents, or a fraction over 80 cents per hundred bushels; for drawing coke for small ovens, 52 cents, and for large ovens 63 cents; haulers, $1.70 to $1.75; general laborers, $1.15 to $1.20. The Connellsville Coke and Iron Company pays for mining 50-bushel wagons 42½ cents, or 85 cents per 100 bushels; for drawing coke from large ovens, 63 cents; general laborers, $1.15. James Cochran & Sons pay for mining 30 bushels 24 cents, at the rate of 80 cents per 100 bushels; for drawing and refilling at small ovens, 60 cents; haulers, $1.70. Laughlin & Co. pay for mining 34-bushel wagons 28 cents, or a fraction over 82⅓ cents per 100 bushels; for drawing coke from small ovens, 63 cents, and from large ovens 68 cents; general laborers, $1.20. Heaped wagons are required at all the works except at those of the H. C. Frick Coke Company and James Cochran & Sons, so that as between these and the other operators the figures do not accurately represent the difference which would otherwise appear to exist for the price of mining. It is stated that the stores of the H. C. Frick Coke Company sell goods cheaper than those of the other companies. It may be stated that a bill has just (May 8, 1889) been passed by the Pennsylvania legislature authorizing the appointment of a commission to investigate miners' wages.

ALLEGHENY COUNTY.

(Coal produced in 1888, 5,575,505 short tons.)

More coal was produced during the year in Allegheny county than in any other county in the State, with the exception of Westmoreland, which produced 944,268 tons more. The coal was mined principally from the Pittsburgh coal bed, which at Pittsburgh is about 350 feet above low-water level in the Monongahela river. The next most important bed which is mined in the county is the Upper Freeport, which is the topmost bed of the Lower Productive Coal Measures. This latter bed outcrops in the Allegheny river in East Deer township, and at Pittsburgh lies 200 feet, more or less, below river level. Although the amount of natural gas which has been consumed by both household and manufacturing consumers during the year has been greater than ever before, still the increase in the production of the Allegheny county mines during 1888 (894,581 tons) over that produced in 1887 has been greater than in any other one county in the State. The largest producing company in the county is the New York and Cleveland Gas Coal Company, which produced during the year 528,298 tons. This increase is significant from the fact that it shows a wider distribution of the coal and a greater demand for the purer product of the Pittsburgh mines in competition with the product of the mines in other States where the coal is now distributed. The distribution is effected by railroads mostly to the east, west, and north of Pittsburgh; by railroads to the north and northeast to Lake Erie, and thence by boat northwest down the Ohio and Mississippi rivers. The small amount of Allegheny county coal which is consumed at the present time in the Pittsburgh district proper is taken almost entirely by the iron blast furnaces in the form of coke, or by other manufacturers, for special uses to which natural gas is not so well adapted as solid fuel. The coal to local consumers is supplied principally by the railroads in the county. The following table exhibits the shipments from the Pittsburgh district by slack-water navigation down the Monongahela and Ohio rivers since 1860:

Shipments of Pittsburgh coal by slack-water navigation since 1860.

Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*
1860	1,517,909	1875	2,275,265
1861	834,630	1876	2,495,800
1862	743,358	1877	2,677,460
1863	1,134,150	1878	2,797,530
1864	1,402,828	1879	2,623,232
1865	1,580,791	1880	3,361,934
1866	1,704,212	1881	3,450,186
1867	1,202,908	1882	4,057,384
1868	1,812,040	1883	4,339,492
1869	2,100,504	1884	3,170,900
1870	2,303,856	1885	3,298,200
1871	1,944,852	1886	4,123,945
1872	2,291,220	1887	3,065,240
1873	2,094,312	1888	4,498,430
1874	2,503,504		

This coal includes not only that shipped from Allegheny county but also from Westmoreland, Washington, and Fayette counties, with a very small amount from Greene county.

Allegheny county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Product.	Mines.	Product.
			Short tons.		*Short tons.*
Allaquippa	Bailey, Wilson & Co	1	77, 539	1	100, 513
Alpsville	Thomas Hackett & Co., limited	1	20, 801	1	26, 263
Amity	J. C. Risher & Co	1	83, 719	1	61, 110
Atlantic	Lake Erie Gas Coal and Coke Company.	1	32, 873	1	2, 437
Beck's Run	James H. Hay's estate	1	39, 520	1	107, 460
Beechmont	Beechmont Coal Company	1	5, 772	1	46, 200
Bellwood	Munhall Brothers	1	47, 500	1	53, 010
Boyd	Edward Fisher	1	9, 000	1	24, 202
Bellevue	Gumbert & Huey	1	71, 000	1	86, 328
Bridgeville	A. J. Schulte	1	74, 436	1	49, 014
Buena Vista	Youghiogheny River Coal Company	1	49, 485	1	56, 405
Boston No. 2	W. H. Brown's Sons	......	....	1	64, 260
Bunola	O'Neil Patterson	......	....	1	49, 020
Camden	George Lysle & Sons	1	83, 600	1	115, 375
Camp Hill	David Steen	1	74, 802	2	39, 900
Castle Shannon	Pittsburgh and Castle Shannon Railroad Company.	1	31, 109	......	....
Cherry	Morris McCue	1	21, 648	1	22, 330
Coal Ridge	Gray & Bell	1	23, 289	1	....
Corey	Corey Coal Company	1	20, 052	......	....
Diamond	Baines Coal Company	1	6, 300	1	....
Dravo	Lake Shore Gas Coal Company	1	38, 000	1	43, 243
Duquesne	New York and Cleveland Gas Coal Company.	1	44, 736	1	63, 211
Enterprise	Hartley & Marshall	1	181, 850	1	166, 463
Do	O'Neil & Co	1	40, 000	1	39, 715
Essen	Sanford & Co	1	75, 000	1	80, 338
Federal Spring	W. J. Steen	1	20, 000	1	25, 000
First Pool	First Pool Monongahela Gas Coal Company.	1	1, 000	1	5, 000
Fort Pitt	The Fort Pitt Coal Company	1	40, 660	1	34, 138
Fox	Thomas Fox	1	121	1	8, 792
Frankstown	Theodore Heilman	......	....	1	2, 520
Fulton	George Jones & Co	1	14, 560	1	16, 391
Glendale (*a*)	J. V. N. & R. Cook	1	14, 598	......	......
Glenshaw	Glenshaw Coal Company	1	17, 500	1	18, 000
Grant	Grant Coal Company	1	82, 311	1	40, 600
Graver	New York and Cleveland Gas Coal Company.	1	34, 061	1	....
Hampton	Hampton Coal Company	1	86, 900	1	87, 325
Harrison	Beadling Brothers	1	30, 000	1	57, 375
Hasting Slope	Pennsylvania Coal Company, limited	1	48, 311	1	31, 206
Horner & Roberts	Horner & Roberts	2	44, 346	2	111, 882
H. D. O'Neil	H. D. O'Neil	1	46, 000	1	67, 400
Idlewood	Stewart, Lewis & Dickson	1	2, 500	1	5, 760
Imperial	Imperial Coal Company	3	160, 248	3	217, 780
Jefferson	Foster, Clark & Wood	1	79, 955	1	96, 926
Keeling	Birmingham Coal Company	1	18, 684	1	36, 718
Keystone	W. H. Brown's Sons	2	19, 166	......	....
Laurel Hill	W. P. Rend	1	350, 000	1	315, 000
Leesdale	Gregg Brothers	1	30, 000	1	49, 900
Lovedale	John A. Wood & Sons	1	49, 231	1	64, 703
Mansfield	Mansfield Coal and Coke Company	2	225, 000	2	192, 175
Milesville	Robert Jenkins, sr	1	34, 003	1	50, 168
National	National Coal Company, limited	1	30, 000	1	77, 780
Natrona	Pennsylvania Salt Manufacturing Company.	2	11, 782	1	4, 438
Nikon	Chartiers Valley Coal Company	1	40, 109	1	42, 480
Ocean	The Youghiogheny River Coal Company.	3	147, 426	3	264, 576
Oak Ridge	Oak Ridge Coal Company	1	57, 687	1	69, 596
Old Bower Hill	A. J. Schulte	......	....	1	23, 728
Old Eagle	W. H. Brown's Sons	1	48, 000	1	118, 137
Osceola	Osceola Coal Company	1	70, 500	1	100, 311
Pacific	Lake Erie Gas Coal and Coke Company.	1	87, 659	1	104, 035
Penney	Penney Coal Company	1	29, 122	1	22, 600

a Abandoned 1888.

Allegheny county mines, operators, and product in 1887 and 1888—Continued.

Collieries.	Operators.	1887.		1888.	
		Mines.	Product.	Mines.	Product.
			Short tons.		*Short tons.*
Pine Creek	Robbins Coal and Coke Company	......	....	1	9, 000
Pittsb'gh Union (*a*)	Joseph McConnel	1	30, 000	1	19, 950
Plum Creek	New York and Cleveland Gas Coal Company.	1	110, 353	1	123, 172
Powers	Chartiers Block Coal Company	1	60, 000	2	75, 000
Rankin (*b*)	William Rankin	1	8, 984	1	6, 001
Robbins	W. M. Robbins & Co	1	45, 582	1	46, 358
Rock Run	W. J. Snodgrass & Co	1	29, 754	1	38, 335
Sandy Creek	New York and Cleveland Gas Coal Company.	2	145, 281	2	118, 733
Sanford No. 2	Sanford & Co	1	36, 004	1	31, 275
Six Mile Ferry (*c*)	J. H. Hays estate	1	71, 440	2	97, 280
Snowden	Pittsburgh and Chicago Gas Coal Company.	1	65, 000	1	70, 200
Spring Hill	Spring Hill Gas Coal Company	2	33, 000	2	29, 696
Star	Francis Mankedick	1	18, 000	1	79, 000
Stone	William Stone's estate	1	75, 000	1	20, 698
Street's Run	J. D. Risher	1	55, 156	1	77, 263
Summer Hill	Frank Armstrong	1	96, 835	1	87, 308
Turtle Creek	New York and Cleveland Gas Coal Company.	1	126, 841	1	223, 132
Venture	Gray & Bell	1	8, 000	1	66, 591
Walton's	Joseph Walton & Co	3	300, 000	3	434, 916
Weinman & Co	Weinman & Co	2	12, 960	2	5, 813
Willow Grove	Willow Grove Mining Company	2	133, 263	2	90, 747
Winona	William Skillen	1	4, 000	......	....
Youghiogheny (*d*)	W. H. Brown's Sons	2	92, 000	2	165, 750
Total		93	4, 680, 924	94	5, 575, 505

a Mansfield and Erie. Mansfield and Erie Coal Company, 1888.
b American Coal Company, 1888.
c Hays Estate Run, 1888.
d Boston No. 1, 1888.

ARMSTRONG COUNTY.

(Coal produced in 1888, 226,093 tons.)

This county produced 9,128 tons less in 1888 than in 1887. The largest operator in the county is the Oak Ridge Mining Company, which mines its coal from the Lower Freeport coal bed.

Armstrong county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Glen	J. R. Smith	1	13, 848	1	16, 317
Gosford	W. W. Acheson	2	27, 947	2	18, 889
International	International Coal Mining Company	1	6, 286	1	8, 200
Kittanning	Kittanning Iron Company	2	40, 729	2	7, 884
Oak Ridge	Oak Ridge Mining Company	1	126, 833	1	120, 391
River View	River View Coal Mining Company	1	19, 578	1	54, 4[illegible]2
Total		8	235, 221	8	226, 093

BEAVER COUNTY.

(Coal produced in 1888, 63,900 short tons.)

The coal production of this county during 1888 was less than one-third of the production during 1887, the falling off being 133,963 tons. This reduction in tonnage is to be accounted for by the abandonment of the operations of the State Line Company in Pennsylvania, this company operating mines on both sides of the Pennsylvania-Ohio State line.

Beaver county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Cannel	Ira F. Mansfield	1	18,700	1	12,657
Clayton	Will J. Clayton	1	3,000	1	(*a*)
Hulmes	James Clayton	1	2,217	1	5,643
Scott & Co	Scott & Co	1	47,313	1	40,600
State Line	State Line Coal Company	1	126,633	1	5,000
Total		5	197,863	5	63,900

a Unreported.

BEDFORD COUNTY.

(Coal produced in 1888, 248,159 short tons.)

The coal mines of this county, together with those of Huntingdon and the greater portion of those of Blair, are located in the Broad Top semi-bituminous coal basin. There was a falling off in the reported product of the mines of this county of 63,293 tons during 1888. The largest operator in the county was the firm of Messrs. Sweet & Brown, who during the year produced 90,000 tons, although it was 6,000 tons less than during the previous year. The coal beds of this county belong to the Lower Productive Coal Measures. The names which have been adopted for these coal beds have been local, since it has only been within the last few years that the Geological Survey of the State has established the identity of these coal beds with those of the Freeport, Kittanning, and Clarion beds of the western Pennsylvania bituminous coal fields.

Bedford county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Brown	Sweet & Brown	1	96,000	1	90,000
Cambria	Clearfield Consolidated Coal Company	1	35,000	1	47,040
Chevington	do	1	23,000	1	16,800
Coaldale	Roda, Maher & Co	1	22,000	1	7,814
Cunard	R. B. Wigton Sons	2	60,000	2	(*a*)
Duval	E. P. Jenkins & Co	1	8,831	1	2,711
Harriet Lane	Langdon & Co			1	10,882
Mount Equity	Kemble Iron Company	1	66,621	1	65,404
New Hampshire	Whitehead & Co			1	7,508
Total		8	311,452	10	248,159

a Unreported.

BLAIR COUNTY.

(Coal produced in 1888, 314,013 tons.)

The total product in this county in 1888 was 26,646 tons greater than in 1887. With the exception of the sub-Carboniferous beds mined by the Tipton Run Coal Company, all the beds worked belong to the Lower Productive Measures. The largest operator in the county during the year was the Blair Iron Company, which operates the Bennington slope and the Lemon drift. In the former mine the Lower Kittanning bed is worked, and in the latter the Upper Freeport. The next largest operator was the Tipton Run Coal Company, working the coal beds in the Pocono formation, No. X, along the eastern escarpment of the Allegheny mountains, southwest of Altoona. This is the only locality in the State where the coal beds of this formation have been worked on a commercial scale.

Blair county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Beech Grove	Beech Grove Coal Company	2	17,100	2	21,863
Bennington Slope	Blair Iron and Coal Company	1	66,554	1	28,538
Glenwhite	Glenwhite Coal and Lumber Company	1	52,666	1	38,848
Horseshoe	Altoona Coal Company	1	27,232	1	38,313
Lemon	Blair Iron and Coal Company	1	53,380	1	97,056
Porter Shaft	Dennison, Porter & Co	1	40,435	1	40,049
Tipton Run	Tipton Run Coal Company	2	30,000	2	49,346
Total		9	287,367	9	314,013

BRADFORD COUNTY.

(Coal produced in 1888, 163,851 tons.)

The total product of this county during 1888 was 3,565 tons less than during the previous year. The Towanda Coal Company is rapidly exhausting its coal territory. This company has been producing coal continuously since 1856. The following table exhibits the product of the Towanda Coal Company since 1865:

Production of the Towanda Coal Company, 1865 *to* 1888.

Years.	Short tons.	Years.	Short tons.
1865	6,886	1877	164,344
1866	3,881	1878	165,025
1867	27,668	1879	237,608
1868	67,080	1880	246,064
1869	176,307	1881	223,172
1870	196,310	1882	210,917
1871	239,240	1883	226,806
1872	263,960	1884	181,786
1873	252,329	1885	246,397
1874	215,572	1886	145,208
1875	200,424	1887	99,416
1876	160,343	1888	109,851

The only other large commercial operator in the county during the year was the Long Valley Coal Company, which produced 54,000 tons, or 14,000 tons less coal than during the previous year. The product of this county is taken almost entirely by local consumers and consumers in central New York State.

BUTLER COUNTY.

(Coal produced in 1888, 194,715 short tons.)

This county produced 32,951 tons more during 1888 than during the previous year. The increased product is to be accounted for largely by the increased shipments of the Pittsburgh and Fairport Coal and Coke Company, the Mahoning Valley Iron Company, the Mercer Coal Company, and the Allegheny Coal Company. All the coal beds which are worked in this county belong to the Lower Productive series, and almost the entire product is taken from the Kittanning coal beds. The product is shipped to consumers north of the county.

Butler county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Acbarr	Acbarr Mining Company	1	4,974	1	....
Allegheny	Allegheny Coal Company	1	25,759	1	39,288
Barnes	Mercer Coal Company	1	25,000	1	33,180
Boyco	Hamilton Cannel Coal Company	1	240	1	(*a*)
Chisholm	Mercer Coal Company	1	15,000	1	21,300
Gomersal	Mahoning Valley Iron Company	1	35,007	1	45,000
Karns	W. C. Mobley & Co	1	10,000	1	9,413
Keisters	Union Coal and Coke Company, limited	1	35,232	1	26,534
Kelly	Kelly Coal Company	1	8,392	1	(*a*)
Keystone	Pittsburgh and Fairport Coal and Coke Company.	1	2,160	1	20,000
Total		10	161,764	10	194,715

a Unreported.

CAMBRIA COUNTY.

(Coal produced in 1888, 1,540,460 short tons.)

The product of coal in this county during 1888 was 118,480 tons greater than during the previous year. This increased tonnage is to be accounted for by the opening of the new coal mines and the increased railroad facilities afforded for the shipment of the coal, which, outside of that consumed in the county, is sent principally to the eastern markets. The largest operator in the county was the Gallitzin Coal and Coke Company, whose product, however, during the year was 2,071 tons less than during the previous year. The introduction of natural gas into this county during the past three years has decreased to a great extent the local consumption of coal. The total product of the county during the past year was greater than during any previous year. Six new coal operating companies commenced mining coal during the past year, and produced in the aggregate 103,878 tons.

Cambria county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Amsbry	Cambria Coal and Coke Company			1	9,374
Anchor	Clearfield Consolidated Coal Company	1	20,196		
Argyle	Huff & Coulter	1	115,337	1	112,854
Aurora	Heist & Luke	1	21,861	1	27,600
Ben's Creek Plane	E. W. Mentzer	1	34,703	1	41,786
Black Diamond	J. H. Miller	1	36,000	1	8,895
Bland				1	11,800
Conemaugh	Cambria Iron Company	1	16,663	1	7,612
Cushon	do	1	19,965	1	24,642
Delaney	J. H. Haywood	1	55,439	1	84,632
Diamond	Haywood Coal Company	1	9,000	1	7,000
Dysart No. 1	Caron Leahy	1	14,500	1	14,000
Dysart No. 2	D. Laughman	1	48,200	1	62,600
Eagle	J. Gwin & Son	1	7,294	1	5,243
Eldorado	Wray & Co	1	10,000	1	7,667
Euclid	Euclid Coal Company	1	21,298	1	22,684
Gallitzin Shaft	Taylor & McCoy	1	165,214	1	149,869
Great Bend	Great Bend Coal Company	2	65,000	2	48,175
Griffiths	Fend & Cover	1	8,020	1	6,720
Hasting	J. L. Mitchell & Co			1	28,262
Lilly	Lilly Coal Company			1	3,480
Lower Gautier	Cambria Iron Company	1	10,448	1	
Martindale Slope	J. C. Martin & Co	1	60,000	1	50,000
Miller	Miller Coal Company	1	20,000	1	6,400
Mitchell Slope	Gallitzin Coal and Coke Company	1	171,525	1	169,454
Moshannon	Felix Toole & Co	1	20,000	1	11,507
Mount Hope	Cambria Iron Company	1	130	1	
Mount Vernon No. 4.	Clearfield Consolidated Coal Company			1	43,000
Rolling Mill	Cambria Iron Company	1	15,704	1	
Rubins		1	7,510	1	80,000
Schuylkill	Schuylkill Coal Company			1	7,962
Smittle	Smittle & Co	1	18,086	1	22,780
Sonman 1 and 2	W. H. Piper & Co	2	100,000	2	84,066
Sonman Shaft	Hughes & Shoemaker	1	46,378	1	56,000
South Fork	South Fork Coal Works Company	1	16,649	1	27,294
Standard	Standard Coal Company	1	40,000	1	28,500
Stineman	J. C. Stineman	1	76,860	1	77,436
Webster No. 3	John C. Scott & Son	1	150,000	1	191,166
Total		33	1,421,980	39	1,540,460

CAMERON COUNTY.

There is but one active coal operator in Cameron county, the Cameron Coal Company. The total amount of coal produced in 1888 was only 700 tons, which was used exclusively for local consumption. The principal coal bed in this county is what is known locally as the Cameron or Dagus bed, the representative of the Lower Kittanning.

CENTRE COUNTY.

(Coal produced in 1888, 382,770 tons.)

The total product of this county for 1888 was 125,485 tons less than during the previous year. With the exception of the rather limited operations of the Elizabeth Coal Company and the Irvona Coal Company, there was less coal produced by each mine in this county during the latter year than during the former. Two new operators started in the county during the year, and produced in the aggregate 22,000 tons. Although the coal mined in the Snow Shoe basin in Centre county has long been favorably known by the coal trade as a superior coal, yet the limited areas which are underlaid by coal beds, and the cost of mining as compared to more favorable conditions which exist in Clearfield county, immediately to the west, have had a direct influence in diminishing the product of Centre county. The principal coal beds mined in the county are the Upper and Lower Kittanning. The largest operator is the Lehigh Valley Coal Company, which mines principally the Upper Kittanning coal bed at the Sugar Camp mines.

Centre county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Black Diamond	W. J. Jackson & Co	1	47, 554	1	8, 977
Central	Thomas C. Heims & Co	1	69, 218	1	47, 783
Elizabeth No. 3	Elizabeth Coal Company	1	41, 000	1	50, 400
Etna	James Passmore	1	700	1	(*a*)
Fountain	Graner & Ma Dill			1	12, 000
Irvona	Irvona Coal Company	1	2, 400	1	7, 609
Retort	Geo. McLanghlin			1	10, 000
Sommerville's	J. L. Sommerville & Co	2	57, 312	2	18, 069
Sugar Camp	Lehigh Valley Coal Company	4	206, 907	4	146, 506
Tunnel	Clearfield Bituminous Coal Corporation	2	83, 164	3	81, 426
Total		13	508, 255	16	382, 770

a Unreported.

Shipments of coal from the Snow Shoe region over the Pennsylvania railroad.

Years.	Shipments.	Years.	Shipments.
	Short tons.		*Short tons.*
1873	95, 257	1881	128, 263
1874	63, 540	1882	233, 708
1875	62, 426	1883	257, 230
1876	51, 399	1884	183, 271
1877	42, 985	1885	148, 500
1878	29, 168	1886	113, 967
1879	56, 654	1887	165, 091
1880	56, 020	1888 Coal	141, 099
		1888 Coke	21, 048

CLARION COUNTY.

(Coal produced in 1888, 535,192 tons.)

Although three new operators started in this county during the year and produced in the aggregate 32,573 tons, its product of coal during the year was 58,566 tons less than during the previous year, the principal falling off being in the product of the mines of the Fairmount Coal and Iron Company, which has recently gone into the hands of a receiver. The largest operator during the year was the Northwestern Coal and Iron Company, which produced in the aggregate 169,708 tons. This coal was mined almost entirely from the Lower Freeport bed, although the Lower Kittanning coal bed is the one which is generally and more extensively mined than any other bed in the county.

Clarion county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Acme	Acme Coal Company	1	9, 897	1	44, 079
Albion	Albion Coal Company			1	400
Avondale	Avondale M. and M. Company			1	19, 119
Catfish	Pittsburgh Coal and Mining Company	1	8, 715	1	11, 807
Church Hill	J. McCollum	1	5, 000	1	
Diamond	Thomas Mitchell & Sons	1	33, 227	1	42, 740
Fairmount	Fairmount Coal and Iron Company	2	178, 472	2	18, 086
Hardscrabble	Brady's Bend Mining Company	1	69, 773	1	56, 314
Keystone	Keystone Coal Mining Company	1	10, 492	1	40, 126
Mineral Ridge	Mineral Ridge Coal Company	1	42, 430	1	37, 950
Monarch	Monarch Coal Company			1	13, 054
Pine Run	Stephenson & Mitchell	1	68, 863	1	50, 374
Red Bank	David & John D. Reynolds	1	40, 000	1	31, 435
Star	Northwestern Coal and Iron Company	2	126, 889	2	169, 708
Total		13	593, 758	16	535, 192

CLEARFIELD COUNTY.

(Coal produced in 1888, 5,398,981 tons.)

The total product of the mines of this county during 1888 was 218,670 tons greater than during the previous year. This increased tonnage is due not only to the increase in the product of many of the old mines, but also to the opening of a large number of new ones, which are now being worked by ten newly-organized coal companies. The total product during the year of the new companies was 89,417 tons. The largest operating company in this county is the Berwind-White Coal Mining Company. The coal beds mined belong exclusively to the Lower Productive Measures, and the coal bed which is most extensively mined, and which supplies the bulk of the company's product, is the Lower Freeport, which is locally known as the Moshannon.

The rapid development of the mines of Clearfield county is sufficiently shown in the coal tonnages of the Tyrone and Clearfield branch of the Pennsylvania railroad during the last twenty-seven years, and also in the tonnages of the Beech Creek railroad, which are given below:

Coal carried over the Tyrone and Clearfield branch railroad during the last twenty seven years.

Years.	Short tons.	Years.	Short tons.
1862	7, 239	1876	1, 281, 861
1863	24, 330	1877	1, 374, 927
1864	65, 380	1878	1, 295, 201
1865	60, 629	1879	1, 631, 120
1866	107, 878	1880	1, 739, 873
1867	166, 364	1881	2, 401, 987
1868	170, 335	1882	2, 838, 970
1869	259, 994	1883	2, 857, 710
1870	379, 863	1884	3, 173, 363
1871	542, 896	1885	2, 901, 613
1872	431, 915	1886	2, 273, 147
1873	592, 860	1887	3, 256, 328
1874	639, 630	1888	3, 389, 864
1875	928, 297		

Beech Creek railroad tonnage.

Years.	Short tons.	Years.	Short tons.
1882	....	1886	1, 050, 238
1883	....	1887	1, 351, 579
1884	234, 751	1888	1, 694, 495
1885	774, 055		

Clearfield county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Alexander	Madera Coal Company	1	6, 568	1	12, 326
Alder Run	Alder Run Coal and Coke Company	1	3, 800	1	....
Ashland	Berwind-White Coal Mining Company	1	36, 712	1	24, 839
Ashman	J. Swires & Co. (*a*)	1	9, 595	1	94, 112
Atlanta	Atlanta Coal Company	2	62, 729	2	30, 220
Atlantic	Berwind-White Coal Mining Company	2	79, 239	2	175, 719
Baltic	Baltic Coal Company	1	41, 747	1	67, 000
Blaine Run	Great Bend Coal Company	......	....	1	22, 780
Brittanic	Mortimer Rees & Company	......	....	1	4, 812
Cataract	Berwind-White Coal Mining Company	1	118, 052	1	112, 424
Catherine	C. F. Blair	......	....	1	8, 000
Coaldale	Holt Chipman (*b*)	4	359, 310	3	408, 783

a Lee and Ashman, 1888. *b* Coaldalo Coal Company, 1888.

Clearfield county mines, operators, and product in 1887 *and* 1888—Continued.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Columbia Nos. 1 and 2.	Mitchell, Lazar & Co.	2	125,312	2	155,015
Columbia No. 3	do	1	31,980	2	26,681
Colorado	Jackman & Ellsworth	1	81,000	1	79,938
Cuba	Cuba Coal Company	1	15,580	1	42,585
Cunard and Shoff	R. B. Wigton Sons	2	39,000	1	19,155
Decatur	John Nuttall & Co	1	36,000	1	67,138
Derby	T. Barnes & Brother	1	36,971	1	44,149
Dixon	H. C. Springer & Co. (*a*)	1	60,000	1	50,617
Drane	T. C. Heems & Co.	1	58,762	1	32,544
Elizabeth	Elizabeth Coal Company	2	55,000	3	70,000
Empire	Empire Coal Company	1	110,500	1	83,665
Eureka	Berwind-White Coal Mining Company	6	493,729	6	628,218
Excelsior	H. G. Fisher	4	155,562	4	163,045
Ferndale	Ferndale Coal Company	1	9,500	1	12,975
Franklin	Berwind-White Coal Mining Company	2	163,307	2	160,937
Gazzam	Clearfield Bituminous Coal Corporation.	1	79,155	1	79,805
Glenwood No. 1	Williams, Morris & Co	1	101,179	1	106,440
Glenwood No. 2	Ruse & Long	1	38,000	1	32,086
Grassflat	Clearfield Bituminous Coal Corporation.	3	11,500	3	121,671
Hawk Run	Jones, Mull & Co	1	24,000	1	37,408
Hudson	R. B. Wigton Sons	1	6,000		
Irvona No. 1	Irvona Coal and Coke Company	1	79,000	1	51,170
Karthaus	Berwind-White Coal Mining Company	1	70,000	1	55,000
Kentuck	Freyburger & Butterworth			1	164
Keystone	Keystone Coal Company (*b*)	1	8,884	2	82,954
Kyler	R. C. Fishburn	1	51,800	1	30,461
Lancashire	T. Barnes & Brother	2	89,632	2	93,682
Laurel Run	J. M. Bacon	2	46,157	2	42,728
Leatherwood	Leatherwood Coal Company			1	3,500
Logan	H. Liveright & Co	1	90,479	1	78,635
Logan Ridge	A. H. Smith	1	8,979		
Loraine	Reakirt Brothers	1	45,081	1	60,126
Lueder Slope	A. B. & G. V. Lueder	1	3,074		
Mapleton	Berwind-White Coal Mining Company	1	34,762	1	18,598
Montana	Squires & Co			1	6,262
Morgan	H. Liveright			1	24,584
Morrisdale	R. B. Wigton Sons	3	120,000	3	81,250
Moshannon	Clearfield Consolidated Coal Corporation.	1	32,000	1	50,400
Mount Vernon	do	3	134,000	3	101,920
National	National Coal and Coke Company	2	38,296	2	38,997
Oakland	Samuel Hegarty	1	35,000	1	
Ocean	Berwind-White Coal Mining Compeny	3	134,423	3	163,368
O'Shanter	O'Shanter Coal Company	1	16,803	1	50,354
Pacific	Berwind-White Coal Mining Company	2	316,510	2	219,351
Pardee	W. P. Duncan & Co. (*c*)	1	217,601	1	237,049
Ramey	Thos. Barnes			1	3,441
Reading	H. Liveright	1	22,658	1	26,215
Rochester	The Bell, Lewis & Yates Coal Mining Company.	3	363,594	3	355,222
Rothrock	R. B. Wigton Sons	1	175,000	1	164,003
Sobieski	Alice Wilkinson	2	40,092	2	9,804
Spring Hill	Walton & Ganoe (*b*)	1	7,370	1	5,454
Sterling	Robert Hare Powel & Co	2	283,206	2	137,498
Victor	Victor Coal Company	3	107,129	3	18,916
Vulcan	R. B. Wigton Sons	1	50,000	1	38,727
Webster No. 4	Beulah Coal Company	1	60,000	1	74,569
Williamsport	Clearfield Coal Company			1	7,874
Wills Run	J. L. Somerville & Co	1	33,492	1	79,741
Woodland	J. M. Cook			1	8,000
Yorkshire	T. Barnes & Co	1	7,500	1	3,877
Estimated production of new mines unreported			8,000		
Total		96	5,180,311	104	5,398,981

a Frank Morrison, 1888. *b* Victor Coal Company, 1888. *c* Geo. J. Magee, 1888.

CLINTON COUNTY.

(Coal produced in 1888, 32,000 short tons.)

There are many isolated areas of the top lands of this county, which are underlaid by the lower beds of the Lower Productive Coal Measures. These beds have been prospected, and worked on a commercial scale at various times during the past twenty-five years. The thinness of many of the beds, the poor character of the coal as compared with that in other counties, and their height in the hill tops above the grade of railroad lines have all militated against the extensive development of the coal, although it is estimated that there are between 15,000 and 20,000 acres of land in the county underlaid by workable coal beds, which have an aggregate available tonnage of about 60,000,000 tons. During 1888 the Kettle Creek Coal Company, whose mines are located on the hill tops above the valley of Kettle creek, produced 32,000 tons.

ELK COUNTY.

(Coal produced in 1888, 555,960 tons.)

Two new operators started in this county during the year: the Hazel Dell mines of Kaul & Hall, and the Whitehead mine of the Elk Coal and Coke Company. The total product of these two new companies for the year was 19,336 tons, although the total production of coal in the county during the year was 53,797 tons less than during the previous year. The coal beds belong to the Lower Productive Coal Measures, which have a greater development of thickness in the Meade Run coal basin, in Wharton township, than anywhere else in the county. The principal coal bed mined is the Lower Kittanning, which is known by different local names, such as Dagus bed, Saint Mary's bed, the Robert's lot, the Gas bed, etc. One of the most important results accomplished by the Geological Survey of the State in northwestern Pennsylvania was the establishing of the identity of the Lower Kittanning coal bed in the different isolated basins of Elk county.

Elk county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Cascade	Kaul & Hall	1	74,310	1	77,861
Dagus	Northwestern Mining and Exchange Company.	17	404,907	17	344,137
Eureka Slope	D. Eldridge	1	32,996		
Hazel Dell	Kaul & Hall			1	7,821
Saint Mary's	Saint Mary's Coal Company	3	81,002	3	100,000
Tannerdale	do	1	16,542	1	14,626
White Head	Elk Coal and Coke Company			1	11,515
Total		23	609,757	24	555,960

FAYETTE COUNTY.

(Coal produced in 1888, 5,208,993 tons.)

The increase in the coal product of this county for 1888 over 1887 was 668,671 tons, being a greater total increase than in any other one county, with the exception of Allegheny. Four new establishments were started during the year, which produced an aggregate of 76,301 tons. There are three distinct coal basins in this county, known respectively as the Second or Ligonier, the Third or Connellsville, and the Fourth basin. The famous Connellsville coke is produced exclusively in this county. The coal from which it is manufactured is taken from the Connellsville bed, which is geologically identical with the gas coal bed in the Pittsburgh region and the great coal bed of the Cumberland region in Maryland. Although most of the coal produced is taken from the Connellsville bed, there are several other coal beds in the county which can ultimately be profitably mined, but whose development at the present time is entirely overshadowed by the exceptional quality and extent of the Connellsville bed.

During the past few years great interest has been manifested in the possibility of the exhaustion of the Connellsville coal bed, and numerous claims have been made by prominent operators that very small areas exist, underlaid by the Connellsville bed, which would supply coke that was not under the control of the present coal-operating or coke-manufacturing companies, and which would compare with that at present being manufactured by these companies. While there are, no doubt, large areas which are underlaid by the Connellsville bed where the coal is not so good nor so well adapted to the manufacture of coke as that contained in the areas at present worked, yet no fear should be entertained by coke consumers but that the Connellsville coke can be made for many generations.

The Third or Connellsville coke basin really extends throughout the eastern limits of Fayette and Westmoreland counties, from Blairsville, on the Conemaugh river, in Indiana county, southwest, east of Latrobe, on the main line of the Pennsylvania railroad, through Pleasant Unity and Mount Pleasant, in Westmoreland county, and through Connellsville, Uniontown, and West Fairchance, in Fayette county. There is no doubt but that large tracts within this area or within this basin will ultimately be developed, and that it will produce a coal which, if not equal to the present Connellsville, will certainly be comparable to it.

The largest operator in the county is the H. C. Frick Coke Company, which is the largest combined coal mining and coke manufacturing concern in the United States.

Fayette county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887. Mines.	1887. Production.	1888. Mines.	1888. Production.
			Short tons.		*Short tons.*
Albany	Snowden & Hogg	1	70,300	1	52,974
Anchor	Pennsylvania Manufacturing, Mining and Supply Company.	1	28,000	1	25,000
Atlas	Atlas Coke Company (limited)	1	48,376	1	34,840
Carondelet	E. C. Furlong	1	12,000	1	22,800
Cedar Hill	Bradford & Lynch	1	14,440	1	15,000
Clarissa	James Cochran Sons & Co	1	58,520	1	11,394
Climax	Eli Leonard & Sons	1	20,000	1	53,200
Clinton	B. F. Keister & Co. (*a*)	1	17,072	1	9,600
Coalbrook	Rafferty & Donnelly (*b*)	1	42,247	1	52,276
Cora	J. S. Newmeyers & Sons	1	21,418	1	21,973
Cupola	H. C. Frick Coke Company	......	....	1	24,000
Dexter	Joseph R. Stauffer & Co	1	16,524	1	8,287
Diamond	Rafferty & Donnelly (*b*)	1	35,399	1	4,934
Eagle	H. C. Frick Coke Company	1	45,000	1	46,000
Fairchance	Fairchance Furnace Company	1	48,254	1	54,300
Fayette	Fayette Coke and Furnace Company	1	73,748	1	52,675
Ferguson	Dunbar Furnace Company	1	41,042	1	....
Fort Hill	W. J. Rainey	1	83,200	1	75,000
Foundry	H. C. Frick Coke Company	1	63,000	1	25,000
Fountain	E. A. Humphries	1	25,293	1	32,380
Franklin	B. F. Keister & Co. (*a*)	1	22,500	1	6,900
Frick	H. C. Frick Coke Company	1	63,000	1	40,000
Furnace	E. A. Humphries	1	2,600	1	....
Grace	W. J. Rainey	1	171,649	1	225,000
Great Bluff	Isaac Taylor	1	5,652	1	6,163
Germania	John W. Hall & Sons (*c*)	1	32,566	1	7,220
Henry Clay	H. C. Frick Coke Company	1	60,000	1	46,000
Hill Farm	Dunbar Furnace Company	1	88,422	1	76,911
Home	Stauffer & Wiley	1	11,303	1	5,457
Jackson	Jackson Mines Company	1	27,000	1	37,500
Kyle Farm	Bliss & Marshall	2	48,435	2	54,520
Leisenring	The Connellsville Coke and Iron Company.	3	376,204	3	567,734
Lemont	R. Hogsett & Co	1	78,000	1	65,000
Little Alps	John Underwood	1	5,000	1	....
Little Pittsburgh	R. E. Schmertz & Co	1	7,348	1	....
Little Redstone	Joseph Rutherford	1	4,560	1	11,400
Luth	Chicago and Connellsville Coke Company.	1	120,000	1	167,360
Mahoning	Cambria Iron Company	1	69,228	1	85,414
Merchant	David Bowdler	1	198	1	152
Moreland	W. J. Rainey	1	14,021	1	....
Morgan	H. C. Frick Coke Co	......	....	1	24,000
Morrel	Cambria Iron Company	1	239,512	1	305,435
Mount Braddock	R. Hogsett & Co	1	17,000	1	36,800
Nellie	Broun & Cochran	2	100,050	2	153,862
Painter	Rafferty & Donnelly (*b*)	1	119,192	1	88,595
Parrish	Dunbar Furnace Company	......	....	1	24,001
Paul	W. J. Rainey	1	7,067	1	42,750
Pinnsville	Pinnsville Coke Company	1	38,683	1	42,200
Percy	Percy Mining Company	1	37,782	1	22,714
Plummer & Davidson.	Pittsburgh and Connellsville Gas Coal and Coke Company (*a*)	2	180,000	2	211,164
Rainbow	Rainbow Coal and Coke Company	1	33,000	1	33,640
Redstone	J. M. Schoonmaker Coke Company	3	215,000	3	316,719
Rist	H. C. Frick Coke Company	1	112,500	1	200,000
Snow Hill	Alps Coal Company	1	51,563	1	70,453
Sterling	J. M. Schoonmaker Coke Company	2	195,000	2	277,061
Stewart	Stewart Iron Company (limited)	1	86,357	1	85,640
Stony Hill	Stony Hill Coal Company	1	28,500	1	45,000
Summit	H. C. Frick Coke Company	2	102,000	2	110,000
Tip Top	do	1	75,000	1	62,000
Tremont	John A. Wood & Son	1	4,000	1	21,829
Trotter	H. C. Frick Coke Company	1	337,500	1	380,000
Tyrone	Laughlin & Co. (limited)	2	94,018	2	52,713
Umpire	C. L. Snowden & Co	1	41,800	1	66,614
Union	J. D. Boyd & Co	1	24,381	1	34,563
Uniondale	Reid Brothers	1	26,619	1	14,025
Ursina	Connellsville and Ursina Coal and Coke Company.	......	....	1	4,300
Valley	H. C. Frick Coke Company	1	105,000	1	125,000
Wheeler	Cambria Iron Company	1	64,070	1	90,110
White	do	1	114,000	1	122,000
Wynn	Wynn Coke and Mining Company	1	11,850	1	22,790
Youngstown	Youngstown Coke Company (limited)	1	107,399	1	98,651
Total		78	4,540,362	82	5,208,993

a H. C. Frick Coke Company, 1888. *b* McClure Coke Company, 1888. *c* Jos. Turnbull & Son, 1888.

GREENE COUNTY.

(Coal produced in 1888, 5,323 tons.)

The great depth at which the more valuable coal beds underlie the surface in Greene county will prevent their active development for many years, since the cost of mining will be so great that operators in the county cannot profitably compete with the cheaper mining of more superficial coals in the adjoining regions. The entire surface is underlaid by available beds.

Greene county mines, operators, and product, 1888.

Collieries.	Operators.	Mines.	Short tons.
Camp	Thomas Flowers	1	1,900
Slippery Rock	Johnson & Leonard	1	2,823
Stewart	Stewart & Clark	1	600
Total		3	5,323

HUNTINGDON COUNTY.

(Coal produced in 1888, 281,823 tons.)

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. The largest operator in the county was the Rock Hill Iron and Coal Company, in the vicinity of Robertsdale, in the east Broad Top field. The production of coal by this company during the year was practically the same as during the previous year. About one-third of the product of this company is consumed at its furnaces located at Orbisonia, and the remaining two-thirds is shipped east by the Broad Top railroad to Mount Union, and thence east and west by the Pennsylvania railroad.

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, since the amount of available tonnage contained is such as to make it impracticable at the present time to enter into any speculation on this question.

Coal carried by the Huntingdon and Broad Top railroad to the Pennsylvania railroad at Huntingdon.

Years.	Short tons.	Years.	Short tons.
1873	350, 245	1881	204, 819
1874	226, 693	1882	271, 216
1875	204, 921	1883	196, 534
1876	159, 779	1884	192, 706
1877	140, 143	1885	176, 075
1878	150, 204	1886	385, 796
1879	141, 594	1887	357, 438
1880	174, 736	1888	375, 958

Coal carried by the East Broad Top railroad to the Pennsylvania railroad at Mount Union.

Years.	Short tons.	Years.	Short tons.
1875	43, 567	1882	99, 095
1876	66, 104	1883	44, 737
1877	54, 738	1884	43, 514
1878	63, 068	1885	51, 878
1879	67, 929	1886	51, 050
1880	72, 450	1887	48, 581
1881	91, 745	1888	55, 795

In this connection it is interesting to note the shipments of Cumberland (West Virginia portion) coal over the former railroad and the Pennsylvania railroad from Huntingdon junction.

Shipments of Cumberland coal over the Pennsylvania and the Huntingdon and Broad Top railroads.

Years.	Short tons.	Years.	Short tons.
1873	114, 589	1881	313, 600
1874	67, 671	1882	208, 031
1875	175, 154	1883	471, 785
1876	145, 796	1884	394, 114
1877	187, 488	1885	460, 289
1878	163, 598	1886	266, 153
1879	171, 930	1887	438, 145
1880	242, 593	1888	812, 574

Huntingdon county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Benedict	Reed Brothers	1	15, 000	1	(*a*)
Fisher	Sweet & Brown	1	7, 000	1	(*a*)
Huntingdon	E. F. Gould	1	2, 000	1	19, 225
Moredale	E. P. Jenkins & Co	1	11, 015	1	8, 600
Ocean	William H. Sweet	1	30, 000	1	44, 000
Prospect	Robert Hare Powel, Sons & Co	2	47, 175	2	55, 473
Robertsdale	Rockhill Iron and Coal Company	2	153, 289	2	154, 525
Total		9	265, 479	9	281, 823

a Unreported.

INDIANA COUNTY.

(Coal produced in 1888, 157,285 short tons.)

The total product of this county for 1888 was 50,312 tons less than during the previous year, accounted for principally by the diminished shipment of the Saltsburgh Coal Company. Although there is a comparatively small amount of the product of the Pennsylvania bituminous field mined in this county at the present time, yet the great resources of the county will ultimately make it one of the greatest coal-producing districts of the State.

Indiana county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Blairsville	Blairsville Coke Company, limited	1	16,000	1	11,800
Centre	Centre Coal Company	......	....	1	2,550
Foster	Saltsburgh Coal Company	1	160,800	1	110,000
Smith	Robert Smith	1	16,000	1	16,400
Turner	J. M. Turner	1	14,797	1	16,535
Total		4	207,597	5	157,285

JEFFERSON COUNTY.

(Coal produced in 1888, 2,275,349 short tons.)

This county produced during the year 581,857 tons more coal than during the year previous. This increased product is to be accounted for by the new establishment of the Berwind-White Coal Company, at West Eureka, which produced over 10 per cent. of the entire product of the county. The largest operator in the county was the Bell, Lewis & Yates Coal Mining Company, whose aggregate product was nearly 600,000 tons. The favorable location of Jefferson county to railroads, both north and south, will always constitute this one of the most important coal-producing districts of the State.

Jefferson county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Adrian	Rochester and Pittsburgh Coal and Iron Company.	2	136,613	2	278,695
Beechtree	......do	1	225,836	3	138,746
Clarion	Northwestern Mining and Exchange Company.	6	210,305	6	361,451
Coal Glen	Jefferson Coal Company	1	123,778	1	154,000
Hamilton	The Bell, Lewis & Yates Coal Mining Company.	1	77,599		
Pleasant Valley	......do	1	4,068	5	586,103
Soldier Run	......do	2	205,296		
Sprague	......do	1	125,862		
Walston	Rochester and Pittsburgh Coal and Iron Company.	3	584,135	3	457,694
West Eureka	Berwind-White Coal Mining Company.	......	....	2	298,660
Total		18	1,693,492	22	2,275,349

LAWRENCE COUNTY.

(Coal produced in 1888, 106,921 short tons.)

This county produced 18,440 tons less coal during 1888 than during the previous year, which is about 6,000 tons less than the increased product of 1887 over that for 1886. But three operating companies reported their product: the Beaver Coal Company produced 36,510 tons; the Penn Coal Company, 38,561, and the Clinton Coal Company, 31,850 tons.

McKEAN COUNTY.

(Coal produced in 1888, 10,443 tons.)

During the past year all the coal mined in this county was produced by the mines of the Buffalo Coal Company. Only the lower coal beds of the Lower Productive coal beds and those of the Pottsville Conglomerate series occur. The coal beds are thin, the coal poor, and the thickness of the beds and the character of the coal extremely uncertain. The coal produced by the Buffalo Coal Company is under the control of the railroads, and is used almost exclusively as a locomotive fuel.

Shipments of coal from McKean county, Pennsylvania.

Years.	Short tons.	Years.	Short tons.
1875	33, 501	1882	73, 834
1876	81, 830	1883	84, 899
1877	73, 222	1884	78, 870
1878	72, 098	1885	44, 312
1879	85, 745	1886	617
1880	100, 046	1887	8, 761
1881	110, 099	1888	10, 443

MERCER COUNTY.

(Coal produced in 1888, 487,122 tons.)

The coal produced in Mercer county during 1886 and 1887 was practically the same, while during 1888 the total product fell off from that of the former year by 52,599 tons. There were two less producing coal mines during 1888 than during 1887. The mine of the Jackson Coal Company, which during 1887 produced 2,000 tons, is reported to have been worked for a limited time during 1888, although the total product of the mine is not known. All the coal beds mined in this county belong to the Lower Productive and Conglomerate groups. The Brookville, or what has been considered to be the lowest bed of the former group, was mined in Pine, Findley, Jackson, and Lake townships, where it has a thickness of about 3½ to 4 feet. The two Mercer coal beds and the Quakertown and Sharon coal beds, which occur in the Conglomerate series, have been worked to a greater or less extent in a number of localities in the county. All these coal beds occur under limited dis-connected areas, occurring in the upper levels of the southeastern portion of the county.

The Mercer Coal and Iron Company produced more coal than any other company in the State. The Mercer Coal Company produced during the year 62,280 tons, which was 7,280 tons more than was produced by the same company during 1887. Most of the coal mined is shipped to lake points with the exception of that mined from the Sharon block bed, which has a special trade distinctively its own, and which finds markets in Ohio and as far west as Chicago.

Mercer county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Bethel	Bethel Coal Company	1	16, 260	1	6, 500
Black Diamond	Filer, Sutliffe & Co	1	41, 104	1	36, 454
Carver	Carver Coal Company	1	50, 409	1	55, 093
Chestnut Ridge	Westerman, Filer & Co	1	45, 088	1	56, 665
Hickory Slope	Hazzard, Wood & Co	1	47, 910	1	25, 521
Jackson	Jackson Coal Company	1	2, 000	1	....
Lackawannock	Pierce Coal Company, limited	1	23, 171	1	5, 093
New Virginia	Virginia Coal Company	1	14, 900	1	14, 760
Ormsby Shaft	Ormsby Coal Company	1	33, 335	1	27, 391
Ormsby Slope	L. M. Ormsby & Co., limited	1	48, 100	1	37, 500
Pardoe	Mercer Coal Company	1	55, 000	1	62, 280
Pine Grove	Pine Grove Coal Company	1	30, 000	1	44, 445
Sharon	Sharon Coal Company	1	39, 255	1	30, 000
Stoneboro	Mercer Iron and Coal Company	2	93, 189	2	85, 420
Total		15	539, 721	15	487, 122

SOMERSET COUNTY.

(Coal produced in 1888, 370,228 tons.)

The total product of this county during 1888 was 46,012 tons less than during 1887, and 20,302 tons greater than during 1886. The geological range of the coal beds mined is greater than in any other county in the State. It includes the Pittsburgh coal bed, which is geologically identical with the great bed of the Cumberland region, and the basin in which it is mined in Somerset county is an extension northeast of the Cumberland basin of Maryland, several beds in the Lower Barren Coal Measures, of which the Price or Berlin bed is the most important, and several beds in the Lower Productive Measures of which the Middle Kittanning forms the most important bed. A number of thinner and less important beds are mined for local consumption by the farmers throughout the county. The largest single producing concern is the Fair View Coal Company, which operates three principal mines, the total production of which during the year was 77,728 tons, or 23,072 tons less than the same company produced during 1887.

Somerset county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887. Mines.	1887. Production.	1888. Mines.	1888. Production.
			Short tons.		*Short tons.*
Berlin	B. D. Morgan & Co	1	6,500	1	5,600
Casselman	Casselman Coal Company	1	39,200	1	44,800
Cochrane	James Cochrane & Co	1	13,440	1	500
Co-operative	Co-operative Coal Company	1	14,560	1	6,200
C. & E. L	Cumberland and Elk Lick Coal Company.	1	81,814	1	66,130
Cumberland	Cumberland Coal and Mining Company.	1	67,000	1	29,120
Fair View	Fair View Coal Company	1	21,280	1	15,120
Flog Hill	do	1	32,480	1	23,856
Grassy Run	Grassy Run Coal Company	1	14,112	1	11,200
Hamilton	Hamilton & Cochrane	1	25,760	1	38,104
Hocking	Hocking Coal Company	1	8,038	1	33,600
Keystone	Keystone Coal Company	1	17,808	1	9,961
Statler	Emanuel Statler	1	13,440	1	12,000
Thomas	Benjamin Thomas	1	8,561	1	10,041
Tree Forest	Buffalo Creek Coal Company	1	5,207	1	20,944
Tub Mill Run	Fair View Coal Company	1	47,040	1	38,752
Ursina	Connellsville and Ursina Coal and Coke Company.	1	....	1	4,300
Total		17	416,240	17	370,228

TIOGA COUNTY.

(Coal produced in 1888, 1,106,146 tons.)

There was a general falling off in the total product in each of the coal companies operating in Tioga county during 1888 as exhibited by the following table, the falling off in the total product of the county for the year being 222,817 tons. Almost the entire product was mined from the "B" or Blossburgh coal bed, which ranges in thickness from 2½ to 4 feet. Nearly all the areas in the county are so scattered, and their heights above the bottoms of the valleys through which the coal must be shipped so great that the cost of mining will be much greater than in the more western counties of the State, where the coal beds are more favorably situated for economical mining, and it is more than probable that the total annual production of the county has already passed its maximum limit. The product of the Blossburgh region since 1872 has been as follows:

Product of coal in the Blossburgh region since 1872.

Years.	Short tons.	Years.	Short tons.
1872	849,262	1881	1,178,581
1873	991,057	1882	1,165,604
1874	796,388	1883	1,217,870
1875	581,782	1884	1,018,342
1876	616,984	1885	1,074,581
1877	602,245	1886	1,388,611
1878	652,597	1887	1,329,239
1879	874,010	1888	1,106,146
1880	921,555		

Tioga county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Antrim	Fall Brook Coal Company	3	403, 592	3	342, 077
Arnot	Blossburgh Coal Company	3	341, 294	3	318, 200
Fall Brook	Fall Brook Coal Company	2	97, 320	2	63, 717
Gaines	Gaines Coal Company	2	10, 856	2	8, 440
Morris Run	Morris Run Coal Mining Company	3	475, 901	3	373, 712
Total		13	1, 328, 963	13	1, 106, 146

VENANGO COUNTY.

(Coal produced in 1888, 2,000 short tons.)

There are only a few scattered areas in the southeastern part of Venango county, principally in the townships of Irwin, Clinton, Scrubgrass, Dotters, and Potterfield, which are underlaid by coal beds.

All the coal is mined to supply a local trade.

Although no reports were received from any mining operators for 1888, it is estimated that the total product of the county did not exceed 2,000 tons.

WASHINGTON COUNTY.

(Coal produced in 1888, 1,793,022 short tons.)

The total amount of coal produced in this county during 1888 was 41,407 tons greater than during 1887. Although this was a large increase over the total product for 1887, it was not as great as the increase during 1887 over 1886. The largest operator in the county was the Jumbo Coal and Coke Company, which produced during the year 136,335 tons, which was a falling off in the total production of this company from the previous year of 46,700 tons. Washington is destined to be one of the greatest coal-producing counties in the State; but on account of the fact that most of the workable coal beds are situated below water level, and will have to be mined from shafts, the large amount of capital which is required to develop these beds and the cost of operation would necessarily be greater than that in the more northern counties, where the coal beds can be mined above water level. These facts will make the development of the coal beds of the county a slow one. At the present time the Pittsburgh coal bed supplies almost the entire product of the county, which is shipped by rail to Chicago, Cleveland, Columbus, and intermediate points, and by boat down the Monongahela river to Ohio and Mississippi river points.

Washington county mines, operators, and product in 1887 and 1888.

Collieries.	Operators.	1887. Mines.	1887. Production.	1888. Mines.	1888. Production.
			Short tons.		*Short tons.*
Acme	Stockdale Coal Company	1	52, 545	1	86, 994
Alex. Hays	W. S. B. Hays	1	26, 256	1	22, 956
Allison's	Hon. Jonathan Allison	1	48, 000	1	55, 100
American	Washington Coal Company	1	41, 208	1	35, 000
Banner	J. M. Risher	2	92, 100	2	63, 924
Black Diamond	W. H. Brown's Sons	1	50, 000	1	58, 492
Black Diamond	Thomas Taylor	......	......	1	25, 500
Boon	Stoner & Co	1	33, 000	1	38, 000
Bowman	Eli Leonard	1	5, 000	1	5, 269
Briar Hill	Patterson & Sauters	1	100, 524	1	84, 488
Buffalo	Youghiogheny Coal Company, limited.	1	90, 000	1	22, 140
Caledonia	Caledonia Coal Company	3	157, 000	3	102, 265
Catsburg	Louis Staib	1	48, 506	1	65, 084
Champion	T. J. Wood	......	......	1	71, 328
Cincinnati	Jordan S. Neel	1	37, 000	1	9, 500
Cliff	J. M. Risher	1	57, 300	1	31, 063
Clipper	Allenport Coal Company	1	25, 000	1	47, 500
Coal Bluff	Monongahela and Peters Creek Gas Coal Company.	1	87, 898	1	61, 679
Cook's	J. V. N. Cook	1	7, 000	1	2, 720
Courtney	Courtney Coal Company	1	46, 000	1	42, 000
Eclipse	Jordan S. Neel	1	50, 000	1	44, 857
Eclipse	Osborne Senger & Co	......	......	1	24, 583
Enterprise	J. V. N. Cook	......	......	......	2, 270
Floersheim	Henry Floersheim	2	54, 571	2	102, 670
Garfield	Jordan S. Neel	1	26, 000	1	22, 683
Gastonville	Pittsburgh and Chicago Gas Coal Company.	1	38, 000	1	52, 400
Globe	Globe Coal Company	1	60, 000	1	33, 128
Greenfield	Jordan S. Neel	1	20, 000	1	24, 853
Hilldale	Hilldale Coal Company	1	40, 000	1	50, 627
Ivill	James Jones	1	75, 889	1	86, 400
Jumbo	Jumbo Coal and Coke Company	1	183, 035	1	136, 335
Knob	Knob Coal Company	1	43, 114	1	75, 507
Midway	Midway Block Coal Company	2	17, 242	2	53, 535
Nickel Plate	J. D. Sauters & Co	......	......	1	49, 392
Robbins	Robbins Block Coal Company	1	61, 000	1	18, 357
Stockdale	John Crombie & Co	......	......	1	9, 784
Venetia	D. M. Anderson	1	38, 427	1	32, 455
Woods Run	W. A. Stone & Co	1	50, 000	1	42, 184
Total		37	1, 761, 615	42	1, 793, 022

WESTMORELAND COUNTY.

(Coal produced in 1888, 6,519,773 short tons.)

The mines of this county have produced more coal during each of the past five years than those in any other county in the Pennsylvania bituminous field. This is to be accounted for by the superior quality of the coal for gas, steam, and coke manufacture, and by the fact that the Pittsburgh coal bed, from which the bulk of the product of the county comes, is generally more favorably situated for economical mining than any other bed. The total product for 1888 was 445,287 tons greater than during 1887, which was about 70 per cent. of the increase of 1887 over that of 1886.

Westmoreland county mines, operators, and product in 1887 *and* 1888.

Collieries.	Operators.	1887.		1888.	
		Mines.	Production.	Mines.	Production.
			Short tons.		*Short tons.*
Alexandria	Alexandria Coal Company	3	138,483	3	137,171
Alice	J. M. Schoonmaker Coke Company	1	125,000	1	142,263
Amieville	N. J. Bigley	1	55,500	1	64,796
Bagdad	Bagdad Coal Company	3	21,506	3	22,865
Buckeye	A. C. Cochran	2	101,727	2	84,385
Bessemer	McClure & Co	2	141,700	2	135,000
Carbon	Carbon Coal Company	......	....	1	83,783
Central	Central Connellsville Coke Company	1	70,000	1	153,000
Columbia	J. T. Jones	1	33,000	1	18,259
Derry	Derry Coal and Coke Company	1	2,000	1	40,333
Dilworth	W. P. Dilworth & Co	1	12,400	1	30,500
Donelly & Dellinger.	McClure & Co	2	103,818	2	112,000
Emma	Maria F. Overholt	1	16,786	1	12,905
Enterprise	McClure & Co	1	27,859	1	14,250
Eureka	Stoner & Co., limited	1	40,000	1	48,000
Fairbank	Saltsburgh Coal Company	1	150,000	1	130,000
Gilmore	Altmeyer & Molsberger	1	28,500	1	25,473
Greensburgh	Greensburgh Coal Company	1	115,124	1	95,174
Hazlett	McClure & Co	2	142,500	2	87,000
Hecla	Hecla Coke Company	1	155,652	1	183,747
Hempfield	Hempfield Coal Company	1	156,356	1	113,055
Isabella	Isabella Furnace Company	1	156,000	1	51,833
Larimer	Westmoreland Coal Company	2	240,148	2	309,473
Latrobe	Latrobe Coal and Coke Company	1	135,165	1	122,739
Leechburgh	Leechburgh Coal and Coke Company	2	84,367	2	96,848
Lockport	Bolivar Coal and Coke Company	1	1,000	1	....
Loyalhanna	Loyalhanna Coal and Coke Company	1	82,316	1	122,441
Mammoth	J. W. Moore	2	226,920	2	200,224
Manor	New York and Westmoreland Gas Coal and Coke Company.	2	19,000	2	12,640
Manor Valley	Manor Gas Coal Company	1	90,031	1	116,584
Mayfield	McClure & Co	1	32,310	1	34,500
Millwood shaft	Millwood Coal Company	1	59,614	1	70,588
Monastery	H. C. Frick Coke Company	1	135,000	1	68,000
Morewood	Southwest Coal and Coke Company	3	300,160	3	366,593
M. Saxman	M. Saxman, jr., & Co	1	85,000	1	90,600
Mullin	McClure & Co	1	43,052	1	24,000
Mutual	Mutual Mining and Manufacturing Company.	3	91,116	3	110,280
Ocean	George Vogele	......	....	1	5,273
Ocean No. 1	The Youghiogheny River Coal Company.	1	125,229	1	133,492
Ohio and Pennsylvania.	Ohio and Pennsylvania Coal Company.	1	5,000	1	6,600
Penn gas	Penn Gas Coal Company	4	557,227	4	640,296
Pittsburgh and Kiskiminitas.	Pittsburgh and Kiskiminitas Coal and Coke Company.	1	28,269	1	38,921
Port Royal	Port Royal Coal and Coke Company	3	67,297	3	141,676
Republic	Republic Coal Company	1	34,000	1	19,796
Ridge View	D. C. George & Co	1	40,000	1	10.000
Rostraver	William Schrader	1	25,000	1	....
Saint Clair	Saint Clair Coal and Coke Company	1	80,000	1	30.000
Shaner	Shaner Gas Coal Company, limited	2	72,000	2	35,000
Smithton	Waverly Coal and Coke Company	2	89,700	2	101,805
South Side	Westmoreland Coal Company	1	211,462	1	288,519
Southwest, 2, 3, and 4.	Southwest Coal and Coke Company	3	122,346	3	139,309
Standard	H. C. Frick Coke Company	2	390,000	2	445,941
Union	McClure & Co	1	34,212	1	27,000
United	United Coal and Coke Company	1	177,333	1	243,000
Webster	Thomas Faucet & Sons	......	....	1	50,000
Westmoreland Shaft.	Westmoreland Coal Company	1	274,183	1	303,840
West Newton	West Newton Coal Company	2	128,252	2	150,000
West Overton	A. C. Overholt & Co	1	54,940	1	37,618
Youghiogheny Slope.	Youghiogheny Slope Gas Coal Company.	1	42,426	1	63,000
Youghiogheny Valley.	Youghiogheny and Ashtabula Coal and Coke Company.	1	96,500	1	77,385
Total		84	6,074,486	87	6,519,773

RHODE ISLAND.

Total product in 1888, 4,000 short tons; spot value, $11,000.

Although the peculiar character of the coal beds found in what is known as the New England basin, and principally within the State of Rhode Island, hardly permits of its classification with the better fuel coals which can be commanded from the Atlantic sea-board, extending from Nova Scotia to Alabama, yet the possible value of the Rhode Island graphite and graphitic coal for special manufacturing and metallurgical uses entitles it to mention in any review of the coal fields and coal trade of the United States.

Prof. N. S. Shaler, of Cambridge, Massachusetts, has made more recent and intelligent studies in this field than any other American geologist, and some two years ago claimed that the graphitic coal of Rhode Island had peculiar advantages for making water gas and for smelting iron and copper. It has also been claimed that the coal possesses a peculiar character especially adapted for certain iron metallurgical work connected with the operations of the Carbon Iron Company of Pittsburgh, which until quite recently was using the Rhode Island coal in the reduction of high grade iron ores to metallic sponge for the direct manufacture of steel. Recently coke has been substituted for graphitic coal by the Carbon Iron Company, with better and more economical results.

As a result of a special inquiry and investigation which has been made during the past year of the Rhode Island product as related to the manufacture either of water gas or the reduction of copper ores, it is questioned very much whether the hopes entertained by Professor Shaler in these two directions will ever be realized on a commercial scale.

The most important development which has latterly been made in the Rhode Island field has been instigated by the Worcester Steel Company, which has manifested great confidence in the value of the graphitic coals of Rhode Island, and has recently pumped out the old 150-foot shaft at the mines at Portsmouth, reported now to be owned by the Worcester Company.

It is claimed that there are associated with the coal and graphite deposits of the State extensive deposits of iron ore, limestone, and fireclay, but from what is at present known of the iron ores they are of very low grade in iron, and in this respect promise to be of comparatively little value, although the low percentage of phosphorus and sulphur which they contain, together with the fact that they can be cheaply mined, has encouraged the hope that they could be mixed with rich foreign iron ores for the manufacture of high-grade Bessemer steel.

Some of the graphite which is mined has been found valuable in the manufacture of stove facings, and from the indefinite data which have been collected from the mines within the State it is estimated that the total product during 1888 amounted to 4,000 tons.

TENNESSEE.

Total product in 1888, 1,967,297 short tons; spot value, $2,164,026.

The coal fields of the State comprise part of the Appalachian field. The area containing workable beds is confined to what is known as the Cumberland table land, which is the southern extension of the Kentucky field. Its area is about 1,500 square miles, and it is embraced by the counties of Scott, Morgan, Cumberland, Fentress, Van Buren, Grundy, Bledsoe, Sequatchie, Marion, Overton, Putnam, White, Warren, Franklin, Claiborne, Campbell, Anderson, Rhea, and Hamilton.

The following table exhibits the amount of coal shipped from the mines in these three districts for fuel consumption and amount of coal coked:

Total product of Tennessee for 1888, as reported by William A. Park, State inspector of mines.

Districts.	1888.		
	Coal.	Coal coked.	Total.
	Short tons.	*Short tons.*	*Short tons.*
First	332, 715	304, 700	637, 415
Second	309, 973	374, 000	683, 973
Third	645, 909	....	645, 909
Total	1, 288, 597	678, 700	1, 967, 297

The principal producing company in Tennessee is the Tennessee Coal Iron and Railway Company, which has its mines at Tracy City and South Pittsburg, Tennessee, and in the city of Birmingham, Alabama. The following is an exhibit of this company's operations, in both Tennessee and Alabama, for the years extending from March, 1887, to March, 1888, and from March, 1888, to March, 1889:

Statistics of the Tennessee Coal, Iron and Railway Company, 1887–'88, and 1888–'89.

Divisions.	1887–'88.	1888–'89.
	Tons.	*Tons.*
Tracy City, coals	426, 274	413, 631
Tracy City, coke	155, 253	154, 414
Cowan, pig iron	24, 540	18, 112
South Pittsburg, pig iron	43, 564	56, 779
South Pittsburg, coals	15, 266	73, 699
South Pittsburg, coke	4, 014	26, 346
Birmingham, pig iron	41, 056	47, 770
Birmingham, coke	64, 071	79, 786
Pratt mines, coals	718, 824	888, 247
Pratt mines, coke	106, 649	196, 059
Ensley, pig iron	....	78, 089
Inman mines, iron ore	107, 750	126, 271

Total output.	1887–'88.	1888–'89.	Increase.
	Tons.	*Tons.*	*Tons.*
Coals	1, 160, 364	1, 375, 577	215, 213
Coke	329, 987	456, 605	126, 618
Pig iron	109, 160	200, 750	91, 590
Iron	107, 750	126, 271	18, 521

The Dayton Coal and Iron Company is operating several mines in the vicinity of Dayton, Rhea county. The town of Dayton is 297 miles south of Cincinnati and 38 miles north from Chattanooga. The company has 250 bee-hive ovens, and its coal is obtained from the Richland mine, 3 miles west of Dayton, and the Nelson mine, 1½ miles distant. The coal bed of the Nelson mine averages about 4 feet in thickness and is considered to be the principal dependence of the company, since the coal bed at the Richland mine varies considerably from point to point. The average output of these mines is about 1,850 tons per week, their product being almost entirely manufactured into coke. The Soddy Coal and Coke Company is the oldest operating company in the State. Its mines are located in Hamilton county, and the product averages about 8,000 tons per month. The company has 165 coke ovens, and when running full time is capable of manufacturing 2,000 tons of coke per month, employing 375 miners and outside hands. The Walden Ridge Coal Company operates mines at Sale Creek, in Hamilton county, 28 miles from Chattanooga. A little over half of the coal produced by this company is manufactured into coke, the other half being taken by local and railroad consumers. In the vicinity of the Walden Ridge Coal Company's operations mines have been opened by the Fox Coal and Coke Company, while 10 miles nearer Chattanooga the Daisy Coal Company is operating a mine, the product of which is consumed almost entirely by local and railway consumers, a very small proportion of the coal being coked. The Roane Iron Company is mining in the vicinity of Rockwood, in Roane county, about 42 miles north of the Walden Ridge Coal Company's operations. The product of the Roane Iron Company's mines is manufactured almost entirely into coke for use by the Roane Iron Company. The Jellico Mountain Coal and Coke Company is operating at Newcombe, in Campbell county. The bed which is worked by this company has become noted as the "Jellico Mountain" coal bed, ranging in thickness from 4 feet to 4 feet 6 inches. The coal from these mines is shipped for direct consumption to Atlanta, Macon, Roane, and a number of other points in Georgia, Alabama, and Tennessee. The Jellico coal, on account of its low percentage of ash and sulphur, makes a very desirable steam and domestic coal.

Many other coal companies which are operating within the State may be noted; the Coal Creek and the Tabler-Crudup in Hamilton county; the Pioneer, the Fox Coal and Coke Company and the Edna Coal and Coke Company in Marion county; the Poplar Creek, Mount Carbon, Widows Gap, Eureka and Oliver coal companies in Anderson county; the Glen Mary in Scott county; the Standard in Campbell county; and the Knoxville Coal Creek, Blue River, Heck and Petree companies in Anderson county.

Special interest has been recently taken in the undeveloped coal fields of the Cumberland plateau, and Prof. Henry E. Colton, formerly connected with the Geological Survey of the State, has recently made some examinations of the area extending from Virginia, near the Cumberland Gap, to Dayton, Tennessee.

The following extracts from Professor Colton's valuable report are inserted here, since they contain information of great interest.

From Virginia, near the Cumberland Gap, to Dayton, Tennessee, there is all along the eastern boundary of the great Tennessee coal field a well defined and persistent mountain range in which the rock strata are pitched at an angle varying from 40 to 45 degrees to full 85 degrees or nearly vertical. The former slight inclination exists near Cumberland Gap, the latter at Big Creek Gap, Coal Creek, and Poplar Creek and Emory Gaps. There are intervals between these points of great inclination where the strata are less inclined. Prof. J. P. Lesley states his belief that this was not caused by an upheaval, but by a downthrow, and this theory is sustained by the fact that there is in all that strata a steady, regular, but slight inclination to the southeast. This inclination is not apparent, and it is common to call all the Cumberland mountain area horizontal. A railroad grade of 60 feet to the mile is not apparent to the eye, yet that grade continued from one point to another 10 miles distant would make the latter point 600 feet lower than the former. The great conglomerate which at Bon Air makes the rim top of the mountain and is 1,900 feet above the sea level does not have to incline a great deal to be 1,900 lower, or so far below the surface as to be at sea level at a point 30 miles to the southeast.

It is difficult to conceive of the great force by which the Cumberland mountain strata were thrown down and the strata of that part of it now called Walden's Ridge pitched upward, nor why it is slight at Cumberland Gap and south of Dayton and heavy at intermediate points, especially those points at which streams cut through it, and why, as has been demonstrated at Rockwood, its coal seams pitch for a considerable distance and then become comparatively horizontal. In a mountain along whose foot the Cincinnati Southern railroad runs for 75 miles is a remarkable feature of nature's works, yet it is in Tennessee noted but by a few geologists, and its wealth of mineral known to only a few practical workers. From a few miles below Cumberland Gap to Dayton, where the outlying mountain ends as a distinct feature, there is always to be found in its strata at least one seam of workable coal. It shows at Big Creek Gap, its black line standing out plainly between the almost vertical pillars of gray sandstone and slate; it shows at Coal creek, has been opened and worked at Emory Gap, and also at a point above; again at Rockwood it has afforded thousands of tons of coal. It is to be seen at White's Creek Gap and is worked at Dayton, where it loses its pitched character, as also at Sale creek and Soddy.

All over the great plateau of the Cumberland mountain at varying depths beneath the surface, but ever outcropping near the northwestern rim, is a seam of coal which may be said to be one of the most valuable in the State. Its thickness is somewhat variable, it is true, but it may be depended upon to average $3\frac{1}{2}$ to 4 feet in thickness of good coal; its quality has but little variation; it is a fair coking coal, and while not so highly esteemed for grates as some others, has few superiors for stove use, and its great freedom from sulphur and large amount of fixed carbon makes it a superior steam coal, especially for use in locomotives. This coal is commonly called the Sewanee bed from the fact that it was first mined to any extent on the Sewanee mountain. It is to Tennessee what the Pittsburgh seam is to Pennsylvania. The seam showing and worked during the war at Big Creek Gap is the same seam. It is the same also that shows at Coal creek, at Emory Gap, that is worked at Rockwood, Darwin, and Dayton, but the writer is not so certain of its identification with the large seam worked at Soddy.

In the Walden's Ridge pitched strata it has the appearance of having been crushed or twisted, but where in regular place, as at many points in the plateau region, it has somewhat the regular cubical fracture. It is opened in Van Buren and Bledsoe, where it is regular. It is not necessary here to discuss reasons for assuming the identity between the Sewanee coal seam at Tracy, and those at the other localities mentioned. The object in thus alluding to the great outlying wall of the Cumberland mountain and this seam of coal is to bring to notice a much neglected source of wealth. Immediately in Emory Gap this seam of coal has been opened on both sides of the Emory river. Where opened on the south side it is under the track of the railway, and an extensive opening has been made developing a permanent source of excellent coal for about 200 yards. The opening on the north side was pushed with considerable vigor for a time, but insufficient capital caused it to be abandoned. About 4 miles northeast from the Gap, many years ago, quite extensive works were erected and considerable coal mined. The company had little money and the management was utterly devoid of practical ideas. Though opened at several points, as stated, this seam of coal has never been systematically worked at any point north of the last mentioned.

In Big Creek Gap it was mined for the use of the blacksmiths of General Burnside's army, but has not been touched since that time. It was also opened by Wiley & Geers near Indian Grove Gap tunnel, on the Richmond and Orange railroad, and a considerable amount of money expended, but, as is too often the case when difficulties are encountered, the work was stopped too soon.

Walden's Ridge from Emory Gap to Dayton has a height of from 600 to 1,000 feet above the valley, and this coal seam usually outcrops an average distance of two-thirds the height up the side of the mountain. At Rockwood the outcrop is more than 400 feet above the general valley level. The dip of the coal bed would be about as three to two of vertical height; hence in that 40 miles of distance from Emory Gap to Dayton it is pretty safe to assume that there is a certainty of finding a coal seam averaging $3\frac{1}{2}$ feet in thickness, with a workable area above water level 600 feet in height, which seam would afford at least 352,000 tons for every mile of distance. The Roane Iron Company has been working this coal seam since 1868, and has mined from it an average of 60,000 tons per annum.

Mr. H. S. Fleming has recently made a careful examination of the composition of commercial samples of Tennessee coals as bearing upon their coking qualities. Mr. Fleming's report upon these coals is of great value, and it is without doubt the most important and practical investigation which has been made of this subject.

The bane of southern coals is the fine slate. This sometimes occurs in an irregular and ill-defined layer in the seam itself, or more frequently it is in a thin seam between the coal and the floor of the mine. In shoveling coal from the floor into a car this is taken up, and so nearly does it resemble the coal in color that it is hard to distinguish it. A heavy slate seam frequently occurs in the middle of a coal bed, but this is readily distinguished and picked out by the miners. The former, commonly termed the "knife-blade slate," from its peculiarity in splitting up into thin splinters, is in the way at all times. Besides these two, some coal seams abound in partings of "mother of coal," "mineral charcoal," or as it is sometimes called, "sulphur tinder." This is common in nearly all bituminous coal mines, but in the South it seems to occur in unusually large quantities.

Weekly analyses are made of these coals, and they may be considered fairly reliable. Those given here have all been sampled carefully, and in most cases are averages of a week's work.

Analyses of Tennessee coals.

Names of mines.	Counties.	Screened lump.				Run of mines.			
		Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Coal Creek	Anderson	38.19	58.54	3.26	.53	34.20	58.80	6.93	.79
Poplar Creek	....do	(*a*)40.87	57.67	1.46	.945	(*a*)40.50	54.06	5.43	1.20
Jellico	Campbell	36.80	61.77	1.41	.82	33.77	60.64	3.59	1.10
Roane Iron Company	Roane (*b*)	34.48	61.51	4.01	.61	27.59	62.10	10.23	1.32
Daisy	Hamilton (*b*)	30.46	63.33	6.21	.93	28.00	60.82	10.58	1.72
Soddy	....do	29.30	64.09	6.61	.64	28.90	56.89	14.21	....
Sewanee	Grundy	30.30	64.39	5.31	.48	27.81	61.52	10.67	1.22
Etna	Marion	28.08	68.05	3.27	.61	27.45	62.71	9.80	1.18
Glen Mary	Scott	36.73	61.63	1.64	.29	33.67	59.68	6.65	.87
Richland	Rhea	29.60	68.08	6.34	1.09	25.19	64.39	10.32	1.48
Nelson	....do	33.14	63.87	2.98	.59	28.34	64.38	7.23	.63
Dade	Dade	28.05	64.50	7.45	.64	24.75	61.48	13.77	1.49

a Includes 1.62 per cent. of moisture in screened lump and 1.89 per cent. in run of mine.
b Picked lump.

TEXAS.

Total product in 1888, 90,000 tons; spot value, $184,500.

On account of the very scattered and meager developments of the coal and lignite beds of Texas it has been impossible to collect any reliable statistics as to the product during 1888 at each point where these beds have been opened.

Among the more prominent mines in the State may be noted the Hertz mine, north of Eagle Pass, in Maverick county, and those at San Tomas, in both of which mines the coal beds worked belong to the Cretaceous formation. In the northern part of the State, 4 miles north of Millsap, in Parker county, a coal bed belonging to the Carboniferous formation has been worked for a number of years at the Carson and Lewis mines. In Erath county one of the Carboniferous coal beds has been worked at the Johnson mine and also at the Gordon mine, which is 4 miles north of Gordon, in Palo Pinto county. The Johnson mine is 2 miles south of the Texas and Pacific railroad. About 1½ miles southeast of the Johnson mine a coal bed has been worked from time to time at what is known as the Palo Pinto mine. About 4 miles northwest of Cisco, in Eastland county, on the land of the Houston and Texas Central railroad, several mines have been worked at intervals during the past two or three years, and during last year considerable coal was taken out of a mine 10 miles west of Decatur, in Wise county. Four miles west of Bowie, in Montague county, coal has been produced at irregular intervals at a mine known as the Stevens mine. In the vicinity of Atascosa, in Bexar county, two mines, known, respectively, as the Kirkwood and Kinney, have been opened on a lignite bed. The mines in the vicinity of Laredo, in Webb county, on the Denver and Rio Grande railroad, when working full, produce about 2,000 tons of coal per month. In the vicinity of Queen City, in Cass county, and Winona, in Smith county, beds have been opened during the past year which it is believed can be profitably worked to supply the local trade.

Probably the most important enterprise which has been organized in the State for mining coal is that of the Texas and Pacific Coal Company, which owns about 25,000 acres of coal land in Palo Pinto and Erath counties. This company has recently opened a coal bed about 13 miles northwest of Weatherford, in a shaft 80 feet in depth. It is reported that the coal bed is sufficiently thick to be economically worked, and that the coal is of superior quality. During the past year a project has been set on foot to build a railroad from Pueblo, Colorado, through the reported coal field in the vicinity of Coleman City, in Coleman county, Texas, and thence to Baird, in Callahan county, and Albany, Shackelford county. This projected line crosses the North Colorado and Santa Fé railroad at Coleman, the Texas Pacific at Baird, and the International and Great Northern railroad at Albany. About 110 miles east of El Paso is the Spring mine, which is operated by Fink, Arthur & Co, A four-foot bed of coal is reported to have been struck at this point, 150 feet below the surface. No reliable and complete statistics have been obtained from the coal operators in any of the localities indicated, so that it is impossible to make any correct statement as to the actual amount of coal produced during the year or its value at the mines. From all the data which have been obtained it is estimated that the total production of coal for the year is 90,000 tons, and that the coal was worth at the mouth of the mine about $2 per ton.

In August, 1888, a survey of the State was commenced under the direction of Prof. E. T. Dumble, State Geologist. Professor Dumble is giving special attention to the coal resources of Texas. He has sent to the United States Geological Survey a preliminary report of the work so far accomplished in the coal districts of the State. This report is of great interest, as being the first systematic and intelligent description of the coal fields of Texas. It is as follows:

There are in Texas three distinct coal fields, the Central or Bituminous, the Nueces or semi-Bituminous, and the Lignitic.

The Central coal field is a continuation of the Missourian or Western coal basin of the United States, of which it is the southern extremity. Its approximate boundary is a line from the eastern corner of Montague county, running southwest from Red river just west of Decatur and Weatherford, through Palo Pinto county, to the eastern line of Brown county, and from this point through Lampasas into Burnet county, where it terminates. It appears again in Kimble and Mason counties, and the line running north passes through Menard, Concho, Runnels, Taylor, Callahan, Shackelford, and Throckmorton counties, through the southeastern portions of Archer and Clay counties to the mouth of the Little Wichita. This field covers in whole or in part some twenty-five counties, and has an area of not less than 12,000 square miles. Its eastern border is overlaid by the rocks of the Cretaceous formation, while the Permian beds rest upon it on the west. The section made by Professor Cummins shows the thickness of the formation to be not less than 2,000 feet with nine seams of coal, of which two at least, and probably three, are workable.

Dr. Charles A. Ashburner, who made a partial examination of these coals in 1879, saw no coal stratum lower than that found 4½ miles northwest of Crystal Falls, in Stephens county, which he named the Brazos coal bed. He says: "The coal strata proper are 85 feet in thickness, and are included between an upper sandstone and conglomerate and lower gray limestone. The coal strata contain two beds of workable thickness. The upper, named Belknap, ranges from 2½ to 4 feet, and the lower, named Brazos, from 4 to 6 feet in thickness. The coals are high in ash and sulphur, but have never been thoroughly tested. The Brazos bed underlies a great area, and will no doubt prove a valuable commercial coal in some localities."

The Nueces coal field.—The Nueces or semi-Bituminous coal field includes parts of Webb, Dimmit, Zavalla, and Maverick counties, and has an area of 3,700 square miles. The northern boundary has not yet been determined. It contains two workable seams of coal, and locally, at least three. These differ somewhat in character; the lower is a semi-Bituminous coal, probably of Cretaceous age, which, so far as it has been examined, gives promise of being a very good fuel. It is being worked north of Eagle Pass at the Hertz mines. The other bed, now being worked at San Tomas, is possibly of the Laramie group. It is somewhat lignitic, although quite different from the lignites of our Tertiary coal field. Another variety which is also found in some quantity in this coal field is albertite. This seam is northeast of the San Tomas exposure, and will prove valuable.

The Lignite field is by far the largest and the coal strata it contains are of much greater thickness than those of either of the others. As nearly as its boundaries can now be marked, they are as follows: Beginning on the Sabine river, in Sabine county, the boundary line runs west and southwest near Crockett, Navasota, Ledbetter, Weimar, and on to Helena and the Rio Grande river; thence back by Pearsall, Elgin, Marlin, Richland, Salem, and Clarksville to Red river. It includes fifty-four counties in whole or in part, and while the occurrence of lignite has not been noted in every one of these, it will in all probability be found in all of them sooner or later. Four, possibly five, strata of lignite can be recognized in this field, one of which attains in many places a thickness of from 15 to 20 feet. The amount of sulphur contained in these lignites is very variable, as is indeed the quality of the lignite itself. In some places there is a good clean lignite, almost if not entirely free from sulphur, while at other places masses of sulphuret of iron are mingled through a carbonaceous mass.

In northern Texas east of the Pecos river there occur the Quaternary, Tertiary, Jurassic, Triassic, Permian, and Carboniferous formations. Of these the Carboniferous is the only one referred to below. The Carboniferous formation in this part of the State embraces only the Carboniferous and Permian periods. The writer is aware of the fact that the sub-Carboniferous period has been reported from Erath and Palo Pinto counties, but has seen nothing to warrant such a conclusion, in fact the evidences are all against it. Only the upper and lower Coal Measures, with the Permian above, are found in this part of the State. The following remarks refer only to the strata of the Carboniferous period, without attempting to separate the strata into upper and lower Coal Measures or epochs. This formation begins at a point on Red river near the northeast corner of Montague county, running thence past Decatur, in Wise county, to Millsap, Parker county, and thence in a southwesterly direction to the Colorado river. The line on the west begins at a point on Red river near the northwest corner of Montague county, thence by a line passing Buffalo Springs, the southwest corner of Archer county, through Throckmorton county to Baird, and thence in a southwesterly direction to the Colorado river. The Carboniferous strata, as observed, are about 2,000 feet in thickness.

The counties embraced in the true Coal Measures are, so far as the present examination shows, Montague, Jack, Young, Palo Pinto, Eastland, Stephens, and Coleman, and parts of Brown, Runnels, Callahan, Wise, and Erath. In the general section of the strata there are nine seams of coal. Only two of these, however, are thick enough where observed to have any commercial value. One seam is worked at the old mine of Carson & Lewis, about 4 miles north of the town of Millsap. It is also seen at Gordon and at the Johnson mine in Erath county. This seam ranges in thickness from 18 to 30 inches. It has a thin parting of slate about the middle of the seam, never over one-half inch thick and generally much less. The Lake mine was developed and worked a few years ago by Mr. W. F. Lake, of Fort Worth. The seam was found to be from 18 to 26 inches in thickness. The coal taken out was hauled in wagons to Millsap and disposed of to the Texas and Pacific railroad and used by them for running the locomotives on their road. It was pronounced by their engineers to be a very fair quality of coal for their purposes. The Carson & Lewis mine is situated one mile north of the Lake mine, and is on the same seam of coal. This mine was opened and worked in 1884, but the work was discontinued for the reason that it would not pay to haul the coal overland in wagons, the only means of transportation, to find a market. The following is a section of the strata as it is found in connection with this seam of coal:

Section of coal-bearing strata near Millsap, Texas.

Consecutive layers.	Feet.
1. Conglomerate	6
2. Sandstone	4
3. Bluish clay	5
4. Coal seam No. 2	$\frac{1}{6}$
5. Yellow and bluish clay	60
6. Yellow clay	7
7. Slate	20
8. Coal seam No. 1	$1\frac{1}{2}$
9. Fire clay	$\frac{1}{2}$
10. Bluish clay	25
11. Thin-bedded sandstone	4
12. Yellowish clay	75

The Gordon coal mine is on the same seam, and is situated about 4 miles northeast of the town of Gordon, in Palo Pinto county.

The seam here is from 26 to 30 inches in thickness, with two thin partings of slate seldom more than one-half an inch thick. The coal has a large percentage of sulphur in it, and in burning makes a great amount of clinker.

The Johnson coal mine, located on the same seam, is situated about equal distance between Gordon and Strawn. The mine is worked by two shafts, about one-fourth of a mile apart. The seam is 30 inches thick, with a very thin parting of slate. There is no hope that this parting will entirely disappear. It is seen at every place where this seam of coal has been exposed. The roof over the seam is very good. The mine is worked by the long wall system. All the coal is taken out and the strata above are permitted to sink down as the mining advances. There is no water in the mine, nor has there been gas of any kind. The mine has now been in operation for two years, and has a producing capacity of about 400 tons per day. The mine is on the north end of the Pedro Herrera survey of 2,300 acres.

The Palo Pinto coal mine is also on this seam, and is situated about 1½ miles southeast of the Johnson mine. The shaft is near the western base of the mountain, and is about 40 feet deep. The coal taken out is similar to that of the Johnson mine. The capacity of the mine is about 300 tons per day, and can be easily increased to 500 tons per day. The property embraces about 2,000 acres. The coal is sold in Fort Worth, Dallas, and other cities in the State.

It will be observed that all these mines are located on the same seam of the general section, and although they are, in the extreme, 30 miles apart, it is not hard to identify the seam as being the same at all of them. It is possible to trace the seam from hill to hill by its outcrop the entire distance.

There are four other very thin seams, and for the present are of no commercial importance where observed. They occur between Strawn and Ranger, on the line of the Texas and Pacific railroad.

The mines at Cisco are on a separate seam. At one time and another there has been considerable work done on this seam in the vicinity of Cisco. The outcrops are numerous. The seam at this place is 20 inches thick, with a band of slate above it, followed by a seam of coal 4 inches thick. The band of slate is from 4 to 10 inches thick between the coal seams. At another place there were 9 inches of coal and 20 inches of bituminous shale. This shale will burn when put on the fire, but loses none of its bulk in burning, and it is absolutely worthless as a fuel. There is no probability that this seam can be worked in this particular locality, owing to the thinness of the seam and the poor quality of the coal. Four miles from Cisco, to the northwest, on the line of the Houston and Texas Central railroad, this same seam of coal was found about the level of Sandy creek. A good deal of work was done at this place several years ago, but the mine has been abandoned on account of the fact that the seam was too thin for successful mining. Attempts have been made to develop this seam in several other places with like results.

There is a thin seam 3 miles east of Putnam, but it was not followed nor investigated sufficiently to give any particular description of it. Ten miles west of Decatur, in Wise county, near the west fork of the Trinity river, there is a seam of coal outcropping in the bed of a branch. A few years ago a mining company was formed at Decatur for the purpose of prospecting and developing this coal. They did a large amount of prospecting by sinking shafts, and did some mining by driving a tunnel into the hill along the seam near the outcrop. The coal taken out was hauled in wagons to Decatur and disposed of to the citizens for domestic and other purposes. The seam is 30 inches thick and of good quality. It is the freest from partings of clay and slate of any coal in the State. The covering is good; it is free from water and gas, and there is a plentiful supply of timber in the vicinity for all necessary mining purposes.

The Stephens coal mine is situated about 4 miles west of Bowie, in Montague county, and is owned by Hon. John H. Stephens, of Montague. The coal seam is 3 feet thick with a parting of clay 3 inches thick. In a stratum of sandstone above the coal a considerable amount of water was found, and for want of suitable pumping apparatus very little was done in the way of taking out coal. Proper prospecting at this place will no doubt develop a good workable bed of coal. There are two distinct horizons where the seams of coal are thick enough to work. I find one seam above the massive limestone and one below it. The Stephens coal seam is above the limestone.

Mr. R. A. F. Penrose, assistant geologist for eastern Texas, reports on the lignites of that part of the State as follows: Lignites occur in very many places in eastern Texas, but only comparatively few of these have as yet been visited. The lignite occurs in from one to four different beds, varying from a few inches to an average of 2 to 8 feet thick, though beds of over 20 feet in thickness have been reported. It has not yet been used to any extent for practical purposes. The main difficulty seems to be in its soft and crumbly character, and its value is also greatly impaired by the presence in it of from 15 per cent. to over 20 per cent. of moisture. It varies considerably in chemical composition, containing besides moisture from 16 per cent. to 50 per cent. of volatile matter; 20 per cent. to almost 60 per cent. of fixed carbon, and 4 per cent. to 14 per cent. of ash.

The lignite beds were seen in large numbers of outcrops in Van Zandt county, where they appear in many places along the Sabine river and the creeks tributary to it. They are found over almost the entire county, until the Cretaceous formation is reached near its western border. The lignite is sometimes in lenticular deposits, and is occasionally interbedded with dark brown lignitic clays, which turn a light buff color when burned. The lignite clays come to the surface in many places in this locality, though often covered by a variable thickness of sand.

Following the lignitic formation towards the east, lignite beds are found in all the country lying between Van Zandt county, along the line of the Texas and Pacific, and the eastern boundary of the State, though in some places it is at considerable depths. At Almo, Cass county, a shaft is now sinking to work the lignite deposits of that region.

Many other deposits of lignite occur throughout many parts of the eastern counties of Texas, but only a few of them have as yet been visited. Large deposits are found in Leon, Limestone, Robertson, Smith, Wood, Henderson, Rains, and other counties.

Prof. Gustav Jermy reports that most positive proof exists of the presence of large deposits of lignite in the southwestern counties, and it has also been discovered at a considerable depth some 29 miles west of San Antonio, where a 50-foot shaft has been sunk to a layer 5 feet in thickness, which is covered by blue clay.

Col. John L. Tait reports the existence of lignite in the following counties:

Edwards county, 3 miles from the town of Leaky.

Bandera county, on Wyman's creek, 15 miles southwest from Bandera city, and on Hondo creek, 20 miles west from Bandera city.

Medina county: This area embraces also all of Atascosa county, the western part of Bexar, and the northern portion of Frio county, and extends west to the Rio Grande river. A mine has been opened on the lands of Mr. John T. Lytle, near the town of Lytle, and the coal finds ready sale in San Antonio at $3 per ton and yields a good profit at that price.

In Atascosa county near Somerset there are two lignite mines that have been in operation for several years. The Kirkwood mine was first discovered in a well on the Harrison place and was subsequently opened out and operated by Mr. Kirkwood, a mining engineer from Scotland. The roof is a friable sandstone, and the coal is about 5 feet 6 inches thick, and has met with much acceptance in San Antonio as a fuel. The Kinney mine, which is on the adjoining property, is in all respects the same as the Kirkwood and need not be described.

Frio county: The places of discovery are on the Echols property, 6 miles northeast of Pearsall; on San Miguel creek, 9 miles south of the International and Great Northern railroad; and on the land of Applewhite & Beaver, on the bank of the Frio river.

Fourteen miles southwest of Uvalde, on the line between Uvalde and Zavalla counties, there is an outcrop of coal in the north bank of the Nueces river. At this place the stratum is 4 feet 10 inches thick, with a 3-inch division of slate in the center. The western boundary of this coal field can be represented by a line drawn from this point on the Nueces river to a point 4 or 5 miles east of Carrizo springs, thence southward across the headwaters of the Moro creek to the hills upon the eastern banks of the San Lorenzo creek; following this geological boundary to the Rio Grande, thence along this stream to a creek 10 miles east of the San Tomas called San Civeale, where it becomes thinner and disappears beneath the surface. This outlines the southern and western boundaries of this coal field in Texas, which covers an area of country embracing 2,700 square miles.

In addition to this coal field, there is at Eagle Pass, which is 40 miles southwest from the outcrop on the Nueces river, another coal stratum

4 feet 6 inches thick, which has an outcrop along the Texas and Mexican sides of the Rio Grande for 10 miles. The abrupt inclination of the stratum here soon carries it to a depth of from 400 to 600 feet below the surface, so that its eastern or southern boundary cannot be determined by surface indications; but allowing that it does not extend further east than the San Lorenzo creek, which is a reasonable deduction, it then increases the area of the coal field just outlined to something more than 3,700 square miles. The writer measured the coal strata at three places in the Hartz mines at Eagle Pass. This is the only place where the coal is worked. At one place there were 4 feet 6 inches of good coal, without any divisions of slate. At another place it was 5 feet 4 inches thick, with three divisions of slate aggregating 5 inches, leaving 4 feet 11 inches of coal. At the third place the stratum was 7 feet 3 inches thick, with five divisions of slate aggregating 14 inches. This gives a coal stratum with an average thickness of over 5 feet. This is a good commercial article and appears to be very firm, hard coal. These two coal strata represent the extent of the coal fields of southwest Texas, although there are at different places in this field three strata of workable coal, and where one overlays the others there will be an aggregate thickness of 10 feet of coal. The stratigraphical position of the Eagle Pass coal is 600 or 700 feet below the Nueces and San Tomas coal strata. In addition to this, there are said to be iron, lead, and silver deposits in the northern part of Uvalde county and asphaltum in Kinney county; but the writer did not examine them. As far as known these constitute the mineral resources of the district. There are 1,000,000 tons of coal for each foot per square mile, and a calculation made upon this basis will give us 3,000,000 tons per square mile, and assuming that one-half of this area will be non-productive, or too thin to be perfectly worked, there is enough to supply all possible demands for hundreds of years.

UTAH.

Total product in 1888, 258,961 short tons; spot value, $543,818.

There has been a great deal of activity in coal mining in the Territory during the past year. During 1887 the total product was about 20,000 tons less than during 1886, while during 1888 there was an increase of 78,940 tons in the total product over 1887. No accurate geological or mining survey has been made of the Territory to define the limits of the productive coal areas.

It would be impossible to determine either the location of the areas underlaid by coal, or their extent, without a very much more careful and thorough geological survey than has been made. It has been estimated that there are over 2,000 square miles of areas underlaid by workable coal. The following estimates have recently been made by local authorities:

In the vicinity of Sunnyside and Castle Gate, where a good coking coal is reported to have been found, it is estimated that there are 500 square miles underlaid by coal; on the Weber river and its tributaries, Grass creek, Chaw creek, etc., 200 square miles; in the vicinity of Pleasant Valley from 100 to 200 square miles; back of Cedar City, 150 square miles; in Castle Valley, 1,000 square miles. While these figures of actual areas are interesting, they are of very little practical value, since it can be safely asserted that there is sufficient coal within the Territory to meet all demands for an indefinite period.

The principal producing mines are at present confined to Summit, San Pete, and Emery counties. The following table exhibits the total production of the Territory by companies during the past three years:

Coal product of Utah, by companies in 1886, 1887, *and* 1888.

Name.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*
Pleasant Valley Coal Company	71, 814	94, 610	164, 473
Utah Central Coal Company	34, 676	44, 465	(*a*) 59, 173
San Pete Coal and Coke Company	1, 800	3, 000	1, 000
Grass Creek Coal Company	29, 131	4, 946	....
Home Coal Company	24, 417	30, 000	30, 815
Small mines unreported	38, 162	3, 000	(*b*) 3, 500
Total	200, 000	180, 021	258, 961

a Does not include 540 tons consumed at the Scofield mines.
b Includes 1,000 tons mined by the Central Pacific Coal and Coke Company at Moroni.

The Pleasant Valley Coal Company during 1888 produced 151,156 tons of coal in commercial sizes, and 13,317 tons of screenings, making an aggregate of 164,473 tons. The average selling price of this coal during 1888, at the mine, was $2 per ton for the commercial sizes and 75 cents per ton for screenings. The mines were worked one hundred and forty-seven days during the year, and usually twenty-five men were employed, the miners being paid on an average $3.03 per day and the outside laborers $2.29 per day. The mines of this company are situated at Scofield, in Emery county, and their product is shipped principally to western Colorado, Utah, Nevada, and California. The coal bed is said to be 11 feet thick. The following is the composition of the coal produced:

Analyses of two commercial specimens of the Pleasant Valley Company's coal.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Water	6. 55	7. 30
Volatile matter	39. 75	39. 85
Fixed carbon	47. 65	47. 30
Ash	6. 05	5. 55
Total	100. 00	100. 00

From tests of this coal made in January, 1888, by the Quartermaster-General of the United States Army it was found that in generating steam 2,407 pounds of coal were equivalent to one cord of standard oak wood. The Utah Central Railway Company's mine is also located at Scofield. The total product of this company during 1888 was 59,713 tons, of which 54,042 tons were in sizes larger than nut, and 5,131 tons were in nut and smaller sizes. Of this 540 tons were consumed at the mines. The average selling price of the coal delivered on the cars at the mouth of the mine during the year was $2 per ton, and the mines were worked for two hundred and forty-four days. The coal bed mined is 28 feet thick, 25 feet of the bed being taken out and three left on the roof. During the year a small enterprise had been commenced at Moroni, in San Pete county, by the Central Pacific Coal and Coke Company, limited. The total product during the year was 1,000 tons, and the average selling price at the mine was $3.50 per ton. Only three miners are employed at $2 per day. A recent discovery of coal has been made in the Pine mountains west of Kanaraville. The character of the coal, it is claimed, is anthracite, although this is improbable, since a large number of reported finds of anthracite in the Territory during the year have turned out to be simply slaty lignite or bituminous coal, which upon exposure to the weather assumes an appearance somewhat like anthracite.

During 1888, 57,440 tons of coal were sold in Salt Lake City, of which 55,640 tons were mined in the Territory; 1,500 tons were Colorado anthracite and 300 tons Colorado bituminous. In addition to this, 200 tons of Colorado coke were used at Salt Lake City. This consumption of coke does not include the Colorado coke consumed by the smelting and ore reduction companies near Salt Lake City.

The only coal mine in the vicinity of Coalville at the present time is that of the Home Coal Company. This company produced during the year 30,815 tons, its capacity for mining and shipping being about 125 tons of coal per day. A third rail placed on the Utah Eastern (narrow gauge) Coal Branch has afforded better facilities for transporting the coal to the Union Pacific tracks and thence to market, thereby preventing unloading and transferring. The product of the Home Company's mines is shipped to Park City, Salt Lake City, and intermediate points. The company employs 100 men.

It is reported there are several coal tracts in Summit county, owned by the Union Pacific and other railroad companies, which are projecting lines towards the west. In this case a greater development of the coal beds in the Coalville district may be early anticipated.

VIRGINIA.

Total product in 1888, 1,073,000 short tons; spot value, $1,073,000.

The total product of the State during 1888 was 1,073,000 short tons, divided among the three prominent fields as follows:

Product of coal in Virginia in 1888.

Coal fields.	Total product.
	Short tons.
First, or Richmond:	
Reported	28,000
Unreported (estimated)	5,000
Second, or Appalachia:	
Reported	41,700
Unreported (estimated)	5,000
Third, or Flat Top:	
Reported	948,300
Unreported (estimated)	40,000
Estimated unreported production elsewhere in southwestern Virginia	5,000
Total	1,073,000

The distribution of this coal into that which was shipped to different markets, that consumed locally (including the unreported estimated product), and that manufactured into coke is shown in the following table:

Distribution of the coal product of Virginia.

	Short tons.
Shipments	821,567
Local consumption	103,814
Manufactured into coke	147,619
Total	1,073,000

The local consumption during the year was nearly 10 per cent. of the total product. This percentage is greater than in any other region in the United States, and is to be accounted for by the fact that of the 46,700 tons of coal produced in the second or Appalachia coal field, 42,183 tons were consumed by markets in the immediate vicinity of the mines. The local consumption in the Flat Top field for mining purposes is exceptionally low as compared to that consumed at mines in other States where the coal beds are worked under conditions similar to those found at the Flat Top mines. The consumption at these mines during 1888, for both colliery and local uses, was only 1.2 per cent. of the total coal produced.

The details of the production during 1888, by counties, are exhibited in the following table:

Production of coal in Virginia in 1888 by counties.

Counties.	Names of operators.	Total production.	Local consumption.	Manufactured into coke.	Total shipped.
		Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Tazewell	Southwest Virginia Improvement Company.	948, 300	11, 631	147, 619	789, 050
Chesterfield	Ellis Martin	28, 000			28, 000
Montgomery	Hugh Price				
	James B. Price	224			224
	J. M. Cronen	112	22		90
	Kanode Bros				
	Smith & Bell				
	John H. Kipps	2, 240	2, 240		
	W. C. G. Myers				
	Myers Bros	3, 360	1, 120		2, 240
	Brush Mountain Coal Company.	1, 000			1, 000
	Hoge Tyler				
	Kinzer & Sheaffer	1, 064	168		896
	Samuel Smith's heirs	33	33		
	J. P. Linkons				
	Moore & Co				
	E. Price	67			67
Pulaski	Altoona Coal and Iron Company.	33, 600	33, 600		
	Unreported Triassic area.	5, 000	5, 000		
	Unreported other areas.	50, 000	50, 000		
Total		1, 073, 000	103, 814	147, 619	821, 567

The following table, compiled from returns received from Mr. D. H. Watson, secretary and treasurer of the Pocahontas Coal Company, shows the shipments of coal in long tons from the mines of the operating companies in the Flat Top field in both Virginia and West Virginia. The Pocahontas Coal Company acts as the trade agent for the mining companies:

Shipments by the Pocahontas Coal Company from the Flat Top region in 1888.

Names of mining companies.	Total production in 1888.
	Long tons.
Southwest Virginia Improvement Company	704, 509
John Cooper & Co	185, 222
Booth-Bowen Coal and Coke Company	136, 369
Caswell Creek Coal and Coke Company	160, 854
Buckeye Coal and Coke Company	99, 272
Robert Goodwill & Co	51, 844
Elkhorn Coal and Coke Company	9, 136
Shamokin Coal and Coke Company	8, 645
Louisville Coal and Coke Company	4, 579
Turkey Gap Coal and Coke Company	10, 040
Houston Coal and Coke Company	3, 181
Crozer Coal and Coke Company	2, 359
Total	1, 376, 010

Under the terms of the mining leases which are made with the operating companies all coal, except that used for colliery consumption and for the manufacture of coke, must be sold to the Pocahontas Coal Company, which makes all sales and assumes all liabilities connected with the same. The Pocahontas Company pays the coal operators by checks on the 15th of each month for all coal shipped by it during the preceding month. All risks for bad debts, shortages in shipments, freight rates, etc., are thus avoided by the mining companies. All the coke manufactured is sold through another agency.

The following tables exhibit the shipments of Virginia and West Virginia (Flat Top) coal over the Norfolk and Western railroad, as reported by President Kimball and Vice-President Eddy:

Shipments of coal over the lines of the Norfolk and Western railroad during 1887 *and* 1888 *from Virginia and West Virginia.*

Localities from which coal is shipped.	1887.		1888.	
	Coal.	Coke.	Coal.	Coke.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Flat Top mines, Virginia	503, 071	103, 209	615, 908	88, 126
Flat Top mines, West Virginia	471, 976	47, 962	560, 730	92, 763
Back Creek, Tyler's, and Belmont stations	2, 646		3, 352	
Vicker's and Pulaski City stations	8, 584		8, 759	
Total	986, 277	151, 171	1, 188, 749	180, 889

The shipments from Virginia and West Virginia during 1888 were composed of the following classes:

Classes of coal shipped in 1888 *from the Flat Top region.*

Classes.	Long tons.
Run-of-mine	1, 129, 311
Lumps	51, 117
Slack	8, 321
Total	1, 188, 749

The different commercial sizes are determined by regulations which have been adopted in common by the railroad and the mining companies. Run-of-mine must contain not less than 40 per cent. of lump coal. This is as sold during the year to the Pocahontas Coal Company for 85 cents per ton on cars at the mines. Run-of-mine coal is generally produced, especially by those companies manufacturing coke, by passing the coal from the mine cars over screens with 1-inch meshes. All coal classified as lump must be passed over screens with 3-inch meshes. Lump was sold during the year on cars at the mines for $1 per ton, and slack coal for 85 cents per ton.

Total shipments over the Norfolk and Western railroad from 1883 to 1888.

Years.	Short tons.
1883 (from month of June)	105,805
1884	272,173
1885	651,987
1886	924,361
1887	1,169,700
1888	1,563,343
Total	4,687,369

Richmond basin.—The reported product of the Richmond basin during 1888 was 28,000 short tons, all of which came from the Raccoon mine in the Winterpock basin. This coal was shipped almost exclusively to Richmond and Petersburgh, and commanded at the mines $1.60 per ton of 2,240 pounds. The following is an average analysis of five samples of the coal:

Average analysis of coal from the Richmond basin, Virginia.

	Per cent.
Water	1.34
Volatile matter	32.45
Fixed carbon	57.05
Sulphur	1.98
Ash	7.18
Total	100.00

It is expected that a new mine will be opened in the vicinity of the Raccoon mine during 1889. It is estimated that a number of small country banks throughout the Richmond field produced 5,000 tons.

Appalachia coal field.—The central coal fields of the State are situated along the western flank of the Great Valley of Virginia in isolated areas extending from Rockingham and Augusta counties southwest to Pulaski county.

The most extensive mining of Vespertine coal during 1888 was in Pulaski county, by the Altoona Coal and Iron Company, the total output being 30,000 long or 33,600 short tons, which was entirely consumed locally at the Bertha Company's Zinc Works, at Pulaski, and in the evaporating of salt at Saltville. This coal is reported as admirably adapted for the uses to which it is put, and although the calorific value of a pound of this coal, on account of its high percentage of ash, is much less than that of the purer Flat Top coal, it is said to be more economical at Pulaski and Saltville.

The Vespertine coal beds are also mined in Montgomery county in a number of small mines whose product is taken entirely by the local trade. These mines are situated along the flanks of Brush and Price mountains, and are considered to underlie Price valley between the mountains. Along Brush mountain the coal beds have a dip as high as 30 degrees toward the south, and along Price mountain an equivalent dip toward the north. The reported product of the Montgomery county mines during 1888 was 8,100 short tons, or about half of the total product of the county during 1887.

WASHINGTON.

Total product in 1888, 1,215,750 short tons; spot value, $3,647,250.

During 1888 the greatest activity existed in coal mining in Washington, and the increase in the total production of the mines has been at a greater rate than during any one of the previous five years. The product of the mines is reported by the State inspectors for the fiscal year ending September 30, and the product for the year ending November 30, 1888, with the spot value of the coal at the mines, has been variously reported to the coal trade by different local authorities and in the coal-trade journals. It is believed, however, that from the numerous facts obtained in the State, independently of those collected by the mine inspectors, the total product and spot value given above for the calendar year are accurate. This is referred to later in detail.

During the last session of the Territorial legislature a change was made in the mining laws, by which the coal regions were divided into two inspection districts instead of being regarded as one, as formerly, of which Mr. James H. Watson was the inspector. During the early part of the year the governor appointed as inspectors of these two districts, for two years dating from February 28, Mr. H. C. Paige of the first and Mr. John Sullivan of the second.

The following table exhibits the product of the coal mines of Washington, by individual mines and by counties, for 1887 and 1888. The statistics for 1887 are for the fiscal year, and those for 1888 for the calendar year:

Product of coal in Washington, by counties, in 1887 and 1888.

Counties.	Names of mines.	Operators.	Production. 1887.	Production. 1888.
			Long tons.	*Long tons.*
King	New Castle	Oregon Improvement Company	136,473	155,000
	Franklin	do	80,703	186,966
	Black Diamond	Black Diamond Coal Company	86,900	148,000
	Cedar River	Cedar River Coal Company	35,885	41,662
	Gilman	(Opened during 1888)		14,907
	Total		339,961	546,535
Pierce	Carbon Hill	Pacific Improvement Company	173,808	213,145
	South Prairie	South Prairie Coal Company	52,524	40,934
	Wilkeson	Tacoma Coal Company	3,453	12,877
	(New mine)	Wilkeson Coal and Coke Company		10,000
	Total		229,785	276,956
Thurston	Bucoda	Northwestern Coal and Transportation Company.	15,295	42,000
Kittitass	Roslyn	Northern Pacific Coal Company	104,782	220,000
	Grand total		689,823	1,085,491

The most important coal fields in Washington are within a radius of 40 miles of tide water, so that as good shipping facilities are afforded to these mines as to those in any other State or Territory. The estimated acreage of developed coal lands is shown in the following table:

Acreage of developed coal lands in Washington.

Counties.	Acreage.
King	80,000
Pierce	50,000
Kittitass	60,000
Lewis	5,000
Thurston	8,000
Whatcom	10,000
Total	213,000

The New Castle mines of the Oregon Improvement Company, which are situated on the Columbia and Puget Sound railway, 20 miles from Seattle, shipped their product principally to San Francisco and Portland, Oregon. The following table shows the annual product of these mines for the past 10 years:

Product of New Castle mines, Washington, since 1879.

Fiscal years.	Production.
	Long tons.
1879	127,381
1880	128,853
1881	149,602
1882	158,340
1883	218,742
1884	149,948
1885	149,050
1886	85,561
1887	140,701
1888 (calendar year)	155,000
Total	1,463,178

The principal mines in Pierce county are the Carbon Hill, the South Prairie, and the Wilkeson. The annual shipments from these mines since 1885 are exhibited in the following table:

Shipments from the Carbon Hill mines, Washington, since 1885.

Fiscal years.	Production.
	Long tons.
1885	135,926
1886	120,965
1887	145,316
1888 (calendar year)	213,145
Total	615,352

The South Prairie mine is owned and operated by the South Prairie Coal Company. The product has the reputation of being the best steam and domestic coal in Pierce county, and the supply is never equal to the demand.

Shipments from the South Prairie mine, Washington, since 1885.

Fiscal years.	Production.
	Long tons.
1885	34, 314
1886	45, 653
1887	59, 815
1888 (calendar year)	40, 934
Total	180, 716

The Black Diamond mines are situated on the same railway as the New Castle mines, but 3 miles nearer Seattle. The product of these mines is shipped principally to the San Francisco market for steam coal. The annual shipments from these mines since April, 1885, are shown in the following table:

Shipments from the Black Diamond mines, Washington, since 1885.

Fiscal years.	Production.
	Long tons.
1885	10, 562
1886	71, 356
1887	66, 500
1888 (calendar year)	148, 000
Total	296, 418

A new field has been opened in King county by the Seattle Coal and Iron Company, a sister corporation of the Seattle, Lake Shore and Eastern railway. This field is situated on the line of the railway about 40 miles distant from Seattle. The only mine thus far developed is the Gilman. Coal was first taken out about nine months ago, and the output up to December 1, was about 14,000 tons. Practically the mine is just now properly opened, and from January 1, 1889, operations will be pushed.

The following table gives an estimate of the total product of the Washington mines up to January, 1889:

Total product of coal in Washington to December 31, 1888.

Names of mines.	Production.
	Long tons.
New Castle	1, 463, 178
Franklin	(*a*) 284, 399
Black Diamond	296, 418
Renton	35, 015
Talbot	10, 000
Cedar River	106, 478
Carbonado	615, 352
South Prairie	180, 716
Wilkeson	33, 250
Bucoda	57, 295
Roslyn	340, 337
Bellingham Bay	250, 000
Clallam Bay	500
Total	3, 672, 938

a Prior to 1886 the shipments from the Franklin were included with those from the New Castle mine.

The demand for Washington coal during the past year has increased to such an extent that it has simply been a question of how much the different mines could produce and load into available ships and railway cars. The market prices have been generally remunerative, and there were only a few weeks during the summer when the product of the mines fully equaled the demand. During the month of June labor troubles interfered materially with the operations of three of the principal mines. During the winter months of the year the facilities for mining coal at the more eastern mines were inadequate to the demand made upon them. It may be said, however, that the output during 1888 was not up to the actual capacity of the mines, owing to the practical embarrassments which naturally ensue in making improvements at mines in the way of introducing new machinery in order to meet the demand for the coming year.

The value of the total product of Washington for 1888 has been estimated by local authorities at $4,250,000. This is believed, however, to be an excessive estimate, since, from a careful review of all the mines in the Territory, and of the market prices, it is believed that the average spot value of all the coal at the mines would not be greater than $3 per ton. It may be stated, however, that coal was retailed by the mining companies at Seattle, at periods during the winter of 1888-'89, at $6.50 per ton. The lowest price to the largest consumers at times during the same winter has been reported at $5 per ton; and in consequence of this fact the above estimate has been based upon an assumed value of the entire output for the year of $5 per ton.

The Roslyn mines make a uniform price of $3 per ton at the mine to all consumers, although there have been seasons of scarcity when it is believed the coal might have netted the company $6 and $7 per ton at the mines, although the price was kept invariably at $3. In the estimate the output of the Roslyn mine is taken at $3 per ton.

The increased demand for Washington coal during 1888 arose partly from the growth of population, steam ships, and general industries, partly from the severity of the winter months of the year, and partly from a strike which took place among the Australian miners, and which lasted for two months, whereby the supply of Australian coal in the San Francisco market was largely stopped. On the resumption of shipments from Australia, Messrs. Dunsmuir & Sons, of the Wellington collieries, in British Columbia, about the middle of December, reduced the price of their coal in San Francisco $4 per ton from $16, at which it had stood for twelve months, to $12. In the middle of February, 1889, a second reduction of $3 per ton was made from $12 to $9, at which it is claimed an effort will be made to keep it during 1889, in order to prevent large shipments of coal to our coast from Australia and elsewhere. The Wellington operators, in addition to their efforts to reduce the price of coal to Pacific coast consumers, shut down their mines when an attempt was made by a standing committee of an organization of laborers to control them in their dealings with their miners.

The following table, which exhibits the annual output for fifteen years of the Wellington collieries in British Columbia, is interesting as showing the growth of these collieries in comparison with those in Washington:

Product of Wellington collieries, British Columbia, for fifteen years, from 1874 to 1888, inclusive.

Years.	Production.	Years.	Production.
	Long tons.		Long tons.
1874	81,000	1882	282,000
1875	110,000	1883	213,000
1876	139,000	1884	394,070
1877	154,000	1885	365,000
1878	171,000	1886	326,636
1879	241,000	1887	413,360
1880	268,000	1888	487,784
1881	228,000	Total	3,873,850

WEST VIRGINIA.

Total product in 1888, 5,498,800 short tons; spot value, $6,048,680.

The following statistics for the calendar year 1888 have been compiled from individual returns received direct by the Survey from many of the operating companies, supplemented by facts received from Mr. Henry Cunningham, State inspector of the first district, comprising the counties of Barbour, Berkeley, Brooke, Calhoun, Doddridge, Gilmer, Grant, Hampshire, Hancock, Hardy, Harrison, Jackson, Jefferson, Lewis, Marion, Marshall, Mason, Mineral, Monongalia, Morgan, Ohio, Pendleton, Pleasants, Preston, Putnam, Randolph, Ritchie, Roane, Taylor, Tucker, Tyler, Upshur, Wetzel, Wirt, and Wood; and from Mr. H. J. Tucker, inspector of the second district, comprising the counties of Boone, Braxton, Cabell, Clay, Fayette, Greenbrier, Kanawha, Lincoln, Logan, McDowell, Mercer, Monroe, Nicholas, Pocahontas, Raleigh, Summers, Wayne, Webster, and Wyoming.

Coal production in West Virginia by counties, 1887 and 1888.

Counties.	Mines.		Production.	
	1887.	1888.	1887.	1888.
			Short tons.	Short tons.
Brooke	3	3	40,366	11,568
Ohio	9	8	131,936	140,019
Marshall	3	2	92,368	47,702
Marion	6	6	365,844	363,974
Preston	3	4	276,224	231,540
Mineral	4	4	478,636	456,361
Tucker	2	2	24,707	62,517
Taylor	2	1	168,000	55,729
Harrison	6	6	154,220	109,515
Mason	10	10	140,968	72,410
Putnam	2	4	53,200	145,440
Kanawha	28	36	1,126,839	863,600
Fayette	25	36	1,252,427	1,977,030
Mercer	5	7	575,885	961,395
McDowell	......	......	....	....
Total	108	129	4,881,620	5,498,800

Although there has been a net increase in the product of the State for 1888 of 617,180 short tons, and in total spot value of $1,453,701, yet there was an increased product in only five different counties, and a decrease in nine different counties. During the year there were seven new mining enterprises started in McDowell county, on the extension of the Norfolk and Western railroad down Elkhorn river, by the following companies: Elkhorn Coal and Coke Company, Shamokin Coal and Coke Company, Turkey Gap Coal and Coke Company, Crozer Coal and Coke Company, Huston Coal and Coke Company, Powhatan Coal and Coke Company, Norfolk Coal and Coke Company.

The coal is similar to the Pocahontas or Flat Top coal, and is mined from the same seam, which here ranges from 6½ feet to 8 feet 3 inches in thickness.

The following table exhibits a list of the mines in the first district, the names of the operators, and the counties in which the mines are located:

Mines and operators in First inspection district of West Virginia.

Names of mines.	Names of operators.	Counties.
Davis No. 1	Davis Bros	Tucker.
Davis No. 4	do	Do.
Elk Garden No. 1	West Virginia Central and Pittsburgh Railway Company.	Mineral.
Elk Garden No. 2	do	Do.
Atlantic	Atlantic and G. C. Coal Company	Do.
Armstrong	Big Vein Company	Do.
Austen	Colgate & Company	Preston.
Mountain Brook Shaft	Orrell Coal Company	Do.
Irondale	F. Nemigyei	Do.
Ocean	Consolidated Coal and Mining Company	Harrison.
Despard	Despard Coal Company	Do.
Harrison County	Harrison County Coal Company	Do.
Pinnick Kinnick	T. P. Brannon and Company	Do.
Howard	Howard Coal and Coke Company	Do.
Tyrconnell	Orrell Coal Company	Taylor.
West Virginia Coal Works	L. F. Roush	Mason.
Hartford	Hartford City Salt Company	Do.
California	Juhling & Company	Do.
New Castle	No report	
Shannon	do	
Mosquito	do	
German Furnace	do	
Clifton	do	
Sterling	Dr. A. Wilson	Mason.
Hope	Edward Edwards	Do.
Camden	Consolidated Coal and Mining Company	Do.
Carver Coal Company	Carver Bros	Putnam.
Energetic Coal Company	Energetic Coal Company	Do.
Raymond City	Marmet Mining Company	Do.
Palatine	Orrell Coal Company	Marion.
Aurora	do	Do.
Gaston	Gaston Gas Coal Company	Do.
Central	Oliver Jackson	Do.
West Fairmont	Marion Gas Coal Company	Do.
Montana	Montana Coal and Coke Company	Do.
Wellsburg	Forbes, Carmichael & Company	Brooke.
Wellsburg Shaft	C. M. Crawford	Do.
Top Mill	Wheeling Iron and Nail Company	Ohio.
Boggs Run	Boggs Run Mining and Manufacturing Company.	Marshall.
Riverside	Riverside Iron and Steel Company	Do.
Central	Oliver Jackson	
Crescent	Kaseley & Brooks	Ohio.
Moundsville Shaft	Moundsville Coal Company	Marshall.
Carter	Thomas E. Kaseley & Co	Ohio.

Coal production, number of employés, and number of accidents from July 1, 1887, to June 30, 1888, in the first district.

Actual coal production of 37 mines as per returns of operators..long tons..	1,380,631
Estimated production of 13 mines from which no returns were received, long tons	151,605
Total production..........long tons..	1,532,236
Coke ovens	575
Quantity of coke produced	144,431
Miners and inside employés	2,048
Outside employés	467
Total persons employed in and about the mines	2,515
Casualties in the mines	28
Fatal casualties in the mines	3
Non-fatal casualties in the mines	25
Coal produced per life lost..........tons..	510,745⅓
Coal produced per non-fatal accident..........do...	61,289
Coal produced per casualty..........do...	57,722
Coal produced per miner employed..........do...	748
Average earnings for miner at 50 cents per ton	$374

The following table exhibits a list of the mines in the second district, the names of the operators, and the counties in which the mines are located:

Mines and operators in second inspection district.

Names of mines.	Names of operators.	Counties.
Black Band Nos. 1 and 2	Black Band Iron and Coal Company	Kanawha.
Beane's	Welton Coal and Salt Company	Do.
New Mine	Campbell's Creek Coal Company	Do.
Calderwood	do	Do.
Boyce	do	Do.
Dana Brothers'	Dana Brothers	Do.
Pioneer No. 4	Pioneer Coal Company	Do.
Dickinson's	John Q. Dickinson & Co	Do.
Winifrede Nos. 1, 2, and 3	Winifrede Coal Company	Do.
Black Diamond	Winkler Coal Company	Do.
Peerless	S. W. Bard	Do.
Stevens'	Stevens Coal Company	Do.
Coalburg	Robinson Coal Company	Do.
Peabody	Peabody Coal Company	Do.
Cedar Grove Nos. 1 and 2	Cedar Grove Mining Company	Do.
East Bank	Stuart M. Buck	Do.
Chestnut Point	do	Do.
Blacksburg	George B. Reynolds	Do.
Belmont Nos. 1 and 2	Belmont Coal Company	Do.
Crown Hill	Crown Hill Splint Coal Company	Do.
Kanawha Nos. 1 and 2	Consolidated Mining Company	Do.
Union Nos. 1 and 2	Union Coal Company	Do.
Mount Morris	Mount Morris Coal Company	Do.
Cannel	Cannelton Coal Company	Do.
Block	do	Do.
Eureka	M. T. Davis & Co	Fayette.
Carver's	Carver Brothers	Do.
Straughan's	Straughan Coal Company	Do.
Crescent	William R. Johnson	Do.
Faulkner's	Faulkner Coal Company	Do.
Eagle	William Wyant	Do.
St. Clair	St. Clair Company	Do.
Mount Carbon	The Mount Carbon Company	Do.
Great Kanawha	Great Kanawha Colliery Company	Do.
Mill Creek	Stevens M. Taylor	Do.
Gaymont	Joseph Pirrung	Do.
Sunnyside	Thomas & Lomax	Do.
Elmo	W. A. Burke Coal Company	Do.
Fayette	Fayette Coal and Coke Company	Do.
Nuttallburg	Nuttallburg Coal and Coke Company	Do.
Keeny's Creek	do	Do.
Caperton	William Beury, Cooper & Co	Do.
New River	New River Coke Company	Do.
Sewell	Longdale Iron Company	Do.
Fire Creek	Fire Creek Coal and Coke Company	Do.

Mines and operators in second inspection district—Continued.

Names of mines.	Names of operators.	Counties.
Central	Central Coal Company	Fayette.
Echo	William Beury, Cooper & Co	Do.
Stone Cliff	Beury Coal and Coke Company	Do.
Beechwood	Beechwood Coal and Coke Company	Do.
Alaska	Alaska Coal and Coke Company	Do.
Slater	Sterling Coal and Coke Company	Do.
Quinnimont	Quinnimont Coal and Iron Company	Do.
Goodwill	Robert Goodwill & Co	Mercer.
West Fork	Louisville Coal and Coke Company	Do.
Buckeye	Buckeye Coal and Coke Company	Do.
Caswell	Freeman & Jones	Do.
Reliance	William Booth & Co	Do.
Mill Creek	Mill Creek Coal and Coke Company	Do.
Sterling	John Cooper & Co	Do.
Elkhorn	Elkhorn Coal and Coke Company	McDowell.
Shamokin	Shamokin Coal and Coke Company	Do.
Turkey Gap	Turkey Gap Coal and Coke Company	Do.
Crozer	Crozer Coal and Coke Company	Do.
Huston	Huston Coal and Coke Company	Do.
Powhatan	Powhatan Coal and Coke Company	Do.
Norfolk	Norfolk Coal and Coke Company	Do.
Louisville	Louisville Coal and Coke Company	Mercer.

Coal production, number of mines, number of coke ovens, and number of employés from January 1, 1887, *to July* 1, 1888, *in the second district.*

[Tons of 2,000 pounds.]

Counties.	Jan. 1, 1887, to July 1, 1887.		July 1, 1887, to Jan 1, 1888.		Jan. 1, 1888, to July 1, 1888.	
	Coal.	Coke.	Coal.	Coke.	Coal.	Coke.
Kanawha	569, 232	61	322, 016	400	660, 294	545
Fayette:						
Bituminous	214, 601	48, 191	204, 509	51, 739	246, 141	40, 001
Semi-bituminous	455, 050	82, 217	485, 488	88, 534	586, 282	80, 803
Mercer	283, 968	12, 833	326, 516	35, 736	436, 129	57, 793
McDowell	....	....	....	....	....	....
Total	1, 522, 851	143, 302	1, 338, 529	176, 409	1, 928, 846	179, 142

Counties.	Mines.		Coke ovens.		Employés.			
	Open.	Opening.	Completed.	Building.	Inside the mines.	Outside the mines.	Making coke.	Total.
Kanawha	33	3	12	....	2, 036	330	4	2, 370
Fayette:								
Bituminous	11	....	457	....	792	95	120	1, 007
Semi-bituminous	20	5	745	10	1, 517	182	247	1, 946
Mercer	6	1	348	134	876	113	147	1, 136
McDowell	......	7	......	530	....	....	....	......
Total	70	16	1, 562	674	5, 221	720	518	6, 459

The product of Mercer county does not include any part of the coal mined by the Southwest Virginia Improvement Company at Pocahontas, Virginia, although a part of their East mine is on the West Virginia side of the State line. There were probably mined from West Virginia territory during the year ending June 30, 1888, 150,000 net tons of coal.

Number of accidents in second district for year ending July 1, 1888.

	No.
Causes of fatal injuries:	
By falls of roof	15
By falls of coal	4
By mine cars	2
By falling down shaft	1
Total	22
Causes of non-fatal injuries:	
By falls of roof	16
By falls of coal	11
By mine cars	19
By explosion of fire-damp	2
By blast	1
Miscellaneous	2
Total	51

The following table exhibits analyses from coal beds which have been opened in eight different counties, and which beds have been popularly considered to be geologically identical with the famous Pittsburgh bed of Pennsylvania:

Analyses of West Virginia coals.

Counties.	Mines.	Thickness of seam.	Coke.	Volatile matter.	Water.	Ash.	Sulphur in coal.	Sulphur in the coke.	Cubic feet gas per 2,240 pounds.	Candle power.	Analysts.
		Feet.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			
Mineral	Virginia mine, top coal.	10	79.82	20.18	0.82	3.95	0.71	0.81	......	.....	C. E. Dwight.
Do	Virginia mine, bottom coal.	4	81.99	18.01	0.50	2.98	1.13	1.12	......	.....	Do.
Monongalia	Near Morgantown.	9–10	60.98	39.02	0.38	6.20	2.54	2.19	......	.....	Do.
Marion	Gaston	9	67.50	32.50	.....	2.10	0.95	1.01	11043	16.00	S. C. Ford.
Do	American	9	65.00	35.00	.....	5.00	.....	.....	10471	15.17	Manhattan Gaslight Company.
Taylor	Flemington	9	61.27	38.73	0.74	7.68	0.88	0.69	......	.....	C. E. Dwight.
Do	Tyrconnel	9	.....	.....	.....	.....	.....	.....	9856	16.63	C. M. Cresson.
Harrison	Despard	9	60.00	10.00	.....	6.70	.....	.....	9500	20.41	Manhattan Gaslight Company.
Do	Murphy's Run	9	.....	.....	.....	.....	2.84	.....	11401	17.20	Harlom Gaslight Company.
Ohio	Wheeling top coal.	5–7	55.28	44.72	1.75	4.30	2.88	3.06	......	.....	C. E. Dwight.
Do	Wheeling bottom coal.	5–7	60.03	39.97	1.52	12.26	3.82	4.88	......	.....	Do.
Putnam	Raymond	6–7	66.00	33.00	.....	6.00	.....	.....	......	.....	C. Vinton.
Mason	Hartford City	5–6	52.19	47.81	3.43	5.31	1.57	1.93	......	.....	C. E. Dwight.

The coal analyzed from the American mine was an average sample taken from two car lots; that from the Despard an average of the coal produced for six months, and that from Murphy's Run an average of the output for three days.

WYOMING.(a)

Product in 1888, 1,481,540 short tons; spot value, $4,444,620.

Nowhere in the Rocky Mountain region has the increase in coal mining during the year 1888 been so great as in Wyoming. The two most important factors in this have been the increased demand for fuel in the great Nebraska, Kansas, and Montana markets, and the more favorable rates for hauling made by the only railway serving the best portion of the coal fields, for by this lowering of freight rates small coal mining companies not connected with or owned by railways have been able to mine their coal and sell it at a profit outside of the Territory's limits. No important new fields have been developed, but new companies have begun working portions of the already opened coal areas. Three of these new companies are mining at or near Rock Spring, but coal production was begun so late in 1888, that their output increased the total but slightly, the principal gain being due to the fact that all of the four principal mining companies show increased production.

The greatest increase has been in the Rock Spring field, where the Rock Spring Coal Company, the Hopkins Coal Mining Company, and Van Dyke Coal Company have begun the shipment of coal from the same veins as those worked for twenty years by the Union Pacific railway.

One of the most important new developments is the opening by the Union Pacific Coal Company of a new field near Dana station, on the Union Pacific, with the probable result that the mines at Carbon will be closed on account of the greater cost of production. The vein opened at Dana is supposed to be an extension of the Carbon vein, and lies further west along the line of the Union Pacific railway. During 1888 no coal was sold, the work done being the driving of a long slope on the dip of the coal and the general preparation for steady production. The vein shows a little more than 8 feet of clean coal, of which it is proposed to break 6 feet, leaving 2 feet of coal for a roof. The dip of the coal vein is about 12°, and the coal can be mined to great advantage. In quality it is said to be slightly better than that mined at Carbon, and very satisfactory for steam and domestic uses.

On the line of the Fremont, Elkhorn and Missouri Valley railway the principal mines opened are at Glenrock and Douglas. At the former point the Deer Creek Coal Company produced, in 1888, 13,000 tons, while at Douglas the Fetterman Coal Company mined and sold 16,933 tons of coal. The vein worked by the Fetterman company is 6 feet in thickness, the coal being a clean lignite. There are two underlying veins, one 5 feet and the other about 9 feet in thickness; but neither has yet been opened. This company has not been in operation long, and will probably increase its production in future. The market for

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a Contributed by F. F. Chisolm.

the coal is in northern and eastern Nebraska in the districts served by the railway.

At Glenrock the Deer Creek Coal Company began regular operation October 1, 1888, on a vein of lignite varying from 5½ to 9 feet in thickness. The following analysis of the coal is furnished by the company:

Analysis of coal mined by the Deer Creek Coal Company at Glenrock, Wyoming.

	Per cent.
Moisture	10.20
Volatile matter	33.40
Fixed carbon	51.11
Ash	5.29
Total	100.00

Underlying the coal seam operated is another, 5 feet in thickness, on which no work has yet been done. This coal also is sold for domestic uses mainly, most of the fuel for the railway being brought from Iowa mines. The Shawnee Coal Company produced no coal in 1888. At Buffalo the Buffalo Fuel Company mined 5,000 tons of coal in 1888 for local uses wholly.

No coal was mined at Turin Creek in 1888.

At Carbon the Union Pacific Coal Company mined 338,947 tons of coal in 1888. The product of the Carbon mines to date has been as follows:

Product of the Carbon mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1879	75,424
1869	30,482	1880	100,433
1870	54,915	1881	156,820
1871	31,748	1882	200,123
1872	59,237	1883	248,380
1873	61,164	1884	319,883
1874	55,880	1885	226,863
1875	61,750	1886	214,233
1876	69,060	1887	288,358
1877	74,343	1888	338,947
1878	62,418		

At Rock Spring the product of coal in 1888 was as follows:

Product of coal at Rock Spring, Wyoming, in 1888.

	Short tons.
Union Pacific Coal Company	662,277
Van Dyke Coal Company	20,280
Rock Spring Coal Company	47,970
Hopkins Coal Mining Company	1,800
Total	732,327

The Union Pacific Coal Company has mined from the Rock Spring field the tonnage given in the following table:

Product of the Rock Spring mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	365	1879	193, 252
1869	16, 933	1880	244, 460
1870	20, 945	1881	270, 425
1871	40, 566	1882	287, 510
1872	34 677	1883	304, 495
1873	44, 700	1884	318, 197
1874	58, 476	1885	328, 601
1875	104, 664	1886	359, 234
1876	134, 952	1887	465, 444
1877	146, 494	1888	662, 277
1878	154, 282		

At Almy the output of coal in 1888 was:

Coal product at Almy, Wyoming, in 1888.

	Short tons.
Union Pacific Coal Company	160, 035
Rocky Mountain Coal and Iron Company	209, 298
Total	369, 333

The product of these mines from the time of opening to January 1, 1889, has been as follows:

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1, 967	1879	71, 576
1870	12, 454	1880	100, 234
1871	21, 171	1881	110, 157
1872	22, 713	1882	117, 211
1873	22, 847	1883	111, 713
1874	23, 006	1884	150, 880
1875	41, 805	1885	164, 441
1876	60, 756	1886	155, 547
1877	54, 643	1887	196, 913
1878	59, 096	1888	160, 035

Product of the Central Pacific mines at Almy, Wyoming. (*a*)

Years.	Short tons.	Years.	Short tons.
1870	16, 981	1880	82, 684
1871	53, 843	1881	90, 779
1872	105, 118	1882	94, 065
1873	130, 989	1883	78, 450
1874	181, 699	1884	68, 471
1875	92, 589	1885	70, 216
1876	69, 782	1886	100, 341
1877	67, 373	1887	164, 510
1878	57, 404	1888	209, 298
1879	60, 739		

a Operated by the Rocky Mountain Coal and Iron Company.

The entire product of the Territory in 1888 is given in the following table, all the figures except those for the Buffalo Fuel Company being furnished by the operators:

Coal product of Wyoming in 1888.

Names of mines.	Location.	Short tons.
Union Pacific	Carbon	338,947
Do	Rock Spring	662,277
Do	Almy	160,035
Central Pacific	do	209,298
Rock Spring Coal Company	Rock Spring	47,970
Van Dyke Coal Company	do	20,280
Hopkins Coal Company	do	1,800
Deer Creek Coal Company	Glenrock	13,000
Fetterman Coal Company	Douglas	16,933
Buffalo Fuel Company	Buffalo	5,000
Small mines		6,000
Total production		1,481,540

Mr. Charles G. Epperson, Territorial inspector of mines for Wyoming, has kindly furnished his returns of production in 1888; but as the figures differ widely from those above, and as it is impossible to reconcile the differences, the returns from Mr. Epperson's office are not used in the summaries except in the cases of the Buffalo Fuel Company and the small unreported mines.

Coal product of Wyoming as compiled by the mine inspector.

Names of mines.	Location.	Short tons.
Union Pacific	Carbon	347,754
Do	Rock Spring	696,147
Do	Almy	155,267
Central Pacific	do	206,532
Rock Spring Coal Company	Rock Spring	47,970
Van Dyke Coal Company	do	20,280
Hopkins Coal Company	do	1,800
Deer Creek Coal Company	Glenrock	13,000
Fetterman Coal Company	Douglas	12,986
Buffalo Fuel Company	Buffalo	5,000
Small mines		6,000
Total		1,512,736

The production of coal in the Territory from the beginning of coal mining to January 1, 1889, is given in the following table:

Total product of coal in Wyoming.

Years.	Carbon.	Rock Spring.	Almy.	Other mines.	Total.
	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	40, 933	1, 481, 540
Total	2, 737, 021	4, 260, 999	3, 354, 496	203, 928	10, 556, 444

The total number of men employed in coal mining in Wyoming varies from summer to winter, but will probably average as stated in the following table furnished by Mr. Epperson, Territorial mine inspector:

Number of coal miners employed in Wyoming in 1888.

Names of mines.	Location.	Number of men.
Rock Spring No. 1	Rock Spring	228
Rock Spring No. 3	do	228
Rock Spring No. 4	do	222
Rock Spring No. 5	do	63
Rock Spring No. 7	do	70
Rock Spring Coal Company	do	66
Van Dyke No. 1	do	49
Hopkins	do	13
Carbon No. 2	Carbon	380
Carbon N. 6	do	211
Almy No. 4	Almy	322
Almy No. 7	do	209
Red Cañon No. 3	do	254
Red Cañon No. 5	do	18
Fetterman	Douglas	46
Deer Creek	Glenrock	68
Buffalo	Buffalo	12
Total		2, 459

The prices paid for mining coal vary from 60 cents to $1.10 per ton where mining machines are not used. Economically, coal mining is the most important industry of the Territory, the value of the coal product in 1888, at $3 per ton, being $4,444,620.

THE MANUFACTURE OF COKE.

By Joseph D. Weeks.

In this report, as in previous ones of the series, the word "coke" is used to denote only that coke made from bituminous coal in ovens, pits, ricks, or "on the ground," and which for convenience may be termed "oven coke." Having in the report for 1887 discussed the statistics of coke made in connection with illuminating gas, which for convenience may be termed "gas coke," this product of bituminous coal will not be considered in the report for the present year.

The unit of quantity throughout this chapter is the short ton of 2,000 pounds. The year, unless otherwise stated, is the calendar year ending December 31.

Production of coke in the United States in 1888.—In the following table are consolidated by States and Territories the statistics of the production of coke in the United States for the year 1888.

Manufacture of coke in the United States, by States and Territories, in 1888.

States and Territories.	Establishments.	Ovens, December 31, 1888. Built.	Ovens, December 31, 1888. Building.	Coal used.	Coke produced.	Yield of coal in coke.	Total value of coke.	Value of coke per ton.
				Tons.	*Tons.*	*Pr. ct.*		
Alabama	18	2,475	406	848,608	508,511	60.0	$1,189,679	$2.34
Colorado	7	602	100	274,212	179,682	65.6	716,305	4.00
Georgia	1	290	0	140,000	83,721	60	177,907	2.12
Illinois	8	221	0	13,020	7,410	56.9	21,038	2.84
Indiana	3	103	0	26,547	11,956	45	31,993	2.68
Indian Territory	1	80	0	13,126	7,502	57	21,755	2.90
Kansas	6	58	0	24,934	14,831	59	29,073	1.96
Kentucky	10	132	2	42,642	23,150	54	47,244	2.04
Missouri	1	4	0	5,000	2,600	52	9,100	3.50
Montana	1	40	0	20,000	12,000	60	96,000	8.00
New Mexico	1	70	0	14,628	8,540	58	51,240	6.00
Ohio	15	547	12	124,201	67,194	54	166,330	2.48
Pennsylvania	120	20,381	1,565	9,673,097	6,545,779	68	8,230,759	1.26
Tennessee	11	1,634	84	630,099	385,693	61	490,491	1.27
Virginia	2	550	0	230,529	149,199	64.7	260,000	1.74
Washington	3	30	100	0	0	0	0	0
West Virginia	52	2,792	318	863,707	531,762	61.6	905,549	1.70
Wisconsin	1	50	0	1,000	500	50	1,500	3.00
Total	261	30,059	2,587	12,945,350	8,540,030	66	12,445,963	1.46

In 1888 a new State, Wisconsin, was added to the list of coke-producing States, though the coal used in coking in Wisconsin was all brought from Pennsylvania. All of the States that made coke in 1887 produced it in 1888.

It may still be said, as reported in previous volumes of Mineral Resources, with regard to the origin of the coal used in coke making, that by far the largest proportion of coal manufactured into coke in the United States comes from the various Coal Measures of the Appalachian basin, and chiefly from the great Pittsburgh coal seam. Of the 12,945,350 tons of coal coked in 1888 but 392,819 tons were from coal fields other than the Appalachian. This would be but 3 per cent. of the total coal coked, not only a much less percentage, but less in amount than in 1887. In 1887, 446,986 tons of coal made into coke came from fields outside of the Appalachian, as compared with 392,819 tons in 1888. Of this amount coked in 1888, 288,840 tons came from the coal fields of Colorado and New Mexico, practically an amount equal to that coked in 1887, and 43,060 tons came from the Missouri basin, which would include the coal used in Kansas, Indian Territory, and Missouri. This is 10,000 tons less than in 1887. In 1888, 34,372 tons were from the Illinois field, including that used in Illinois and western Kentucky, as compared with 45,725 tons coked in 1887, and 26,547 tons were from Indiana, as against 35,600 tons in 1887.

In the production of coke, Pennsylvania still outranks all the other States, producing, in 1888, 6,545,779 tons out of a total of 8,540,030 tons, or 76.6 per cent. West Virginia was next, producing 531,762 tons, or 6.2 per cent. of the total. Alabama came third, with 508,511 tons, or 5.9 per cent of the total, while Tennessee ranged fourth with a production of 385,693 tons, or 4.5 per cent. of the total. Pennsylvania produced, in 1887, 76⅗ per cent. of all the coke made. The product of coke in 1888 increased from 7,611,705 tons in 1887 to 8,540,030 tons, an increase of 928,325 tons, or 12 per cent., which makes the product of 1888 by far the largest known in the history of the coke trade.

Statistics of coking in the United States.—In the following table are consolidated the statistics of coking in the United States for the year 1888. These statistics relate not only to the production of coal and coke, but also to the consumption of coal and its percentage yield in coke, as well as the number of establishments making coke and the number of ovens built and building at the close of each year.

Statistics of the manufacture of coke in the United States, 1880 *to* 1888, *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	64.2
1888....	261	30,059	2,587	12,945,350	8,540,030	12,445,963	1.46	66

From the above table it appears that the number of establishments in the United States decreased from 270 in 1887 to 261 in 1888. This fact, however, is of little significance, as the word "establishment" is not always used with the same meaning. Several separate works may be reported, when owned by the same party, as one establishment one year and separate establishments in another. The number of ovens built at the close of the year has increased from 26,001 at the close of 1887 to 30,059 at the close of 1888, an increase of 4,058 in number, or of 13.5 per cent. The number of ovens building has decreased from 3,584 at the close of 1887 to 2,587 at the close of 1888. The production of coke has increased from 7,611,705 tons in 1887 to 8,540,030 tons in 1888, an increase of 928,325 tons, or 12 per cent. The increase in the coal used has been from 11,859,752 tons in 1887 to 12,945,350 tons in 1888, an increase of 1,085,598 tons, or of 9 per cent. The yield of coal and coke is given this year at 66 per cent., as compared with 64.2 per cent. in 1887. The value of the coke produced has decreased from $15,321,116 to $12,445,963, while the value of the coke per ton has decreased from $2.01 to $1.46, a decrease of 27 per cent.

On the whole, characterizing the production of 1888, it may be said that there has been a decided increase in the number of ovens and in the production of coke and in the yield of coal in coke, while there has been a decided decrease in the selling price of the coke. In the nine years covered by this report—namely, from 1880 to 1888, both inclusive—the number of ovens has increased from 12,372 to 30,059, or over 143 per cent. The production of coke has increased from 3,338,300 tons to 8,540,030 tons, an increase of 156 per cent., while there has been a decrease in the average value, the price for 1888, $1.46 per ton, being the lowest average for the nine years.

Total number of coke works in the United States.—The following table gives the number of establishments manufacturing coke in the United States in each year from 1880 to 1888 by States:

Number of establishments in the United States manufacturing coke from 1880 *to* 1888.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Alabama	(a) 4	4	5	6	8	11	14	15	18
Colorado	1	2	5	7	8	7	7	7	7
Georgia	1	1	1	1	1	2	2	2	1
Illinois	6	6	7	7	9	9	9	8	8
Indiana	2	2	2	2	2	2	4	4	3
Indian Territory	1	1	1	1	1	1	1	1	1
Kansas	2	3	3	4	4	4	4	4	6
Kentucky	5	5	5	5	5	5	6	6	10
Missouri	0	0	0	0	0	0	0	1	1
Montana	0	0	0	1	3	2	4	2	1
New Mexico	0	0	2	2	2	2	2	1	1
Ohio	15	15	16	18	19	13	15	15	15
Pennsylvania	124	132	137	140	145	133	108	151	120
Tennessee	6	6	8	11	13	12	12	11	11
Texas	0	0	0	0	0	0	1	0	0
Utah	1	1	1	1	1	1	1	0	0
Virginia	0	0	0	1	1	1	2	2	2
Washington	0	0	0	0	1	1	1	1	3
West Virginia	18	19	22	24	27	27	29	39	52
Wisconsin	0	0	0	0	0	0	0	0	1
Total	186	197	215	231	250	233	222	270	261

a The number of establishments on December 31 of each year.

As has already been stated, the word "establishment" is rather an indefinite one. In some cases proprietors of coke works owning several different banks of ovens will report them all as one establishment, they being all under one general management. In other cases they will be reported as separate establishments. The number differs so much from year to year, even at the same works, 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	1883, December 31	231
1860 (census year)	21	1884, December 31	250
1870 (census year)	25	1885, December 31	233
1880 (census year)	149	1886, December 31	222
1880, December 31	186	1887, December 31	270
1881, December 31	197	1888, December 31	261
1882, December 31	215		

Number of coke ovens in the United States.—The following table gives the total number of coke ovens in the United States on December 31 of each year from 1880 to 1888. In addition to the coke made in ovens some has been made in pits and on the ground; but, as the number of pits varies greatly at different times, no attempt has been made to give their total number.

Number of coke ovens in the United States on December 31 *of each of the years from* 1880 *to* 1888.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Alabama	316	416	536	767	976	1, 075	1, 301	1, 555	2, 475
Colorado	200	267	344	352	409	434	483	532	602
Georgia	140	180	220	264	300	300	300	300	290
Illinois	176	176	304	316	325	320	335	278	221
Indiana	45	45	37	37	37	37	100	119	103
Indian Territory	20	20	20	20	20	40	40	80	80
Kansas	6	15	20	23	23	23	36	39	58
Kentucky	45	45	45	45	45	33	76	98	132
Missouri	0	0	0	0	0	0	0	4	4
Montana	0	0	0	2	5	2	16	27	40
New Mexico	0	0	0	12	70	70	70	70	70
Ohio	616	641	647	682	732	642	560	585	547
Pennsylvania	9, 501	10, 881	12, 424	13, 610	14, 285	14, 553	16, 314	18, 294	20, 381
Tennessee	656	724	861	992	1, 105	1, 387	1, 485	1, 560	1, 634
Texas	0	0	0	0	0	0	0	0	0
Utah	20	20	20	20	20	20	20	0	0
Virginia	0	0	0	200	200	200	350	350	550
Washington	0	0	0	0	0	2	11	30	30
West Virginia	631	689	878	962	1, 005	978	1, 100	2, 080	2, 792
Wisconsin	0	0	0	0	0	0	0	0	50
Total	12, 372	14, 119	16, 356	18, 304	19, 557	20, 116	22, 597	26, 001	30, 059

The number of coke ovens in the United States at the close of 1888 was 30,059, an increase from 26,001 at the close of 1887. The number of ovens in Missouri, New Mexico, and Indian Territory, is the same as at the close of 1887. There has been a decrease in Georgia, Illinois, Indiana, and Ohio, while in all the other States there has been an increase, Wisconsin appearing for the first time in this report with 50 ovens. In 1885 but three States, Pennsylvania, Tennessee, and Alabama, had over 1,000 ovens. In 1888 three States had over 2,000, namely, Pennsylvania, West Virginia, and Alabama, while Tennessee had 1,634 ovens. All the other States had less than 1,000. Pennsylvania stands first in the list, with 20,381 ovens, or 68 per cent. of all; West Virginia, with 2,792, or 9 per cent.; Alabama, which ranked fourth in 1887, now becomes the third, with 2,475 ovens, or 8 per cent., while Tennessee, which ranked the third, takes the fourth place, with 1,634 ovens, or 5 per cent.

As has already been stated, most of the ovens in operation in the United States are of the beehive or solid wall type, in which the coal is coked by heat generated in the oven itself. Most of the ovens are of the regular beehive shape. A few are in a modified form, the oven being longer and shaped like a muffin. Notwithstanding the repeated experiments that have been made to produce coke from American coals in a flue oven, they have been almost universally a failure, for reasons that need not be discussed here. Owners of works at which most earnest efforts have been made to use the flue ovens have finally been compelled to abandon the idea, and the flue ovens have either been torn down and beehive ovens erected in their stead, or new constructions and extensions of these works have been made with the beehive oven. It is but fair to say, however, that at the present moment considerable attention is again being paid to the propriety of erecting flue or retort ovens. There is a growing 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 their production of these by-products has been considerably lessened by the use of the enriched water-gas process. The owners of the Coppèe oven have established an agency in this country, and purpose erecting a plant from their own designs in order to demonstrate the value of their system of coking.

Number of ovens building in the United States.—In the following table is given the number of ovens that were actually in course of construction in the United States at the close of each year from 1880 to 1888:

Number of coke ovens building in the United States at the close of each of the years from 1880 to 1888.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Alabama	100	120	0	122	242	16	1, 012	1, 362	406
Colorado	50	0	0	0	24	0	0	0	100
Georgia	40	40	44	36	0	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0
Indiana	0	0	0	0	0	0	18	0	0
Indian Territory	0	0	0	0	0	0	0	0	0
Kansas	0	0	0	0	0	0	0	0	0
Kentucky	0	0	0	0	0	0	2	0	2
Missouri	0	0	0	0	0	0	0	0	0
Montana	0	0	0	0	12	0	0	0	0
New Mexico	0	0	12	28	0	0	0	0	0
Ohio	25	0	0	0	0	0	0	223	12
Pennsylvania	836	761	642	211	232	317	2, 558	802	1, 565
Tennessee	68	84	14	10	175	36	126	165	84
Virginia	0	0	0	0	0	0	100	300	0
Washington	0	0	0	0	0	0	21	0	100
West Virginia	40	0	0	0	127	63	317	742	318
Wisconsin	0	0	0	0	0	0	0	0	0
Total	1, 159	1, 005	712	407	812	432	4, 154	3, 594	2, 587

There is no attempt in this table to indicate the increase in the total number of coke ovens during the year. That is shown under the previous title. In this table is given only the number of ovens reported as being in course of construction at the close of 1888, and only indicates the condition of oven building at the close of the year.

It will be noted that there was a less number of ovens building at the close of 1888 than at the close of either of the two preceding years, the largest number building being in Pennsylvania instead of in Alabama, as was the fact one year ago.

Total product of coke in the United States.—The product of coke in the United States for the years 1880 to 1888, inclusive, was as follows:

Amount of coke produced in the United States, 1880 to 1888, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	60, 781	109, 033	152, 940	217, 531	244, 009	301, 180	375, 054	325, 020	508, 511
Colorado	25, 568	48, 587	102, 105	133, 997	115, 719	131, 960	142, 797	170, 698	179, 682
Georgia	38, 041	41, 376	46, 602	67, 012	79, 268	70, 669	82, 680	79, 241	83, 721
Illinois	12, 700	14, 800	11, 400	13, 400	13, 095	10, 350	8, 103	9, 198	7, 410
Indiana	0	0	0	0	0	0	6, 124	17, 658	11, 966
Indian Ter	1, 546	1, 768	2, 025	2, 573	1, 912	3, 584	6, 351	10, 060	7, 502
Kansas	3, 070	5, 670	6, 080	8, 430	7, 190	8, 050	12, 493	14, 950	14, 831
Kentucky	4, 250	4, 370	4, 070	5, 025	2, 223	2, 704	4, 528	14, 565	23, 150
Missouri	0	0	0	0	0	0	0	2, 970	2, 600
Montana	0	0	0	0	75	175	0	7, 200	12, 000
New Mexico	0	0	1, 000	3, 905	18, 282	17, 940	10, 236	13, 710	8, 540
Ohio	100, 596	119, 469	103, 722	87, 834	62, 709	39, 416	34, 932	93, 004	67, 194
Pennsylvania	2, 821, 384	3, 437, 708	3, 945, 034	4, 438, 464	3, 822, 128	3, 991, 805	5, 406, 597	5, 832, 849	6.545.779
Tennessee	130, 609	143, 853	187, 695	203, 691	219, 723	218, 842	368, 139	396, 979	385, 693
Utah	1, 000	0	250	0	0	0	0	0	0
Virginia	0	0	0	25, 340	63, 600	49, 139	122, 352	166, 947	149, 199
Washington	0	0	0	0	400	311	825	14, 625	0
West Virginia	138, 755	187, 126	230, 398	257, 519	223, 472	260, 571	264, 158	442, 031	531, 762
Wisconsin	0	0	0	0	0	0	0	0	500
Total	3. 338, 300	4, 113, 760	1, 793, 321	5, 464, 721	4, 873, 805	5, 106, 696	6, 845, 369	7, 611, 705	8,540,030

The product of coke in the United States in 1888 was the largest in its history, being 928,325 tons greater than in 1887, which was the year of the largest production prior to 1888. From the table it will be seen that Pennsylvania still remains the great coke-producing State of the Union, its production being 6,545,779 tons. Following Pennsylvania comes West Virginia, with 531,762 tons, and Alabama, with 508,511 tons. In 1887, Pennsylvania was the only State that produced over half a million tons of coke, West Virginia, which was the second State in total production in 1887, producing only 442,031 tons. In 1888 West Virginia and Alabama each produced upwards of half a million tons.

The following table gives the relative rank of the States and Territories in the production of coke in the years 1884 to 1888, inclusive:

Rank of the States and Territories in production of coke in 1884, 1885, 1886, 1887, *and* 1888.

States and Territories.	1884.	1885.	1886.	1887.	1888.	States and Territories.	1884.	1885.	1886.	1887.	1888.
Pennsylvania	1	1	1	1	1	Illinois	10	10	11	15	16
Alabama	2	2	2	4	3	Kansas	11	11	9	10	11
West Virginia	3	3	4	2	2	Indiana	.....	.....	13	9	13
Tennessee	4	4	3	3	4	Kentucky	12	13	14	12	9
Colorado	5	5	5	5	5	Indian Territory	13	12	12	14	15
Georgia	6	6	7	8	7	Washington	14	14	15	11	10
Virginia	7	7	6	6	6	Montana	15	15	.....	16	12
Ohio	8	8	8	7	8	Missouri	.....	.....	.....	17	17
New Mexico	9	9	10	13	14	Wisconsin	.....	.....	.....	.....	18

It will be noted that there has been quite a change in the relative rank of the States in 1888 as compared with 1887. Pennsylvania still retains its pre-eminence. West Virginia still remains the second State in point of production, while Alabama and Tennessee exchange places, Alabama being the third and Tennessee fourth. Colorado retains its relative position, the fifth State, as does Virginia its place, the sixth, but Georgia and Ohio exchange places, Georgia becoming seventh instead of eighth, and Ohio eighth instead of seventh. Indiana drops from ninth to thirteenth, while Kentucky advances from twelfth to ninth.

Value and average selling price of coke.—In the following table is given the total value of the coke produced in the United States for each year from 1881 to 1888, inclusive:

Total value at the ovens of the coke made in the United States in the years from 1881 *to* 1888, *inclusive, by States and Territories.*

States and Territories.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Alabama	$326, 819	$425, 940	$598, 473	$609, 185	$755, 645	$993, 302	$775, 090	$1, 189, 679
Colorado	267, 156	476, 665	584, 578	409, 930	512, 162	569, 120	682, 778	716, 305
Georgia	88, 753	100, 194	147, 166	169, 192	144, 198	179, 031	174, 110	177, 907
Illinois	45, 850	29, 050	28, 200	25, 639	27, 798	21, 487	19, 594	21, 038
Indiana	0	0	0	0	0	17, 953	51, 141	31, 993
Indian Ter....	5, 304	6, 075	7, 719	5, 736	12, 902	22, 229	33, 435	21, 755
Kansas	10, 200	11, 460	16, 560	14, 580	13, 255	19, 204	28, 575	29, 073
Kentucky	12, 630	11, 530	14, 425	8, 760	8, 499	10, 082	31, 730	47, 244
Missouri......	....	....	....	....	....	....	10, 395	9, 100
Montana	0	0	0	900	2, 063	0	72, 000	96, 000
New Mexico ..	0	6, 000	21, 478	91, 410	89, 700	51, 180	82, 260	51, 240
Ohio	297, 728	266, 113	225, 660	156, 294	109, 723	94, 042	245, 981	166, 330
Pennsylvania.	5, 898, 579	6, 133, 698	5, 410, 387	4, 783, 230	4, 981, 656	7, 664, 023	10, 746, 352	8, 230, 759
Tennessee	342, 585	472, 505	459, 126	428, 870	398, 459	687, 865	870, 900	490, 491
Utah	0	2, 500	0	0	0	0	0	0
Virginia	0	0	44, 345	111, 300	85, 993	305, 880	417, 368	260, 000
West Virginia	429, 571	520, 437	563, 490	425, 952	485, 588	513, 843	976, 732	905, 549
Wisconsin	0	0	0	0	0	0	0	1, 500
Total	7, 725, 175	8, 462, 167	8, 121, 607	7, 240, 978	7, 627, 641	11, 149, 241	15, 218, 741	12, 445, 963

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.

Though the production of coke in the United States increased from 7,611,705 tons in 1887 to 8,540,030 tons in 1888, an increase of 12 per cent., the total value of the coke dropped from $15,218,741 to $12,445,963, or about 19 per cent. Indeed, the reduction in the value of coke in 1888 was quite marked, making its average value per ton the lowest yet given in these reports.

What the average value per short ton in each State was during 1888, as compared with previous years, is shown in the following table:

Average value per short ton at the ovens of the coke made in the United States in the years from 1880 to 1888, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Alabama	$3.01	$3.00	$2.79	$2.75	$2.50	$2.50	$2.65	$2.39	$2.34
Colorado	5.68	5.29	4.67	4.36	3.45	3.88	3.99	4.00	4.00
Georgia	2.15	2.15	2.15	2.20	2.13	2.04	2.17	2.20	2.12
Illinois	3.30	3.10	2.55	2.10	1.96	2.68	2.65	2.13	2.84
Indiana	0	0	0	0	0	0	2.93	2.81	2.68
Indian Territory	3.00	3.00	3.00	3.00	3.00	3.60	3.50	3.33	2.90
Kansas	1.95	1.80	1.70	1.96	2.02	1.65	1.54	1.91	1.96
Kentucky	2.88	2.89	2.83	2.87	3.94	3.14	2.23	2.18	2.04
Missouri	......	......	......	......	......	......	......	3.50	3.50
Montana	0	0	0	0	12.00	11.72	0	10.00	8.00
New Mexico	0	0	6.00	5.50	5.00	5.00	5.00	6.00	6.00
Ohio	2.54	2.49	2.57	2.57	2.49	2.78	2.69	2.65	2.48
Pennsylvania	1.86	1.70	1.55	1.22	1.25	1.25	1.42	1.84	1.26
Tennessee	2.42	2.33	2.52	2.25	1.95	1.31	1.87	2.19	1.27
Utah	10.00	0	10.00	0	0	0	0	0	0
Virginia	0	0	0	1.75	1.75	1.75	2.50	2.50	1.74
West Virginia	2.30	2.30	2.26	2.19	1.19	1.86	1.94	2.22	1.70
Wisconsin	0	0	0	0	0	0	0	0	3.00
Total average	1.99	1.88	1.77	1.49	1.49	1.49	1.63	2.01	1.46

The average value of coke in the several States ranges from $1.26 in Pennsylvania to $8 in Montana, the average value being $1.46 per ton, which is the lowest value given in this table, the nearest approach being the years 1883–'84–'85, when the average value was $1.49. It is to be understood that this average value was obtained not by taking the average of the prices, but by dividing the total value of the coke produced by the total number of tons of coke sold.

Prices of coke.—The prices of Connellsville coke, free on board at the ovens, is given elsewhere in detail. The price for furnace coke dropped from $1.75 a ton, at which price it stood January 1, 1888, to $1.50 early in March, to $1.25 later in the month, and to $1 in April. It remained at this figure until November, when it advanced to $1.25, at which price it stood at the close of the year. Prices of Connellsville coke in other markets were, at the close of the year, as follows: Chicago, $4.25; Saint Louis, $4.70; Louisville, $4.70; Kansas City, $7.25; Toledo, $4; Buffalo, $4.50. Crushed coke sold for $4.50 at Toledo and $5.40 at Saint Louis. Flat Top coke sold at the close of the year at $1.75 for furnace coke, and $2.25 for foundry free on board ovens. Reynoldsville coke sold for $3.75 at Buffalo, while Walston and New River were quoted at the same price as Connellsville coke in the Chicago markets. At Louisville, New River coke was quoted 5 cents higher than Connellsville.

Amount of coal consumed in the manufacture of coke.—In the following table is given the total number of tons of coal which entered into the manufacture of coke in the United States for the years 1881 to 1888, inclusive:

Amount of coal used in the manufacture of coke in the United States from 1881 *to* 1888, *inclusive, by States and Territories.*

States and Territories.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	184, 881	261, 839	359, 699	413, 184	507, 934	635, 120	550, 047	848, 608
Colorado	97, 508	180, 549	224, 089	181, 968	208, 069	228, 060	267, 487	274, 212
Georgia	68, 960	77, 670	111, 687	132, 113	117, 781	136, 133	158, 482	140, 000
Illinois	35, 240	25, 270	31, 370	30, 168	21, 487	17, 806	16, 596	13, 020
Indiana	0	0	0	0	0	13, 030	35, 600	26, 547
Indian Ter	2, 852	3, 266	4, 150	3, 084	5, 781	10, 242	20, 121	13, 126
Kansas	8, 800	9, 200	13, 400	11, 500	15, 000	23, 062	27, 604	24, 934
Kentucky	7, 406	6, 906	8, 437	3, 451	5, 075	9, 055	29, 129	42, 642
Missouri	0	0	0	0	0	0	5, 400	5, 000
Montana	0	0	0	165	300	0	10, 800	20, 000
New Mexico	0	1, 500	6, 941	29, 990	31, 889	18, 194	22, 549	14, 628
Ohio	201, 145	181, 577	152, 502	108, 164	68, 796	59, 332	164, 974	124, 201
Pennsylvania	5, 393, 503	6, 149, 179	6, 823, 275	6, 204, 604	6, 178, 500	8, 290, 849	8, 938, 438	9, 673, 097
Tennessee	241, 644	313, 537	330, 961	348, 295	412, 538	621, 669	655, 857	630, 099
Utah	0	500	0	0	0	0	0	0
Virginia	0	0	39, 000	99, 000	81, 899	200, 018	235, 841	230, 529
West Virginia	304, 823	366, 653	411, 159	385, 588	415, 533	425, 002	698, 327	863, 707
Wisconsin	0	0	0	0	0	0	0	1, 000
Total	6, 546, 762	7, 577, 646	8, 516, 670	7, 951, 974	8, 071, 126	10, 688, 972	11, 859, 752	12, 945, 350

In this statement is included all of the coal charged into the ovens, without any reference to its condition when so charged. A large proportion of the coal used is "run of the mine"—that is, all of the coal as it comes from the pit—lump, nut, and slack—is charged, without screening, into the ovens, the coal in these cases being mined only for the purpose of being made into coke. This is especially true of the Connellsville, Allegheny Mountain, and Reynoldsville-Walston districts in Pennsylvania, the New River district in West Virginia, and the Warrior district in Alabama, as well as several others. On the other hand, a large amount of coking, as will appear from the statement made in connection with the industry in different districts, is for the purpose of utilizing the slack coal produced in mining. This is true of the Pittsburgh district in Pennsylvania, as well as of many of the localities producing but a small amount of coke. It is not found practicable, however, as suggested above, to distinguish between the coal which was used as "run of the mine" and that which was used as "slack."

The amount of coal necessary to produce a ton of coke in 1888 was 1.51 tons, or 3,032 pounds; in 1887, 1.56 tons, or 3,120 pounds; in 1886, 1.56 tons, or 3,120 pounds; in 1885, 1.58 tons, or 3,160 pounds; in 1884, 1.63 tons, or 3,260 pounds.

Yield of coal in coke.—The table given below shows the average yield of the coal coked in the United States for the nine years covered by this report. By the yield is meant the percentage of the constituents of the coal that remained in the coke after th e rocess of coking.

Percentage yield of coal in the manufacture of coke in the United States in the years 1880 *to* 1888, *inclusive, by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Alabama	57	59	58	60	60	59	59	59	60
Colorado	49	50	57	60	64	63	62.6	64	65.6
Georgia	60	60	60	60	60	60	60	50	60
Illinois	41	42	45	43	43	48	46	55½	56.9
Indiana	0	0	0	0	0	0	47	50	45
Indian Territory	62	62	62	62	62	62	62	50	57
Kansas	64	64.4	65	62.9	62¼	53⅔	54.2	54	59
Kentucky	60	60	59	60	64	53	50	50	54
Missouri	....	....	....	....	....	....	....	55	52
Montana	0	0	0	0	46	58½	0	66⅔	60
New Mexico	0	0	66⅔	57¼	57½	56¼	56	61	58
Ohio	58	59	57	58	58	57	59	56	54
Pennsylvania	65	64	64	65	62	64.6	65.2	65¼	68
Tennessee	60	60	60	62	63	53	59	61	61
Texas	....	....	....	....	....	....	50	....	....
Utah	50	0	50	0	0	0	0	....	....
Virginia	0	0	0	64½	64¼	60	61.1	70.8	64.7
West Virginia	60	61	63	63	62	63	62	63.3	61.6
Wisconsin	....	....	....	....	....	....	....	....	50
Total average	63	63	63	64	61	63	64	64.2	66

Some of the percentages of this table are in part estimates. As has been stated, a great deal of the coal coked is slack, and this is frequently charged into the ovens without weighing. In such cases only an estimate of the amount used could be given.

The above table indicates an increased yield of coal in coke equivalent to 1.8 per cent., the yield in 1888 being 66 per cent. and in 1887 64.2 per cent. There is no doubt that more careful management and burning at the ovens is giving an increased percentage of the coal in coke. The careful experiments as to yield, referred to in last year's report, were continued during 1888 with the most gratifying results. One establishment in Pennsylvania, by changing the form of its oven very slightly, materially added to its yield.

Imports and exports of coke.—The following table gives the quantities and value of coke imported and entered for consumption in the United States from 1869 to 1888, inclusive. In the statement is included not only that coke which is entered for consumption through the custom-houses, but the withdrawals from warehouses for consumption. In the reports of the Treasury Department the quantities are long tons. These have been reduced to short tons to make the table consistent with the other tables in this chapter:

Coke imported and entered for consumption in the United States, 1869 *to* 1888, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30, prior to 1886—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869	....	$2,053	1879	6,035	$24,748
1870	....	6,388	1880	5,047	18,406
1871	....	19,528	1881	15,210	64,987
1872	9,575	9,217	1882	14,924	53,244
1873	1,091	1,366	1883	20,634	113,114
1874	634	4,588	1884	14,483	36,278
1875	1,046	9,648	1885	20,876	64,814
1876	2,065	8,657	1886 (*a*)	28,124	84,801
1877	4,068	16,686	1887 (*a*)	35,320	100,312
1878	6,616	24,186	1888 (*a*)	35,201	107,914

a Calendar years ending December 31, from 1886 to 1888.

The coke imported into the United States goes chiefly to the Pacific coast, where it is used in smelting argentiferous lead ores of the Rocky Mountain region. The coke imported is chiefly English and Welsh. Some coke from Nova Scotia is imported into New England.

The exports of coke, which have always been insignificant, seem to have ceased entirely.

ALABAMA.

A notable development in the blast-furnace industry in Alabama during the past year has led to a largely increased demand for coke, and consequently largely increased production. In no one year has this increase been so marked as in the year 1888. In every respect, except in the number of ovens building at the close of the year and the average value of the coke at the ovens per ton, the figures given in the following table show an increase.

At the close of 1888 there were 18 coke works in Alabama, an increase of 3 as compared with 1887. Of these, 10 were in the Warrior district; 5 in the Cahaba district, an increase of 2; and 3 in the Coosa district, an increase of 1. Three works in the Cahaba district made no coke in 1888. One of these three was idle and two were building. There were in this State, at the close of 1888, 2,475 ovens, an increase from 1,555 at the close of 1887. There were building, at the close of 1888, 406 ovens. Of these, 215 were building in the Warrior district, 153 in the Cahaba district, and 38 in the Coosa district. Of the ovens built at the close of the year, 1,914 were in the Warrior district, 459 in the Cahaba district, and 102 in the Coosa district.

The total product of coke in Alabama in 1888 was 508,511 tons, an increase from 325,020 tons in 1887, making 1888 the year of the largest production of coke. Of these 508,511 tons, 471,047 tons were produced in the Warrior district, 25,772 tons in the Cahaba district, and 11,692 tons in the Coosa district.

There were used in the production of this coke 848,608 tons of coal, a yield of 60 per cent., the yield at the various establishments running from 54 to 67 per cent.

The total value of the coke at the ovens was $1,189,579, the average value being $2.34 per ton.

The following are the statistics of the manufacture of coke in Alabama from 1880 to 1888, inclusive:

Statistics of the manufacture of coke in Alabama, 1880 to 1888, 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

a One establishment made coke on the ground.

COLORADO.

Colorado still retains the position it occupied at the close of 1887 in the list of coke-producing States. Its product of coke in 1888, however, was about 9,000 tons greater than in 1887, the product in the latter year being 170,698 tons and in 1888, 179,682 tons. The number of ovens increased from 532 to 602, with 100 building at the close of the year. The amount of coal used increased from 267,487 tons in 1887 to 274,212 tons in 1888, the percentage yield having increased from 64 to 65.6 per cent. The total value of the coke in 1888 was $716,305, the average value being the same as in 1887, $4 per ton.

Of the coke produced in this State in 1888, 111,053 tons were produced in the El Moro district, 65,494 tons in the Crested Butte, and 3,135 tons in the Durango district.

The statistics of the production of coke in Colorado for the years 1880 to 1888 are as follows.

Statistics of the manufacture of coke in Colorado, 1880 to 1888.

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

GEORGIA.

In the report on the manufacture of coke in this State given in the table below there is a decrease of one in the number of establishments and of ten in the number of ovens. The establishment that dropped out was a small one, with ten banks of ovens, situated two miles distant from the larger works of the Dade Coal Company, and belonging to it. The works have been abandoned and the ovens wrecked. Little or none of the coke made in Georgia is sold in the general market, the companies who make it using most of it in their own furnaces.

The statistics of the manufacture of coke in this State for the years 1880 to 1888 are as follows:

Statistics of the manufacture of coke in Georgia, 1880 to 1888, 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	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

ILLINOIS.

During the year the number of coke ovens in Illinois has dropped from 278 to 221, a reduction of 57 ovens. All attempts at making coke on an extensive scale in Illinois have thus far been without favorable results, although extraordinary efforts have been made, chiefly with a view to utilizing the large amount of slack coal that now goes to waste. The chief difficulty is the impurity of the coal, and no methods that have yet been employed on a large scale have produced a coke free enough from these impurities and of a quality good enough in other respects to make it a blast-furnace fuel.

Coke was made at but three establishments in this State in 1888. The amount made at one of these was so small that practically all the coke made in Illinois was made at two works.

The following are the statistics of the manufacture of coke in Illinois for the years 1880 to 1888:

Statistics of manufacture of coke in Illinois, 1880 *to* 1888.

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	0	31,240	12,700	$41,950	$3.30	41
1881	6	176	0	35,240	14,800	45,850	3.10	42
1882	7	304	0	25,270	11,400	29,050	2.55	45
1883	7	316	0	31,170	13,400	28,200	2.10	43
1884	9	325	0	30,168	13,095	25,639	1.96	43
1885	9	320	0	21,487	10,350	27,798	2.68	48
1886	9	335	0	17,806	8,103	21,487	2.65	46
1887	8	278	0	16,596	9,198	19,594	2.13	55.5
1888	8	221	0	13,020	7,410	21,038	2.84	56.9

INDIANA.

Three works in this State produced coke in 1888; but the product was less by some 6,000 tons than in 1887. The ovens of the Central Iron and Steel Company at Brazil, in Clay county, which for many years were the only ones in the State, are entirely wrecked. At the Laclede Coal and Coke Company's works no coke was made after March 1, 1888, the works being idle at first on account of litigation and later on account of low prices. The largest producer of coke in Indiana during the year was the New Pittsburgh Coal and Coke Company at Alum Cave.

The statistics of the manufacture of coke in Indiana for the years 1886, 1887, and 1888 are as follows. No coke was made in Indiana from 1879 to 1886:

Statistics of manufacture of coke in Indiana for 1886, 1887, *and* 1888.

	1886.	1887.	1888.
Number of establishments	4	4	3
Ovens built	100	119	103
Ovens building	18	....	0
Coal used, short tons	13,030	35,600	26,547
Coke produced, short tons	6,124	17,658	11,956
Total value of coke at ovens	$17,953	$51,141	$131,993
Value of coke at ovens, per ton	$2.93	$2.81	$2.68
Yield of coal in coke, per cent	47	50	45

INDIAN TERRITORY.

The coke works of the Osage Coal and Mining Company, located at McAlester, still continues to be the only one in Indian Territory. The coal used at these works and the coke made have been fully described in previous volumes of Mineral Resources. There has been no increase in the number of ovens during the year. On the other hand, there has been a decrease in the production of coke.

The statistics of the manufacture of coke in the Territory for the years 1880 to 1888 are as follows:

Statistics of the manufacture of coke in Indian Territory, 1880 *to* 1888.

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	0	2,494	1,546	$4,638	$3.00	62
1881	1	20	0	2,852	1,768	5,304	3.00	62
1882	1	20	0	3,266	2,025	6,075	3 00	62
1883	1	20	0	4,150	2,573	7,719	3.00	62
1884	1	20	0	3,084	1,912	5,736	3.00	62
1885	1	40	0	5,781	3,584	12,902	3.60	62
1886	1	40	0	10,242	6,351	22,229	3.30	62
1887	1	80	0	20,121	10,060	33,435	3.33	50
1888	1	80	0	13,126	7,502	21,755	2.90	57

KANSAS.

The production of coke in Kansas in 1888 was practically the same as in 1887, the product being 119 tons less. This coke is chiefly used for domestic purposes and in the smelting of lead, the most of the coke being used by lead smelters for their own use.

The statistics of the manufacture of coke in Kansas from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in Kansas, 1880 *to* 1888.

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	0	4,800	3,070	$6,000	$1.95	64
1881	3	15	0	8,800	5,670	10,200	1.80	64.4
1882	3	20	0	9,200	6,080	11,460	1.70	65
1883	4	23	0	13,400	8,430	16,560	1.96	62.9
1884	4	23	0	11,500	7,190	14,580	2.02	62.5
1885	4	23	0	15,000	8,050	13,255	1.65	53⅗
1886	4	36	0	23,062	12,493	19,204	1.54	54.2
1887	4	39	0	27,604	14,950	28,575	1.91	54
1888	6	58	0	24,934	14,831	29,073	1.96	59

KENTUCKY.

In Kentucky there are four districts: the first is the Cincinnati district, which includes the ovens on the Ohio river in Kentucky opposite Cincinnati; the second is the Louisville district, which includes the ovens near that city; (at both of these places slack coal from the coal yards is all that is used, the coal being brought from the upper Ohio); the third district is the western district, which has been thoroughly described in previous volumes of Mineral Resources; and in the fourth, the southeastern, only experimental work has been done.

In the southeastern district reports have been received from the Pine Mountain Iron and Coal Company, operating mines near Pineville in Bell county, and which had five ovens completed at the close of the year, and from the Main Jellico Mountain Coal Company, mining at Kensee, in Whiteley county, and which has only made some experimental coke on the ground. Mr. J. S. Ray, president of the Pine Mountain Iron and Coal Company, writes that their coal is exceptionally pure and clean, and that it will make a very good coke, low in ash, sulphur, and iron, and high in carbon. The company expected to be making coke by February 1, 1889.

At the mines of the Main Jellico Mountain Coal Company two beehive ovens were building for the purpose of testing the coke. An analysis of the coke is as follows:

Analysis of Jellico Mountain coke.

	Per cent.
Fixed carbon	84.60
Ash (gray brown)	14.70
Water	.70
Total	100.00

The amount of coke produced in Kentucky in 1888 was 23,150 tons, as compared with 14,565 tons in 1887, the chief increase in production being in the western district.

The statistics of the manufacture of coke in Kentucky from 1880 to 1888 are as follows:

Statistics of the total manufacture of coke in Kentucky, 1880 to 1888.

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	45	0	7,206	4,250	$12,250	$2.88	60
1881	5	45	0	7,406	4,370	12,630	2.89	60
1882	5	45	0	6,906	4,070	11,530	2.83	59
1883	5	45	0	8,437	5,025	14,425	2.87	60
1884	5	45	0	3,451	2,223	8,760	3.94	64
1885	5	33	0	5,075	2,704	8,489	3.14	53
1886	6	76	2	9,055	4,528	10,082	2.23	50
1887	6	98	0	29,129	14,565	31,730	2.18	50
1888	10	132	2	42,642	23,150	47,244	2.04	54

MISSOURI.

Nothing can be added to the information given in the last volume of Mineral Resources as to the manufacture of coke in this State. But one establishment, the Southwest Lead and Zinc Company, of Rich Hill, Bates county, produced coke.

The following are the statistics of the manufacture of coke in Missouri for the years 1887 and 1888:

Statistics of the manufacture of coke in Missouri in 1887 *and* 1888.

	1887.	1888.
Number of establishments	1	1
Ovens built	4	4
Ovens building	0	0
Coal used, short tons	5, 400	5, 000
Coke produced, short tons	2, 970	2, 600
Total value of coke at ovens	$10, 395	$9, 100
Value of coke at ovens, per ton	$3. 50	$3. 50
Yield of coal in coke, per cent	55	52

MONTANA.

Coke was made at but one establishment in this Territory in 1887, that of the Livingston Coal and Coke Company. At this plant there are now 40 ovens. A full description of the coal deposit from which this coke is made is given in previous volumes of Mineral Resources, and need not be repeated here.

The statistics of the manufacture of coke in Montana from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in Montana, 1880 *to* 1888.

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	0	0	0	0	0	0	0	0
1881	0	0	0	0	0	0	0	0
1882	0	0	0	0	0	0	0	0
1883	1	2	0	0	0	0	0	0
1884	3	5	12	165	75	$12	$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	$66\frac{2}{3}$
1888	1	40	0	20, 000	12, 000	18. 00	96, 000	60

NEW MEXICO.

The only concern making coke in New Mexico in 1888 was the San Pedro Coal and Coke Company, whose works are located at San Antonio, on the Rio Grande river.

The production declined in 1888, as compared with 1887, 5,170 tons, the total product in 1888 being but 8,540 tons, as compared with 13,710 tons in 1887.

The statistics of the manufacture of coke in New Mexico from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in New Mexico, 1880 to 1888.

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.*
1880	0	0	0	0	0	0	0	0
1881	0	0	0	0	0	0	0	0
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	91,410	57¼
1885	2	70	0	31,889	17,940	5	89,700	56¼
1886	2	70	0	18,194	10,236	5	51,180	56
1887	1	70	0	22,549	13,710	6	82,260	61
1888	1	70	0	14,628	8,540	6	51,240	58

a At one works there are ten stone pits, with an average capacity of 10 tons each.

OHIO.

The great increase in the production of coke in Ohio, noted in the last report, was not continued in 1888, the product falling from 93,004 tons in 1887 to 67,194 tons in 1888. In the Cincinnati district there was a slight increase, owing chiefly to the increased production at the North Bend Works of Lysle, Crow & Co. The great falling off was in the Steubenville, Leetonia, and Hocking Valley districts.

The same division of the State into districts that was contained in the last report is carried forward in this, the State being divided into two districts: the Cincinnati district, including the ovens near that city, and the Ohio district, which includes the ovens in the remainder of the State.

Cincinnati district.—As stated above, all the coke made in this district is from the dust and screenings of the coal yards of Cincinnati and from the coal boats and barges which bring coal from the upper Ohio, chiefly from Pittsburgh and the Kanawha region of West Virginia. The largest block of ovens in this district is that of North Bend, on the Ohio river a short distance below Cincinnati.

The statistics of the manufacture of coke in the Cincinnati district from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Cincinnati district, Ohio, 1880 to 1888.

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	12,545	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	56,733	32,894	2.91	95,754	56
1888	6	156	12	63,217	35,868	2.67	95,618	57

Ohio district.—This district includes all of the ovens coking Ohio coal, and comprises the ovens of the Cherry Valley Iron Works, at Leetonia, those of the Nelsonville Coal and Coke Company, and the Federal Valley Coal Company, in the Hocking valley, and the five coke works in the vicinity of Steubenville and Bridgeport.

The statistics of the manufacture of coke in Ohio from Ohio coal from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Ohio district, Ohio, 1880 *to* 1888.

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	40, 899	1. 68	57¾
1887	10	435	203	108, 251	60, 110	130, 227	2. 12	55½
1888	9	391	0	60, 984	31, 326	70, 712	2. 25	51

Total coke statistics for Ohio.—In the following table the statistics of the coke made in the several districts of Ohio for the years 1880 to 1888 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880 *to* 1888.

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	91, 042	2. 69	59
1887	15	585	223	164, 974	93, 001	245, 981	2. 65	56
1888	15	547	12	124, 201	67, 194	166, 330	2. 48	54

PENNSYLVANIA.

The same division into districts that was observed in the last volume of Mineral Resources is continued in this, the "Irwin-Latrobe" district of the early reports now being called the "Upper Connellsville," while what was known as the "Snow Shoe" district is now called the "Clearfield-Centre," from the two counties in which the ovens are located. These divisions into districts are based in part upon geographical and topographical distinctions and in part upon the routes to market of the coke produced.

Total coke production in Pennsylvania.—Consolidating the statistics of the different districts given hereafter, the following are the statistics of the production of coke in Pennsylvania from 1881 to 1888:

Statistics of the manufacture of coke in Pennsylvania, 1881 *to* 1888.

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.*
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

In 1888, Pennsylvania produced 6,545,779 tons, or 76.5 per cent. of the 8,540,030 tons, the total product of the United States in that year. This is practically the same as its percentage of the product in 1887, the percentage for that year being 76.6 per cent. As Pennsylvania has 20,381 of the 30,059 ovens in the United States, or 68 per cent., it will be seen that the percentage of ovens is much less than the percentage of product. The production per oven in Pennsylvania in 1888 was therefore greater than in the rest of the country.

The number of ovens in Pennsylvania increased during the year from 18,294 to 20,381, or 10 per cent. At the close of 1888 there were 1,565 ovens building, as compared with 802 at the close of 1887. The coke produced, as has already been stated, in 1888 was 6,545,779 tons, as compared with 5,832,849 tons in 1887, an increase of 712,930 tons, or 12 per cent. In the production of this coke 9,673,097 tons of coal were used, the yield being 68 per cent. The total value of the coke produced in 1888 was $8,230,759, the average value per ton being $1.26. This is the lowest price since 1885. In that year and 1884 the average value of coke produced was $1.25. In 1883 it was $1.22.

The Connellsville district.—The Connellsville district, which still remains the most important coke-producing center in the United States, and one of the most important in the world, has been so thoroughly described in previous volumes of Mineral Resources as to require only the briefest reference here. It may be well to say, however, that the Connellsville coal basin is in the southwestern part of Pennsylvania, some 50 or 60 miles from Pittsburgh. It is a slender prong, separated from the Upper Coal Measures, and may be regarded as extending from south of Latrobe, on the Pennsylvania railroad, in a southwesterly direction, to the Virginia line, forming a basin some 3 miles wide and 50 miles long, almost without a fault, the beds yielding from 8 to 10 feet of workable coal. The same trough that contains the Connellsville coal extends northwesterly from Latrobe, but the Connellsville region proper is regarded as extending no farther north than the vicinity of Latrobe. We have designated the district north of the Connellsville proper as the "Upper Connellsville." It is known locally as the "washed coal district."

In the Connellsville district there were produced, in 1888, 4,955,553 tons of the 6,545,779 tons produced in Pennsylvania, or 75 per cent. As 8,555,030 tons of coke were produced in the United States in 1888, the product of the Connellsville region would be 57 per cent. of this amount. Of the product of Pennsylvania in 1887, the Connellsville region is credited with 71 per cent., and in the same year 54.4 per cent. of the total product of the United States. It will thus be seen that in both respects—that is, in the percentage of the product of Pennsylvania and in the percentage of the product of the United States—there was an increase in the Connellsville region in 1888.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1888:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880 *to* 1888.

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

This production of the Connellsville region is the largest in its history, and, as is shown above, by far the largest of any district in the United States. The production is also increasing, the amount of coke made in this district in 1889 promising to be much in excess of that made in 1888.

It will be noticed that there has been during the year a marked increase in the yield of coal and coke in the Connellsville district. It has been generally believed that it is not possible to get a product of more than about 66 to 67 per cent. in coke from the Connellsville coal. Reports received from those who have made a careful study of this question would indicate that a yield in excess of this is obtained at very many of the works. One establishment, where the coal was weighed carefully during the past year, reported a yield of 74 per cent., and another a yield of 72 per cent., and quite a number report 67, 68, and 69 per cent.

Prices of Connellsville coke.—At the close of 1887 the price of coke was $2 free on board cars at ovens, but with the opening of 1888 producers reduced the price to $1.75. By the end of January the demand declined and the trade rapidly grew worse. When March closed a large proportion of the ovens in the Connellsville region were shut down, and prices declined. In April, as the result of the failure of the syndicate to maintain its organization, coke for the first time since 1884 sold at $1. By the middle of June the closing down of mills and furnaces made the coke trade still worse, and about one-fourth of the ovens in the entire region were closed down, and those that were kept running were on limited production. July increased the dullness, but before the end of that month a slight improvement was noticeable. August strengthened the improvement, and a reduction of wages which had been effected some time previously cheapened production somewhat and increased trade, but without bettering prices. During this month began the series of unsuccessful efforts to form a new coke combination comprising the firms interested in the former syndicate. The demand continued to improve until the close of August, when occurred the heavy rains that almost blockaded the region and threw shipments greatly behind. Throughout September the prospects grew brighter, and a marked increase in shipments was noted early in October. Transient orders swelled eastern shipments particularly, and when October closed the shipments during that month had beaten all previous records in the history of the Connellsville coke region, and showed an increase of 50 per cent. in five months. The scarcity of cars and the prevailing low price were the only drawbacks to the prosperity of the trade. On October 29, the Connellsville Coke Producers' Association was formed by a number of the smaller concerns combining to sell their coke through Messrs. J. W. Moore & Co. This had the effect of raising prices, and when November came coke was put up to $1.25. The record of shipments for November exceeded even those of October, and was ahead of anything previously known in the region. During December there was considerable talk of advancing prices, but nothing definite was done. The Frick scale was continued until February 1, thus postponing a general discussion of the wage question in the coke region.

The following table gives prices free on board at the ovens for the past eight years:

Monthly prices of Connellsville blast-furnace coke, free on board at ovens.

Months.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
January	$1.50–$1.75	$1.70–$1.80	$1.15–$1.20	$1.00	$1.10	$1.20	$1.50	$1.75
February	1.50 1.75	1.70– 1.80	1.20– 1.10	1.00	1.10	1.20	2.00	1.75
March	1.50– 1.75	1.70– 1.75	1.05	1.00	1.10	1 35	2.00	$1.25– 1.50
April	1.60– 1.75	1.70– 1.75	1.05	1.10	1.20	1.35	2.00	1.00
May	1.60– 1.65	1.65– 1.70	.95– 1.05	1.10	1.20	1.50	2.00	1.00
June	1.60– 1.65	1.50– 1.65	.90	1.10	1.20	1.50	2.00	1.00
July	1.50– 1.60	1.35– 1.50	.90	1.10	1.20	1.50	2.00	1.00
August	1.60	1.35	.90	1.10	1.20	1.50	2.00	1.00
September	1.60	1.25– 1.35	1.00	1.10	1.20	1.50	2.00	1.00
October	1.60– 1.65	1.25	1.00	1.10	1.20	1.50	2.00	1.00
November	1.60– 1.65	1.25– 1.35	1.00	1.10	1.20	1.50	2.00	1.25
December	1.60– 1.70	1.15– 1.35	1.00	1.10	1.20	1.50	2.00	1.25

The above rates are for coke for blast-furnace use, and are the ruling prices for this grade of coke free on board cars at the ovens. For other grades the prices at ovens, at the close of the year, were as follows: Furnace coke to dealers, $1.35; foundry coke, $1.50; crushed coke, $2.20.

The freights on furnace coke per net ton in car lots from Connellsville to chief points of consumption in the west at the close of the year were: From the ovens to Pittsburgh, 70 cents per ton; to the Mahoning and Shenango valleys, $1.35; East Saint Louis, $3.20; Cleveland, $1.80; Chicago, $1.75.

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, second only to the Connellsville. Its product for several years prior to 1888 was in excess of that of any other State, and among the districts of Pennsylvania it is surpassed only by the Connellsville.

This district includes not only the ovens in the upper part of the Connellsville basin, but also the others along the line of the Pennsylvania railroad from Larimer to Blairsville. These ovens are situated in three of the coal basins of western Pennsylvania, the Upper Connellsville, the detached Greensburgh basin, and the upper part of the Irwin basin. The lower part of the Irwin basin, or the ovens along the line of the Baltimore and Ohio railroad, are included with the ovens of the Pittsburgh district. In this district most of the coke made is from washed slack, and at most ovens the coal used, whether slack or run-of-mines, is washed before coking.

It will be noted that the number of ovens has increased from 1,442 to 1,977, an increase of 535. The production of coke, however, has decreased by 28,267 tons, or about 4 per cent. This is due, of course, to the depression in trade during the earlier part of the year, which caused the closing down of many of the ovens, and the light running of others. The yield of coal in coke, which has been steadily improving since 1884, shows a gain of 2.4 per cent. as compared with the average yield for the year before. In 1887 the yield had gained 1.5 per cent. over that of the year preceding.

The total value of the coke produced was $617,189, or $1.40 per ton, which, with the exception of 1888, is the highest price reached since 1882.

The following are the statistics of the manufacture of coke in the Upper Connellsville region for the years 1880 to 1888:

Statistics of the manufacture of coke in the Upper Connellsville district, 1880 to 1888.

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

Allegheny Mountain district.—The Allegheny Mountain still continues to be third in importance of the coke districts of Pennsylvania. It includes not only the ovens along the line of the Pennsylvania railroad, comprising those on both sides of the Alleghenies in Cambria and Blair counties, but those of Somerset county also. The number of establishments in the district has increased from 10 to 12, and the number of ovens built from 694 to 950, while 145 ovens are reported as building, against 150 the year before. The increase in product of coke over 1887 amounts to 59,125 tons, or a little over 11 per cent.

As noted in the last report, the coke made in this locality is an excellent fuel, and, being within comparatively easy reach of the Eastern markets, finds great popularity in them. The Gallitzin Coke Works continues to lead the district in number of ovens and quantity of coke produced, but several other establishments have materially increased their capacity and output within the year and still greater extensions of plant are in contemplation.

The following is an analysis of the coke made at the Altoona Coal and Coke Company's works. Other analyses of cokes from this district will be found in former reports.

Analysis of coke from the Allegheny Mountain district, Pennsylvania.

	Per cent.
Fixed carbon	89. 275
Ash	9. 030
Sulphur	. 783
Volatile matter	. 748
Moisture	. 164
Total	100. 000

A very material decline in price is shown by a comparison of the average rate for this year, $1.43 per ton, and the $2.25 rate of the year before.

The following are the statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania for the years 1880 to 1888:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880 *to* 1888.

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

Clearfield-Centre district.—In this district, formerly known as the "Snow Shoe district," the number of establishments remains the same, while the number of ovens built has been increased by 78. The production for the year was 115,338 tons, as compared with 97,852 tons the year before. The yield of coal in coke has increased about 3.3 per cent. The average price per ton for the year is $1.51, as compared with $2.02 in 1887.

The statistics of the manufacture of coke in the Clearfield-Centre district for the years 1880 to 1888 are as follows:

Statistics of manufacture of coke in the Clearfield-Centre district, Pennsylvania, 1880 *to* 1888.

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

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 decrease in the number of ovens reported as built is due in part to the fact that one firm, owning ovens in another district also, last year reported all of its ovens as in this district. At another establishment the number of ovens reported for this year is considerably lower than that of a year ago. The product of coke for the year is about one-fourth less than that of the year before, and the average price is greater, being $2.40 as against $2.11 in 1887. The last-named item, however, is not significant, as little of the coke is sold, most of it being used by the owners of the coke works, who give in some cases the market price and in others the cost at the ovens.

The statistics of the manufacture of coke in the Broad Top region, Pennsylvania, for the years 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Broad Top region, Pennsylvania, 1880 *to* 1888.

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	491	0	196,015	119,469	2.40	286,655	61

Pittsburgh district.—This district ranks fifth in importance among the districts of Pennsylvania. As noted in the last report, the experiments in connection with Belgian ovens in this State, which were conducted at so much expense, with so much intelligence, and through such a long period of time, were finally abandoned, and there are now no ovens in western Pennsylvania except the beehive ovens. An examination of the following table will show that the number of establishments in the district has increased by 2 and the number of ovens an even 100. The product of coke has advanced 87,059 tons, or nearly 50 per cent., being the largest in the history of the region; and the average selling price has fallen from $1.78, in 1887, to $1.33, in 1888. The yield of coal in coke at several establishments has materially increased, and the general average for the district has risen from 48.4 per cent., in 1887, to 62 per cent., in 1888. Much of this difference may be due, however, to the stage in the operation at which the coal is weighed—that is, whether before or after washing.

The statistics of the manufacture of coke in the Pittsburgh district, Pennsylvania, for the years 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Pittsburgh district, Pennsylvania, 1880 *to* 1888.

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

Beaver district.—The use of natural gas in the Beaver district destroyed the demand for coke in that locality during 1888, only one of the four establishments in the district reporting any production for the period covered by these statements. The supply of gas in the neighborhood is, however, diminishing, and the owners of the coke plants expect that the suspension of demand for their product will prove but temporary.

The increase of 1 in number of establishments and 80 in number of ovens built given in this report is due not to increased construction, but to the fact that one works failing to report in 1887 sent its statement for 1888.

The following are the statistics of the manufacture of coke in the Beaver district, Pennsylvania, for the years 1880 to 1888:

Statistics of the manufacture of coke in the Beaver district, Pennsylvania, 1880 *to* 1888.

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	0	8, 013	4, 880	$10, 150	$2.08	61
1881	5	106	0	6, 887	4, 333	9, 013	2.08	63
1882	5	106	0	11, 699	7, 960	15, 124	1.90	68
1883	5	107	0	19, 510	12, 395	21, 062	1.70	64
1884	4	89	0	2, 250	1, 390	2, 168	1.56	62
1885	4	89	0	686	438	696	1.59	63
1886	3	87	0	698	411	646	1.57	59
1887	3	65	0	25, 207	13, 818	24, 137	1.75	55
1888	4	145	0	262	175	260	1.48	66.6

Allegheny Valley district.—This 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 eighty-eight ovens reported as building at the close of 1887 were completed during the year, and increase the total number of ovens built at the close of 1888, but the production of coke has dropped to one-half that of the preceding year. The yield of coal in coke is reported as a trifle in advance of that of 1888, and the selling price has averaged $1.66, as against $1.90 a year ago.

The statistics of the manufacture of coke in the Allegheny Valley district for the years 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Allegheny Valley district, Pennsylvania, 1880 to 1888, 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	77,766	44,621	84,913	1.90	57.1
1888	5	376	0	37,792	21,719	36,008	1.66	57.5

Reynoldsville-Walston district—This district continues to hold its place as one of the most important of the coking districts of the United States, including as it does all of the ovens on the Rochester and Pittsburgh railroad, as well as those on the low-grade division of the Allegheny Valley road, and the Dagus mines of the New York, Lake Erie and Western. A full description of the district will be found in previous volumes of Mineral Resources. In number of ovens built this district, which in 1887 ranked second only to the Connellsville, now descends one in rank, that is, below the Upper Connellsville, the increase for the year being the number reported as building a year ago. It will also be noted that the Reynoldsville-Walston is one of the three districts in the State having ovens building at the close of 1888. In point of production, however, the district ranks fifth in the State, many of the ovens having been idle a portion of the year. The yield of coal in coke is substantially what it was for the previous year, and the average price $1.26, as compared with $1.88 the year before.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1888:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880 to 1888.

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	1.34½	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

Blossburgh district.—In this district are included the two establishments making coke from the coal of the Blossburgh coal field.

The returns for 1888 show a decline in production since 1887 of 63 per cent.

The following are the statistics of the manufacture of coke in the Blossburgh, Pennsylvania, district from 1880 to 1888:

Statistics of the manufacture of coke in the Blossburgh district, Pennsylvania, 1880 *to* 1888.

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

Statistics of coke production in Pennsylvania, by districts.—In the following table is given in a consolidated form the statistics of coke production in Pennsylvania, by districts, for 1888:

Coke production in Pennsylvania in 1888, 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 cent.*
Connellsville	39	12,818	1,320	7,191,708	4,955,553	$5,884,081	$1.19	69
Upper Connellsville	16	1,977	0	657,966	441,966	617,189	1.40	68
Allegheny Mountain	12	950	145	521,047	335,689	479,845	1.43	64.4
Clearfield-Centre	6	601	0	172,999	115,338	174,220	1.51	66.6
Broad Top	5	491	0	196,015	119,469	286,655	2.40	61
Pittsburgh	22	980	0	428,899	264,156	350,818	1.33	62
Beaver	4	145	0	262	175	260	1.48	66.6
Allegheny Valley	5	376	0	37,792	21,719	36,008	1.66	57.5
Reynoldsville-Walston	9	1,636	100	404,346	253,662	320,283	1.26	62.7
Blossburgh	2	407	0	62,063	38,052	81,400	2.14	61
Total	120	20,381	1,565	9,673,097	6,545,779	8,230,759	1.26	68

TENNESSEE.

In number of ovens and production of coke Tennessee, which in the last volume of Mineral Resources was ranked as the third State in the Union, has, in 1888, been surpassed by Alabama, and is now the fourth State as regards importance in this respect. The total number of ovens has increased by 164 during the year, and 84 ovens were reported as building at the close of 1888. A slight decrease in the production of coke is noted, amounting to less than 3 per cent.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1888:

Statistics of the manufacture of coke in Tennessee, 1880 to 1888.

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 ton.	*Short ton.*			*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

a One establishment made coke in pits.

TEXAS.

No coke was produced in Texas in 1888.

VIRGINIA.

As was remarked in the last report, the ovens at Low Moor, Alleghany county, just across the line from West Virginia, draw their coal supply from West Virginia, but are reported as a Virginia establishment. A comparison of the figures for 1888 with those of the previous year shows an increase of 200 ovens, but a slight decrease in production. The comment upon the high percentage yield of coal in coke noted in the last report, to the effect that the rate reported was incredibly high, is borne out by the report for 1888, which gives the yield as some 6 per cent. less, and probably nearer to the correct figure.

The following are the statistics of the manufacture of coke in Virginia from 1880 to 1888:

Statistics of the manufacture of coke in Virginia, 1880 to 1888.

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	0	0	0	0	0	0	0	0
1881	0	0	0	0	0	0	0	0
1882	0	0	0	0	0	0	0	0
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	49,139	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

WASHINGTON.

An insignificant amount of coke was made at the ovens of the Tacoma Coal Company, at Wilkeson, Washington in 1888, the energy of the company being confined to developments in its coal property. It started up its ovens again at the close of the year, however, and promises an increased production in 1889. Two new establishments in this locality are reported as having under construction fifty ovens each. One of these, the Atlas Coal and Coke Company, which is building ovens at Tacoma, gives the following as an analysis of its coke:

Analysis of Atlas coke, Tacoma, Washington.

	Per cent.
Water and volatile matter	2
Carbon	84
Ash	14
Total	100

Analysis of ash from above coke.

	Per cent.
Silicon	35.00
Aluminum	18.03
Lime	4.02
Oxide of iron	37.08
Magnesia	None.
Total	94.13

The following are the statistics of the manufacture of coke in Washington for the years 1884 to 1888, the only years in which coke has been made:

Statistics of the production of coke in Washington, 1884 to 1888.

	1884.	1885.	1886.	1887.	1888.
Number of establishments	1	1	1	1	3
Number of ovens built	0	2	11	30	30
Number of ovens building	0	0	21	0	100
Coal used in the production of coke, short tons	700	544	1,400	22,500	....
Coke produced, short tons	400	311	825	14,625	....
Total value of coke at ovens	$1,900	$1,477	$4,125	$102,375	....
Value of coke at ovens, per ton	$4.75	$4.75	$5.00	$7.00	....
Yield of coal in coke, per cent	57½	57	58.9	65	....

WEST VIRGINIA.

The division of West Virginia into districts is precisely the same as that followed in the volume of Mineral Resources for 1887. 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 what was formerly known as the Chesapeake and Ohio railroad from Low Moor, in Virginia, to the Kanawha valley. The Flat Top region includes the ovens in the new 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 Pittsburgh railway, in what may be called the Upper Potomac basin.

The Kanawha district.—In this district are included the ovens from Ansted down the Kanawha, all drawing their coal from the formations described in the volume of Mineral Resources for 1886.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880 *to* 1888.

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 ct.*
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

a Eighty of these ovens are Coppée, the balance beehive.
b Sixty of these ovens are Coppée, the balance beehive.

An increase of 2 in the number of establishments is noted and of 24 in ovens built. The amount of coke produced during the year has decreased something less than one-eighth as compared with the production of the year before, which was unusually large.

Production of West Virginia by districts.—In the following table will be found the statistics of the production of coke in West Virginia in 1888 by districts:

Production of coke in West Virginia in 1888, *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.
								Per ct.
Kanawha	9	572	8	141,641	84,052	$146,837	$1.75	59
New River	12	743	0	334,695	199,831	390,182	1.95	60
Flat Top	13	882	200	164,818	103,947	183,938	1.77	63
Northern	17	567	110	213,377	138,097	175,840	1.27	64.7
Upper Potomac..	1	28	0	9,176	5,835	8,752	1.50	64
Total	52	2,792	318	863,707	531,762	905,549	1.70	61.6

New River district.—The New River coking district includes the ovens along the line of what was formerly known as the Chesapeake and Ohio railroad from Quinnimont to Nuttallburgh. It has been so frequently described in these reports as to require no description at this time.

The statistics of the manufacture of coke in the New River district from 1880 to 1888 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880 to 1888.

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	63¾
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

A comparison of the reports for this and the preceding year shows an increase of one in the number of establishments, 225 in the number of ovens built, and 39,995 tons in the amount of coke produced. The total value of product for the year is less, however, owing to the reduced price per ton.

The following is an analysis of the coke made by Messrs. Thomas and Lomax at Sunnyside, Fayette county:

Analysis of coke from the New River district, West Virginia.

	Per cent.
Fixed carbon	92.180
Ash	6.680
Sulphur	.618
Volatile matter	.350
Moisture	.110
Total	99.938

Flat Top district.—The statistics of the manufacture of coke in the Flat Top district for the years 1886 and 1888 are as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia for 1886, 1887, and 1888.

	1886.	1887.	1888.
Number of establishments	2	5	13
Ovens built	10	348	882
Ovens building	38	642	200
Coal used, short tons	1,075	76,274	164,818
Coke produced, short tons	658	51,071	103,947
Total value of coke at ovens	$1,316	$100,738	$183,938
Value of coke at ovens, per ton	$2.00	$1.97	$1.77
Yield of coal in coke, per cent	61.2	67	63

Coke was made in this field for the first time in 1886. Consequently the table covers the operations for 1886, 1887, and 1888 only. The remarkable development of coke manufacture in this district within its short history, has been noted in previous reports, and still continues. Within the past year the number of establishments has increased from

5 to 13, the number of ovens from 348 to 882, and the amount of product from 51,071 tons to 103,947 tons, or nearly 104 per cent.

This field is of so much importance that a description of it and its coke may be of interest. A portion of the field lies in Virginia, but it will be treated as a whole.

This district was known in its early history as the Pocahontas, from the mining town where the first important developments were made, and then as the Flat Top, from the great Flat Top mountain in which the Measures are found, but which is now known accurately as the Pocahontas Flat Top field, but called usually the Flat Top.

This field is located, so far as the Measures have been worked, in the counties of Tazewell, in southwest 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.

This mountain is the most conspicuous and important feature in the region. Numerous streams find their source on its sides, run rapidly down a short distance, and then follow a sluggish course with moderate fall. High ridges between these streams hold the coal beds. The valleys are narrow, usually, with steep slopes.

Until April 1, 1887, the territory east of Flat Top mountain was owned by several coal companies. At this date these were all consolidated into what is known as the Flat Top Land Trust, which now owns most of the lands, with the exception of those owned by the Crozer Land Company, on the Elkhorn. The Trust owns 10,000 acres in Tazewell county, Virginia., including the Pocahontas lease of 3,800 acres; 45,000 acres in Mercer county, West Virginia—the Bluestone district; 55,000 acres in McDowell county, West Virginia—the Elkhorn district; and over 90,000 acres in Wyoming county, on which no leases have yet been made. The Crozer Land Company owns 16,000 acres. The lands of the two companies are so interwoven on the Elkhorn that they squared the connecting tracts and organized the South Elkhorn Coal Company, the two companies jointly forming this company, on whose land four leases have been made. The Crozer Land Company also have lands on the Elkhorn other than these in the South Elkhorn Coal Company. No land is sold, all being held and worked by the operators under lease. Even the Southwest Virginia Improvement Company, which was one of the first to mine coal in this region, and which is the only operator in the Pocahontas district proper, sold all of its land to the trust, when it was formed, and became a lessee under practically the same terms as the other companies. The royalties are from 6 to 10 cents a ton (2,240 pounds) of coal sold as coal and 12 to 15 cents a ton (2,240 pounds) coke produced. The standard royalty of coal is 10 cents, the 6 and 8 cent royalty being paid in the northern part of the field where the coal bed is smaller than in the southern part. A minimum payment of $7,500 per year is required from each lease. There are at present, including those given by the Crozer Land Company, fifteen leases in this field; one in the Pocahontas district; six in the Bluestone; four on the land of the South Elkhorn Land Company, and four on the land of the Crozer Land Company. The total land covered by these leases is only about 10,000 acres of the 216,000 acres of coal land in this district, and only about 9,000 acres of the 162,000 actually underlaid with coal. The Land Trust employs a mine inspector to visit all parts of the mines and see that a proper system of mining is carried on, and that no coal is unnecessarily lost. Since this coal has made such a fine grade of coke, all leases now given require the building of 100 coke ovens.

There are in this field at least three workable beds above water level. No. 3, the Pocahontas bed, is the one worked. This bed has a workable thickness of from 11 to 13 feet at Pocahontas, though the whole thickness is not mined, a portion of the top of the seam being left for the roof, and in some cases a portion of the bottom is left for the floor. The thickness of the seam diminishes toward the northwest and northeast from Pocahontas. On the Virginia line it is about 11 feet, and diminishes to 5 or 6 feet on Flipping creek, in the Bluestone region, and 4 to 5 feet further north. On the Elkhorn it is from 7 to 9 feet, and on the Tug Fork of the Big Sandy from 6 to 10 feet.

This coal seam is absolutely without a slate parting. It is split up into two distinct workable seams by the thin streak of bone coal quite rich in carbon. This has been called a slate parting, though improperly so. This bone coal increases in thickness northward, reaching 6 or 7 feet on Flipping creek, dividing coal bed No. 3 into two seams. The seam is also free from all faults. Clay veins, spars, rolls, or horse-backs are never found in it. Everything handled by the miner is placed in the wagon, excepting in the Elkhorn district. A small streak of "bone coal" is here found near the top which is condemned by the inspectors, and has to be thrown out. Certain portions of the coal at some openings that have been discolored by water, termed "rusty coal," are also thrown out by the inspectors, though analysis shows it to be equal to coal not thus discolored.

This coal field occupies a very large area in Tazewell county, Virginia, and in Mercer, Wyoming, McDowell, and Raleigh counties, West Virginia. In this territory there are nearly, if not quite, 215,000 acres owned or controlled by the two chief owners of the coal land in this section, the Flat Top Land Trust and the Crozer Land Company. Of this large area from 160,000 to 175,000 acres are underlaid with coal. The No. 3 vein, the one worked, has an average thickness of about 8 feet. At the usual estimate of 1,000 tons per acre for each foot of coal, from these figures some idea of the vast amount of coal in this field may be gained. Not only have the operators this magnificent seam of coal to work upon, with its good roof and floor, but the mines are situated above water level, requiring no drainage. Indeed, some of the mines of the Southwest Virginia Improvement Company are so dry as to require constant wetting to guard against a recurrence of the disastrous explosion for which this mine has become unfortunately noted. The Measures seem to be nearly horizontal, the rise of the coal bed being no more than is needful for drainage. This also reduces the cost of hauling to a minimum. Where mules are employed the absence of heavy grades permits large loads, and the coal bed is so high that mine locomotives can be employed when desired without many of the objections to their use that are found in other sections. There is an ample supply of timber to furnish all that is required in mining operations. The lessees are permitted to cut from the premises all timber necessary for building purposes or mine use. The most of the companies set up saw mills and get out all lumber required for their buildings, etc., thereby saving a large bill of expense.

The Flat Top coal is semi-bituminous, somewhat dull in luster, rather hard in the bed, requiring powder to mine it, but, as will be seen from the following analyses, low in volatile matter and ash and high in fixed carbon. It is a superior grate and steam coal, giving an exceedingly bright, hot, clear fire. It makes an excellent coke. Of the analyses of the Flat Top coal given below, No. 1 is an average of five samples from the mines of the Southwest Virginia Improvement Company in the Pocahontas field; No. 2 is "run-of-mine" from same district; No. 3 is from Mill creek in the Bluestone district, and No. 4 from Flipping creek in the same district; while No. 5 is an average of 15 analyses of the coal from the two districts; No. 6 is from the Elkhorn.

Analyses of Pocahontas Flat Top coal.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	.932	.684	.492	.786	1.011	1.112
Volatile matter	20.958	19.964	19.278	18.939	18.812	17.898
Fixed carbon	73.728	73.021	73.948	76.077	72.708	74.524
Sulphur	.668	.656	.847	.793	.787	.514
Ash	3.984	5.675	5.435	3.405	5.191	5.952

Taking No. 5 of the above, which is an average of 15 analyses, as the average analysis of the Flat Top coal, and the analysis of the coal of the Broad Ford mines of the H. C. Frick Coke Company as the typical analysis of Connellsville coal, and we have the following for comparison:

Comparative analyses of Connellsville and Flat Top coal.

	Flat Top coal.	Connellsville coal.
	Per cent.	*Per cent.*
Water	1.011	1.260
Volatile matter	18.818	30.107
Fixed carbon	72.708	59.616
Sulphur	.787	.784
Ash	5.191	8.233

The rates paid for mining in this district are 75 cents per wagon of 90 cubic feet (2 tons) for room coal and $1.05 a car for entry coal. As more than the usual proportion of the coal taken out is entry coal, this increases the cost at the present time somewhat above the average, but in the near future when the rooms are mined out the cost will be reduced below the average. On the basis of 45 cubic feet to the ton of 2,240 pounds, the price of mining is 37½ cents for the room coal and 52½ cents for entry coal. Breaking through rooms is paid $1 per yard and tonnage; turning rooms, 50 cents per yard and tonnage. The company lays all roads and posts the rooms, the miner having nothing to do but mine and load into the car everything he brings down from the bed. Drivers are paid $1.68; trappers, 58 cents; track layers, $1.75; men at the head of the tipple, $1.75; men standing props, $2; laborers, $1.20 per day. Powder costs the men about 5 cents a ton of coal mined; tool sharpening, 50 cents a month. Good miners average 4 cars a day in the Pocahontas mines. On the narrower seam on the Bluestone a miner with a boy or a common laborer will average about the same. It is estimated that the average wages of miners per month are $45; some make as high as $120 to $130 per month. Prop setting and track laying costs the operators at some places, it is claimed, 5 to 6 cents per ton of coal produced. It is asserted, however, that in some cases it can be done from 2½ to 3 cents, and even as low as 1¼ cents. When so large a proportion of entry work is done as in this field, the cost of timbering is above the average. From the above figures some idea as to the cost of coal per ton may be gathered. It is claimed that the cost of dead work and hauling is 25 cents a ton. On the basis of room coal, then, the cost would be as follows:

Cost of mining Flat Top coal.

	Cost.
	Cents.
Mining	37½
Dead work and hauling	25
Royalty	10
Total	72½

This is probably very near the cost of run-of-mine coal. If the mine cars hold over 2 tons, the cost of mining will be relatively reduced. In estimating profits it should be borne in mind that pay is largely in store orders, which may be regarded as either reducing the cost or increasing the profit.

An inspection of the analysis of the Flat Top coal would not lead to the belief that it is a good coking coal. While it has the advantage of being low in ash, and consequently should produce a coke high in carbon, it would be regarded as being too low in volatile matter to agglutinate properly, having, as per the typical analysis given elsewhere, only 18.812 per cent. as compared with 30.107 per cent. in the Connellsville coal. While it makes an excellent coke when burned as run-of-mine, the coke is greatly improved by having the coal specially prepared for coking by crushing. When run-of-mine is charged the lumps frequently come out of the oven simply charred, the volatile matter being driven off and the bond of the coal entirely broken. This charred coal is known locally as "roasted coal." Notwithstanding this lack of volatile matter, the coal makes a most excellent coke, not as bright as the Connellsville, possibly more friable, but having more fixed carbon, making a first-class furnace fuel, capable of carrying in the furnace as heavy a burden as the Connellsville and being much lower in ash.

The coking process is carried on, however, at the expense of a considerable portion of fixed carbon. To make a ton of coke requires 1.6 tons of coal, containing, on the basis of 72.708 per cent. of fixed carbon, $126\frac{1}{3}$ units of carbon. In other words, as the coke contains only $91\frac{1}{2}$ units of fixed carbon there has been a loss of $34\frac{5}{6}$ units of carbon in the coking process, or more than one-fourth of the fixed carbon contained in the coal necessary to make a ton of coke. In coking Connellsville coal little or no fixed carbon is lost, or if it is burned its loss is made up by the carbon from the volatile matter, so that in the coke there will be found more carbon than the total fixed carbon in the coal. The practice with this Flat Top coal should certainly be better than it is at present, and the percentage of coke obtained greater. Better results, no doubt, will be secured through improvements in preparing the coal for coking, through other improvements in the ovens and in coking methods.

The cost of a bank or block of ovens in this district, which are all beehive, varies somewhat with the nature of the ground and consequent amount of grading to be done. Mr. Wilhelm, who has built a large number of ovens in this district, estimates the cost per oven of a block or bank of 100 ovens as follows:

Double block, including rail on top of ovens and larry, each	$375
Double block, with rail only, each	350
Single bank, $25 each less.	

Mr. Wilhelm also estimates the cost of block ovens, including grading, wharf, larries, tipple cars, etc., at $450 each. The actual cost of a block of 100 ovens built in 1888, not including mine cars, was $43,600. This block required some heavy grading. The brick used are chiefly Mount Savage and Black Lick, and were delivered in 1888 as low as $27 per thousand. Mr. Wilhelm is of the opinion that the ovens are too large for the coal used. His view is that the 11-foot 6-inch oven burns more actively and quicker than the 12-foot oven. The charge for the 12-foot oven he regards as so heavy and deep that either the charge must be coked at the expense of the coal at the top or the bottom of the charge will be improperly burned, giving black ends. It is possible that in changes in shape and size of oven will be found a method of reducing the waste of fixed carbon in the process of coking referred to elsewhere.

The first coke ovens erected in this field were those built by the Southwest Virginia Improvement Company, at Pocahontas, in 1883. The first ovens built in the Bluestone region were in 1886, while the first ovens built in the Elkhorn district were built in 1888. At the close of 1888 there were in this field 1,282 ovens, about equally divided between the three districts, there being 400 in the Pocahontas, 486 in the Bluestone, and 396 in the Elkhorn district. The number of ovens built and building at the close of 1888, and the number contemplated in the near future, are shown in the following table. The ovens put down as "completed" represent all the ovens ready for operation in May or June, as all construction work was discontinued during the winter. The ovens reported in the column "under construction" were partially built at the time of writing this report, to be completed rapidly when spring opened, while those given as "contemplated" constituted those upon which no actual work had begun.

Coke ovens built, building, or contemplated in the Flat Top region.

	Completed.	Under construction.	Contemplated.
Pocahontas district.			
Southwest Virginia Improvement Company	400		
Bluestone district.			
John Cooper & Co	150		50
Freeman & Jones (Casewell Creek Coal and Coke Company.)	114	16	
Wm. Booth Co	66		34
Stephenson, Mullin & Co	56		56
Robert Goodwill & Co	50		
Louisville Coal and Coke Company	50		
Elkhorn district.			
Elkhorn Coal and Coke Company	50		50
Shamokin Coal and Coke Company	50		50
Norfolk Coal and Coke Company	16	34	50
Norfolk Coal and Coke Company, Lick Branch Colliery			100
Turkey Gap Coal and Coke Company	80	20	
Crozer Coal and Coke Company	100		
Houston Coal and Coke Company	100		
Powhatan Coal and Coke Company		50	50
Total	1,282	120	440

It will thus be seen that, when all of the ovens that are under construction and contemplated are built, the total number of ovens in the field will be 1,842. This will make this coking district one of the most important, in number of ovens, in the country. It will be surpassed in this respect only by the Connellsville and the Alabama districts. The indications are also that the growth of this district will in the near future place it both in number of ovens and production far in advance of any other coking district in the United States, except the Connellsville.

The growth in the number of ovens in this district since 1883 is shown in the accompanying table:

Number of ovens in the Flat Top region from 1883 *to* 1888.

Years.	Pocahontas district.	Bluestone district.	Elkhorn district.	Total.
1883	200	....	....	200
1884	200	....	....	200
1885	200	....	....	200
1886	200	10	....	210
1887	300	384	....	684
1888	400	486	396	1,282

The charge to a 12-foot oven is about 9,000 pounds for 72-hour coke, and 8,000 for 48-hour. In burning, the oven is exceedingly hot—"a white heat." Though the oven is so hot in burning, there is still difficulty experienced in maintaining hot ovens except at the expense of the fixed carbon in the coal. Great care is also required in quenching the ovens properly in drawing in order to avoid "cold bottoms" and "black ends." When these do result, the greatest care is necessary to bring the ovens up to the proper heat again. As suggested elsewhere, this waste of fixed carbon in the process of coking indicates that the process is not the best, in view of the character of the coal, and that there is room for improvement. It is a well-known fact that within certain limits, the higher the temperature in the oven during coking, other things being equal, the greater the yield of the coal in coke. As the heat in coking this coal is so high, the yield should certainly be greater than it is. The coke made, however, is most excellent fuel, and while it may not be possible to conduct the process of coking with the loss of volatile matter only, there should be a large reduction in the amount of fixed carbon consumed.

Not only this, but there should be a great improvement in the looks of the coke. It is not as handsome as the Connellsville. It lacks that bright luster which characterizes the Pennsylvania coke. The coke on the wharves at the time the ovens were visited contained a large proportion of "black ends," but this was explained by the fact that the demand for coke was sufficient to keep the ovens in operation but about half-time, and the bottoms of the ovens were not kept hot enough, There is no doubt but that a marked improvement in the coke can be secured by reducing the coal, previous to coking, to a uniform degree of fineness. By this course not only will the production of "roasted coal" be avoided, but the exposure to the heat of a large surface of fine coal will cause it to evolve its volatile matter more quickly, and to coke more rapidly than when lumps of coal are present in the charge. Crushing is done at some of the coke works. The coke made from this crushed coal seems to be more regular and compact than that from uncrushed coal. So great benefit has resulted from crushing that most of the works are adding crushers to their plants. Another difficulty experienced in this region at some works is the want of water at times. This is being remedied by sinking wells.

Some very good results have been obtained with this coal in the Soldenhoff-Coppée oven. Some 175,650 pounds of coal from the Bluestone district was sent to the Coppée ovens in the New River district. Of this amount 46,850 pounds were "run-of-mine;" the rest was slack. Five different tests were made, the charges being from 2½ to 3 tons to an oven, the number of ovens charged from 4 to 9, and the time of coking twenty-four to forty-eight hours. The average yield in the five experiments was 67½ per cent. The coke burned thirty-six to forty-eight hours was the best; it was bright, regular, compact, and uniform throughout. There is a great difference of opinion as to the yield of coal; that is, as to the amount of coal that is required to make a ton of coke. The yield is usually placed at 62½ per cent.; that is, it requires 1.6 tons of coal to make a ton of coke. At some works it is claimed that the yield is only from 54 to 60 per cent. No doubt there is a great difference in the practice in this respect. With a coal containing as little volatile matter as this, it will be very easy by careless practice to greatly decrease the yield so as to require more than 1.6 tons of coal to a ton of coke. As the yield is usually assumed to be 62½ per cent., that is, that 1.6 tons of coal is required to make a ton of coke, this will be regarded in our discussion as the yield. Charging costs 4 to 5 cents an oven; leveling, 8 cents; drawing and loading, 50 to 58 cents; loaders, $1.20 to $1.25 per day; loading from wharf to cars, 10 to 12 cents a ton; cleaning out ovens, 1 to 2 cents.

There is the widest diversity of statement, not only between the operators and those owning lands, but among the operators themselves, as to the cost of coke. The figures given range all the way from $1.35 to $1.75 per ton. This great diversity arises in many instances from differences in opinion as to the price at which the coal should be charged to the ovens. In the Connellsville region (and we refer to this region so frequently because it is always used in this district for comparison by the operators themselves) the operators mine coal for no other purpose than coke making. In estimates of cost of coke in that district, therefore, coal is charged to the ovens at just what it costs to mine it. In the Flat Top region, however, coke making is only an adjunct to production for sale; coal mining and producing, and not coke making, being the chief business. The operators argue, therefore, that they should charge the coal to the ovens at the price they get for it as coal, including in this price their profit as coal producers. It is immaterial what custom is adopted, providing that in making comparisons of cost with other districts the different items be calculated on the same basis. It would seem, however, that the fairer way would be to charge the coal to the ovens at cost.

On this basis, then, the cost of coking will stand about as follows, a charge of 8,000 pounds to an oven and a yield of 62½ per cent., say 2½ tons (2,000 pounds) of coke being assumed:

Cost of coking in the Flat Top region.

	Per oven.	Per ton (2,000 lb.) of coke.
	Cents.	*Cents.*
Charging	05	02
Leveling	08	03½
Drawing	50	20
General labor	....	02½
Cleaning ovens	....	01
Supplies and repairs	....	07
Total		36

If the charge is more than 8,000 pounds some of these items will be proportionately reduced. On a charge of 10,000 pounds the coke would cost 5 cents a ton less.

Assuming that the coal costs, not including royalty, 62½ cents per ton of 2,240 pounds, or 55.8 cents per ton of 2,000 pounds, and that it requires 1.6 tons of coal to make a ton of coke, the cost of a ton of coke on the basis of the above figures would be as follows:

Cost of a ton of coke in the Flat Top region.

	Cost.
1.6 tons coal at 55.8 cents	$0.89¼
Cost of coking	.36
General expense	.05
Royalty (15 cents on 2,240 pounds)	.13⅜
Total	1.43$\frac{13}{16}$

If the yield is less than 62½ per cent. this cost will be increased, and, on the other hand, as some coal is sold as lump, at an advanced rate, the slack of which is coked, this slack should be held to be worth less than "run-of-mine," and so decrease the cost. So, also, if mining is less than 37½ cents a ton, and if the charge to the oven is more than 8,000 pounds, the cost will be decreased. It would be fair to assume $1.40 to $1.45 as the cost of coke at works well managed. This does not include commission for selling.

The increase in the product of coke in this district from 1883 to the close of 1888, is shown in the following table:

Product of coke in the Pocahontas Flat Top field.

Years.	Short tons.
1883	22,718
1884	57,107
1885	50,194
1886	60,436
1887	150,708
1888	201,317

When it is remembered that there were but 684 ovens in this district at the close of 1887, and that most of the ovens built during the year 1888 were burning but a short time, this product is remarkable.

The following are analyses of Flat Top coke. The first is one made recently by the Pulaski furnace; the second is from Messrs. Stephenson, Mullin & Co. in the Bluestone region; the third is Mr. McCreath's average of three samples:

Analyses of coke from the Flat Top region, West Virginia.

	No. 1.	No. 2.	No. 3.
Moisture	.70	.664	.347
Volatile matter	1.27	1.059	.757
Fixed carbon	91.43	92.816	92.550
Ash	6.09	4.913	5.749
Sulphur	.509	.548	.597

That the Flat Top coke is a most excellent fuel can not be questioned. It is low in ash, high in carbon, cellular, and as compared with most of the cokes of the country, bright and hard, strong and dense. It is, however, somewhat fragile and dull in luster. The wastage in drawing and transporting is large, but in the furnace it bears a heavy burden. At a Virginia furnace, using a washed ore carrying 12 per cent. of water in mechanical combination, the burden at the time of the visit to the field was as follows:

	Pounds.
Ore	8,600
Lime	2,800
	11,400
Coke	4,300

This is 2.65 to 1. A very good record when the water in the ore is considered.

At present the coke produced in this district, as will be seen from the following table of its distribution in 1887 and 1888, finds its chief market in the South. Of the 8,063 cars shipped in 1887 but 675, or about 8 per cent., went to points north of the Ohio river, while of the 8,044 cars shipped in the first nine months of 1888 but 72 cars, less than 1 per cent., went to northern points. The shipment to Saint Louis doubled in 1888. It is probable that this coke, at least until the Elkhorn branch of the Norfolk and Western railroad is opened to the Ohio, will find its market chiefly in the South, as freights to other points will in many cases be against it as compared with Connellsville and New river. Even when the Elkhorn branch is open it is doubtful if this coke will reach points far away from the Ohio in any great quantities. Because of quality, however, it will control the southern market, and that will be sufficient in the near future to tax its resources very heavily. We give below a statement of the distribution of coke for the year 1887 and first nine months of 1888.

Cars of coke shipped from the Pocahontas Flat Top district and their distribution in 1887, *compared with* 1888.

	1887.	1888.
	Cars.	*Cars.*
To points on the Norfolk and Western railroad	4,324	6,715
To points on the Shenandoah Valley railroad	1,650	379
To points on other railroads in Virginia	13	14
To southern points (south of Bristol)	1,275	2,717
To points in North and South Carolina	13	11
To Chicago	525	71
To East Saint Louis	653	527
To East Carondelet	....	660
To Louisville	65	....
To Joliet	84	....
To Terre Haute	3	....
To Centralia, Illinois	....	1
Total	8,605	11,095
	Tons.	*Tons.*
Representing a total tonnage of	151,171	201,307

The Northern district.—The statistics of the product of coke in the Northern district of West Virginia from 1880 to 1888, are as follows:

Statistics of the manufacture of coke in the Northern district, West Virginia, 1880 *to* 1888.

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	.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	......	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

The Upper Potomac district.—The statistics of the manufacture of coke in the Upper Potomac district of West Virginia for 1887 and 1888, are as follows:

Statistics of the manufacture of coke in the Upper Potomac district of West Virginia 1887 and 1888.

	1887.	1888.
Number of establishments	1	1
Ovens built	20	28
Ovens building	50	0
Coal used, short tons	3,566	9,176
Coke produced, short tons	2,211	5,835
Total value of coke at ovens	$4,422	$8,752
Value of coke at ovens, per ton	$2	$1.50
Yield of coal in coke, per cent	62	64

Statistics of the production of coke in West Virginia.—Consolidating the statistics of the five different districts given below, the following is a statement of the product of coke in West Virginia for the years 1880 to 1888:

Statistics of the manufacture of coke in West Virginia, 1880 to 1888.

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	0	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	1.70½	61.5

WISCONSIN.

During the year 1888 the Lehigh Coal and Iron Company, which is a large shipper of coal over the lakes to the northwest, erected 50 beehive ovens for the purpose of coking coal brought from the Pennsylvania coal fields. The ovens were started up in December, and all the work done in 1888 was on an experimental scale. The following is the only statement we have of the manufacture of coke in this State in 1888:

Statistics of the manufacture of coke in Wisconsin in 1888.

Number of establishments	1
Ovens built	50
Ovens building	0
Coal used, short tons	1,000
Coke produced, short tons	500
Total value of coke at ovens	$1,500
Value of coke at ovens, per ton	$3.00
Yield of coal in coke, per cent	.50

UTAH.

The Pleasant Valley Coal Company, whose works are located in Pleasant Valley, Utah, erected an experimental oven in 1888. The only coke made, however, was for a few experimental charges. The coke will be still further tested, and reports of it will be given in the next vloume of Mineral Resources.

PETROLEUM.

By Joseph D. Weeks.

The noticeable features in connection with the production of petroleum in 1888 are, first, the great reduction in the product of the Pennsylvania and New York oil fields, growing out of the agreement among the producers to restrict drilling, and the great increase in the new Ohio field; second, the increase in the average price of pipe-line certificates during the year, the average price being greater than during 1886 or 1887; and, third, the great depression and low prices of oil in the Lima region. The same reduction of product in the New York and Pennsylvania oil fields noticeable in the report for 1887 is still more obvious in the present report. The product of petroleum in Pennsylvania and New York in 1888 was but 16,484,668 barrels as compared with 22,356,193 barrels in 1887, a reduction of 5,871,525 barrels, or 26 per cent. On the other hand, the production in Ohio has shown a remarkable increase, it having risen from 5,018,015 barrels in 1887 to 10,010,868 barrels in 1888, an increase of nearly 100 per cent. West Virginia shows somewhat of a decrease, the product in 1887 having been reported as 145,000 barrels as compared with 119,448 barrels in 1888. There has been a slight increase in the production of California, the figures for 1887 being 678,572 barrels, and those for 1888, 690,333 barrels. In Colorado the product is reported as 297,612 barrels as compared with 76,295 in 1887, and in States other than those named 13,000 barrels.

Localities in which petroleum is found in the United States.—For convenience we reproduce here the statement as to the localities in which petroleum is found in the United States.

Petroleum has been found in nearly if not quite all of the States lying entirely or in part in the great Mississippi basin, as well as in several of the Rocky Mountain States and in California. The localities, however, in which it is produced on a commercial scale are few, in view of the great extent of territory in which it has been discovered. These producing localities are the well-known oil regions of western New York and western Pennsylvania, Macksburgh, and the northwestern or Lima field of Ohio, the Volcano and other oil districts of West Virginia, and the oil-producing portions of California and Colorado.

The oil fields of Tennessee and Kentucky, where some oil was produced shortly after the great discoveries in the Pennsylvania region, as well as the Wyoming oil fields, did not produce sufficient oil in 1886 or 1887 to be considered in speaking of the localities that produce oil in those years. What their possibilities may be is as yet uncertain, and can only be determined by more extensive explorations.

Several of these districts are subdivided into smaller fields, which are known by some geographical name in the field. There are also other divisions of these districts based upon the character of the oil, or the sand from which the oil of these districts is produced.

TOTAL PRODUCT OF PETROLEUM IN THE UNITED STATES AND CANADA.

In the following table will be found consolidated the statistics of the product of petroleum in the various fields of the United States and Canada, from the beginning of operations in these fields, so far as the same could be ascertained:

Product of crude petroleum in the United States and Canada from 1859 *to* 1888.

Years.	Pennsylvania and New York.	West Virginia.	Ohio.	Kentucky, Tennessee, and other States.	California.	Total United States.	Canada. (*a*)
	Barrels. (*b*)	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1859 ..	2,000	....	....	....	....	2,000	....
1860 ..	500,000	....	....	....	....	500,000	....
1861 ..	2,113,609	....	....	....	....	2,113,609	....
1862(*c*)	3,056,690	....	....	....	....	3,056,690	11,775
1863 ..	2,611,309	....	....	....	....	2,611,309	82,814
1864 ..	2,116,109	....	....	....	....	2,116,109	90,000
1865 ..	2,497,700	....	....	....	....	2,497,700	110,000
1866 ..	3,597,700	....	....	....	....	3,597,700	175,000
1867 ..	3,347,300	....	....	....	....	3,347,300	190,000
1868 ..	3,646,117	....	....	....	....	3,646,117	200,000
1869 ..	4,215,000	....	....	....	....	4,215,000	220,000
1870 ..	5,260,745	....	....	....	....	5,260,745	250,000
1871 ..	5,205,234	....	....	....	....	5,205,234	269,397
1872 ..	6,293,194	....	....	....	....	6,293,194	308,100
1873 ..	9,893,786	....	....	....	....	9,893,786	365,052
1874 ..	10,926,945	....	....	....	....	10,926,945	168,807
1875 ..	8,787,514	(*d*)3,000,000	(*d*)200,000	....	(*d*)175,000	12,162,514	220,000
1876 ..	8,968,906	120,000	31,763	....	12,000	9,132,669	312,000
1377 ..	13,135,475	172,000	29,888	....	13,000	13,350,363	312,000
1878 ..	15,163,462	180,000	38,179	....	15,227	15,396,868	312,000
1879 ..	19,685,176	180,000	29,112	....	19,858	19,914,146	575,000
1880 ..	26,027,631	179,000	38,940	....	40,552	26,286,123	350,000
1881 ..	27,376,509	151,000	33,867	....	99,862	27,661,238	275,000
1882 ..	30,053,500	128,000	39,761	....	128,636	30,349,897	275,000
1883 ..	23,128,389	126,000	47,632	....	142,857	23,444,878	250,000
1884 ..	23,772,209	90,000	90,081	....	262,000	24,214,290	250,000
1885 ..	20,776,041	91,000	650,000	....	325,000	21,842,041	250,000
1886 ..	25,798,000	102,000	1,782,970	(*e*) 225,000	377,145	(*e*) 28,285,115	250,000
1887 ..	22,356,193	145,000	5,018,015	51,817	678,572	28,249,597	868,345
1888 ..	16,484,668	119,448	10,010,868	310,612	690,333	27,615,929	772,392
	346,797,111	4,783,448	18,041,076	587,429	2,980,042	373,189,106	7,712,682

a There are no reliable statistics of production for Canada. Those given are the estimates of parties intimately connected with the industry.
b All barrels in this table are of 42 gallons.
c In addition to the above, 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 and Canada fields; also a large amount from West Virginia and Tennessee.
d Including all production prior to 1876, except that produced in Kentucky and Tennessee.
e This includes the 175,000 barrels produced in Kentucky and Tennessee prior to 1886.

In the above table are brought together statements showing the production of the various fields of the United States and Canada from the beginning of operations, the statements being by years and by the total of fields and years. The detail of the production by States is given elsewhere.

From this table it appears that the total reported production of all the oil fields of the United States, since the discovery of oil in Pennsylvania in 1859, has been 373,189,106 barrels. To this should be added an amount variously estimated from 10,000,000 to 20,000,000 of barrels that have run to waste in the various fields for want of a market. Of the total amount reported, the Pennsylvania and New York oil fields have produced 346,797,111 barrels, or 92 per cent. of the whole. All of the other States have produced but 26,391,995 barrels. The proportion of the oil produced outside of Pennsylvania is increasing, owing to the increased production in Ohio, Colorado, and California, while the production in Pennsylvania is decreasing, being in 1888 the smallest in any year since 1878.

The value of this oil, based on the value of petroleum in Pennsylvania since 1860, has ranged from $19.25 in January, 1860, to 10 cents per barrel during October and December, 1861, and January, 1862. The average value of this oil through all these years can not vary much from that given in the report for 1887, that is, $1 per barrel, which would make the total value of petroleum produced in the United States $373,189,106.

TOTAL PRODUCT AND VALUE OF PETROLEUM IN THE UNITED STATES IN 1887 AND 1888.

The total product of oil in the United States in 1887 and 1888, arranged by States, so far as the product of the individual States could be ascertained, was as follows, the barrel being uniformly 42 gallons:

Product of petroleum in the United States in 1887–'88.

States.	1887.	1888.
	Barrels.	*Barrels.*
Pennsylvania and New York	22,356,193	16,484,668
Ohio	5,018,015	10,010,868
California	678,572	690,333
West Virginia	145,000	119,448
Colorado	76,295	297,612
Elsewhere	50,000	13,000
Total	28,324,075	27,615,929

As compared with 1887 the product in the United States in 1838 shows a reduction of 633.668 barrels, and this notwithstanding the largely increased product in Ohio and Colorado. It is nearly impossible to arrive at the actual value of this oil. The average value of pipe-line certificates in Pennsylvania during the year 1887 was 87$\frac{5}{8}$ cents. This, however, is the selling price of but little of the oil. As is shown elsewhere, the oil from certain regions commands a higher price than that of quoted pipe-line certificates. The heavy oil from Franklin, of which, however, but a small quantity was produced, is worth very much more than the ordinary crude. On the other hand, Lima oil sold in 1888 as low as 10 cents a barrel, and the product of Lima oil was about five-eighths as much as the total product of Pennsylvania oil. On the basis that 10,000,000 barrels of the product of the country was worth 10 cents a barrel, 16,000,000 barrels 95 cents, 600,000 barrels 50 cents, and 1,000,000 barrels $1.50, the average value of the oil produced in 1888 would be about 65 cents a barrel, or a total for the 27,615,929 barrels of $17,950,353. The value of the oil produced in 1887 was given at $18,856,606; for 1886, $20,028,457; and for 1885, $19,193,694.

THE PENNSYLVANIA AND NEW YORK FIELDS.

As has been stated in previous reports, the intimate connection in a commercial way is such as to render it almost impossible to make an exact separation between the oil produced in New York and that from the wells in Pennsylvania.

The Pennsylvania and New York oil fields.—There are five general divisions of the Pennsylvania and New York oil fields. These are the Allegany, Bradford, Middle, Lower, and Washington districts. These have been fully described in previous reports. It may be well to say, however, that the Allegany field lies wholly in Allegany county, New York, and is of an irregular shape, with an average length of some 20 miles. Outlying this district, in the same county, are four smaller fields, of which one, about a mile north of the town of Niles, and bearing its name, has a few small wells and produces dark oil; it is the farthest north of any of the petroleum developments of the two States of Pennsylvania and New York. The Wirt field, midway between the Niles and Allegany fields, has a few small wells, but produces more gas than oil. The Waugh and Porter field, near the Pennsylvania State line, and lying southwestwardly from the most southerly point of the eastern limit of the Allegany field, produces an amber-colored oil from small wells. Southeastwardly of the eastern limit of the Allegany field proper is the Harding-O'Connor territory, in which there are a few small wells.

The second district, Bradford, lies chiefly in Pennsylvania, in McKean county, but the main field extends some 5 miles into the State of New York, and an outlying basin of oil rocks, which properly belongs to the Bradford basin, is situated for the greater part in Carrollton township, in Cattaraugus county, New York. This field also includes the small outlying district of Kinzua, which lies southwestwardly 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 lower field covers a large extent of territory from Sugar Run, in McKean county, just across the border from Warren county, down through Forest to Beaver county, including, in addition to Warren and

Forest, all the oil-producing territory in Venango, Clarion, Butler, Lawrence, and Beaver counties, with the Pleasant Unity district in Westmoreland county.

In the Washington field are included the wells in Washington and Greene counties, Shoustown, in Allegheny, and other small districts, as the Mount Morris, Nineveh, and Brush creek, in the neighborhood.

Production in Pennsylvania and New York by months.—In the following table is given the actual product in the State of Pennsylvania by months. This product differs materially from the table given elsewhere, showing the pipe-line runs in the Pennsylvania and New York oil fields, which are generally, but incorrectly, taken as the actual product. All of the product is not shown in the runs that are published from month to month.

Actual product by months of petroleum in Pennsylvania and New York in 1888.

Months.	Production.	Months.	Production.
	Barrels.		*Barrels.*
January	1,155,936.68	August	1,382,077.05
February	1,290,718.08	September	1,273,079.70
March	1,338,877.29	October	1,354,518.03
April	1,349,403.60	November	1,442,404.80
May	1,473,361.80	December	1,582,740.96
June	1,450,703.40		
July	1,394,846.86	Total	16,488,668.25

The production in the earlier months of the year was very much curtailed owing to the agreement to shut down, entered into by the members of the Petroleum Producers' Association. The agreement was that at least 17,500 barrels daily product, and as much more as possible, should be "shut in." The average daily product in the months of August, September, and October, 1887, the three months previous to the shut-down, was about 64,000 barrels; the average daily product for November, December, and January, the first three months after the "shut-in," was about 41,000 barrels, making a decreased product of about 23,000 barrels, so that the minimum "shut-in" had been not only fully obtained, but exceeded.

On the first of November, 1888, the twelve months' "shut-in" covered by the agreement came to an end. The agreement, it will be remembered, was to cease drilling, to cease cleaning out and shooting of wells for one year, and to shut in a certain part of the product. The practical results of the movement are seen not only in the decrease in product during the year, but also in the decrease of stocks and the increase of average prices. The product, as shown elsewhere, decreased from 22,356,193 barrels in 1887 to 16,488,668.25 in 1888. The average prices increased from 66¾ cents per barrel, in 1887, to 87⅝ cents in 1888, while the stock of petroleum, which stood at 30,662,583 barrels on the last day of October, 1887, had declined to 18,995,814 barrels on the last day of December, 1888.

Production in the several districts of Pennsylvania and New York.—We give below a statement of the product of the different fields of Pennsylvania and New York in 1888:

Product in Pennsylvania and New York in 1888 by districts.

Districts.	Production.	Districts.	Production.
	Barrels.		*Barrels.*
Bradford and Allegany	6, 284, 374. 85	Greene	9, 527. 54
Forest	204, 250. 37	Mt. Morris	79, 278. 96
Warren	1, 865, 366. 19	Nineveh	4, 227. 36
Butler	3, 478, 387. 29	Shannopin	301, 906. 04
Bald Ridge	1, 220, 054. 02	Brush Creek	54, 778. 03
Tideoute	660, 327. 87		
Washington	2, 322, 189. 73	Total	16, 484, 668. 25

From the above table it will appear that the largest per cent. of the product from any district is still from the Bradford and Allegany district, this district producing 6,284,375, or 38 per cent. of the 16,484,668 barrels produced in Pennsylvania. Butler comes next, with a little more than one-half of the product of Bradford and Allegany, its product being 3,478,387 barrels, or about one-fifth of the total product of the State. Washington county stands third on the list, with a total product of 2,322,190 barrels, or about one-seventh of the production. Warren is fourth, with a total product of 1,865,366 barrels, and Bald Ridge fifth, credited with 1,220,054 barrels.

Notwithstanding that the Bradford and Allegany district was the largest producer of any district in 1888, its product fell off nearly one-third as compared with 1887, the product in 1887 being 9,226,113 barrels as compared with 6,284,375 barrels in 1888. Washington also fell off from 2,859,344 barrels in 1887, to 2,322,190 barrels in 1888. Shannopin declined about one-half; Bald Ridge from a little over 2,000,000 barrels to a fraction over 1,220,000 barrels.

Pipe-line runs in the Pennsylvania and New York oil fields.—In the following table will be found a statement of the pipe-line runs in the Pennsylvania and New York oil fields, by months, for the past seven years:

Pipe-line runs of crude petroleum in the Pennsylvania and New York oil fields for the years 1882 to 1888, by months.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	2, 353, 551	1, 948, 319	1, 825, 838	1, 652, 176	1, 748, 958	1, 990, 851	1, 126, 035
February	2, 131, 332	1, 756, 188	1, 880, 650	1, 437, 884	1, 604, 848	1, 827, 924	1, 240, 092
March	2, 482, 170	1, 830, 674	2, 052, 262	1, 638, 133	1, 928, 448	2, 007, 196	1, 211, 086
April	2, 402, 790	1, 816, 530	2, 065, 860	1, 780, 290	1, 938, 360	1, 960, 860	1, 320, 936
May	2, 486, 572	1; 962, 052	2, 381, 854	1, 771, 371	2, 178, 773	1, 993, 517	1, 433, 469
June	2, 825, 940	1, 977, 900	1, 862, 190	1, 767, 210	2, 335, 380	1, 912, 860	1, 422, 960
July	3, 258, 162	2, 020, 394	2, 059, 950	1, 775, 804	2, 418, 961	1, 899, 525	1, 370, 080
August	3, 104, 495	1, 879, 437	2, 099, 165	1, 705, 961	2, 413, 206	1, 848, 877	1, 365, 992
September	2, 620, 380	1, 913, 370	1, 948, 260	1, 712, 790	2, 418, 540	1, 779, 930	1, 253, 149
October	2, 297, 658	2, 076, 659	1, 961, 866	1, 874, 105	2, 408, 111	1, 843, 291	1, 311, 643
November	2, 192, 940	1, 958, 340	1, 811, 700	1, 761, 660	2, 222, 790	1, 125, 450	1, 416, 448
December	1, 897, 510	1, 988, 526	1, 822, 614	1, 898, 657	2, 181, 625	1, 288, 602	1, 550, 902
Total	30, 053, 500	23, 128, 389	23, 772, 209	20, 776, 041	25, 798, 000	21, 478, 883	16, 022, 792

It will be noted that the above table gives simply the pipe-line runs as reported on the 10th of each month by the several pipe lines in Pennsylvania and New York. This does not, however, include all of the product, and those reports that give as the product the total of the pipe-line runs are in error. To the runs, as given above, should be added certain amounts of dump oil and certain amounts of product that are not received in the pipe-lines of the seven pipe-line companies making reports. The pipe-line runs show a total of 16,022,792 barrels; the actual product, as stated elsewhere, is 16,488,668.25 barrels.

Average daily product.—In the following table will be found the average daily production of all wells in the Pennsylvania and New York districts for the years 1882 to 1888:

Average daily product of crude petroleum in the Pennsylvania and New York oil fields for the years 1882 *to* 1888, *by months.*(*a*)

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	75, 921	62, 849	58, 898	53, 296	56, 418	64, 221	37, 228
February	76, 119	62, 721	64, 850	51, 353	57, 316	65, 283	44, 508
March	80, 070	59, 054	66, 202	52, 843	62, 208	64, 716	43, 190
April	80, 093	60, 551	68, 862	59, 343	64, 612	65, 372	44, 980
May	80, 212	63, 292	76, 834	59, 141	70, 283	64, 307	47, 528
June	94, 198	65, 930	62, 073	58, 907	77, 846	63, 762	48, 357
July	105, 102	65, 174	66, 450	57, 284	78, 031	61, 275	44, 995
August	100, 145	60, 627	67, 719	55, 031	78, 426	59, 641	44, 661
September	87, 346	63, 779	64, 942	57, 093	80, 618	59, 321	42, 436
October	74, 118	66, 989	63, 286	60, 455	77, 681	61, 822	43, 694
November	73, 098	65, 278	60, 390	58, 722	74, 093	37, 515	48, 080
December	61, 210	64, 146	58, 794	61, 247	70, 375	41, 568	51, 057
Yearly averages	82, 338	63, 365	65, 129	56, 921	70, 679	58, 846	45, 037

a The yearly averages in this table were computed by dividing the total production for each year by 365, or 366 for a leap year.

From the above table it will be noticed that the average daily product in 1888 was but 45,037 barrels. This average daily product, as stated in note in the table, is ascertained not by dividing the sum of the monthly averages by 12, but by dividing the total production of the year by 366, the number of days in 1888.

It will be noted that the lowest average daily production given in the above table for any one month was 37,228 barrels on the 1st of January, 1888, the next lowest being in November, 1887, the first month after the beginning of the "shut-in." This product for January is the smallest average daily product for any month since November, 1887, when the average daily product was 37,515 barrels. The average for the year is the smallest since 1878, when the average daily product was 41,544 barrels.

Total shipments.—In the following table will be found a statement of the number of barrels of crude petroleum and of refined reduced to crude equivalent shipped out of the Pennsylvania and New York oil regions, whether by pipe or by railroad, for the years 1882 to 1888. A considerable portion of this oil is shipped as refined. This is reduced to its equivalent in crude, a barrel of refined being regarded as equal to 1⅓ barrels of crude.

Shipments of crude petroleum and of refined petroleum reduced to crude equivalent out of the Pennsylvania and New York oil regions for the years 1882 to 1888.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	1,657,067	1,357,815	1,686,961	1,804,028	1,991,561	2,312,067	2,265,109
February	1,787,909	1,250,824	1,723,261	1,895,021	2,032,794	1,995,757	2,163,957
March	1,718,956	1,641,899	1,873,890	1,887,034	2,055,750	2,332,324	1,979,753
April	1,678,134	1,908,379	1,643,336	1,823,726	2,070,468	1,938,278	1,928,435
May	1,827,356	1,995,634	1,899,329	2,097,099	2,032,672	2,328,564	1,773,994
June	2,172,685	1,747,789	1,827,553	2,034,025	2,117,489	2,165,439	1,956,115
July	2,402,970	1,634,407	1,740,021	1,961,152	2,418,961	2,000,173	2,098,531
August	2,047,545	2,086,478	2,000,371	2,049,099	2,059,299	2,220,768	2,223,263
September	1,992,171	2,325,574	2,292,087	2,116,659	2,157,323	2,342,227	2,289,486
October	2,089,428	2,215,421	2,510,283	2,050,150	2,441,848	2,573,008	1,558,115
November	1,404,640	2,065,602	2,078,261	1,857,080	2,724,796	2,462,082	2,503,491
December	1,121,453	1,749,547	2,382,244	2,138,253	2,550,891	2,608,341	2,397,782
Total	21,900,314	21,979,369	23,657,597	23,713,326	26,653,852	27,279,028	25,138,031

Notwithstanding the greatly reduced product of 1888, the shipments out of the Pennsylvania and New York oil region show a reduction of only a little over 2,000,000 barrels from the shipments of 1887, which were the largest known in the shipments of the trade; indeed, the shipments of 1888 were exceeded by those of but two years, 1886 and 1887.

These figures of shipments must not be taken as the actual consumption. To them must be added, in order to arrive at consumption, dump oil and the shipments of private lines, as well as the amount of oil destroyed by fire and disposed of in other ways than by refining or direct consumption. What the amount of this oil is we have no means of ascertaining.

Total stocks.—In the following table will be found a statement of the total stocks held in the Pennsylvania and New York oil regions at the close of each month for the years 1882 to 1888. In addition to the net stocks held by the pipe-lines (the term net stocks meaning the stocks after making a certain deduction for surplus and sediment), these stocks include an estimate of field oil which, in the tables of *Stowell's Petroleum Reporter* whence these tables are taken, is carried as surplus.

Total stocks of crude petroleum in the Pennsylvania and New York oil regions at the close of each month for the years 1882 to 1888.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	26,716,188	35,187,116	35,884,509	37,214,274	34,186,238	33,835,389	26,927,631
February	27,059,611	35,692,480	36,041,898	36,757,137	34,082,775	33,288,630	26,084,571
March	27,822,825	35,881,255	36,220,270	36,508,236	33,954,493	32,932,502	25,404,276
April	28,547,481	37,789,406	36,642,794	36,464,800	33,823,385	32,955,084	24,893,223
May	29,206,697	35,755,824	38,631,203	36,139,072	33,969,486	32,642,330	24,653,043
June	29,859,952	35,985,935	38,665,838	35,872,257	34,187,377	32,389,750	24,219,496
July	30,715,144	36,371,922	38,985,767	35,686,909	34,428,490	32,289,269	23,586,951
August	31,772,094	36,164,881	29,084,561	35,343,771	34,800,397	32,003,536	22,825,298
September	32,400,303	35,752,677	38,740,734	34,939,902	35,061,614	31,340,939	21,876,681
October	32,608,533	35,613,915	38,192,317	34,763,857	35,027,877	30,662,583	20,722,024
November	33,728,555	35,506,653	37,925,756	34,668,437	34,525,871	29,325,951	19,734,132
December	34,596,612	35,745,632	37,366,126	34,428,841	34,156,605	28,006,211	18,995,814
Average	30,419,500	35,953,975	37,698,481	35,732,291	34,350,467	31,806,015	23,326,845

It will be noted from the foregoing table that the total stocks held at the close of December, 1888, were but 18,995,814 barrels, the lowest stock since December, 1880. The average stock held at the close of each month of the year was 23,326,845 barrels, the lowest average since 1880. This reduction of stocks is, of course, due chiefly to two causes: first, the volume of shipments out of the region as compared with the product; and secondly, the reduction of output reached according to agreement among the shippers.

Prices.—In the following table will be found a statement of the monthly and yearly average price of pipe-line certificates for the years 1882 to 1888:

Monthly and yearly average price of pipe-line certificates or crude petroleum at the well for the years 1882 *to* 1888.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
January	$0.83⅛	$0.93¾	$1.11	$0.70⅞	$0.88⅜	$0.70	$0.91¼
February	.84½	1.01	1.04⅜	.72⅜	.79⅞	.64⅝	.91⅝
March	.81⅜	.97⅝	.98⅛	.80⅛	.77¼	.63⅜	.93⅝
April	.78⅜	.92⅜	.94	.78½	.74⅛	.64⅞	.82⅝
May	.71½	1.00⅛	.85⅝	.79	.70	.64⅛	.86¾
June	.51⅜	1.16⅜	.68⅜	.82	.66½	.62⅝	.75⅞
July	.57 4/10	1.05⅞	.63½	.92½	.66	.59¼	.80⅝
August	.58⅝	1.08½	.81⅛	1.00¼	.62⅛	.60⅛	.90⅛
September	.72⅛	1.12½	.78	1.00¾	.63⅜	.67	.93⅝
October	.93¾	1.11⅛	.71⅛	1.05½	.65⅛	.70⅝	.90⅝
November	1.14	1.14½	.72½	1.04⅜	.71⅝	.73⅞	.85⅜
December	.96	1.14¾	.74⅜	.89⅞	.70⅜	.80¾	.89¼
Average	.78⅞	1.05¾	.83½	.88	.71¼	.66¾	.87⅝

These averages, it is to be understood, are not true average prices; that is, averages that consider both price and quantity sold at that price, but they are the averages of prices obtained. This is, under the circumstances, the only average that can be ascertained, and does not vary greatly from the average of the prices. It is also to be understood that the oil of certain districts brings a price in excess of the average price of pipe-line certificates.

The average price of pipe-line certificates for 1888 is 87⅝ cents per barrel; the average being increased as the result of restriction of production, as has been previously pointed out. This average is exceeded only by the years 1883 and 1885, in the seven years covered by the table.

Prices of refined oil.—In the following table will be found a statement of the highest and lowest prices of refined oil at New York, by months, the price being cents per gallon:

Prices of refined oil, 1888.

Months.	Opened.	Highest.	Lowest.	Closing.	Average price per month.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	$7\frac{5}{8}$	$7\frac{3}{4}$	$7\frac{5}{8}$	$7\frac{3}{4}$	7.70
February	$7\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	7.75
March	$7\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{3}{4}$	7.75
April	$7\frac{1}{2}$	$7\frac{1}{2}$	$7\frac{1}{4}$	$7\frac{3}{8}$	7.40
May	$7\frac{1}{2}$	$7\frac{5}{8}$	$7\frac{3}{8}$	$7\frac{3}{8}$	7.48
June	$7\frac{1}{4}$	$7\frac{1}{4}$	7	7	7.14
July	$7\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{1}{8}$	$7\frac{1}{2}$	7.39
August	$7\frac{5}{8}$	$7\frac{3}{4}$	$7\frac{3}{8}$	$7\frac{5}{8}$	7.66
September	$7\frac{5}{8}$	$7\frac{7}{8}$	$7\frac{5}{8}$	$7\frac{7}{8}$	7.83
October	$7\frac{7}{8}$	$7\frac{7}{8}$	$7\frac{3}{8}$	$7\frac{3}{8}$	7.65
November	$7.37\frac{1}{2}$	$7.37\frac{1}{2}$	7.20	7.20	7.31
December	7.20	7.30	7.10	7.10	7.20

Average per year.

	Cents.
1888	$7\frac{1}{2}$
1887	$6\frac{3}{4}$
1886	7
1885	8
1884	$8\frac{1}{4}$
1883	$8\frac{1}{2}$
1882	$7\frac{1}{2}$
1881	8

Foreign quotations.

Months.	Antwerp (100 kilograms).		Bremen (50 kilograms).		London (imperial gallons).	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
	Francs.	*Francs.*	*Marks.*	*Marks.*	*Pence.*	*Pence.*
January	21	$18\frac{1}{2}$	8.90	7.35	$8\frac{1}{2}$ to $9\frac{1}{2}$	$6\frac{9}{16}$ to 7
February	20 to $20\frac{1}{8}$	$18\frac{5}{8}$ to $\frac{3}{4}$	7.70	7.00	$6\frac{13}{16}$ to $7\frac{13}{16}$	$6\frac{1}{2}$ to $\frac{5}{8}$
March	20	$16\frac{3}{8}$	7.35	6.85	$6\frac{5}{8}$ to $\frac{7}{8}$	$6\frac{1}{16}$ to $\frac{1}{4}$
April	$16\frac{3}{8}$	$15\frac{7}{8}$	6.85	6.15	$6\frac{1}{16}$ to $\frac{1}{4}$	6 to $\frac{1}{8}$
May	$16\frac{3}{4}$	$16\frac{1}{8}$ to $\frac{1}{4}$	6.70	6.35	$5\frac{7}{8}$ to 6	$5\frac{3}{8}$ to $\frac{5}{8}$
June	$16\frac{5}{8}$	$16\frac{1}{4}$	6.55	6.45	$5\frac{5}{8}$ to $\frac{3}{4}$	$5\frac{1}{2}$ to $\frac{11}{16}$
July	$18\frac{1}{4}$ to $\frac{3}{8}$	$16\frac{1}{4}$	7.50	6.40	$6\frac{1}{2}$ to $\frac{5}{8}$	$5\frac{1}{2}$ to $\frac{5}{8}$
August	21	$18\frac{1}{2}$ to $\frac{5}{8}$	8.00	7.45	$7\frac{1}{2}$ to $\frac{5}{8}$	$6\frac{5}{8}$ to $\frac{3}{4}$
September	$20\frac{1}{2}$ to $\frac{5}{8}$	$20\frac{1}{8}$ to $\frac{1}{4}$	8.15	7.95	$7\frac{5}{8}$ to $\frac{3}{4}$	7
October	21	$19\frac{1}{4}$	8.15	7.75	$7\frac{1}{2}$ to $\frac{11}{16}$	$6\frac{11}{16}$ to $\frac{13}{16}$
November	20	$19\frac{1}{8}$ to $\frac{1}{4}$	7.85	7.65	$6\frac{5}{8}$ to $\frac{3}{4}$	$6\frac{1}{4}$ to $\frac{9}{16}$
December	20	$19\frac{1}{4}$ to $\frac{3}{8}$	7.70	7.45	$6\frac{7}{8}$ to 7	$6\frac{3}{8}$

Clearances.—The following table gives the total clearances at the several exchanges of the country for 1888:

Total clearances of refined oil at the several exchanges of the country for 1888.

Months.	Consolidated Stock and Petroleum Exchange of New York.	Oil City Oil Exchange.	Bradford Oil Exchange.	Pittsburgh S. P. and M. Exchange.	Philadelphia Oil Exchange.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	188,344,000	88,136,000	58,672,000	104,731,000	20,666,000
February	107,830,000	47,000,000	31,164,000	64,759,000	11,917,000
March	116,480,000	82,784,000	46,852,000	87,024,000	15,837,000
April	126,198,000	91,418,000	47,710,000	106,012,000	19,262,000
May	62,902,000	46,966,000	25,462,000	52,690,000	10,002,000
June	94,796,000	54,118,000	27,758,000	82,973,000	12,591,000
July	75,976,000	64,000,000	28,424,000	67,558,000	11,306,000
August	101,996,000	83,742,000	34,228,000	92,033,000	17,537,000
September	90,568,000	77,212,000	34,336,000	92,063,000	15,696,000
October	96,076,000	67,392,000	35,132,000	96,363,000	12,417,000
November	54,694,000	41,016,000	22,781,000	54,435,000	9,759,000
December	77,472,000	64,284,000	34,548,000	84,975,000	11,707,000
Total	1,193,332,000	808,068,000	427,070,000	985,616,000	168,697,000

Charters.—In the following table is given a statement of the charters for the year 1888 by months, the average daily charters for each month of 1887 and 1888, and the total and average charters for 1884–1888:

Statement of the charters of refined oil for the year 1888, *with average daily charters for the years* 1887 *and* 1888, *by months.*

Months.	Total 1888.	Average 1888.	Average 1887.
	Barrels.	*Barrels.*	*Barrels.*
January	914, 199	29, 499	35, 010
February	1, 199, 169	41, 351	31, 491
March	998, 923	32, 223	35, 518
April	973, 208	32, 440	51, 707
May	1, 257, 607	40, 568	49, 012
June	1, 219, 188	40, 639	40, 954
July	1, 330, 147	42, 908	43, 337
August	1, 221, 935	39, 419	53, 138
September	1, 487, 452	49, 582	43, 417
October	1, 505, 673	48, 570	45, 542
November	847, 693	28, 256	37, 357
December	959, 752	30, 960	32, 656

Total and average charters of refined oil for the years 1884 *to* 1888.

	1888.	1887.	1886.	1885.	1884.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Grand total	13, 914, 946	15, 204, 738	15, 906, 992	15, 374, 490	14, 469, 108
Average	38, 034	41, 595	43, 548	42, 080	39, 481

Exports.—The exports of petroleum for the years ended December 31, 1887 and 1888, were as follows:

Exports of petroleum for the years 1887 *and* 1888.

	1887.	1888.
	Gallons.	*Gallons.*
Crude	80, 650, 286	77, 549, 452
Naphtha	12, 382, 213	13, 481, 706
Illuminating	485, 242, 107	455, 045, 784
Lubricating	20, 582, 613	24, 510, 437
Residuum	71, 169	44, 538

The following table shows the total number of drilling wells completed in the Pennsylvania and New York oil fields, by months, for each of the years from 1882 to 1888. In this table are included not only those completed wells which produced oil, but also the dry holes:

Number of drilling wells completed in the Pennsylvania and New York oil fields each month from 1882 to 1888, by months and years.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
January	347	125	229	64	270	158	57
February	340	126	227	62	280	164	52
March	385	142	256	82	291	138	56
April	432	209	298	116	328	160	49
May	469	231	311	213	343	148	56
June	340	228	244	242	365	160	97
July	185	261	268	217	357	159	82
August	253	309	145	283	313	142	96
September	164	321	89	356	253	134	132
October	117	321	59	397	272	100	229
November	150	302	73	384	221	101	307
December	122	272	66	345	185	96	302
Total	3,304	2,847	2,265	2,761	3,478	1,660	1,515

Wells completed.—In the following table will be found a statement of the number of wells completed in each district in the Pennsylvania and New York oil fields during each month of 1888. This table shows the total number completed, the number of those completed that produced oil, and the number of dry holes in each district, together with the totals of these several items for the entire year:

Number of wells completed during each month of the year 1888 in the Pennsylvania and New York oil fields, by districts.

Months.	Bradford-Allegany district.			Middle district.			Lower district.		
	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.
January	4	2	2	22	17	5	23	16	7
February	1	0	1	30	23	7	15	10	5
March	2	2	0	21	16	5	23	14	9
April	3	1	2	22	15	7	11	6	5
May	1	1	0	19	16	3	16	10	6
June	5	3	2	22	18	4	25	19	6
July	2	2	0	28	26	2	30	14	16
August	2	1	1	27	18	9	32	25	7
September	7	6	1	70	69	1	32	26	6
October	8	5	3	149	118	31	44	33	11
November	25	21	4	173	151	22	68	50	18
December	30	25	5	181	154	27	53	36	17
Total	90	69	21	764	641	123	372	259	113

Number of wells completed during each month of the year 1888, etc.—Continued.

Months.	Southwest district.			Totals.		
	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.
January	8	3	5	57	38	19
February	6	2	4	52	35	17
March	10	5	5	56	37	19
April	13	7	6	49	29	20
May	20	17	3	56	39	17
June	35	28	7	87	64	23
July	22	15	7	82	57	25
August	35	16	19	96	60	36
September	23	14	9	132	114	18
October	28	19	9	229	175	54
November	41	25	16	307	247	60
December	38	30	8	302	239	63
Total	279	181	98	1,505	1,134	371

Average daily product of new wells.—The average daily product of the new wells completed in the years from 1882 to 1888, by months, is shown in the following table:

Average daily product of the new wells in the Pennsylvania and New York oil fields from 1882 to 1888, by months and years.

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	19.5	22.4	13.7	40.0	13.5	25.5	15.43
February	19.4	14.9	15.0	41.3	13.4	44.75	12.48
March	22.25	22.5	17.0	23.3	22.9	29.75	66.00
April	22.0	21.0	12.0	40.0	32.0	43.5	9.40
May	21.3	17.5	18.0	23.0	38.6	22.0	68.71
June	36.8	15.0	17.5	10.6	25.0	38.51	40.55
July	108.8	15.0	59.3	10.3	31.1	18.14	14.38
August	84.2	13.8	22.6	10.6	51.9	49.3	19.00
September	25.75	14.4	41.7	13.2	62.4	57.7	19.00
October	15.9	14.2	165.5	14.0	28.0	25.98	13.72
November	12.9	13.8	87.4	10.9	28.0	19.09	12.80
December	20.4	11.8	92.6	10.9	23.0	11.4	13.30

Number of drilling wells in the Pennsylvania and New York oil fields at the close of each month for the years 1871–'88, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.
1871	140	173	240	279	356	303
1872	363	369	313	302	386	391
1873	361	349	227	177	228	395
1874	37	55	99	213	225	210
1875	40	40	45	64	127	162
1876	142	151	230	267	307	340
1877	457	463	395	448	512	395
1878	334	326	379	409	376	266
1879	265	323	406	468	460	381
1880	540	535	577	580	460	440
1881	383	420	437	446	470	408
1882	422	438	408	405	381	226
1883	126	151	205	199	236	228
1884	270	273	260	284	244	123
1885	97	109	139	190	228	209
1886	320	337	356	318	358	403
1887	201	177	155	155	157	142
1888	64	72	65	59	82	106

Number of drilling wells in the Pennsylvania and New York oil fields, etc.—Continued.

Years.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly averages.
1871	329	330	439	486	477	394	329
1872	359	392	301	311	354	318	347
1873	340	267	197	163	137	60	242
1874	180	128	107	82	57	54	121
1875	118	96	132	170	179	168	112
1876	353	374	511	565	618	493	363
1877	365	417	535	573	565	426	463
1878	188	185	210	282	297	218	292
1879	329	258	270	313	372	440	357
1880	452	515	491	469	475	408	495
1881	379	352	388	445	475	468	423
1882	240	194	177	184	154	138	276
1883	262	315	314	341	301	263	243
1884	123	91	79	100	86	78	168
1885	242	308	382	355	359	277	241
1886	349	290	322	272	285	238	324
1887	135	137	107	104	114	88	139
1888	124	106	166	187	327	337	141

Number of drilling wells completed in the Pennsylvania and New York oil fields each month for the years 1872–'88, *by months and years.*

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.
1872	37	120	89	121	135	84
1873	93	91	100	105	102	130
1874	102	104	110	113	109	101
1875	190	187	195	186	172	190
1876	240	231	242	200	202	261
1877	281	241	291	269	320	403
1878	274	226	211	409	470	269
1879	136	132	238	270	402	330
1880	320	230	367	500	426	310
1881	222	220	271	316	406	374
1882	347	3'0	385	432	469	340
1883	125	126	142	209	231	228
1884	229	227	256	298	311	244
1885	64	62	82	116	213	242
1886	270	280	291	328	343	365
1887	158	162	138	160	148	157
1888	57	52	56	49	56	97

Years.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1872	128	118	82	100	64	105	1,183
1873	114	120	106	101	100	98	1,263
1874	121	107	104	120	106	120	1,317
1875	290	210	201	220	217	230	2,398
1876	248	270	209	273	272	272	2,920
1877	317	255	322	467	391	382	3,939
1878	203	186	174	229	248	165	3,064
1879	327	283	210	232	227	261	3,048
1880	338	368	356	364	336	302	4,217
1881	336	332	312	322	363	406	3,880
1882	185	253	164	117	150	122	3,304
1883	261	309	321	321	302	272	2,847
1884	268	145	89	59	73	66	2,265
1885	217	283	356	397	384	345	2,761
1886	357	313	253	272	221	185	3,478
1887	159	142	134	100	90	96	1,640
1888	82	96	132	229	307	302	1,515

Monthly and yearly average price of pipe-line certificates or crude petroleum at well for the years 1860–'88.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
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	.62½	.50	.50	.50	.25	.20	.10	.10	.10	.49
1862	.10	.15	.22½	.50	.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	2.10	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	2.82½	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	2.60	2.20	2.12½	2.30	2.47½	2.22¼	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	.95	.95	.85	.55	.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	.98¾	1.01	.86⅝	.82⅛	.89⅜	1.16	1.19
1879	1.03	.98	.86¼	.78½	.76	.68⅜	.69⅞	.67⅛	.69⅜	.88⅛	1.05⅝	1.18⅛	.85⅞
1880	1.10¼	1.03⅛	.88¾	.78	.80	1.00	1.06¼	.91	.96	.96⅞	.91⅞	.91⅝	.94½
1881	.95⅛	.90⅜	.83⅜	.86¼	.81⅞	.81¼	.76⅞	.78⅛	.97 3/16	.91¼	.85¼	.84⅜	.85⅞
1882	.83⅛	.84½	.81⅜	.78⅜	.71½	.54⅜	.57 4/16	.58⅝	.72⅛	.93¾	1.14	.96	.78⅞
1883	.93¾	1.01	.97⅝	.92⅜	1.00⅛	1.16⅜	1.05⅞	1.08½	1.12½	1.11⅛	1.14½	1.14¾	1.05¾
1884	1.11	1.04⅜	.98⅛	.94	.85⅝	.68⅝	.63½	.81⅛	.78	.71⅛	.72½	.74⅜	.83½
1885	.70⅞	.72⅜	.80⅛	.78½	.79	.82	.92½	1.00¼	1.00¾	1.05½	1.04⅜	.89⅞	.88
1886	.88⅜	.79⅞	.77¼	.74⅛	.70	.66½	.66	.62⅛	.63⅜	.65⅛	.71⅝	.70⅜	.71¼
1887	.70	.61⅝	.63⅜	.64⅞	.64½	.62⅝	.59¼	.60⅛	.67	.70⅞	.73⅞	.80¾	.66¾
1888	.91¼	.91⅝	.93⅝	.82⅝	.86¾	.75⅞	.80⅝	.90⅛	.93⅝	.90⅝	.85⅜	.89¼	.87⅝

Total stocks of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'88, by months and years.

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	537, 751	587, 021	642, 000	771, 000	605, 000	554, 000
1872	532, 971	579, 793	662, 497	877, 832	950, 803	1, 010, 302
1873	1, 183, 728	1, 265, 373	1, 244, 657	1, 178, 643	1, 192, 541	1, 324, 493
1874	1, 948, 919	2, 283, 032	2, 648, 210	2, 623, 534	2, 594, 286	2, 701, 625
1875	4, 011, 703	4, 546, 188	4, 592, 364	4, 537, 843	4, 552, 672	4, 502, 896
1876	3, 585, 143	3, 734, 835	3, 829, 250	3, 900, 703	3, 989, 904	3, 791, 642
1877	2, 604, 128	2, 860, 636	3, 210, 454	3, 279, 731	3, 173, 008	2, 912, 674
1878	3, 555, 342	3, 875, 964	4, 342, 832	4, 692, 090	4, 996, 058	5, 078, 189
1879	5, 321, 222	5, 813, 663	6, 318, 099	6, 689, 111	6, 980, 064	7, 263, 150
1880	8, 724, 194	9, 004, 002	9, 606, 683	10, 780, 153	11, 916, 577	13, 099, 934
1881	20, 110, 903	21, 108, 003	22, 105, 789	22, 963, 171	23, 793, 028	24, 441, 191
1882	26, 716, 188	27, 059, 611	27, 822, 825	28, 547, 481	29, 206, 697	29, 859, 952
1883	35, 187, 116	35, 692, 480	35, 881, 255	37, 789, 406	35, 755, 824	35, 985, 935
1884	35, 884, 509	36, 041, 898	36, 220, 270	36, 642, 794	38, 631, 203	38, 665, 838
1885	37, 214, 274	36, 757, 137	36, 508, 236	36, 464, 800	36, 139, 072	35, 872, 257
1886	34, 186, 238	34, 082, 775	33, 954, 493	33, 823, 385	33, 969, 486	34, 187, 377
1887	33, 835, 389	33, 288, 630	32, 932, 502	32, 955, 084	32, 642, 330	32, 389, 750
1888	26, 927, 634	26, 084, 574	25, 404, 276	24, 893, 223	24, 653, 043	24, 219, 496

Years.	July.	August.	September.	October.	November.	December.	Averages.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	511, 220	530, 146	541, 300	495, 102	502, 960	532, 000	567, 458
1872	990, 229	997, 166	951, 410	914, 423	886, 909	1, 084, 423	869, 896
1873	1, 433, 620	1, 513, 890	1, 521, 185	1, 452, 777	1, 493, 875	1, 625, 157	1, 369, 161
1874	2, 279, 479	2, 932, 444	2, 758, 504	3, 134, 902	3, 449, 845	3, 705, 639	2, 755, 035
1875	4, 386, 720	4, 223, 397	3, 812, 945	3, 672, 101	3, 701, 235	3, 550, 207	4, 174, 189
1876	3, 326, 726	3, 304, 405	2, 930, 456	3, 040, 108	2, 955, 092	2, 551, 199	3, 411, 622
1877	3, 004, 728	2, 852, 544	2, 503, 657	2, 504, 012	2, 471, 798	3, 127, 837	2, 875, 434
1878	5, 031, 600	4, 717, 877	4, 599, 362	4, 221, 769	4, 289, 309	4, 615, 299	4, 501, 308
1879	7, 353, 382	7, 114, 195	7, 620, 525	7, 794, 634	8, 051, 469	8, 470, 490	7, 065, 834
1880	14, 116, 753	15, 063, 651	16, 157, 316	16, 887, 019	18, 025, 409	18, 928, 430	13, 541, 682
1881	24, 888, 337	25, 005, 187	25, 066, 657	25, 309, 361	25, 509, 285	26, 019, 704	28, 850, 051
1882	30, 715, 144	31, 772, 094	32, 400, 303	32, 608, 533	33, 728, 555	34, 596, 612	30, 419, 500
1883	36, 371, 922	36, 164, 881	35, 752, 677	35, 613, 915	35, 506, 653	35, 745, 632	35, 953, 975
1884	38, 985, 767	39, 084, 561	38, 740, 734	38, 192, 317	37, 925, 756	37, 366, 126	37, 698, 481
1885	35, 686, 909	35, 343, 771	34, 939, 902	34, 763, 857	34, 668, 437	34, 428, 841	35, 732, 291
1886	34, 428, 490	34, 800, 397	35, 061, 614	35, 027, 877	34, 525, 871	34, 156, 605	34, 350, 467
1887	32, 289, 269	32, 003, 536	31, 340, 939	30, 662, 583	29, 325, 951	28, 006, 211	31, 806, 015
1888	23, 586, 951	22, 825, 298	21, 876, 681	20, 722, 024	19, 734, 132	18, 995, 314	23, 326, 928

Shipments of crude petroleum, and refined petroleum reduced to crude equivalent, out of the Pennsylvania and New York oil fields, for the years 1871–'88, by months and years.

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	437, 691	347, 718	383, 890	389, 147	587, 375	501, 754
1872	476, 960	407, 606	276, 220	428, 512	510, 417	529, 228
1873	573, 124	527, 440	668, 374	708, 191	768, 176	696, 414
1874	843, 663	501, 220	518, 246	803, 409	899, 027	815, 413
1875	453, 095	327, 776	693, 918	729, 581	681, 679	745, 986
1876	677, 289	519, 193	623, 762	603, 037	646, 150	921, 862
1877	743, 461	484, 904	913, 919	993, 526	1, 234, 324	1, 391, 124
1878	775, 791	774, 234	741, 512	846, 632	960, 894	1, 135, 119
1879	663, 998	702, 729	973, 879	1, 136, 188	1, 331, 469	1, 369, 314
1880	1, 650, 409	1, 395, 151	1, 613, 371	842, 268	1, 095, 259	975, 083
1881	1, 061, 617	915, 028	1, 276, 746	1, 348, 398	1, 563, 436	1, 729, 697
1882	1, 657, 067	1, 787, 909	1, 718, 956	1, 678, 134	1, 827, 356	2, 172, 685
1883	1, 357, 815	1, 250, 824	1, 641, 899	1, 908, 379	1, 995, 634	1, 747, 789
1884	1, 686, 961	1, 723, 261	1, 873, 890	1, 643, 336	1, 899, 329	1, 827, 553
1885	1, 804, 028	1, 895, 021	1, 887, 034	1, 823, 726	2, 097, 099	2, 034, 025
1886	1, 991, 561	2, 032, 794	2, 055, 750	2, 070, 468	2, 032, 672	2, 117, 489
1887	2, 312, 067	1, 995, 757	2, 332, 324	1, 938, 278	2, 328, 564	2, 165, 439
1888	2, 265, 109	2, 163, 957	1, 979, 753	1, 928, 435	1, 773, 994	1, 956, 115

Shipments of crude petroleum, and refined petroleum reduced to crude equivalent, out of the Pennsylvania and New York oil fields, etc.—Continued.

Years.	July.	August.	September.	October.	November.	December.	Totals.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	541, 137	528, 134	551, 075	505, 071	480, 977	410, 822	5, 664, 791
1872	591, 238	621, 954	541, 607	607, 468	477, 945	430, 786	5, 899, 947
1873	814, 449	864, 768	952, 955	1, 010, 852	959, 589	955, 443	9, 499, 775
1874	910, 281	793, 865	1, 014, 570	543, 341	546, 117	602, 318	8, 821, 500
1875	904, 537	882, 089	1, 109, 392	871, 917	671, 066	871, 902	8, 942, 938
1876	1, 228, 539	1, 203, 402	1, 154, 549	524, 190	871, 496	1, 190, 983	10, 164, 452
1877	1, 096, 951	1, 425, 943	1, 563, 797	1, 268, 971	1, 205, 634	600, 019	12, 832, 573
1878	1, 330, 454	1, 655, 651	1, 434, 225	1, 747, 390	1, 281, 410	992, 688	13, 676, 000
1879	1, 625, 035	1, 808, 239	1, 627, 120	1, 662, 269	1, 453, 645	1, 532, 585	15, 886, 470
1880	1, 231, 611	1, 394, 129	1, 252, 635	1, 665, 933	1, 226, 030	1, 335, 613	15, 677, 492
1881	1, 925, 532	2, 214, 877	2, 131, 950	2, 080, 467	2, 066, 906	1, 969, 581	20, 284, 235
1882	2, 402, 970	2, 047, 545	1, 992, 171	2, 089, 428	1, 404, 640	1, 121, 453	21, 900, 314
1883	1, 634, 407	3, 086, 478	2, 325, 574	2, 215, 421	2, 065, 602	1, 749, 547	21, 979, 369
1884	1, 740, 021	2, 000, 371	2, 292, 087	2, 510, 283	2, 078, 261	2, 382, 244	23, 657, 597
1885	1, 961, 152	2, 049, 099	2, 116, 659	2, 050, 150	1, 857, 080	2, 138, 253	23, 713, 326
1886	2, 418, 961	2, 059, 299	2, 157, 323	2. 441, 848	2, 724, 796	2, 550, 891	26, 653, 852
1887	2, 000, 173	2, 220, 768	2, 342, 227	2, 573, 008	2, 462, 082	2, 608, 341	27, 279, 028
1888	2, 098, 531	2, 223, 263	2, 289, 486	1, 558, 115	2, 503, 491	2, 397, 782	25, 138, 031

Average daily product of crude petroleum in the Pennsylvania and New York oil fields each month for the years 1872–'88, *by months and years.*

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
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, 859	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

Years.	July.	August.	September.	October.	November.	December.	Yearly averages.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1872	16, 702	17, 739	16, 681	4, 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, 251	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	41, 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

[Yearly average is the total product divided by the number of days in the year, *not* an average of monthly averages.]

PRODUCTION STATISTICS.

Total product of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'88, *by months and years.*

Years.	January.	February.	March.	April.	May.	June.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130
1873	632, 617	608, 300	665, 291	641, 520	776, 361	793, 470
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	921, 750
1875	852, 159	719, 824	789, 539	675, 060	696, 508	696, 210
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600
1877	842, 890	783, 216	901, 697	972, 810	1, 127, 594	1, 130, 790
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210
1886	1, 748, 956	1, 604, 848	1, 928, 448	1, 938, 360	2, 178, 773	2, 335, 380
1887	1, 990, 851	1, 827, 924	2, 007, 196	1, 960, 860	1, 993, 157	1, 912, 860
1888	1, 155, 937	1, 290, 718	1, 338, 877	1, 349, 404	1, 473, 362	1, 450, 703

Years.	July.	August.	September.	October.	November.	December.	Totals.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871	456, 475	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	517, 762	519, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	867, 473	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 893, 786
1874	1, 033, 447	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	788, 361	718, 766	698, 940	731, 073	700, 200	720, 874	8, 787, 514
1876	763, 623	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	1, 189, 005	1, 273, 759	1, 214, 910	1, 269, 326	1, 173, 420	1, 256, 058	13, 135, 475
1878	1, 283, 865	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 637, 767	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 685, 176
1880	2, 248, 430	2, 341, 027	2, 346, 300	2, 385, 636	2, 274, 420	2, 238, 634	26, 027, 631
1881	2, 372, 678	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	3, 258, 162	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 053, 500
1883	2, 020, 394	1, 879, 437	1, 913, 370	2, 076, 659	1, 958, 340	1, 988 526	23, 128, 389
1884	2, 059, 950	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 775, 804	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041
1886	2, 418, 961	2, 413, 206	2, 418, 540	2, 408, 111	2, 222, 790	2, 181, 625	25, 798, 000
1887	1, 899, 525	1, 848, 877	1, 779, 930	1, 843, 291	1, 125, 450	1, 288, 602	21, 478, 883
1888	1, 394, 847	1, 384, 477	1, 273, 080	1, 351, 518	1, 442, 405	1, 582, 756	16, 491, 084

OHIO.

The producing fields of this State have been so fully described in previous volumes of Mineral Resources that it is unnecessary to more than refer to them here.

The two chief sources of oil in Ohio are the Trenton limestone and the Berea grit. The old and well known fields of Mecca and Grafton derive their oil from the Berea grit; at Macksburgh, the only important oil district at present in the eastern part of Ohio, there are four productive sand rocks. Interest, however, centers in the Berea grit. In Athens and Morgan counties a little shallow oil is produced from the Coal Measures, and some oil is found in the Waverly conglomerate. The chief producer of oil in Ohio at present, however, is the Trenton limestone.

The important producing fields in Ohio are the Macksburgh and the Lima or Northwestern, the latter of which includes, in addition to the Lima field proper, the Findlay, North Baltimore, and Saint Marys.

Total product of petroleum in Ohio.—To the product of the Lima and Macksburgh fields, which can be ascertained with some approach to accuracy, must be added an estimate of the oil produced at Smith's Ferry and the other points named above, in order to arrive at the total product of the State. This latter does not exceed 100 barrels per day. The product would then stand as follows:

Product of petroleum in Ohio in 1888.

	Production.
	Barrels.
Lima district	9,682,683
Macksburgh district	291,585
Other districts	36,600
Total	10,010,868

Northwestern or Lima field.—This is in production the most important oil field in the United States, next to the Pennsylvania and New York fields. The character of the oil produced, however, is such that its use has been chiefly confined to fuel, and consequently has commanded but a small price as compared with Pennsylvania oil.

During the year the product of this field has increased from 4,650,375 barrels in 1887 to 9,682,683 barrels in 1888, or from a daily average of 13,617 barrels in January to 33,846 barrels in December.

The product of petroleum in the Lima field, by months, for 1887 and 1888 is as follows:

Product of petroleum in the Lima, Ohio, field, 1887 *and* 1888.

	1887.	1888.
	Barrels.	*Barrels.*
January	131,011	422,125
February	206,026	479,824
March	303,084	586,781
April	352,798	629,932
May	449,062	745,896
June	474,535	862,106
July	389,997	905,218
August	490,862	995,938
September	465,743	979,943
October	444,941	1,036,712
November	458,612	988,997
December	483,704	1,049,211
Total	4,650,375	9,682,683

In the above table is included not only the statement of the receipts of the several Lima pipe lines that make publications once a month, but also an estimate of that contained in private lines. We have no such figures, however, for the deliveries of Lima oil, and are only enabled to give the statements of deliveries as published by the pipe lines. These are as follows:

Deliveries of Lima oil for 1888, as per pipe-line statements.

Months.	Production.	Months.	Production.
	Barrels.		*Barrels.*
January	81, 569	July	227, 707
February	207, 040	August	401, 175
March	243, 964	September	301, 316
April	210, 725	October	370, 378
May	164, 436	November	287, 934
June	179, 192	December	382, 448
		Total	3, 057, 884

The same statement can be made relative to stocks in the Lima field, the stocks given in the table below being only those on hand at the the close of each month in pipe-lines which make reports. The stock at the close of each month was as follows:

Stocks on hand in the Lima oil field at the close of each month in 1888.

Months.	Stocks.	Months.	Stocks.
	Barrels.		*Barrels.*
January	4, 367, 355	July	7, 282, 088
February	4, 588, 323	August	7, 852, 705
March	4, 949, 446	September	8, 392, 493
April	5, 367, 401	October	8, 920, 086
May	5, 948, 407	November	9, 499, 482
June	6, 593, 165	December	9, 810, 714

It will thus be seen that the stocks have increased from 4,367,355 barrels at the close of January, 1888, to 9,810,714 barrels, or more than double, at the close of December. The product during the same time increased from 422,125 barrels to 1,049,211 barrels, or about two and one-half times. This would indicate that only about 40 per cent. of the production of the Lima field went into consumption in 1888, some 60 per cent. being added to the already large stocks.

In the following table is given the number of wells drilling at the close of January and December, 1888; the number of wells completed in the months of January and December, and the total number of wells completed during the year.

Well record in the Lima oil field.

Wells drilling.	Jan. 31, 1888.	Dec. 31, 1888.
Lima	4	14
North Baltimore	17	18
Findlay	8	1
Total	29	33

Wells completed.	January.	December.	Total for one year.
Lima	5	9	96
North Baltimore	18	35	300
Findlay	2	1	129
St. Marys	....	1	6
Total	25	46	531

The Macksburgh oil field.—It is equally true of the Macksburgh as of the Lima field, that the pipe-line runs do not show the product. The pipe-line runs in this field as reported in 1888, by months, are as follows:

Pipe-line runs in the Macksburgh field, 1888.

Months.	Production.	Months.	Production.
	Barrels.		*Barrels.*
January	16, 257	August	18, 558
February	18, 861	September	22, 058
March	20, 526	October	18, 809
April	21, 187	November	20, 802
May	22, 227	December	20, 950
June	21, 510		
July	21, 785	Total	243, 530

From information received the following estimate of the actual product of this district is given, and may be regarded as approximately correct.

Product of Macksburgh, Ohio, district, 1888.

Months.	Production.	Months.	Production.
	Barrels.		*Barrels.*
January	20, 144	July	25, 335
February	25, 327	August	23, 537
March	23, 515	September	22, 945
April	23, 720	October	25, 452
May	25, 837	November	25, 831
June	24, 426	December	25, 516
		Total	291, 585

The estimated product is thus far 291,585 barrels as against pipe-line runs of 243,530 barrels.

Other districts.—Outside of the Lima, the Northwestern, and the Macksburgh districts there is a small product of oil in Ohio. The most important field is the old and well-known district in the neighborhood of Smith's Ferry, which produces from 50 to 60 barrels per day. The oil in this district is from the same horizon as the producing sand in Turkey Foot in West Virginia. At Mecca a few barrels of lubricating oil are still secured by hand baling from the shallow wells of the district. At Tiffin there is a production of a few barrels per day. The whole of this oil is, however, burned on the spot. About Gibsonburgh, Sandusky county, there is promise of a small field, but the present price discourages production. The Wood county oil field is being rapidly pushed to the northward. At Cambridge a few barrels of oil are brought up from month to month.

The total product of Ohio outside of the Lima and Macksburgh fields is estimated at 100 barrels per day, or for 1888, 36,600 barrels.

WEST VIRGINIA.

As has already been pointed out in previous volumes of Mineral Resources, West Virginia was at one time quite a producer of oil, but had for some years ceased almost entirely to yield oil for refining purposes, though some quantities of lubricating oil have been produced in this State. Recently, however, the search for natural gas and the extension of some of the lower Pennsylvania oil fields into West Virginia have resulted in somewhat of a production of oil for refining purposes, which increased rapidly as the year closed, the product in one of these new fields, the Turkey Foot, in January, being 400 barrels per day. A little oil is also produced in what is known as the Moundsville district, the well at this place being struck when drilling for gas.

The total product of oil in the West Virginia district for 1888 is as follows:

Product of oil in West Virginia in 1888.

Districts.	Production.
	Barrels.
Burning Springs	4,000.00
Volcano	81,069.63
Eureka	23,884.68
Turkey Foot	9,034.00
Moundsville	1,460.00
Total	119,448.31

KENTUCKY AND TENNESSEE.

Nothing can be added to the statements contained in previous volumes of Mineral Resources relative to the petroleum fields or production of Kentucky and Tennessee. Some explorations for oil and gas have been prosecuted in these States during the past year, but the results have been of little importance commercially. The wells near Glasgow, in Kentucky, still yield a small quantity of oil, and possibly a few barrels have been produced in Tennessee, but the amount of product in the latter State is not of sufficient importance to justify its tabulation.

Product of petroleum in Kentucky from 1883 to 1888, inclusive.

Month.	1883.	1884.	1885.	1886.	1887.	1888.
	Gallons.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
January	11,136	7,806	20,100	12,332	19,802	12,501
February	15,626	15,863	12,083	16,547	20,042	17,101
March	13,977	7,806	15,992	20,029	16,082	21,032
April	19,403	19,666	20,124	16,432	12,146	17,166
May	23,283	20,943	12,484	20,138	20,730	12,871
June	19,038	12,157	16,137	16,137	16,131	12,620
July	16,112	15,746	24,487	12,076	16,119	16,620
August	15,223	15,840	16,057	16,021	16,137	25,166
September	18,722	14,310	20,191	20,141	16,111	24,562
October	19,209	20,174	22,945	16,120	16,007	16,711
November	11,793	8,013	16,162	16,113	15,755	16,860
December	16,172	15,872	20,117	16,379	16,160	20,815
Total	199,694	174,196	216,879	198,465	201,222	214,025
Total ..... barrels	4,755	4,148	5,164	4,726	4,791	5,096

INDIANA.

Oil has been found at many localities on the western and northern borders of the gas area, but as yet the only points where it has been obtained in what might be considered paying quantities are at Montpelier, Blackford county, and about one mile west of Portland, Jay county. About 50 barrels per day is what is claimed as the capacity of the wells at these local cities.

CALIFORNIA.

In California, petroleum wells are now being operated in the following counties:

Alameda, Colusa, Humboldt, Los Angeles, Monterey, San Benito, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, and Ventura. The counties where the flow is largest are Los Angeles, Ventura, and Santa Cruz.

The total flow of last year is placed at 28,993,986 gallons, or 690,333 barrels, valued at $2 a barrel, of which Ventura county turned out 237,000 barrels of 42 gallons each, and Los Angeles county 420,000 barrels of 42 gallons each. The principal points of production are as follows: Newhall and Puente, Los Angeles county; Santa Paula, Ventura county; Alma, Santa Cruz county, and Half Moon Bay, San Mateo county.

The oil refinery at Alameda Point, San Francisco bay, turns out yearly 73,000 barrels of gas oil, which is consumed chiefly in San Francisco.

The consumption of crude oil, has largely increased on the Pacific coast, where it is used as a fuel for manufacturing purposes, and would still further increase were the supply adequate.

Many large industrial establishments in San Francisco, Oakland, Los Angeles, and smaller cities now use oil fuel under their boilers. No new refineries were built in 1888, but a number of new wells have been opened, and very vigorous prospecting is going on in many counties. Steamers have been built to bring the oil in bulk from the southern coast ports to San Francisco. The Pacific Coast Oil Company now manufactures about 35 per cent. of the naphtha used on the coast, and are increasing their facilities. For illuminating oils, manufactured from this petroleum, the average price last year for 110° fire test was 10 cents per gallon and 15 cents for 150° test. It is estimated that 20 per cent. of the product is lubricating oil.

COLORADO.

In the search for oil that followed its discovery in Pennsylvania, Colorado shared, and oil was discovered near Cañon City some twenty that it was found in paying quantities at Florence, near Cañon City, in the neighborhood of which are the only wells that have been worked. There are frequent indications of oil over a wide territory. It is probable, however, that the condition of the rocks is such that in many cases the oil has been lost.

The oil bearing rock of Colorado is, according to Professor Newberry, the Colorado shales, the middle member of the Cretaceous group. This adds a new horizon to those from which oil has heretofore been obtained. The supply at Findlay, in Ohio, Burkesville, in Kentucky, and Collingwood, Canada, comes from the lower Silurian, while in the great fields of western Pennsylvania and western New York the oil is derived from the Devonian black shales which underlie that region, and have a thickness of 500 feet. The oil of Mecca, Ohio, is taken from the Berea grit, and originates in the Cleveland black shale which underlies it.

The crude Colorado oil has a pleasant, ethereal odor, and is easily refined and deodorized. The residuum is used as fuel.

The growth of the petroleum industry at Florence, Colorado, in 1888, was very great, and the oil field is now assuming an important position in the market. The known oil field is confined to a small area of the valley of the Arkansas river and the adjacent "mesa" or table land, in Fremont county, and about 10 miles east of Cañon City. It is reached by the Denver and Rio Grande, and the Atchison, Topeka and Santa Fé railways. The refineries are in the town of Florence, in the immediate neighborhood of the wells. The United Oil Company is the only producer. This company is restricted by agreement with the Standard and Continental Oil companies to the territory of Colorado, New Mexico, Utah, Wyoming, and Montana. During 1888 the capacity of the refineries, which was 400 barrels per day, became insufficient, and it was increased to 1,000 barrels per day. To supply the increased capacity of the refineries, 16 new wells were sunk in 1888, making the total number of wells 46, of which 22 are productive. The deepest well is 3,047 feet deep. None of the wells are gushers, but they flow in a steady stream, yielding from 20 to 100 barrels per day, the average of the wells being about 50 barrels per day.

The Colorado oil, when crude, has a gravity of 31 degrees Baume, and yields, on refining, from 35 to 40 per cent. of pure white oil. It is easily refined and deodorized. The residuals are rich in paraffin, and would be worth much more than is now asked if the market were larger. The wells have failed to reach sand rock, and get oil from what are apparently small reservoirs in the shale. These reservoirs, while of small area, seem to be connected with a source of steady supply, for instead of decreasing in flow, many have increased. The crude oil contains about 35 per cent. of illuminants. Small quantities of later distillates are occasionally made on order, but the bulk of the residuals is used for steam making. These residuals are sold at 50 cents per barrel of 42 gallons. The product of the United Oil Company in 1888 was 12,500,000 gallons of crude oil, or 2,500,000 gallons of refined oil.

The product in 1887 and 1888 was as follows:

Product of petroleum in Colorado in 1887 and 1888.

	1887.	1888.
	Barrels.	*Barrels.*
United Oil Company	56,295	297,612
Florence Oil Company	20,000	
Total	76,295	297,612

The oil springs in various parts of western Colorado, especially in Garfield and Routt counties, have remained undeveloped.

WYOMING.

Petroleum has been known to exist in Wyoming for over thirty years, its first recorded use being as a lubricant for emigrant wagons before the Pacific railroads were built. Since then it has been occasionally used as a lubricant at the coal mines of the Territory, and some shallow wells have been put down near the Union Pacific and the Oregon Short Line railways, but the wells were soon abandoned. The most productive oil territory is still far from transportation facilities, and its value is not yet well known. The most valuable property developed lies in Carbon county, on the Popo Agie river, and near the town of Lander. This tract is known by the name of the late Dr. George B. Graff, of Omaha, who had full faith in the oil field, but died before he could accomplish much. Mr. L. D. Ricketts, Territorial geologist, states concerning this property:

"These wells, which varied in depth from 350 to nearly 800 feet, were cased and supplied with valves to prevent the oil from escaping, but owing to the great gas pressure a large leakage cannot be prevented. The pressure is so great that, upon suddenly opening the valves, the oil spurts up 75 feet into the air like some black-watered geyser. After the pipe thus clears itself the steady flow of oil is resumed which, as variously estimated, will aggregate from 600 to 1,000 barrels per twenty-four hours. As these wells are about 100 miles from the nearest railroad, no oil has been shipped on account of the expense of transportation, and the oil that escapes in spite of the valves is wasted, and drains into several large ponds where there are always thousands of barrels of oil collected. Its presence is indicated long before the ponds are reached by the strong but not disagreeable smell of escaping gas. In color this oil is black. When fresh it contains a very large amount of absorbed gas. It will yield both illuminating and lubricating oil of excellent quality when distilled, and leaves a residue which can be used as fuel for steam making."

The oil is low in illuminants, averaging, perhaps, 25 per cent. It is proposed (and a company has been organized for the purpose) to pipe the crude oil to Denver, 250 miles distant, and to sell the oil for fuel. The estimated cost of a 6-inch main and two pumping stations is $1,500,000.

The crude oils further north and east, and away from the neighborhood of volcanic disturbances, are reported to be much higher in illuminants, in some cases yielding 60 per cent., but no wells have been sunk there.

COST OF DRILLING WELLS.

Prices per foot for drilling wells are agreed upon from time to time between the Producers' Association and the Oil Well Drillers' Union. The prices agreed upon in August of 1888 between these two associations were as follows:

All drilling in Allegany county, New York, 60 cents per foot; all drilling in McKean county, Pennsylvania, 50 cents; all drilling in Warren and Forest counties, Pennsylvania, 55 cents; all drilling in Elk county, Pennsylvania, 60 cents; all drilling in Crawford county, that part of Venango county north of Petroleum Center, and the lower part of Warren county, 55 cents; all drilling in that part of Venango county south of Petroleum Center and north of Emlenton, Clarion county, 50 cents; all drilling in Washington county, Smith & Fergus pool, $1.25 per foot; all drilling in Taylorstown, $1.15 per foot; all drilling in Mount Morris, $1.40 per foot; all drilling in Nineveh, $2 per foot; all reaming down north of Emlenton, when required to shut off salt-water, 40 cents per foot; use of machinery north of Emlenton, 10 cents per foot.

All water wells drilled north of Emlenton shall be paid for at the same rate as the oil wells. Where five or more wells can be secured in the same immediate vicinity, where no unreasonable delays are to be encountered, a reduction of 5 cents per foot may be made from the above scale, all north of Emlenton.

CANADA.

The oil-producing territory of Canada is situated in the county of Lambton, Ontario, the paying wells being confined to a belt running northeast and southwest for about 20 miles, with a width varying from 1 to 4 miles. This belt is situated some 16 miles easterly of Port Sarnia, running nearly parallel with the Saint Clair river. In this territory are two districts, Petrolia and Oil Springs.

Petrolia, which is the center of the Canadian oil district, was settled in 1839. It is about 160 miles from Toronto, on Bear creek, a tributary of the Sydenham river.

Below is given a statement of the shipments of crude and refined oil and of the equivalent of both in crude for 1887 and 1888. These shipments form the only basis for calculating the production:

Petroleum shipments from Canada in 1887 *and* 1888.

[Barrels, 45 gallons.]

Months.	1887.			1888.		
	Crude.	Refined.	Crude equivalent.	Crude.	Refined.	Crude equivalent.
January	14,331	15,697	51,524	19,482	16,595	60,969
February	15,152	14,282	50,858	15,735	11,758	41,098
March	16,079	15,102	53,834	17,239	12,998	49,734
April	17,617	6,400	33,617	16,749	9,283	39,956
May	15,045	10,063	40,227	16,508	7,294	33,743
June	11,611	6,129	27,933	12,766	9,543	36,624
July	11,477	16,006	51,492	15,204	11,842	42,209
August	14,357	24,003	74,334	14,978	19,309	63,241
September	19,923	35,605	108,935	15,860	30,482	92,090
October	25,220	34,923	112,526	21,913	33,881	106,615
November	23,953	26,932	91,383	23,816	25,588	87,796
December	18,867	21,130	71,682	22,984	17,536	66,824
Total	....	....	768,345	....	....	720,899

The product of petroleum in Canada since 1862 is estimated as follows:

Product of crude petroleum in Canada from 1862 *to* 1888, *inclusive.*

Years.	Barrels.	Years.	Barrels.	Years.	Barrels.
1862	11,775	1871	269,397	1880	350,000
1863	82,814	1872	308,100	1881	275,000
1864	90,000	1873	365,052	1882	275,000
1865	110,000	1874	168,807	1883	250,000
1866	175,000	1875	220,000	1884	250,000
1867	190,000	1876	312,000	1885	250,000
1868	200,000	1877	312,000	1886	250,000
1869	220,000	1878	312,000	1887	868,345
1870	250,000	1879	575,000	1888	772,392

There are no reliable statistics of production in Canada. The above are the estimates of parties intimately connected with the industry.

The stocks of crude oil in possession of the tanking companies at the end of December, 1887 and 1888, were as follows:

Stocks of crude petroleum of tanking companies at the close of the years 1887 *and* 1888.

	1887.	1888.
	Barrels.	*Barrels.*
Crown	53,979	69,265
Producer	51,424	80,107
P. C. O. & T. Co	110,470	149,341
Total	215,873	298,713

In the mineral statistics report of the Geological and Natural History Survey of Canada is a very interesting statement relative to petroleum for 1887, from which the following is condensed:

"The petroleum inspection returns as entered in the books of the Inland Revenue Department show that the number of packages of Canadian refined oil (refined petroleum and naphtha) inspected during the year 1887 were: (1) 221,684 packages at 10 cents inspection fee; (2) 619 packages at 5 cents inspection fee; (3) 35,134 packages at 2½ cents inspection fee. Rating the different packages as containing, respectively, 35, 10, and 4 imperial gallons, we have a total of Canadian refined oils during the year of 7,905,666 imperial gallons, or 225,876 barrels of 35 imperial gallons. This at the yield of 100 crude oil for 38 refined, corresponds to 20,804,384 imperial gallons, or to 594,411 barrels of 35 imperial gallons, of crude oil. Taking the average price for the year on the Petrolia oil exchange of 78 cents per barrel of crude oil, the value would be $463,641. Compared with our inspection returns of 1886, which were made up as above from the number of packages inspected entered in the books of the Inland Revenue Department, the above statement shows an increase in 1887 of 107,970 barrels, or of 22 per cent. in the quantity, but of only $25,844 in the total value.

"In the following table will be found the quantities of Canadian oil inspected, and the corresponding equivalents in crude oil since 1881, obtained for each year by a similar calculation based on the number of packages entered in the books of the Inland Revenue Department:

Canadian petroleum and naphtha inspected, and corresponding quantities of crude oil.

Years.	Refined oils inspected.	Crude equivalent calculated.	Ratio of crude to refined.
	Gallons.	*Gallons.*	
1881	5, 380, 081	10, 760, 162	100 : 50
1882	5, 111, 893	11, 359, 762	100 : 45
1883	6, 204, 544	13, 787, 875	100 : 45
1884	6, 730, 068	16, 825, 170	100 : 40
1885	5, 853, 290	14, 633, 225	100 : 40
1886	6, 469, 667	17, 025, 439	100 : 38
1887	7, 905, 666	20, 804, 384	100 : 38

"Direct returns were sent from 13 refineries, 9 of which are situated in Petrolia, 2 in London, 1 in Hamilton, and 1 in Sarnia; it is believed that the whole of the refining operations in Canada is nearly covered by these returns, and that there were only two other small refiners, one in Petrolia and one in Montreal, both of whom went out of business during the year, so that it has been impossible to ascertain the statistics of their production and consumption. The three tanking companies of Petrolia have also very willingly forwarded to us the statistics of their operations. These returns are summarized in the following tables:

Main products of Canadian refineries in 1887.

Products.	Imperial gallons.	Value at refinery.
Illuminating oils	10,387,825	$991,290
Benzine and naphtha	344,570	31,447
Black and paraffin oils (including fuel, gas, and lubricating oils)	6,793,461	240,851
Paraffin wax ... Pounds..	400,036	24,521
Total		$1,288,109

Main consumption of the Canadian refineries in 1887.

Crude petroleum ... Imperial gallons....	26,737,668
Sulphuric acid (*a*) ... Pounds....	3,215,410
Soda (*a*) ... do......	331,898
Litharge (*a*) ... do......	496,163
Sulphur (*a*) ... do......	96,816

a The quantities consumed by the Sarnia refinery could not be ascertained, but they were small and do not materially affect the result.

"The above tables show that the percentage of the different oils per 100 crude petroleum was as follows:

Percentage of different products from Canadian oil.

	Per cent.
Illuminating oils	38.00
Benzine and naphtha	1.30
Black and paraffin oils (including fuel, gas, and lubricating oils, and paraffin wax)	25.70
Heavy tar and residuum, coke, and waste (not returned)	35.00
Total	100.00

"There were 763,933 barrels of 35 imperial gallons of crude oil consumed during the year in the manufacture of illuminating oils. Besides and above the 7,905,666 imperial gallons of refined petroleum and naphtha inspected during the year, there were also 2,836,729 imperial gallons produced in the refineries, and not yet inspected at the close of the year. As this would indicate a stock carried over from year to year in the country of some 5,000,000 gallons of refined oils which is much more than the real stock carried, it shows that the calculations based on the number of packages of refined oils inspected give an incorrect and too low result. The figures above, showing the main products of Canadian refineries in 1887, are consequently believed to be about one-third too low. It is to be regretted that the Inland Revenue Department does not keep a record of the number of gallons inspected instead of the number of packages. The returns of the tanking companies give the following results:

Tanking companies' statement of crude oil product in Canada in 1887.

	Barrels.
Stocks on January 1, 1887	$388,192\frac{3}{35}$
Quantity of oil delivered to tanking companies from wells in 1887	$414,273\frac{31}{35}$
Quantity of oil delivered by tanking companies in 1887	$584,672\frac{23}{35}$
Stocks on January 1, 1888	$217,793\frac{8}{35}$

"Compared with the direct returns of the refiners the above statement shows that the refiners themselves must have received directly from the wells about 180,000 barrels of crude petroleum during the year, making the total product from the wells in 1887 to be $414,273\frac{31}{35}$ barrels, received by tanking companies; 180,000 barrels received by refiners; total, $594,273\frac{31}{35}$ barrels. This total product from the wells in 1887 of 594,274 barrels added to the balance in the stocks on January 1, 1887, and on January 1, 1888, which was one of 170,399 barrels, gives 764,673 barrels as the quantity of oil available for consumption during the year, and proves that the direct returns from the refiners of their crude consumption are correct. The returns of the tanking companies exhibit also a decrease in the stocks at the end of 1887 of nearly 44 per cent.

"Mr. James Kerr, secretary of the Petrolia oil exchange, gives the following tables of the business during the year 1887 on that exchange and of the average closing prices per month for the years 1885, 1886, and 1887:

Crude petroleum business for the year 1887 of the Petrolia oil exchange, Canada.

Month.	Price.						Total sales, barrels of 35 imperial gallons each.
	Opening.	Highest.	Lowest.	Closing.	Average closing.	Average.	
January	92	92	80	$83\frac{1}{4}$	81.78	84.71	41,549
February	$83\frac{1}{2}$	$84\frac{1}{2}$	$79\frac{3}{4}$	$79\frac{3}{4}$	81.63	82.38	37,969
March	$79\frac{1}{2}$	$79\frac{1}{2}$	75	$77\frac{1}{4}$	76.72	78.26	44,763
April	77	77	74	$74\frac{1}{2}$	75.04	75.61	36,153
May	74	74	76	$67\frac{1}{2}$	69.29	75.89	34,462
June	$67\frac{1}{2}$	$68\frac{1}{2}$	66	$68\frac{1}{2}$	67.26	73.42	35,937
July	$68\frac{1}{2}$	$68\frac{1}{2}$	$66\frac{1}{4}$	$66\frac{1}{2}$	67.50	72.34	18,127
August	$66\frac{1}{2}$	$83\frac{1}{2}$	$66\frac{1}{2}$	$82\frac{1}{2}$	71.36	78.55	31,011
September	83	84	$78\frac{1}{2}$	79	81.03	83.78	32,639
October	$79\frac{3}{4}$	$79\frac{3}{4}$	75	$75\frac{3}{4}$	77.12	$77\frac{1}{8}$	25,338
November	$75\frac{1}{2}$	$75\frac{1}{2}$	76	$73\frac{3}{4}$	72.21	$72\frac{1}{2}$	20,479
December	$73\frac{3}{4}$	80	$72\frac{1}{2}$	76	76.30	$77\frac{2}{3}$	47,836
Year 1887	92	92	66	76	78.02	78	406,203
Puts and calls							45,000
Total							451,203

"The above is a résumé of sales and re-sales of crude oil warehouse certificates on the Petrolia oil exchange during the year 1887, and indicates the market price of petroleum oil (crude) as stated in warehouse. The further charge of 3 cents per barrel is made when the oil is delivered for pipeage to refiners in each case.

Average closing price of crude oil on Petrolia oil exchange, Canada.

Months.	1885.	1886.	1887.
January	75¼	88¼	84¾
February	85¾	88¼	81¾
March	83¾	89½	76¾
April	80¼	90	75
May	78	90	69¼
June	79	90	67¼
July	83	80	67½
August	91¾	75½	71¼
September	89½	75	81
October	79½	84¼	77¼
November	79½	93¾	72¼
December	83½	97	76¼
Year	82¼	86¾	78

Exports of Canadian petroleum in 1887.

Provinces.	Gallons.	Value.
Ontario	472, 362	$13, 616
Quebec	916	147
Nova Scotia	281	68
Total	473, 559	$13, 831

"Of the following tables the first is from the inspection returns of the Inland Revenue Department, the second is from the returns of the Customs Department, and the last shows the imports of crude oil, calculated by taking the difference between the totals of the first and second tables:"

Refined petroleum and naphtha imported and inspected in Canada.

Years.	Imperial gallons.
1881	1, 111, 338
1882	1, 226, 918
1883	1, 110, 580
1884	1, 231, 984
1885	1, 211, 152
1886	1, 584, 422
1887	1, 511, 433

Imports of crude and refined petroleum into Canada.

Provinces.	1886.		1887.	
	Gallons.	Value.	Gallons.	Value.
Ontario	1, 563, 864	$179, 756	1, 688, 611	$174, 768
Quebec	759, 312	69, 526	805, 197	69, 527
Nova Scotia	699, 480	66, 690	762, 316	63, 096
New Brunswick	804, 911	82, 636	820, 639	61, 697
Prince Edward Island	170, 736	18, 818	173, 852	13, 793
Manitoba	7, 627	871	15, 486	1, 905
British Columbia	173, 921	50, 934	198, 913	44, 826
Total	4, 179, 851	$469, 231	4, 465, 044	$429, 612

Crude petroleum imported.

Years.	Imperial gallons.
1885	2,599,064
1886	2,595,429
1887	2,953,611

NEW ZEALAND.

In a recent note on the "Petroleum and Native Paraffin of New Zealand," Mr. R. W. Emerson MacIvor states that petroleum has been known to exist in several localities in New Zealand since 1866, but it is only within recent years that attempts have been made to ascertain whether the oil occurs in sufficient quantity to have a commercial value. The first discovery was made at Waiapu, Poverty bay, on the east coast of the provincial district of Auckland, and the second one at Manutahi, Waiapu, East Cape. Many thousands of pounds have been spent in boring operations, but, though fair quantities of good oil are generally obtainable, no steady supply has been found. The depth of the borings made has exceeded 1,000 feet. The oil obtained from the first locality named much resembles Canadian oil. By several successive distillations, and treatment with acid and alkali, it yields from 65 to 70 per cent. of excellent illuminating oil, having a specific gravity of 0.844 at 15.5 degrees centigrade. The oil obtained at Manutahi has a pale brown color, is nearly transparent, and has a specific gravity of 0.830 at 15.5 degrees centigrade. It contains very little solid paraffin, and on distillation yields about 80 per cent. of illuminating oil, fit for use in ordinary lamps. When subjected to two more distillations, about 65 per cent. of oil of specific gravity 0.812 is obtained. The natural gas which escapes from the ground in some places consists mainly of methane, but burns with a bright luminous flame, owing to the presence of higher paraffins in the form of vapor. Large quantities of a white or gray, somewhat gelatinous, substance occur on the property of the South Pacific Petroleum Company, and examination has shown it to vary in composition. Samples submitted to Mr. W. E. Dixon, of Sydney, New South Wales, Mr. J. Cosmo Newbury, of Melbourne, and to Mr. MacIvor were found to contain a large percentage of solid paraffin, and to consist of a substance which, when heated, would neither melt nor burn, but simply charred. Mr. Skey, chemist to the New Zealand Geological Survey, examined the material and reported it to be a sort of dopplerite, or, at least, a body allied in chemical composition to that mineral. Mr. MacIvor found, however, that on charring it "the smell of burning feathers" was perceptible, indicating the presence of a proportion of nitrogen.

BURMAH.

The companies for working petroleum on the Aracan coast have failed, and earth oil there is raised only by native workers on a limited scale. The upper Burmah oil field, near Yenangyoung, is being prospected, and the old oil wells are being worked under the same system as under the Burmese rule. The oil is brought down to Rangoon to a refinery. It yields a comparatively small portion of burning oil, and the industry is not at present flourishing. At the end of the year the Khatun oil field in Beloochistan was still being investigated, and it is hoped that it may pay to burn this oil in locomotives on the Quetta railway.

COLOMBIA.

Mr. Alexander J. Jones, consul at Barranquilla, Colombia, reports under date of November, 1888, that an American mining engineer has lately reported that petroleum exists in very considerable quantities in Tubará, 12 miles from Barranquilla. This is all the information given relative to the deposit.

JAPAN.

In an article on petroleum and natural gas in Japan, published in the *American Manufacturer*, Mr. Jinzoo Adachi gives a clear statement relative to the occurrence of these products in that country, from which we condense the following relative to petroleum. This should be noted in connection with the article on natural gas in Japan.

It is said in Japanese history that, "In the seventh year of Tenji-Tenno, the thirty-ninth Emperor (668 A. D.), a province of Koshi (now Echigo, Etchiu, etc.) presented to the Emperor a water (petroleum) and an earth (coal) to be burned instead of wood and oil." This seems to have been the first discovery of petroleum and coal in the empire.

The rocks of the oil region are undoubtedly of the Tertiary formation. In Yesso, Mr. Benjamin Smith Lyman, who began his researches into the geology of Japan in 1876, named them the Toshibetsu group, which is to distinguish them from the Horumui or coal-bearing group. Lately, Dr. D. Brauns, professor of geology in the University of Tokio, mentions that the Toshibetsu group is representative of the Upper Pliocene, and Horumui group, the Miocene. The oil-bearing rocks in Echigo consist of soft greenish-gray shales and gray fine-grained sand rocks, sometimes with small quartz pebbles. Mr. Lyman says:

"The oil-bearing formation seems to be of nearly, if not exactly, the same age as that of Yesso, the Toshibetsu group, and resembles it not only in the oil deposits and cold mineral springs, but in many of its deposits of fibrous lignite, as well as in some degree in lithological character and, apparently, in fossils. In Echigo, however, fibrous lignite is sometimes closely associated with black shining coal. It seems therefore highly probable that the formation may be, at least in part, somewhat older than the Toshibetsu group observed in Yesso, perhaps covering a portion of the gap between the Yesso Toshibetsu rocks and the older Horumui, or coal-bearing group, and at any rate of Tertiary age."

The oil-bearing rocks appear generally to be in folds that have axes running nearly northeast and southwest; sometimes so sharply waving as to form perfectly closed folds with the dip reversed on one side. The reversed dip is in all cases towards the neighboring sea-shore, to the northwest in Echigo and to the southeast in Tootoomi. But the structure is still further complicated by folding with nearly north and south axes, which causes the strike of the northeasterly and southwesterly set of axes to have a wave form, and shows them to have existed earlier than the north and south one. The two sets of axes were also observed by the writer in the Yesso coal surveys, and their relative ages appeared there to be the same as here, though the surveys there did not happen to make it quite so clear. The north and south direction already remarked in regard to the volcanic mountains of Kiushiu would seem likely to be of the same late date as the later folding of the oil fields.

The name of the place, Kusodsu, in Echigo, where oil is found is the name given in the country to rock oil, and means stinking water, and the very fact that the word is by contraction so much changed from its original form, Kusai-Midze, shows, of itself, considerable antiquity. The present mode of drilling wells is very simple, and not many more men are needed than for boring with steam. The digging is all done by two men, one of whom digs in the morning from 9 o'clock until noon, and the other from noon until 3. The one who is not digging works the large blowing machine or bellows that continually sends fresh air to the bottom of the well. The blowing apparatus is nothing but a wooden box about 6 feet long by 3 wide and 2 deep, with a board of the same length and width turning on it upon a horizontal axis at the middle of each long side of the box and with a vertical division below the board between the two ends of the box. The workman stands upon the board and walks from one end of it to the other alternately, pressing down first one end and then the other. At his first step on each end he gives a smart blow with his foot, so as to close with the jerk a small valve (0.3 foot square) beneath each end of the board, a valve that opens by its own weight when the end of the board rises. The air, therefore, is driven first from one end of the box then from the other into an air pipe, about 0.8 foot square, provided at the top of course with a small valve for each end of the blowing box, and made of boards in lengths of about 6 feet and placed in one corner of the well. The well is besides timbered with larger pieces at the corners and light cross-pieces, which serve also as a ladder for going up and down, though at such a time in addition a rope is tied around the body under the arms, and held by several men above the mouth of the well. The earth or rock dug up is brought out of the well in rope nets by means of rope that passes over a wheel 1 foot in diameter hung just under the roof of the hut, about 10 feet above the mouth of the well, and is pulled up by three men, one at each corner of one side of the well and the third in a hole 2 or 3 feet deep and a foot and a half wide, dug alongside of the well."

Mr. Kada reports that he found the prices at Coarto, in September, 1878, to be as follows:

Cost of digging a well in Japan.

One board, 9 feet long, enough for one length of timbering	$0.136
Four posts, each 4 feet long, for one length of timbering	0.125
Twelve cross-pieces for one length of timbering	0.168
Material for one length (4 feet) timbering	0.429
One hut	5.000
One pair bellows, 8 feet long	5.000
One length air pipe, 6 feet	0.166
One wheel (two are needed for one well)	1.26
One large bucket	1.25
One well bucket (four are needed for one well)	0.74
Sixty feet straw rope (each well needs three as long as its depth)	0.13
One pick (two or three are needed for one well; a large one weighs 20 pounds, a small one 15 pounds)	(?)
One rake	0.75
One rope net (for raising earth; three are needed for every 5 fathoms)	0.15
One oil-paper for skylight	0.31
One digger's daily wages (without food)	0.25
One common laborer's daily wages (without food)	0.08
One shoo rice beer (one must be given daily to the workmen all together) about	0.065

The following is the number of workmen needed in Japanese oil-well digging, according to depth:

Japanese workmen needed to dig a petroleum well.

Depth.	Men.
1 to 20 fathoms (5.8 feet each)	4
20 to 30 fathoms	6
30 to 40 fathoms	7
40 to 50 fathoms	8
50 to 60 fathoms	9
60 to 70 fathoms	10

In 1879 the number of productive wells was 874; average daily yield, 4 gallons; average depth, 177 feet; greatest depth, 780 feet. Mr. Kada gives the following as the results of oil refining at Coarto:

Refined products of Japanese petroleum.

	Per cent.
Naphtha	15
Refined oil	60
Heavy oil	10
Asphalt	15
	100

The oil fields in Japan do not seem to be very promising, according to the results of the geological survey under Mr. Lyman, who made the examination very carefully from 1876 to 1879, and published reports which contain full information of the oil regions. The American method of oil drilling has been tried twice, but has failed. There are no wagon roads on which to transfer such heavy machines as would be needed, and no shops to repair them when they are broken. Most of the oil is obtained from wells dug by cheap labor, which methods are in those regions cheaper than the artesian wells.

Total product of petroleum in Japan from 1874 *to* 1884.

Years.	Quantity "Kwan."	Years.	Quantity "Kwan."
1874	123, 156	1880	1, 078, 954
1875	193, 208	1881	708, 954
1876	316, 212	1882	820, 589
1877	404, 560	1883	866, 377
1878	756, 812	1884	1, 139, 624
1879	992, 621		

Product of petroleum in Japan in 1883.

Provinces.	Quantity "Kwan."	Value.	Number of hands.	Area "Tsubu."	Tax.
Echigo	732, 477	$106, 668	112	420, 661	$120
Tootoomi	89, 338				
Ugo	35, 593				
Shinano	8, 689				
Ishicari	280				

NOTE.—Kwan=8½ lbs.; Tsubu=36 square feet.

A specimen of about 400 cubic centimeters of oil from Echigo was taken by Mr. J. Ban from the middle well of Y. Nishimura in the village of Miyohoji. It proved to be of a dark olive green color, and in thin films transmits a yellowish brown. At the ordinary temperature (60° Fahrenheit) it is moderately limpid, and has a slight odor of naphtha. Its specific gravity is 0.813 or 43½ degrees of Baume's scale at 52° Fahrenheit, and it burns at from 194° to 237° F. It burns in the natural state in a common lamp with a bright flame, a little smoky, and with a strong light for five minutes. After ten minutes the flame begins to cool, and after twenty minutes it smokes and goes out. The oil was subjected to slow distillation by a careful application of regulated heat of different degrees until the vapor had completely escaped, and a series of hydrocarbons had been separated. In the first place just 300 cubic centimeters of the oil weighed 24.39 grams; this was placed in a tubulated glass retort holding about one liter, and in the tubulus a Celsius thermometer was inserted with a good perforated cork, as usual, to indicate the temperature of the liquid within. The following table shows the results:

Distillates from Japanese petroleum.

Temperature and time.	Color.	Specific gravity.	Per cent. to weight.	Per cent. to volume.
1. Below 100° C.—11 hours	Colorless	0.737	19.45	21.66
2. 100°–145° C.—19½ hours	Light yellow	0.797	31.98	32.00
3. 145°–310° C.—8½ hours	Bright yellow	0.847	17.61	12.67
4. Without thermometer, 10 hours	Yellow	Not taken	21.92	13.64
5. Coke	Black		6.11	20.03
Loss			2.93	
Total			100.00	100.00

The portions No. 1 and No. 2 were submitted to fractional condensation according to the method of Mr. C. M. Warren (*American Journal of Science*, second series, Volume XXXIX, No. 117), and continuing the temperature to 199.4°–208.4° F. 92.34 per cent. of benzine was obtained from No. 1, or 20 per cent. of the original volume, and 4.06 per cent. from No. 2, or 1.30 per cent. of the original volume. It is highly volatile and takes fire from a match at the common temperature, and burns with a smoky flame. No. 2 is a good burning oil. It is slightly colored and has little smell, and burns with a bright flame.

No. 3 is a common burning oil; it is colored yellow and has a rich smell, and burns with a bright red flame and a strong light. After obtaining this oil the tarry matter was transferred into a weighed earthen retort and distilled. No. 4 is a dark yellowish heavy liquid which is used for lubricating machinery. This oil was obtained from the earthen retort by distilling to dryness. No. 5 is hard compact coke, and was determined by subtracting the weight of the retort from the weight of the retort and its contents.

After treating with sulphuric acid and soda, the oils No. 2 and No. 3 became quite colorless. No paraffin could be detected by cooling the heavy oils in a mixture of salt and ice.

A well in Japan 300 feet deep would cost $300, and would be completed in three months. This is about the average depth, cost, and time.

There are no flowing wells in the Japanese oil regions. The oil is never pumped, but is hoisted out of the well by buckets. These buckets are attached to a rope, which runs over a wheel at the surface, and while one bucket is coming up the other is going down, the weight of the empty bucket thus helping the one man who does the hoisting. The average bucket contains 5 gallons.

RUSSIA.

Though there was a decided increase not only in the production of Russian petroleum in 1888 but in its export as well, there are indications that the marvelous production that has marked the Baku district is declining and it is further evident that the world at large is not taking so kindly to the Russian product as it did in 1887. The consumption of Russian oil outside of Russia itself is declining, and American oil, which for a while seemed to be losing its prestige in some of the markets in the world, is regaining it.

The product and exports of petroleum in the Baku oil fields for the past five years is given below. This statement is largely an estimate, as are all statements of production from Russia, no accurate figures of the product of petroleum being kept. The amount of product is estimated from the output of refined oil and illuminating distillate, of which fairly correct statistics are obtainable, upon the basis of 3½ gallons of crude to every gallon of these products. To this amount is added the crude oil shipped.

Product and exports of Russian oil from 1884 *to* 1888, *inclusive, in poods of* 36,067 *pounds.*

Years	Production.	Exports.
1884	89, 000. 000	54, 685, 429
1885	115, 000, 000	68, 601, 310
1886	123, 000, 000	72, 849, 104
1887	131, 000, 000	79, 495, 123
1888	165, 000, 000	117, 821, 020

These amounts reduced to pounds would be as follows:

Product and export of Russian oil from 1884 *to* 1888, *inclusive, in pounds.*

Years.	Production.	Export.
	Pounds.	*Pounds.*
1884	3, 209, 963, 000	1, 972, 339, 368
1885	4, 147, 705, 000	2, 474. 243, 448
1886	4, 436, 241, 000	2, 627, 448, 634
1887	4, 724, 777, 000	2, 867, 155, 759
1888	5, 951, 055, 000	4, 249, 450, 728

Now, assuming that the weight of the oil is 6.75 pounds to a gallon and that the barrel contains 42 gallons, the production and export of oil in the Baku oil fields, from 1884 to 1888, in barrels of 42 gallons would be as follows:

Product and export of Russian oil from 1884 *to* 1888, *inclusive, in barrels.*

Years.	Production.	Export.
	Barrels.	*Barrels.*
1884	11, 322, 267	6, 957, 105
1885	14, 630, 352	8, 727. 490
1886	15, 648, 116	9, 267, 896
1887	16, 665, 527	10, 113, 424
1888	20, 991, 375	14, 989, 244

Early in 1889 the alarm regarding the impending exhaustion of the Baku oil fields was given, which was followed by considerable advance in price. The increased price brought a larger production and the excitement has subsided. A recent statement relative to the outlook in Baku says: "Intelligence has been received here from Baku to the effect that a permanent decrease is showing itself in the production of naphtha in that region, and that there is probability of a very serious crisis shortly coming. The naphtha basins of the Apsheron Peninsula and Bibicicat are no doubt still very productive, but the yield is no longer to be relied on. Almost all the factories at Baku are suffering for want of the raw product. The price has risen from 2 copecks to 5 or 6 copecks per pood."

NATURAL GAS.

By Joseph D. Weeks.

In but one instance have the operations of the drill, in 1888, added any important natural gas field to those known at the close of 1887. The result of drilling has been the defining of boundaries of gas fields known before, and the opening up in old fields of new wells to increase the supply, and in some instances of new gas horizons. In the Washington county, Pennsylvania, field, for example, almost all the gas produced at the close of 1888 was from a lower sand than that furnishing the supplies in the earlier history of the field. It is also true that in what may be regarded as an extension of the Grapeville district a new gas horizon has been found in the sand that produced no gas in the older part of the field. The single exception noted above is the development of the Meade county district in Kentucky, and the arrangements to pipe this gas to Louisville. This field is fully described in connection with the statement relative to Kentucky.

During the year 1888 there was a large increase in the production of natural gas; not so large, however, as in previous years. At the same time it is to be noted there has been relatively a much larger consumption, that is, a much greater proportion of the gas produced has been utilized and less permitted to go to waste than in previous years. Furthermore, the gas used has been employed more effectively, a larger proportion of its heating power having been utilized.

The knowledge concerning the geological distribution of natural gas in the United States is still the same as stated in Mineral Resources for 1887. It is found from the Drift to the Potsdam, but it occurs chiefly in the Trenton limestones of Ohio, and the Paleozoic strata of the upper Coal Measures of Pennsylvania. The question of the geological distribution of natural gas has already been treated of in previous volumes of Mineral Resources, and will also be discussed to some extent in this report in connection with several gas fields. It is, therefore, not necessary to enter into a discussion of the subject here.

TOTAL CONSUMPTION OF NATURAL GAS IN THE UNITED STATES.

It is impossible to ascertain the total product or even the consumption of natural gas in the United States. While a great many wells have been accurately measured, these measurements only give the rate of production for the moment when the observations were taken. The rate changes not only from day to day, but from hour to hour and from moment to moment. It is usually greater in the morning; it varies with the temperature and with the state of the barometer. It will thus appear that, while an estimate of the yearly production could be made for the wells that have been measured, it is evident that even this would be only a rough approximation, while for those wells that have not been measured only the wildest guess could be made; and since the tendency is to very much overestimate the production, such estimates would have but very little value. Nor is it possible to arrive at the consumption of gas in cubic feet. It might be possible to ascertain in a given locality, for example, how many mills, how many furnaces, how many boilers, how many grates were using natural gas, but the rate of consumption in furnaces, boilers, and grates varies greatly. Pittsburgh measurements show that while some furnaces use but 13,000 cubic feet of gas to produce a ton of iron others use 35,000 cubic feet, and still others as much as 65,000 cubic feet.

The best basis of calculation, therefore, is that which has been given in previous volumes of Mineral Resources of the United States, viz: the coal displaced by gas. Where coal is not used in a locality, or where it furnishes only a portion of the fuel, the value of wood or other fuel used is regarded as the value of coal displaced, and an estimate of the tonnage of coal that would be displaced is made, based on the selling price of coal in that locality.

The total displacement of coal by natural gas in 1888 and its value are as follows:

Amount of coal displaced by natural gas in 1888, *and its value.*

Locality.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*	
Allegheny county	7, 302, 700	$10, 223, 780
Remainder of Pittsburgh district	2, 447, 330	3, 670, 995
Western Pennsylvania, outside of Pittsburgh district	2, 693, 800	5, 387, 600
Total Pennsylvania	12, 443, 830	19, 282, 375
New York	125, 000	332, 500
Ohio	750, 000	1, 500, 000
West Virginia	60, 000	120, 000
Indiana	660, 000	1, 320, 000
Elsewhere	25, 000	75, 000
Total	14, 063, 830	22, 629, 875

Similar statements for 1885 to 1888 are as follows:

Amount and value of coal displaced by natural gas from 1885 to 1888, inclusive.

Localities.	1885.		1886.	
	Coal displaced.	Value.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*		*Short tons.*	
Allegheny county	2, 000, 000	$2, 500, 000	4, 000, 000	$5, 000, 000
Remainder of Pittsburgh district	500, 000	750, 000	1, 000, 000	1, 500, 000
Western Pennsylvania, outside of Pittsburgh district	500, 000	1, 250, 000	1, 000, 000	2, 500, 000
New York	56, 000	196, 000	60, 000	210, 000
Ohio	50, 000	100, 000	200, 000	400, 000
West Virginia	20, 000	40, 000	30, 000	60, 000
Indiana			150, 000	300, 000
Illinois	600	1, 200	2, 000	4, 000
Kansas			2, 000	6, 000
Michigan			4, 000	12, 000
Elsewhere	5, 000	20, 000	5, 000	20, 000
Total	3, 131, 600	4, 857, 200	6, 453, 000	10, 012, 000

Localities.	1887.		1888.	
	Coal displaced.	Value.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*		*Short tons.*	
Allegheny county	5, 477, 000	$6, 846, 250	7, 302, 700	$10, 223, 780
Remainder of Pittsburgh district	1, 610, 500	2, 415, 750	2, 447, 330	3, 670, 995
Western Pennsylvania, outside of Pittsburgh district	1, 795, 500	4, 487, 500	2, 693, 800	5, 387, 600
Total Pennsylvania	8, 883, 000	13, 749, 500	12, 443, 830	19, 282, 375
New York	111, 000	333, 000	125, 000	332, 500
Ohio	500, 000	1, 000, 000	750, 000	1, 500, 000
West Virginia	60, 000	120, 000	60, 000	120, 000
Indiana	300, 000	600, 000	660, 000	1, 320, 000
Elsewhere	5, 000	15, 000	25, 000	75, 000
Total	9, 859, 000	15, 817, 500	14, 063, 830	22, 629, 875

From the above tables it will appear that the total consumption of natural gas in the United States in 1888, measured in coal displacements, was 14,063,830 tons, as compared with 9,859,000 tons in 1887, the amount of gas used in 1888 being equivalent to a displacement of 4,204,830 tons, or 42½ per cent. more than in 1887.

An unusual amount of labor has been expended in endeavoring to secure accurate returns as to the amount of coal displaced by natural gas, especially in Ohio and Indiana. Two difficulties have been encountered in securing accurate statements. The first grows out of the tendency to unduly magnify the amount of the product of gas, and consequently the amount consumed in various industrial establishments and in domestic and other private uses. The second difficulty has been the lack of exact information. In a given establishment, for example, it must be known how much coal was used prior to the introduction of natural gas in order to secure a given result. The use of gas, which in many cases has led to an increase in the extent and consequent capacity of the plant, has also in a large number of instances led to somewhat of an increase by reason of the greater facilities for manufacture. It is also true that at many establishments economy would be practiced when coal was used and paid for by the ton that is not necessary when natural gas is used, the methods of payment not requiring these economies. As the result, however, of investigation at individual works and the checking of these returns by the estimated figures of those who are acquainted, in the first place, with the probable production of gas, and in the second place with the consumption of coal in rolling mills, glass works, and other industrial establishments, the figures given, as the coal equivalent of the consumption of natural gas, are believed to be correct. Some of the statements secured in connection with this attempt to arrive at the actual consumption of gas, and equivalent coal displacement, have been of great interest and will well repay publication. Mr. J. W. Righter, superintendent of the City Gas Works of Findlay, Ohio, writing of the actual consumption of gas in that city, makes the following statement:

Consumption of natural gas in Findlay, Ohio, per year.

	Cubic feet.
For domestic use	2, 820, 000, 000
In glass works	2, 970, 000, 000
In iron works	2, 970, 000, 000
In machinery establishments	390, 000, 000
In clay and lime works	720, 000, 000
Miscellaneous uses	365, 000, 000
Total	10, 235, 000, 000

Mr. Righter says: "It would be safe to divide this amount by 28,000, the amount of gas which, in my judgment, it takes to equal a ton of coal, which would equal 365,555 tons of coal per year." While there is no doubt that Mr. Righter is approximately correct in taking 28,000 feet of gas in heating value as equivalent to a ton of coal, it is probable that, were coal to be used to perform the same work that is done by the amount of gas above named, the economies in the use of the coal would be so great that it would very materially reduce the coal used below the 365,555 tons, of which this gas is the equivalent.

Relative to the amount of coal displaced by natural gas in Lima, Mr. George P. Waldorf, general manager of the Lima Rock Gas Company, gives the following statement:

Coal displaced by natural gas in Lima, Ohio.

	Tons.
For domestic use	54, 000
In iron works (foundries)	10, 000
In machinery establishments	2, 000
Steam production	25, 000
Miscellaneous uses	1, 500
Total	92, 500

Relative to the consumption in Toledo, Mr. John A. Lambing, general superintendent of the Toledo Natural Gas Company, speaking of the gas furnished by the two natural gas companies of Toledo, and also the gas furnished in Perrysburgh and Maumee, states that at the close of the year they had about 8,700 house contracts, and the balance of the trade was based on the coal consumed before the gas was used, making a fair allowance for misrepresentations where the coal bills and power developed were out of proportion. His statements as to the displacement of coal by gas are as follows:

Use of natural gas in Toledo, Ohio.

	Tons.
For domestic uses	156,400
In glass works	12,000
In iron works	36,100
In machinery establishments	18,000
In clay and lime works	16,000
Steam production	41,000
Miscellaneous uses	12,000
Total	291,500

Relative to the coal displaced by natural gas in Fremont, Ohio, Ex-President Hayes gives the following statement:

Coal displaced by natural gas in Fremont, Ohio.

	Tons.
Domestic uses	25,000
Other uses	35,000
Total	60,000

From Indiana quite a number of reports were received, some of them such evident overestimates that no use could be made of them. A very interesting letter, however, was received from Mr. William Moore, of Kokomo, who has devoted considerable attention to the natural gas developments in Indiana, and especially in Howard county, in the vicinity of Kokomo. Mr. Moore says that there are twenty-eight producing gas wells in the county, some of which are closed in and not yet put to use. Measurements have been taken of most of these wells. The product of the others has been estimated. This estimate will approximate very closely to the actual product. The amount of gas produced by these twenty-eight wells is about 78,000,000 cubic feet per day. This would be in heating power equal to 890,000 tons of average bituminous coal per annum. Of this, however, they are not using more than one-fifth or the equivalent of 178,000 tons. In arriving at this estimate Mr. Moore has gathered all the information possible relative to the equivalent of coal which is being displaced by gas, including the preparations now being made to use gas. Now, as his estimate of 178,000 tons of coal displaced includes that which will be displaced in works not yet in operation, and as the consumption of gas at the close of the year was greater than at the beginning, it is believed that the consumption of gas in this neighborhood in 1888 would not exceed a coal displacement of more than 100,000 tons. Another gentleman, well posted in relation to natural gas in Indiana, writes that his estimate of the total production of the Indiana wells is between 600,000,000 and 700,000,000 cubic feet per day. Of this he estimates that about 200,000,000 cubic feet are used. It is evident, however, that if this amount is consumed it is used very wastefully, as this would be equivalent to a consumption of about 6,600 tons of coal a day or 2,309,000 tons a year, which is very much in excess of the amount of coal that would be required to do the same work that is now being done by the gas.

EXHAUSTION OF DISTRICTS.

While it is true that individual wells and even certain so-called districts may cease to supply gas, there is as yet no indication of the exhaustion in the very near future of the gas in any of the well-defined and important gas districts. It is true that the gas in certain "districts" has been exhausted, and that the wells in these districts have either ceased to produce gas or produce it in such small quantities as to make the district of little importance commercially. The Homewood district in Pittsburgh, where the Westinghouse well was drilled, the well whose drilling practically marks the beginning of the natural gas era at Pittsburgh, is an example of an exhausted district. The drilling of other wells in the immediate vicinity of the Westinghouse proves that the "district" was a limited one, that the reservoir of gas struck was a pocket of small extent and was soon exhausted, and that it had no connection with the source of supply that feeds the Murraysville and Grapeville and Washington wells. A careful collation of the facts relative to the exhaustion of wells and districts seem to show:

1. That the word "district" is used in a very loose way. It may include a single well sunk to a small pocket of gas or the wells that tap stores like those of Murraysville, Pennsylvania, Lima, Ohio, or Muncie, Indiana.

2. That no district where ten or more deep wells have been sunk, all or most of which have produced gas in some considerable quantities for a length of time, has yet been exhausted.

3. That when individual wells have been exhausted in such districts, these wells have usually been on the rim of the district and have been drowned out by the rising of water in them.

4. That the failure to find gas at one place in a section of country or the rapid exhaustion of a pocket does not prove, if any other indications point to the existence of gas in quantities, that it may not be found by drilling at other points.

This last point is a most important one. The conditions under which gas is stored are such that it is not always possible to judge from surface indications whether there is, even in localities in which there is a probability of finding gas, such a structure as to allow of gas storage in quantities. There may be no surface indications of an anticlinal, which may exist and give a rock structure sufficient to hold an immense supply of gas. In a gas section wells may be drilled at points some distance apart and no gas be found, or, if found, it may be in small quantities and soon exhausted, and yet at a point between these two a large and persistent supply may be tapped. From these considerations it will appear that it is not always possible to decide when a territory has been exhausted until the section has been thoroughly drilled over. Relative to exhaustion Mr. I. C. White is reported as saying that there is no indication of a failure of the gas supply. Indeed he believes that more gas will be produced in the next few years than ever before. He says there is an immense stretch of territory that has hardly been touched as yet, and even after all the gas from the present strata of rock has been exhausted the wells can be drilled deeper and another abundant supply obtained.

WASTAGE OF GAS.

As the use of natural gas in the older districts has increased, the proportion of gas used to the amount actually necessary to perform a given amount of work, or the "wastage" of gas, has assumed an importance that it did not possess when the field was a new one and when the supply was far in excess of the demands upon it. The Philadelphia Company of Pittsburgh, near the close of the year, when the demand for gas is much increased, sends out annually a circular to manufacturers requesting them to prevent so far as possible the waste of fuel at their works. The request, the circular suggests, can best be carried out by the managers of the various plants instructing watchmen, furnacemen, and other employés to shut off the gas from all furnaces or other parts of the mills when the latter are not running. This request has been cited as proof that the supply of gas was giving out, but it can not bear this interpretation, as it has been sent out every year since the use of gas in Pittsburgh became at all general. It is simply precautionary and designed to urge more economical use of gas. At the same time it is evident that gas producers in the older districts can not long permit the wasteful use of gas that is going on. For over a year past the Philadelphia Company officials have been measuring the consumption of gas, making tests on improved furnace appliances, and otherwise investigating the fuel waste in the various mills. The investigations show what a large proportion of the natural gas is wasted. As an illustration we append the following figures given by the Philadelphia Company, showing by exact measurement the amount of gas required and the amount used to make a ton of iron in a puddling furnace of the ordinary style:

Gas required compared with amount actually used in making one ton of wrought iron.

	Gas consumed in actual work.	Gas consumed through whole time.
	Cubic feet.	*Cubic feet.*
1	48,264	65,234
2	39,996	53,850
3	38,264	55,892
4	34,583	48,144
5	27,372	40,811

This record was taken in five of Pittsburgh's leading mills. The figures in the right-hand column show the waste occasioned by burning the gas too high between heats, excessive use of the gas in keeping furnaces hot between turns, and the thousand and one ways in which careless employés waste the fuel because there is no check upon its use and because there is no inducement to prevent its waste. When the Philadelphia Company saw the loss occasioned, an effort was made to introduce furnace improvements with the idea of economizing in the use of gas. In one mill great care in consuming the gas brought the consumption down to 21,535 cubic feet in making a ton of iron, and further improvements reduced the consumption to 15,952 feet. The best result yet attained was when a ton of puddled iron was produced in an improved furnace with an expenditure of 12,100 feet of gas. The companies further complain that gas is expended in the most unwarrantable manner. At one mill, and that not a large one, where measurement was taken it was found that 3,000,000 feet of gas had been used between Saturday evening and Monday morning in merely keeping the furnaces warm. When coal was the only fuel mill furnaces were allowed to become comparatively cool from the time that one turn finished work until another came on, but with the gas everything is kept at a white heat whether in operation or not. Representatives of the gas companies say they have visited the glass factories when no one was at work; yet the gas was burning at a full head, because in many instances "the watchman forgot to turn it down." On the whole it is estimated that at least 50 per cent. of the gas now used in Pittsburgh mills is lost through ineffective methods and bad management.

This question it seems is demanding attention also in the more recently discovered gas districts. A late issue of the Muncie (Indiana) *Times* has the following:

"The waste of natural gas should be stopped. The torches left burning in the streets of this city every day may lead the stranger within our gates to conclude that gas is cheaper with us than daylight, but it is a waste that we may live to regret. Economy in the use of this great gift of nature should be enforced by law if not practiced voluntarily."

PENNSYLVANIA.

Relative to the distribution and geological conditions under which natural gas is found in Pennsylvania little can be added to the statements made in the last volume of Mineral Resources, pages 467–474. Most of the work in this State, in 1888, has resulted simply in defining the boundaries of old fields and discovering new horizons in them. While gas has been discovered in some few places, not reported in the volume of 1887, these localities are, in effect, extensions of old districts. The most important facts ascertained in connection with the Pennsylvania field are those bearing on the exhaustion of districts, the reduced pressure of gas, in some cases, in several of the districts, and the increased gas pressure in others as the result of tapping new gas horizons. In the Murraysville district, for example, the pressure in some parts of the district has been reduced to 100 pounds, while in others it is 200 and 300. In Washington, on the other hand, the pressure has risen as the result of drilling in new horizons.

NEW YORK.

The reports of the discovery of gas in sections of New York outside of the well known and well defined gas districts have been frequent during the year, but in no instance, so far as has been ascertained, have producing districts of any value been added to those already described in previous volumes of Mineral Resources. In the volume of Mineral Resources for 1887, pages 474–479, inclusive, quite full descriptions are given of the geology and the production of the several districts.

OHIO.

In a review in the *American Manufacturer* of the developments in connection with natural gas in Ohio in 1888, Prof. Edward Orton states that no important discoveries have been made in Ohio during 1888 in the sources or in the fields of natural gas. The productive horizons, as shown at the close of 1887, have been re-inforced by a single anomalous and (up to the beginning of the year) unimportant element. A few small additions to gas territory are also to be reported, but none of them at present possess more than local interest. It must not, however, be inferred that the search for the new fuel has been abandoned or even greatly relaxed in the State. A good deal of miscellaneous drilling has been going forward in certain sections, while in others proper guidance for the work of exploration has been sought from various forms of the divining rod, old and new; but, as already stated, the total outcome for the year makes no conspicuous addition to the resources which could be enumerated at its beginning.

Turning to the work of application and use, however, the record is altogether different. In this respect the past year has been a very important one. The people of the favored regions of the State have come into general possession of natural gas as fuel, and the establishment and extension of manufactures based on a cheap and abundant supply has gone forward apace at many centers. The pipe lines that were reported one year ago have been in full and successful operation during the interval, and several important additions have been made to this way of extending the wonderful advantages of the new fuel.

The productive horizons remain as named in the last volume of Mineral Resources. They are described at length in that volume, pages 479 to 482, and therefore the description need not be reproduced here. The Trenton limestone is still the most important single source of petroleum and gas in the geological scale of the continent. The character of the oil is inferior, and its use is restricted mainly to fuel. As to the gas from this source, however, there is no question as to its value.

In composition, it reaches the highest standard of excellence, as is apparent from the following table of analyses made for the United States Geological Survey by Prof. C. C. Howard, of Columbus:

Composition of natural gas from the Trenton limestone, Ohio.

	Findlay.	Fostoria.	Saint Mary's.
Hydrogen	1.64	1.89	1.74
Marsh gas	93.35	92.84	93.85
Olefiant gas	.35	.20	.20
Carbonic oxide	.41	.55	.44
Carbonic acid	.25	.20	.23
Oxygen	.39	.35	.35
Nitrogen	3.41	3.82	2.98
Sulphureted hydrogen	.20	.15	.21
Totals	100.00	100.00	100.00

Objection will scarcely be made to the small fraction of one-fifth of one per cent. of sulphureted hydrogen, which is here shown, when it is understood that the offensive odor of this gas furnishes a prompt and reliable means of detecting any leakages from mains or pipes.

In some of the districts in which gas is produced from the Trenton limestone the gas is giving evidence that it must be used without that waste and recklessness that marked its first introduction. Speaking of this Professor Orton says:

"The gas supply is furnishing abundant and unmistakable signs, signs which none are so blind as not to read and interpret, that it is a stored product, and that it needs to be used with the utmost care and circumspection to insure even a moderate length of life to the industries established on it. These facts will appear more fully in the detailed accounts of the several subdivisions of the new field."

Relative to the developments in the district procuring its supply of gas from the Trenton limestone, Professor Orton has written the following:

"Findlay deserves for the best of reasons to be named first in the review which is here begun. It was in this town that the surprising discovery was made in November, 1884, that the Trenton limestone underlying the flat country of northwestern Ohio was, in certain places at least, charged with high pressure gas. It was here in January, 1886, that a well was brought in large enough to accredit the new gas rock as a first-class source of production, one which could safely endure comparison with the most prolific horizons of the new fuel in Pennsylvania or elsewhere. It was here in June of the same year that the successful application of Trenton limestone gas to the welding of steel demonstrated its adaptation to metallurgical work, and as the greater carries the less, to all other manufacturing purposes. Here, also, the speculative excitement of the new field reached its highest point in the early part of 1887, and here, finally, a far larger and more important growth has taken place in manufactures, wealth, and population than in any other of the towns that fortune has favored with Trenton limestone gas.

"The progress of Findlay during 1888 has been important and substantial. Glass manufacture naturally has taken the lead of all other industries. There are at present ten firms established in the town that are manufacturing glass, and two more are building works at the present time. Four of these establishments are making window glass, using an aggregate of forty-four pots. Five firms, with a united capacity of one hundred and one pots, are making flint glassware of fine quality. In addition to these there are bottle works with a capacity of ten pots.

"Two rolling mills, two chain works, a wire-nail factory, several machine shops, an edge-tool factory, and aluminum works, are among the chief consumers of gas on the metallurgical side, and their total demands are very large. A score or more of other enterprises, large and small, would need to be named to fill out the catalogue of the gains of Findlay in the last two years. The population of the town has increased from 6,000 to 30,000 since January, 1886.

"The city owns a dozen gas wells and the distributing plant connected therewith, and supplies fuel to citizens at the rate of 50 cents per month, per stove. It also maintains a high-pressure line for the supply of the factories that have been established here. A part of the latter, however, are dependent on wells of their own. The gas of the high pressure line is practically free to the factories that use it. Of the wells owned by the city, one. the famous Karg well, has been the main reliance for the last two years. Its original volume was 12,000,000 cubic feet per day. Several new wells have been drilled by the city since it undertook this large supply, but it has so happened that none of them have made important additions to the previous stock. The city supply has, up to a recent date, been abundant enough to fill all the new lines, both high pressure and low pressure, as fast as they were laid, and no misgivings as to its permanence or adequacy seem to have been entertained by the people at large. That this popular confidence in a perennial supply was ill-founded was from the first recognized by all persons who had any right to an opinion on the subject, but the check came sooner and in more peremptory fashion than was generally expected. Findlay suffered a notable shortage in its city supply. The fires burned low in many parts of the town, and shops and factories were cut short to a considerable extent. The failure did not result from a lack of gas in Findlay, but from the overtaxing and natural shrinkage of the wells in the city circuit.

"No experience could, however, be more timely or salutary to Findlay than that which is here recorded. While all discerning persons recognized from the first that they were dealing with stored power, a shock like the one mentioned was required to convince the people at large that such was the case. So long as the so-called theories of perpetually renewed supplies were rife, neither the proper economy in use nor the proper provision for the future could be effectually urged. The present object-lesson was, however, successful, and now none will object to holding all consumers to a careful use of fuel nor to the securing by the city of as much additional gas territory as possible.

"The largest gas well of the Findlay field is situated about one mile north of the court-house. But little gas was found in the Trenton limestone at the usual levels, and consequently the rock was penetrated to a depth of 60 feet, but still without large returns. The well was heavily shot, however, and responded with an amazing flow. Mr. J. W. Righter, superintendent of the city line, reported 38 to 40 pounds open pressure in the casing. A pressure of 40 pounds in the casing stands for 31,600,000 cubic feet per day. This initial flow was not long kept up, the later production of the well being reduced to 18,000,000 to 20,000,000 feet per day. This well was offered to the city trustees by the company that drilled it, but as the parties could not agree upon terms, the city drilled for itself on an adjacent lot, and at a distance of 70 feet from the great well.

"Data are coming in by which the life of the large wells of this field, when flowing practically unrestrained, can be determined. None of them thus far have flowed three years without giving unmistakable signs of nearing their limits. In some cases oil invades them, and in others salt water, before the end of the period named. The smaller wells appear in some instances to have a longer lease of life than the great wells. In some of the town wells the original rock pressure has been reduced by about three-eighths, but in others it is claimed that it is fully maintained, the only difference being in the time required for gathering. How large an area a vigorous well exhausts we have not yet been able to learn; but drilling is now going forward that will give valuable information upon this point. It will undoubtedly be found that the central portions of the city have been already, at least partially, drained of their original supply. The city has a great task before it to maintain in full vigor the splendid industries that it has invited. It has pledged itself to supply without charge many million feet of gas each day, and to keep good this promise great energy and sagacity will be required. The manufactures now established there, if fully sustained, will insure great prosperity to the town.

"Bowling Green is next to Findlay in the discovery and utilization of Trenton limestone gas. It has made substantial progress in all directions during 1888. Five glass factories are already in successful operation here. Lime burning by gas has been carried on also on a large scale. The corporation gives gas free to manufacturers, as in the other towns of the new field. Its wells are small compared with those to the south of it; but thus far the supply has been fairly well maintained. As to length of life, the wells appear to agree in the main with those of Findlay, judging from the few available facts. Well No. 6 was completed in April, 1886. It brought a much-needed addition to the pipe line of the town. For a considerable period it furnished the main supply of gas for the town proper and met all demands; but it has been overrun with salt water, and consequently withdrawn from the lines. Its duration as an effective source of supply is thus seen to be about two and half years. It has been flowing practically free during the entire period. The largest wells of the company do not exceed 1,000,000 feet of gas per day. It is obvious that the corporation will be kept constantly drilling new wells in new territory to maintain the free supply to the factories which it has guaranteed. Economy in use is being insisted upon throughout the entire gas service of the town, and the introduction of meters is spoken of as a possible necessity.

"Fostoria derives its gas from two sources. The domestic supply is derived from the pipe lines of the Northwestern Ohio Gas Company, the representative of the Standard Oil Company, while the corporation has laid a pipe line around the town and drilled wells of its own in the field a few miles to the westward. It supplies gas at a nominal charge to all manufacturers who locate here, using public funds for drilling and piping through various devices which the practical unanimity of the citizens at present allows. Five glass works, with a total capacity of eighty pots, are already established here. The corporation furnishes fuel for $25 per pot for a year. Constant expenditure will be required to maintain this free supply.

"No better place can be found to describe the work of the Standard Oil Company in the new gas field than the present. It is established here under three distinct companies, each of which admits more or less local representation. The companies are as follows: the Northwestern Ohio Natural Gas Company, the Toledo Natural Gas Company, and the Tiffin Natural Gas Company. These companies have jointly secured control of 70,000 acres of the most promising gas land of Wood and Hancock counties. They own all the great wells of the new field, the two largest wells of Findlay only excepted, and large areas of their territory lie in solid blocks. They use scrupulous care in avoiding all waste of gas at the wells. They aim to drill no faster than the necessities of their lines require, though an ample surplus is always available. Their wells are never allowed to flow free, but are locked back with 100 to 150 pounds pressure, thus insuring the proper protection of the gas rock from oil and salt water. Their pipe lines are constructed in the most thorough and approved way, and their entire service leaves nothing to be desired by the towns they reach unless it be lower prices. In a word, they are managing their large interests here with their usual far-seeing sagacity. The Northwestern Company reaches Toledo, Fostoria, and Fremont, together with a few minor towns along the lines. The Toledo Company makes the city from which it takes its name its objective point. The Tiffin line in like manner supplies this thriving town with its domestic fuel.

"Tiffin lies beyond the proper boundaries of the Findlay and Wood county gas field, but a low and narrow ridge of the deep-lying Trenton limestone here is found to contain the porous dolomite, which admits the formation a reservoir of gas and oil wherever proper relief is secured for it. The Trenton limestone is found at a depth of 1,700 feet in this vicinity, and a consequent high rock pressure accompanies the gas that it contains. The relief of the rock is, however, so small that oil or salt water overruns every well in the course of a few weeks or months after it is drilled, and although an initial production of a million or more cubic feet can be obtained in the best wells it has been at last decided by a costly experience that the result does not justify the expense.

"Tiffin has displayed great ingenuity and originality in securing public funds for manufacturing plants and geological explorations. The corporation is now engaged in buying and leasing land in Wood county, in drilling wells there, and piping gas in from them for a free manufacturing supply, and its last ventures in drilling are said to be very successful. This use of public funds for these purposes goes on, as stated in another connection, because and as long as the community is practically unanimous in regard to it. No citizen cares to render himself conspicuous and unpopular by opposing the steps that are counted necessary to 'build up the town.' About $200,000 has been thus far expended in these ways. There have already been brought in under this policy three glass works, one nail works, and one pulp or straw paper works. One of the glass works received from the council $50,000 as an inducement to locate here, in addition to the pledge of free fuel. The domestic fuel of the town is furnished by the Tiffin Natural Gas Company, already referred to. The town is gaining rapidly in population and wealth.

"North Baltimore, which is located in the Wood county gas field, has not only secured a supply of gas for household use, but has pluckily joined the ranks of the dispensers of free fuel to manufacturers. Two glass factories have been put into operation here under its invitations, and the village is growing apace to match the new surroundings. Considerable prominence is given to it by its contiguity to the best part of the Wood county oil field.

"Oak Harbor still maintains its modest gas supply. In the same list Lindsey and Gibsonburgh must be counted. Upper Sandusky has after persistent search been rewarded with a well of fair volume and promise, the initial flow of which was 1,500,000 cubic feet. Further drilling is going forward, and steps are being taken to convey the gas to the town, 3 miles away.

"Perrysburgh and South Toledo have also been added to the gas-using towns, but their home production has proven weak and treacherous. Several small wells have been brought in by each town, but they seem to show but little persistency or promise.

"Carey has figured heretofore among the favored towns that have obtained a home supply of gas for fuel, but it has always been recognized as situated on the edge of the field. One source after another has failed it, and it is now, after large outlay of public and private funds, left without the advantages that its neighbors enjoy. It may, however, obtain a supply from the adjoining Hancock county field, toward which it is now working.

"A small gas field has been developed in the extreme northwestern corner of the State; but it is quite likely that it would have been better for the people if they had never discovered it. As the outcome of an expenditure of more than $25,000 one weak well has been struck, which, after running to waste for a long while, was finally piped into the town. One hundred stoves were attached to it, but this number was found too great by half, and the supply, such as it is, is maintained only by a constant struggle with the salt water of the well. The supply of Edgerton is said to be somewhat more favorable, but it comes under the same general conditions.

"The Mercer-Auglaize gas field vies in acreage with the Wood county field. Its wells are of smaller volume than those already reported upon. They range in production from 1,000,000 to 5,000,000 feet per day. Their rock pressure is also lower, since the gas rock is less deeply buried here. They are rendering, however, excellent service to the western counties. Lima, Saint Mary's, Celina, Wapakoneta, Sidney, Piqua, Troy, and several smaller towns already receive a very satisfactory supply of household fuel from this source. It is claimed that Dayton will soon be reached by the line. As to the recent behavior of the wells no opportunity has been had to learn the facts. It is scarcely to be expected that they will show any greater vitality than those of the fields already described. It is fortunate for this territory that it is held in the main in quite large blocks and by strong and sagacious companies, who understood the necessity of economy in the management of the gas from the beginning.

"All of the above places derive their gas from the Trenton limestone. The other gas rock added by the drill in Ohio to the gas strata of the county is the Clinton limestone. This was first proved to be an oil rock, but only on a small and unimportant scale, in Southwestern Ohio, where it rises in outcrop. Valuable accumulations of oil and gas were first found in it as it occurs in Sandusky and Wood counties of northern Ohio. At Fremont, in 1885 and 1886, it yielded small volumes of gas from a depth of 500 feet below the surface, and these were at once turned to good account for fuel, but great expectations were not justified by any facts in this occurrence. It was not until two years later that Lancaster stumbled upon a considerable volume of high-pressure gas at a depth of 2,000 feet below the surface in a rock that could be identified with absolute certainty as the Clinton limestone. It is thus Lancaster, rather than Fremont, that gives character to the new production. Seven wells have been drilled here up to this date, and all of them produce gas in notable quantity, the initial daily yield of each ranging from 1,000,000 feet downwards. The rock pressure of the gas is the highest yet reported in the State, viz: 690 pounds to the inch. Unfortunately the relief of the reservoir rock is very slight and the salt water is found to lie in perilous proximity to the gas. Drilling is very expensive on account of the presence of salt water at various horizons, and particularly not far above the gas rock, casing of extra strength being thus required for almost the entire depth of the well.

"The Pioneer Company, that discovered the gas and drilled the first three wells, gave way to another company, prepared to utilize the gas; but legislation was secured early in 1888 by which the town was empowered to spend $50,000 in the purchase and completion of the plant. This amount has been expended and the result is five gas wells, a fair distributing service and an entirely inadequate supply of gas. A total of about seven hundred stoves is attached to the lines, but the number is much greater than the wells can adequately sustain. But two gas fires are allowed to a single residence. The principal trouble comes, however, from the fact that one person has as much right to gas furnished by a public tax as another, and there is far from being enough for all. The public appropriation is already exhausted, and all future drilling must be done by private parties on some arrangement to be completed with the city. The outlook is not a flattering one, and it now looks as if it were an unkind fortune that lured Lancaster to drill for Clinton limestone gas. There are, however, some avoidable mistakes in the policy that has been pursued here.

"At two other points in this general region—viz., Newark and Hadley Junction, lying on a northeast line from Lancaster, a direction so dear to the well-driller's heart—gas in good volume has been found in the Clinton limestone. At Newark the search for gas has been very persistent, the need of it in a glass factory located here being a chief incentive. Five deep and expensive wells have been already drilled. Four are practically failures. From one, gas enough is derived to make three melts in the glass works per week. Two other wells are now being drilled in this field. At Hadley Junction two wells have been already drilled by Columbus capital, with reference to supplying this city with the new fuel. Other wells are located, and a large amount of territory is leased along the belt already pointed out. Newspapers are authority for the statement that the second well shows a daily volume of 1,700,000 cubic feet. This is considerably in advance of any production thus far obtained at Lancaster. It is to be hoped that the conditions of production will also be found more favorable here, giving promise of longer life to the wells.

"It is probable that a very low northeast axis traverses the district last named. Hints of it were found several years ago in cross-sections that traversed central Ohio, but no consideration was given to the fact at the time.

"The next horizon to be reached in this review is the Ohio shales. There is nothing new to be reported from this wide-spread source of shallow wells and low-pressure gas.

"Cambridge, after a long and costly search in a field which gave better promise geologically than any other in central Ohio, has at last struck gas in quantity sufficient to warrant piping to the town in the judgment of two companies who have drilled on opposite sides of Cambridge. The Cambridge Light and Fuel Company is a home company that falls heir to a large amount of outlay that has been made in and around Cambridge within the last six or eight years. The company has several light wells to the east and southeast of town. It has laid about 20,000 feet of pipe, 4-inch in the field and 6-inch in the town. It has taken on five hundred stoves, but is far from being able to supply them adequately. It has piped quite thoroughly the central portions of the corporation, and now needs nothing but gas to justify its name and existence. A new well gives promise of helping out the supply considerably. The company started out with a rate for gas that was found to be vague and unsatisfactory. The price was to be three-quarters of the price of the coal which it displaced. Fixed rates are being substituted, the present schedule being as follows: Stoves, $12 per annum; grates, $8 for first, $6 for each succeeding.

"The Southeastern Natural Gas Company represents a considerable preliminary expenditure in testing the field. It has planted money in large amount in Guernsey and Muskingum counties, its main object having been to find gas for Zanesville. Finally at a well-selected point, about 8 miles northeast of Cambridge, favorable conditions were discovered in drilling and wells, the daily volume of which is reported to reach into the millions of cubic feet, were brought in. Eastern capital was interested in the utilization of the gas, and more than $100,000 has been spent in a pipe line from the wells to Cambridge and in the subsequent piping of the town. The streets and alleys are all occupied by the double lines of the two companies. Gas was brought in by the Southeastern Company, and as far as learned the supply has been adequate up to the present time, barring sundry interruptions from breaks in the line. There are more than 1,800 stoves supplied by the company. The present schedule of prices is as follows: Stoves, $16 per annum; grates, $12 for first, $8 for each succeeding. No effort is made to supply the few factories of the town as yet, and no new factories are coming in thus far.

"The Cambridge gas rock is the Berea grit, which is the same thing as the Macksburgh deep sand. It lies here about 900 to 1,000 feet below the valley levels. The rock pressure of the best wells reaches 500 pounds per inch. The gas rock has good thickness, but its quality is often unsatisfactory. The greatest deficiency, as a rule, however, is in its want of adequate relief.

"If the Southeastern Company's wells prove fairly steady and reliable, they have the best of markets before them, for Zanesville will come next after Cambridge is supplied. The best that can be hoped for Zanesville in this connection is household fuel. The Berea grit of this part of the State is not at all likely to yield gas enough to warrant its introduction into iron working or clay burning, or, in fact, into manufactures of any sort in the large way. This is the only considerable addition to the gas supply of eastern Ohio during 1888.

"This review must not close without mentioning the new gas horizon to which reference has heretofore been made. The city of Cleveland is the site of the discovery. A sharp sandstone was struck in the deep well of the Cleveland Rolling Mill Company at a depth of about 1,700 feet, which proved to be a salt-water horizon. The fact of its occurrence was duly noted in the record of that famous well, but no warrant was deduced from its character for expecting gas to be somewhere found in it. Such a deduction might well have been made, as the sequel shows. The sandstone is intercolated in the great Devonian Upper Silurian limestone series. It is certainly not the Oriskany sandstone, but comes in about the place of the Sylvania sandstone, which has elsewhere been shown to be a member of the Lower Helderberg series.

"The search for gas for Cleveland was kept up even after the rolling-mill well was abandoned at a depth of more than 3,100 feet. The Axeworthy well was drilled deep, but without result. Finally a well was located on the Jewett farm, 3 miles from the city, and in this, at a depth of about 1,800 feet, a fairly vigorous flow of gas was struck in the sandstone which has been already named. The volume has been estimated to be 200,000 to 300,000 cubic feet per day, but no measurements have been given. Considerable interest was aroused by this discovery, and a number of wells were located forthwith in contiguous territory. Several of them have been completed, but they do not show the sandstone to be gas bearing. On the other hand, it agrees with the stratum in the first well in holding salt water.

"While the possibility of a reservoir of some value in this deep sandstone may be conceded, there does not seem to be any promise of public service in it from the facts that have thus far come to light.

"In conclusion, the present situation of the State with reference to natural gas, which has been briefly reviewed, may be summed up as follows:

"(1) All the large and vigorous supplies are furnished by the Trenton limestone.

"(2) The supplies are practically confined to four counties, viz, Hancock, Wood, Auglaize, and Mercer.

"(3) They are connected with accumulations of oil and salt water, one or both, and the salt water, which is under artesian pressure in turn follows, and compresses the gas originating the force with which the latter issues from the rock when reached by the drill.

"(4) As an obvious result of this state of things, all large accumulations of gas are short-lived. If they are to be utilized at all, they should be handled and with great care from the first.

"(5) The facts now in hand point to a period of somewhat less than three years as the life of a Trenton limestone well which is allowed to flow freely either into the air or into pipe lines. Small wells may maintain a longer flow, especially if left 'natural.'

"(6) These wells gain greatly in vitality when kept locked under a pressure of 100 to 200 pounds.

"(7) In all of the really remunerative territory the level of the Trenton limestone is not more than 500 feet below tidewater, and it is a misfortune to a town rather than an advantage to find one of the small arches that come in at lower levels. None of these lower arches have returned the money spent in developing them, except in the single case of Oak Harbor.

"(8) The Clinton limestone has not yet proved itself valuable as a gas rock. Its character remains to be established.

"(9) The Berea grit has in it unexhausted possibilities of service as a gas rock, despite the long list of failures chargeable to it. Good gas fields are still in order in Berea grit territory."

INDIANA.

The subject of natural gas in Indiana has been exhaustively treated in a paper prepared for the United States Geological Survey by Dr. W. J. Phinney, and is to be published under the title of "The Indiana Natural Gas Field."

In a communication to the *American Manufacturer* Dr. Phinney summarizes the developments up to the close of 1888, from which is extracted the following:

In Dr. Phinney's previous papers on natural gas in Indiana, an epitome of which was published in Mineral Resources for 1887, he set forth certain facts as to the structure of the field that have been questioned. His views seem to be substantiated by the more recent developments

The dominating structural feature of the State is the Cincinnati arch. Its influence is clearly shown in the disposition or arrangement of the geological formations of Indiana. The strata dip to the north or north-east into the Michigan basin, or to the southwest or west into the Mississippi basin.

The portion of the arch in Indiana is the continuation of the main body, while the Findlay arch, of Ohio, is the smaller fork or branch. The highest point in the arch, north of the Ohio river, is located near Point Pleasant, east of Cincinnati, as determined by Professor Orton. From this point it trends to the northwest, passing entirely across the State into Illinois, where the Trenton limestone comes to the surface. The arch, it must be borne in mind, is confined to the Trenton limestone and underlying formations, as it was formed soon after the deposition of the Trenton limestone. This arch is from 25 to 50 miles wide on its summit and its slopes dip gradually away on either side. The whole arch has a northwesterly dip throughout the State until it reaches Monticello, White county, where its summit is 338 feet below sea level. Northwest of this point it rises again towards the Illinois line.

The Cincinnati arch is the reservoir for the gas. The Trenton limestone being higher on this arch than in the territory adjacent to it, the gas has not only found its way into it, but has sought the highest portion in it that was sufficiently porous to act as a reservoir. Over the greater portion of the arch, where the upper surface of the Trenton limestone lies lower than about 120 feet above sea level, it contains a porous stratum that is usually found near its upper surface at a depth ranging from 4 to 50 feet. This porous stratum is continuous over the whole gas area and over a large area adjacent to it, and where not filled with gas or oil it contains salt water. Over the higher portion of the arch and from Greensburgh south to the Ohio river the Trenton rock is not porous, and consequently cannot act as a reservoir for either gas, oil, or salt water. The thickness of the porous stratum varies from 1 to 30 feet, and it is probable that different portions of the field are in communication through this porous rock; in other words, there is but one main reservoir. It is quite likely also that this upper gas-bearing stratum is, in places at least, in communication with others below it that contain only salt water. In no other way can we explain some of the variations in the rock pressure of the gas in the different portions of the field. The Cincinnati arch, the reservoir for the gas, is like a great tube, closed at its upper or higher portion because of lack of porosity of the rock. The gas, oil, and salt water have arranged themselves in obedience to the laws which govern them. The gas, being lightest, is obtained from the highest portion of the tube, the oil, being heavier, from just below it, while the salt water fills the lower end and all porous strata adjacent to it.

How shall we account for this porosity of the Trenton limestone over so large an area? Professor Orton was the first to demonstrate that the gas-bearing porous stratum is a magnesian limestone, while the more compact rock is a carbonate. Not only has there been a change in the chemical character of the rock, but there has been a removal of portions of it. As the gas-bearing stratum is full of small cavities, no doubt free passages of rather open rock exist over most of the gas area, though large open spaces can hardly exist. This porosity has probably been brought about by water that has removed part of the rock in solution. Just how this was brought about is a problem yet to be solved.

The limits of the gas area are as yet very indefinite. On the east, southeast, and south the porous rock gradually becomes thinner, and instead of being continuous it is patchy, with hard, compact rock intervening, or in some cases narrow strips of porous rock are found with compact rock on either side. Over the southern limits of the field the porous rock seems quite constant, but has so little thickness that it affords wells of feeble flow, though nearly every well will yield gas.

The territory, high on the arch, is exceedingly treacherous, as the porous portions or strips are usually of small extent and the wells never vigorous producers. The limits of the field on the west, northwest, and north are also indefinite because the local waves or swells in the Trenton limestone may contain gas, while in the depressions oil or salt water will be found. These swells are, many of them at least, only local, and should be considered only as independent reservoirs, though some are undoubtedly connected with the main body. The edge or border of the field where such conditions prevail is also treacherous, as experience has shown that salt water is found here about as often as gas. The limits of the gas area must be considered as including the local waves in the Trenton, and also some portions where water only is present. In the higher portions of the arch some compact rock will be met with within what is considered productive territory, while no doubt some gas may yet be found outside of the limits here given.

After a careful study of the field, making due allowance for probable unproductive territory, we would assign to the gas area about 2,525 square miles, arranged by counties as follows:

Distribution of the natural gas area in Indiana, by counties.

Counties.	Square miles.	Counties.	Square miles.
Blackford	180	Hancock	200
Jay	150	Marion	70
Delaware	350	Miami	20
Randolph	80	Wabash	10
Wayne	5	Henry	90
Madison	440	Rush	40
Grant	350	Decatur	40
Howard	160	Shelby	20
Tipton	120		
Hamilton	200	Total	2,525

Sufficient drilling has not been done as yet in De Kalb and Dearborn counties to allow any estimate to be made of the area of these independent fields.

While all the territory included in the estimate given above is probably productive, it is not all equally so. Rush, Decatur, and Shelby counties afford so far, with one or two exceptions, only wells of feeble flow, though some are of sufficient capacity to prove a paying investment. The remainder of the field shows some localities where the wells are only moderate, but every county has furnished a good number of vigorous wells. The writer has not been able to keep a close watch on the production of the field since the first of July last. At that time the combined flow of all the wells, from actual measurements and fair estimates, was about 500,000,000 cubic feet per day. Developments since then would increase this to about 650,000,000 or 700,000,000. The flow of the wells in Rush, Decatur, and Shelby counties ranges from 25,000 to 500,000 cubic feet per day, though the well at Carthage, in the northern part of Rush county, is claimed to be larger. It is quite likely that the northwestern portion of Rush county will afford fair wells when more drilling has been done. Each of the other counties in the field shows a number of wells with a daily capacity ranging from 350,000 to 2,000,000 cubic feet. All the wells of Wayne, Henry, and Randolph counties can be placed in this class. Each of the other counties in the field has a large number of wells that show a daily capacity ranging from 2,000,000 to 4,500,000 cubic feet, while there is a liberal supply of wells in each county in the more productive portion of the field that range from 4,500,000 to 10,000,000 cubic feet per day. Of the wells belonging to this class the following are given, though there are probably others belonging to the gas companies, of which no measurements were obtained, or that are located in some of the smaller towns, that are necessarily omitted from the list, which is by no means complete:

Jay county.—Dunkirk No. 1 and probably one or two near Camden.

Delaware county.—The Fay well at Muncie, the Selma well, and the Royerton well.

Blackford county.—Nos. 2 and 4 at Hartford City, and probably the well at Millgrove.

Grant county.—No. 2 at Fairmount, the Jonesborough well, Nos. 11 and 12 at Marion, and the Herbst well. A much larger flow is claimed for this well, but as it is tubed with 3-inch pipe it probably belongs to this class.

Miami county.—Probably the Abbott well and one recently drilled near Xenia.

Howard county.—The big Schrader at Kokomo, the Greentown well, and one in Union township; possibly one or two others.

Tipton county.—Probably one or two near Kempton and one near Hobbs station.

Hamilton county.—The Wainwright, Wheeler, Granger, Princess, Enterprise, Waddell, and probably a few others.

Hancock county.—No. 1 at Greenfield.

Madison county.—The McCollough well and No. 6 at Anderson, possibly No. 9; the well at Summitville, and No. 1 at Alexandria; the well at Perkinsville is also claimed to belong to this class; Nos. 1 and 4 at Chesterfield.

It is possible that one or two wells placed in this class would show a greater measured capacity than 10,000,000.

The Somerset well, Wabash county, is claimed to belong to this class, but nothing definite could be learned regarding it.

Marion county may have one or two wells that should be placed in this class. Fairmount No. 1 shows a measured capacity of 11,500,000 cubic feet per day.

While it may be seen in the above description that the most vigorous wells are, as a rule, not found in the higher portion of the field, yet if the philosophy of the field is correct, the longer lease of life that wells so situated will have will more than make up for any deficiency in capacity. Where the salt water is crowding the gas all around the lower borders of the field, any diminution in the supply in the reservoir must certainly result in a rise of the salt water.

Wells situated high on the arch are also liable to suffer if drilled too deep, or if the drill is sunk too deep into the Trenton rock before torpedoing the well. Many people must learn by their own experience that there is a water-bearing stratum below the one containing the gas, rather than profit by the experience of others. The higher portion of the field is liable to suffer where too great a demand is made upon too small an area, as a reduction of rock pressure may cause a rise of salt water from lower porous strata. It must be borne in mind that the water has a pressure of about 300 pounds per square inch, and any draught upon a portion of the field that reduces the rock pressure of the gas is likely to result in a rise of the water, especially where some wells have opened up communication with a lower stratum by being drilled too deep or by being shot too deep. Wells situated near the lower borders of the field are often injured by being drilled too deep in hopes of obtaining a greater flow, when experience has again and again shown that such practice is dangerous to the well.

When the gas blows a white powder, then it is time to stop drilling, as the porous rock has been penetrated. Many a well that shows a little water is the result of ill-advised drilling after the gas-bearing stratum has been penetrated. Had drilling been suspended at the proper time, the well would have yielded only dry gas. The fault is due to mismanagement, not to the field.

Portland is now largely supplied with gas from wells near Camden. Wabash and Peru are both now furnished with gas from Miami county and territory adjacent to it.

Companies organized at Frankfort and Lafayette have a number of good wells near Kempton, Tipton county, and in Howard county. The field near Kempton has proved quite extensive and productive, yielding a number of vigorous wells. It may prove continuous with that of

Howard and Hamilton counties. Tipton, being located in an unproductive portion of the field, obtains its supply of gas from near Hobbs station, five miles east of Tipton. Logansport is also preparing to pipe gas from Howard county. Three pipe lines convey gas to Indianapolis. The Broad Ripple Company obtains its supply from near Broad Ripple and the northern portion of Marion county. The Indianapolis company has thirty-five wells in Marion and Hamilton counties, with a combined estimated flow of 100,000,000 cubic feet per day, an average per well of 2,850,000 cubic feet.

The Trust company has sixteen wells in Hamilton county, and claims an estimated daily flow of 70,000,000 cubic feet. The Capital City Company has a number of wells in Marion county, and a pipe line will soon be constructed to Brightwood. A pipe line now conveys gas from Chesterfield, Madison county, to Richmond. Seven wells, it is claimed, furnish 35,000,000 cubic feet of gas per day.

It is quite probable that gas will be conveyed from Blackford county to Fort Wayne in the near future. Shelbyville obtains a supply of gas from wells 5 or 6 miles east of the city.

The total daily consumption of natural gas in Indiana will during the cold weather probably reach 200,000,000 cubic feet.

The total output of the wells at Muncie, Marion, Kokomo, Anderson, Hartford City, Noblesville, and Greenfield is in excess of the demand if properly distributed. All the larger cities in the gas area are located at some distance from the center of the more productive portion, which, as near as can be located, is found near Summitville, Madison county, and close to the northwestern corner of Delaware county.

There have been so far as has been ascertained no failures in the main body of the field, where the wells were properly cared for, unless drilled too deep and into the salt water. It is, however, difficult to obtain reliable information regarding this question, as few wells have been so arranged as to allow of repeated tests being made. Reported failures, on investigation, usually prove to be due to improper management of the well or to other causes independent of the supply.

Within what is considered the reliable portion of the field every well drilled so far has proved a paying one, though some needed torpedoing before the flow was obtained.

It is almost impossible to keep track of the production of the field, so rapidly is it increasing. Every city, town, and hamlet in the gas area is being supplied or soon will be. The farmers also are sinking wells for their use, while the neighboring cities, not desiring to be left behind in the great industrial race, are also making efforts to secure their share of this best of fuels. Any estimate of production made to-day would be much too small two or three months hence.

So far as we have been able to learn, the rock pressure of the gas has shown no diminution. Where the draught made on any portion of the field is very large any well when closed may show quite a loss of rock pressure, but this loss is due to the influence exerted by the flow from the other wells. If the explanation given of the rock pressure is correct, we shall expect the first evidences of failure of the field to be a diminution in the flow and the presence, with a gradual increase, of the salt water. Investigations have shown that the closed or rock pressure of the gas is due largely to the transmission of the artesian pressure of the salt water, and we shall not expect any material loss of rock pressure so long as the field proves productive. There are many interesting problems connected with the rock pressure that deserve careful investigation before one can speak positively regarding many of the queries that are put forth by those desiring information.

Much has been added to our knowledge of the geology of eastern and northern Indiana by the exploration for gas and oil. Formations that were before unknown, or that were wrongly identified, have been determined and their limits approximately made out, though considerable work still needs to be done in the way of a careful survey. It has also been possible to determine approximately the formations underlying the Drift in the northern portion of the State. While so much has been added to our knowledge of Indiana geology, it is still difficult to correlate the strata of northern Indiana with those found in the southern portion of the State. It is still impossible to construct a correct vertical section of the formations of the State, and any geological map that is or may be published must be considered as only approximately correct, or more properly, preliminary.

Below is given a vertical section of the rocks of the northern portion of the State.

The Niagara shale, the Clinton shale, and the Medina limestone, with all below the Hudson River group, are only found in the bores. None of them, so far as now known, is exposed at the surface.

Geological section of Northern Indiana.

	Feet.
Carboniferous:	
Section Waverly or Knobstone group	0 to 200
Devonian:	
Devonian black shale	70 to 120
Brown shale	25 to 47
Hamilton limestone	27
Hamilton shale	20
Upper Helderberg limestones	5 to 20
Schoharie grit	14 to 20
Upper Silurian:	
Lower Helderberg limestones	25 to 230
Waterlime	05 to 150
Niagara limestone	50 to 440
Niagara shale	2 to 40
Clinton limestone	30
Clinton shale	16
Medina limestone	0 to 60
Lower Silurian:	
Hudson River limestones and shales	100
Hudson River shales	160 to 700
Utica shales	0 to 300
Galena limestone	250
Trenton limestone	235
Saint Peters sandstone	150 to 224
Cambrian:	
Lower Magnesian limestone	50

The Lower magnesian limestone has not been penetrated, so its exact thickness is not known. It has been customary to speak of the gas and oil as being found in the Trenton limestone. It must be remembered, however, that it is found in the upper portion of the Trenton series; the Galena limestone, and not in the Trenton limestone proper, forms the base of the series.

Quite a productive field has been developed in the southern portion of Harrison county, along the Ohio river, the gas being found here in strata overlying the Devonian black shale. Some of the wells are quite vigorous producers. Quite a number of wells have been drilled in Meade county, Kentucky, south of Harrison county, and it is claimed that one or two show a daily capacity of about 5,000,000 cubic feet.

KENTUCKY.

In the volume of Mineral Resources for 1887 (page 491) it is stated that "The Black shale is the most promising oil and gas horizon" in Kentucky, "having an average of 10 per cent. of bitumen. This shows an enormous amount of hydrocarbon stored in it, and how productive a horizon of gas it may become." The exploration of 1888 has fully justified this statement, and Meade county, in which are located the wells whose sections were given in the Mineral Resources for 1887, has become an important gas district.

The first well drilled in this district which produced gas in any quantity was the Moreman, drilled in 1863 on the Moreman farm near Bradenburgh, Meade county, not far from the Ohio river. Quite a number of other wells drilled for oil about the same time, or later, produced considerable quantities of gas and brine. In 1872 the Moreman Salt Works were established, and the gas from the well utilized to make salt from the associated brine. With the utilization of natural gas in other sections of the country, attention was directed to the Meade County field. Companies were formed to drill for gas, and many wells have been drilled at Bradenburgh and eastward to West Point.

The gas from the Meade county field is a shale gas, its source being the Black or Ohio shale, which under various names has long been known as a gas producer. Speaking of the shale as a source of gas, Prof. Edward Orton, from whose reports on the Meade County district much of the information contained in this report is derived, says: "The Ohio shale under its various names, has been as long and as well known in connection with natural gas as any other strata in our entire series. Along its outcrops in western New York, on the shores of Lake Erie, the gas springs that issue from it have been known since the region was first occupied by civilized men. The utilization of the gas in this region goes back, in fact, to the first quarter of the present century. Since these earlier examples of successful use, wells have been drilled by the hundred along the lake shore and in contiguous territory, expressly in the search for gas for household use. There is scarcely a mile, and certainly not a single township, along the line of the outcrop of this formation, from Silver creek in New York to Huron river in Ohio, in which wells have not been drilled for gas. In many towns and villages a large and conspicuous service has been rendered by these wells. Erie, in Pennsylvania, and Conneaut, Ashtabula, Painesville, and Cleveland, in Ohio, may all be named as examples of this successful use. Throughout the entire district success in drilling these wells has been the rule, and failure the comparatively rare exception."

While the Meade County gas is, without doubt, derived from the black shale, agreeing in composition with the gas from these Measures in the Ohio field, Professor Orton points out that all the important conclusions as to the characteristics of shale, as drawn from the experience with the gas from New York and Ohio, are promptly set aside by the experience with the Meade county gas. Unlike the Ohio shale gas, the Meade county gas is reservoir or high-pressure gas. It is associated with and driven by a salt-water column. Its wells reach a maximum production of 2,000,000 cubic feet per day. They are greatly improved by the use of torpedoes. The rock pressure is low, it is true, but this evidently results from the shallow depth at which the gas rock is found, for the depth is always a function of the rock pressure in reservoir wells. In the heart of the new field the rock pressure ranges from 100 to 125 pounds per square inch, the depth of the wells ranging from 300 to 500 feet below the surface. Again, the gas wells of this district produce salt water freely in connection with the gas, without, in all cases at least, being overrun by it.

Commenting on these facts, Professor Orton says: "All this is confusing to a high degree. It seems at first sight as if such an experience destroyed all possibilities of scientific or practical provision in the search which our cities and towns are so eagerly pressing. But a closer examination shows us that only a single change has occurred in the character of the shale. Through the accidents of its history it has become a porous rock, and consequently a reservoir for gas, oil, and salt water. All the other changes above noted follow at once upon the transformation of the shale from an approximately impervious rock to a porous rock."

Though, as stated above, the first gas well in this district was the Moreman well of 1863, the real development of this section as a gas-producing district began with the boring of Well No. 1, known as the Major Davis well of the Union Gas Company, drilled in 1887, near Tobacco Landing, on the Indiana side. A daily flow of 800,000 cubic feet of dry gas was obtained from this well, at a depth of about 400 feet. At least three other wells, one unproductive, have been drilled by this company. The total production of these wells is 2,500,000 cubic feet daily.

The Kentucky Rock Gas Company, which is now the largest in interest in this district, has drilled a number of wells on the Fountain, McGehee, Bickerstaff, and other farms in this immediate district, and it is this group of wells that mainly gives character to the field.

The first well to be drilled by this company was the one known as the Bickerstaff well No. 1. It found the shale at a depth of 386 feet, and gas was found in good volume at 392 feet. The well was completed in January, 1888, and was allowed to burn without check until March, when it was shut in. On being opened a few weeks thereafter it was found to contain salt water. The water gained rapidly upon the gas, greatly reducing its flow. This is a type of several wells that have been drilled within the limits of the company. In some, indeed, the salt water makes the conspicuous feature of the production.

Another and better type is represented in the Bickerstaff well No. 2. In this the shale was found at 342 feet, and gas in large volume at 368 feet. The well was torpedoed with 45 pounds of dynamite of 75 per cent. strength, and the flow of gas was greatly increased thereby. The gas proves to be entirely dry, and its production exceeds 2,000,000 cubic feet per day.

A recent statement shows that at or near the close of 1888 this company owned about fifteen wells, with a daily flow of 11,000,000 cubic feet, but some of these are small producers, and controlled thirteen other wells giving 7,000,000 cubic feet more; in all, about 18,000,000 cubic feet per day. A gas line of 8-inch pipe is being constructed to Louisville, 30 miles distant, by the company.

The First National Gas Company's expenditures and tests in the search for natural gas have been made a few miles up the river from these other wells. They have found gas in excellent volume in several wells; but in all cases it has been associated with salt water, at least after the wells have flowed for a few weeks. The original production of the Smith well in this series is represented to have been as vigorous as any yet found in the valley. The well drilled at West Point by Messrs. Cox and Montgomery produced salt water and gas, the latter in comparatively small amount. The statements given above suffice to show that the black shale when dipping from its outcrop, at New Albany, to a depth of 300 to 500 feet in the Ohio valley becomes, under certain conditions, a reservoir of natural gas and salt water on a large scale.

As to the value of this field, Professor Orton says: "In answering this question we are obliged to bear in mind that the Meade County field stands by itself in several important particulars. There is nothing, so far as I know, in the records of gas production that is exactly comparable with it. In the first place, it is peculiar from the large production of its wells when taken in connection with their shallow depth and their consequent low rock pressure. In the second place, it is peculiar because of the almost constant association with the gas of salt water of fair strength and exceptional purity. Up to a very recent date the pressure of salt water has been counted so unfavorable to the flow of gas that fields are promptly condemned by the appearance of this last-named element in them. In the usual reservoir rocks it is counted certain that the salt water, if it once finds access to them, will steadily gain upon the gas and overpower it at last unless kept down by unremitting care.

"In default of like experience in other fields, we are obliged to use the experience that has been acquired in this. The Moreman well will furnish us our best example. As already stated, it has been steadily producing gas and salt water since 1863. Since 1872 salt production has been going on continuously at the works. But the production of salt is not the end for which the present development is going forward. It is natural gas which is now in demand. What is the promise of the new field, as seen in the light of the Moreman well, in this respect? Through the courtesy of the proprietor the writer had an opportunity, in August, 1888, to measure the volume of the original well. It was found that its daily flow was but little less than 200,000 cubic feet. It is not at all probable that the original flow has been maintained throughout all these years without diminution. But assuming that it has been 200,000 cubic feet per day, what is the total volume of gas to be credited to this little drill hole? The calculation shows it to be 1,825,000,000 cubic feet. We are certainly warranted in enlarging the amount to cover the diminution of the well to a total of 2,000,000,000 cubic feet. What value would this amount yield at a rate of 10 cents per 1,000 cubic feet? On this basis the gas that has flowed out of the Moreman well would be worth $200,000. It is the extreme vitality of the Moreman well that has impressed me most favorably in my study of the field."

CALIFORNIA.

From a statement made in the report of the State Mineralogist of California it appears that the natural gas of San Joaquin county, whose occurrence was described in the report on natural gas in Mineral Resources for 1887 (pages 500 and 501), has been put to practical use. The gas from the well at the Crown mills, in this county, struck at a depth of 1,330 feet, and which yields 15,000 cubic feet of gas in twenty-four hours, is being utilized for heating the boilers of the mill, being burned in the same furnace, together with a small quantity of coke. Experiments have been made also with the gas as an illuminator. The gas was passed through coal oil and also through gasoline, the resulting product being burned in an ordinary gas burner. It was found, however, that the uncarbonated natural gas burned in the Siemens-Lundgren burner was preferable.

The Old California Well Company was re-incorporated in April under the name of the Stockton Natural Gas Company. Its well, which is situated on the southwest edge of the city, is over 2,000 feet deep, and yields 70,000 to 80,000 cubic feet of gas in twenty-four hours. The company proposes laying pipes and running the gas into the city for lighting and heating purposes. The gas, as it issues from the well, burns with a luminous flame, producing a slightly empyreumatic odor, due no doubt to imperfect combustion, as no smell is perceptible when the gas is burned with the Siemens-Lundgren burner. The following is an analysis of the gas, made for Mr. Haas, who bored the well, and is a director of the Stockton Natural Gas Company:

Analysis of inflammable gas from the well of the Stockton Natural Gas Company.

Marsh gas, CH_4	83.00
Hydrogen	.06
Oxygen	.06
Carbonic dioxide, CO_2	.05
Carbonic oxide, CO	Trace.
Total	83.17

The artesian wells bored during the past year are as follows: Artesian well 4 miles east of Stockton, on Bishop ranch, 1,180 feet deep, no gas, good water; artesian well at paper mills, Stockton, 1,225 feet, yields good flow of water, and probably as much gas as at the Crown mills; no use is made of the gas at present. The old Standard well on the old Camp road is now owned by the Standard Gaslight and Fuel Company. The company has commenced boring a second well 1,375 feet southwest from the old one. Operations upon it are suspended for the present, but it is the intention to resume work at an early date.

Gas is reported to have been struck near Salinas, in Monterey county, at a depth of 100 feet. No use has as yet been made of it.

On the south side of Sulphur creek, Colusa county, about 300 yards back of the original Wilbur Springs, there is a gas well which has been burning for years. The gas here comes to the surface near a small stream which empties into Sulphur creek. The entire formation at this point is a coarse-grained friable sandstone. The gas issues under a slight pressure and burns with a flame resembling that of a "Bunsen burner." This flame rises from 8 inches to 2 feet. No effort has ever been made to utilize this gas.

TENNESSEE.

Quite full descriptions of the geological conditions under which natural gas has been found in Tennessee, as well as the probabilities of the discovery of further supplies, have been given in previous volumes of Mineral Resources, and nothing can be added to what is there stated.

During the year 1888 no natural gas was used in Tennessee so far as has been ascertained.

DAKOTA.

Some quantities of natural gas have been found at shallow depths in and near Ashton, Dakota. Gas was first struck at a depth of 78 feet, and was used for six weeks in the Bowman House for cooking.

The well filled with water and drowned out the gas. Since then several wells have been drilled and gas found in every instance at a depth varying from 75 to 125 feet. The water was not properly cased off and the gas was drowned out. On January 1, a farmer, in boring a 3-inch hole for water, struck gas at a depth of 75 feet. The gas is conveyed 165 feet in 1-inch gas pipe to his house, where he is using it for cooking and heating. There is more gas than is needed for the purpose. The well is cased with 3-inch casing driven 70 feet into the gas rock.

The drill in these wells passed through 15 feet of soil and clay and then through 55 feet of hardpan, soapstone, and black shale. In this last well was found a light-colored sandstone. Some oil is found before gas is struck.

OTHER STATES.

In Illinois and the States west of the Mississippi there have been no developments of any importance during the year 1888, and nothing can be added to what has been already said in previous volumes of Mineral Resources relative to the districts, the production of natural gas, geological features of the districts, and the probabilities of finding gas in commercial quantities. In general, it can be said that while in these States small amounts of gas have been found, and will continue to be found sufficient to supply fuel for local purposes, there does not promise to be any such development of gas-producing territories as found in Pennsylvania, Ohio, and Indiana.

JAPAN.

From an article contributed to the *American Manufacturer* by Jinzoo Adachi, we condense the following statement relative to natural gas in Japan. This should be noted in connection with the statement relative to petroleum in Japan, published elsewhere in this volume.

In one of the early Japanese writings it is stated that, "a noted Buddhist priest, Kobo Daish, performed seven miracles in the province of Echigo (800–840, A. D.). One of these miracles was that of an everlasting fire coming from the center of the earth." It is an old story of the people of the Golden Age, but many curiosity seekers still visit this locality. This was probably the original discovery of natural gas in Japan.

In 1876 the government of Japan began its geological survey. Mr. Adachi traveled with Mr. Benjamin Smith Lyman, chief geologist and mining engineer, in his researches into the mineral resources of the empire of Japan. They found gas in different localities, but always within the boundaries of the oil fields or along their borders, which indicates the intimate geological connection of the two.

Natural gas is called in Japan, Kazakusodzu, the first two syllables meaning wind or air, and evidently identical, etymologically, with the very modern western word "gas," which is usually stated to be the invention of the chemist Van Helmont (who died in 1644), but which he perhaps obtained from some colloquial expression in use from ancient times, and which is, at any rate, clearly identical in its turn with the German word "geist" and the English "ghost" (spirit, the Latin *spiritus*, breath or breeze).

At the Tae-Kusodzu (in Echigo) there are several producing oil wells of small product; but the most interesting feature is a couple of gas wells some 10 feet in diameter, near together, where the gas bubbles up in great quantity with violent commotion in water nearly level with the ground, and burns with dancing, flickering flames when lighted. At another spot within half a league some gas is utilized in a house for cooking, lighting, and even as a spectacle, when burned in jets of various size and position; but all the flames are flickering ones. At the same place the gas is also used to heat a small rude still, for refining the oil of the neighboring regions.

ASPHALTUM.

There are many localities in the United States where asphaltum occurs impregnating sandstone or shale, and occasionally it occurs in veins quite free from foreign substances, as the gilsonite and elaterite in Utah. Several places are given in Texas, Alabama, Tennessee, and Wyoming, but the only present useful sources are in Utah and California. Hard varieties of asphaltum, such as gilsonite and elaterite, occur in several widely separated localities in Utah. Frequently they are associated with ozokerite. The principal localities are Fort Duchesne, in the Uintah reservation, and at a place east of this reservation. In Utah and Emery counties several deposits have been noted, all comparatively near the Denver and Rio Grande railroad. In Juab county asphaltum has been reported near Nephi, and several specimens have been shown from other localities. The product in Utah in 1888 was 700 tons of gilsonite, which was hauled to Thistle and shipped to Saint Louis for making varnish. Its value there was $35,000. Of ordinary asphaltum about 100 tons were melted out of sandstone near Thistle.

Mr. C. G. Yale states that California produces between 4,000,000 and 5,000,000 gallons of liquid asphaltum from Los Angeles and Ventura counties. In 1888 the product is estimated at 4,600,000 gallons. It is of a glossy black color, imprevious to water, and is particularly adapted for coating iron. It is principally used in the manufacture of paint, which is found superior for some purposes to that made from lead. It is also made into a special varnish. It is largely used for wood and iron pipe "dipping" and for coating ropes, bridges, etc. The demand will undoubtedly increase, as the demand for ordinary coal tar is becoming greater than the supply.

During 1888 the mining of sandstone, or loose sand, cemented by asphaltum, became an important industry in California. The material, as mined, is heated till it becomes soft, and in this condition laid down as a pavement. The use of this cement is not new; but the industry attracted little attention until 1888, when in land speculation and town improvements it proved valuable, and now it is produced in large quantities, and deposits are eagerly sought.

Mr. F. Adams, of San Luis Obispo, states that the first discovery of bituminous rock, as this material is called, was in the winter of 1868, at Santa Cruz. As usual, it was accidental. Mr. Pray, the proprietor of a hotel, put down redwood blocks as a street pavement in front of the hotel. A man was sent to get asphaltum to pour between the blocks. This asphaltum was then known to occur in a wild region about 10 miles north of Santa Cruz. By mistake he went to the wrong place and returned with a wagon load of bituminous rock. This was melted and laid over the redwood blocks and proved satisfactory. (*a*) The next attempt to use the rock was in 1876, when the town introduced street cars. Soon after this, sidewalks were demanded by the tourists, and Mr. I. L. Thurber began laying the asphalt as a business. In 1884 it became the standard material for street pavements in Santa Cruz, and in subsequent years it has been shipped to other places to a slight extent; but although the quality of the material is very good, wagon hauling is necessary, and the roads are very poor. The product in 1888 was about 7,000 tons, worth $6 per ton on cars at Santa Cruz.

The principal source of the bituminous rock is now San Luis Obispo, where it was noticed by Mr. James McCormick early in January, 1887. The experience at Santa Cruz caused this land to be bought up at once. Work began in May, and at the close of 1887 about 36,000 tons had been sold. The deposits, as developed in 1888, are about 6 miles south of San Luis Obispo. Four companies are operating them, the Bituminous Rock Company, the Black Rock Company, the California Paving Company, and the Pacific Paving Company. The deposits are usually opened from the side of a hill, and the cost of putting the material on cars is very small. Part of the hillside is blasted off and in some cases loaded directly on cars; in others a short wagon haul is necessary. Thirty cents per ton is fully as much as it now costs to load on the cars. The material sells for about $5 per ton at Port Harford, about 5 miles away. The total product for the region was 43,000 tons in 1888.

It seems to be good paving material and resists wear better than ordinary asphaltum. It is largely used in Los Angeles, San Diego, Santa Barbara, and San Bernardino, and to some extent in San Francisco.

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a It was still in good condition in this place in 1888, and similar pavements are used throughout the town.—DAY.

OZOKERITE.

It has been known for years that ozokerite occurs in several localities in Utah, but the seams are usually quite small, varying from an inch to 4 inches in thickness, and little effort has been made towards securing a supply; but in 1888 Mr. R. J. Kroupa, acting for the Ozokerite Mining Company, began active developments which have met with success, largely on account of Mr. Kroupa's experience in the Galician ozokerite mines. The property of this company covers a large area, and exploration has been carried on since 1885 with varying results. More than twenty-five openings have been made at various points on the property, and more than a dozen veins of the ozokerite have been exposed. The work has been slowly but thoroughly pursued, and in August, 1888, at Soldiers Summit, a deposit was discovered which has proved to be quite extensive. About 65,000 pounds were mined in 1888, and a car load of this was favorably received in New York.

The foreign product is principally from Galicia, and Mr. Jacob Wallace estimates that in all 60,000,000 pounds are produced there. The discovery of ozokerite was made in 1859, and the industry began in 1862. It has gradually increased since then. At first no financial support could be found for the enterprise, but in 1865 the Lemburg Credit Bank pushed the undertaking. Now thirty-five English, French, and Austrian companies are engaged in the field.

Refined ozokerite is applicable to almost all uses for ordinary beeswax and the crude substance is particularly valuable as an insulator.

STRUCTURAL MATERIALS.

BY WILLIAM C. DAY.

THE BUILDING INDUSTRY IN GENERAL.(a)

The year 1888, while by no means an unprosperous one for the building industry throughout the country, does not show the gains in production of structural materials generally which characterized the year 1887 as compared with 1886 and former years.

The following table has been constructed on the basis of statistics furnished by the building inspectors and commissioners of the various cities considered. The figures represent in general the number of permits issued during the year and the estimated values of the buildings for which permits were given. Although the buildings for which permits are issued may not all be completed during the same year, still this fact does not diminish the value of the figures as showing the comparative condition of the industry in different years:

Number and value of the buildings for which permits were issued in forty-four cities during the years 1885, 1886, 1887, *and* 1888.

Cities.	1885.		1886.		1887.		1888.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Portland, Maine:								
Frame buildings	67		91		109	$140,000		
Brick, stone, and iron buildings	14		32		33	225,000		
Total	81	$250,000	123	$300,000	142	365,000		
Bangor, Maine								
Frame buildings							190	
Brick, stone, and iron buildings							10	
Total							200	$300,000

a In the preparation of this report valuable aid has been rendered by the following gentlemen, to whom especial acknowledgments are hereby tendered: Mr. Robert H. Dalby, of Slatington, Pennsylvania, for general statistics in regard to slate from the Slatington region, Pennsylvania; Mr. U. Cummings, general superintendent of the Standard Cement Company, of New Haven, Connecticut, formerly of Buffalo, New York, for statistics in regard to the production of natural-rock cement in the United States; the New York *Real Estate Record and Guide*, for statistics of structural materials in New York City.

Number and value of the buildings for which permits were issued, etc.—Continued.

Cities.	1885.		1886.		1887.		1888.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Boston, Massachusetts:								
Frame buildings	1,372	$4,552,538	1,353	$3,992,792	1,431	$4,153,181	1,480	$4,455,515
Brick, stone, and iron buildings	348	6,218,800	346	8,813,100	417	6,108,825	315	4,994,350
Total	1,720	10,771,338	1,699	12,805,892	1,848	10,262,006	1,795	9,449,865
Fall River, Massachusetts:								
Frame buildings	200	....	205	....	273	....	279	....
Brick, stone, and iron buildings	12	....	25	....	27	....	17	....
Total	212	330,975	230	666,750	300	831,450	296	1,160,650
Salem, Massachusetts:								
Frame buildings	92	....	90	....	102	....	121	200,000
Brick, stone, and iron buildings	9	....	4	....	10	....	10	30,000
Total	101	376,000	94	317,000	112	406,000	131	230,000
New Bedford, Massachusetts:								
Frame buildings	......	....	......	....	......	....	169	338,000
Brick, stone, and iron buildings	......	....	......	....	......	....	3	160,000
Total	......	....	......	....	......	....	172	498,000
Providence, Rhode Island:								
Frame buildings	452	1,273,745	407	1,194,607	465	1,166,540	427	1,251,780
Brick, stone, and iron buildings	13	364,700	12	168,750	14	293,500	23	774,000
Total	465	1,638,445	419	1,363,357	479	1,460,040	450	2,025,780
Bridgeport, Connecticut:								
Frame buildings	280	420,000	350	630,000	......	....	......	....
Brick, stone, and iron buildings	25	125,000	34	170,000	......	....	......	....
Total	305	545,000	384	800,000	......	....	......	....
Brooklyn, New York:								
Frame buildings	1,261	....	1,774	....	2,123	....	1,923	....
Brick, stone, and iron buildings	1,377	....	2,216	....	1,752	....	1,738	....
Total	2,638	11,465,795	3,990	20,318,485	3,875	18,008,325	3,661	17,937,270
New York City:								
Frame buildings	580	1,416,683	650	1,505,735	840	2,151,765	771	1,861,965
Brick, stone, and iron buildings	2,788	43,957,330	3,442	57,233,998	3,504	64,917,805	2,474	49,193,016
Total	3,368	45,374,013	4,092	58,739,733	4,344	67,069,570	3,245	51,054,981
Newark, New Jersey:								
Frame buildings	809	....	724	....	916	....	1,060	....
Brick, stone, and iron buildings	221	....	223	....	252	....	313	....
Total	1,030	....	947	....	1,168	....	1,373	....
Wilmington, Delaware:								
Frame buildings	......	....	......	....	......	....	......	....
Brick, stone, and iron buildings	280	668,590	192	622,983	301	548,340	276	648,450
Total	280	668,590	192	622,983	301	548,340	276	648,450
Philadelphia, Pennsylvania:								
Frame buildings	......	....	......	....	80	....	85	....
Brick, stone, and iron buildings	......	....	......	....	7,615	....	7,722	....
Total	6,326	25,000,000	7,561	24,500,000	7,695	26,780,000	7,807	30,000,000

Number and value of the buildings for which permits were issued, etc.—Continued.

Cities.	1885.		1886.		1887.		1888.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Pittsburgh, Pennsylvania:								
Frame buildings	795	....	847	....	1,173	$1,157,341	1,838	....
Brick, stone, and iron buildings	647	....	568	....	737	2,757,558	926	....
Total	1,442	$3,030,429	1,415	$2,401,809	1,910	3,914,899	2,764	$5,341,193
Baltimore, Maryland:								
Frame buildings	......	....	......	....	......	....	......	....
Brick, stone, and iron buildings	3,237	4,340,125	2,305	3,587,900	2,464	3,244,750	2,188	3,613,480
Total	3,237	4,340,125	2,305	3,587,900	2,464	3,244,750	2,188	3,613,480
Washington, District of Columbia:								
Frame buildings	325	195,255	392	295,689	366	351,260	266	313,760
Brick, stone, and iron buildings	1,333	3,297,252	1,802	4,412,240	1,885	4,584,500	1,611	5,389,611
Total	1,658	3,492,507	2,194	4,707,929	2,251	4,935,760	1,877	5,703,371
Richmond, Virginia:								
Frame buildings	244	124,900	137	125,000	355	205,000	......	....
Brick, stone, and iron buildings	238	896,400	204	528,600	184	668,700	......	....
Total	482	1,021,300	341	653,600	539	873,700	555	750,000
Louisville, Kentucky:								
Frame buildings	604	....	570	....	420	....	742	....
Brick, stone, and iron buildings	243	....	340	....	496	....	192	....
Total	847	2,160,523	910	1,507,368	916	1,487,602	934	1,223,047
Memphis, Tennessee:								
Frame buildings	......	....	......	....	......	374,007	198	441,544
Brick, stone, and iron buildings	......	....	......	....	......	748,014	106	790,412
Total	......	....	......	....	......	1,122,021	304	1,231,956
Nashville, Tennessee:								
Frame buildings	212	135,245	211	126,025	470	200,952	636	310,624
Brick, stone, and iron buildings	95	235,220	151	391,545	230	594,260	201	624,995
Total	307	370,465	362	517,570	700	795,212	837	935,619
Saint Louis, Missouri:								
Frame buildings	510	456,825	491	405,892	648	555,370	......	....
Brick, stone, and iron buildings	2,160	6,919,694	1,732	6,624,927	1,842	7,607,544	......	....
Total	2,670	7,376,519	2,223	7,030,819	2,490	8,162,914	......	....
Kansas City, Missouri:								
Frame buildings	2,227	1,357,207	3,420	3,098,802	3,758	2,622,306	4,263	2,987,891
Brick, stone, and iron buildings	703	4,401,420	629	7,244,655	650	6,646,955	715	6,679,540
Total	2,930	5,758,627	4,049	10,343,457	4,408	9,269,261	4,978	9,667,431
Savannah, Georgia:								
Frame buildings	278	....	228	....	190	....	204	....
Brick, stone, and iron buildings	55	....	52	....	28	....	32	....
Total	333	360,535	280	335,845	218	255,500	236	272,970
Galveston, Texas:								
Frame buildings	116	177,630	181	394,400	......	....	......	....
Brick, stone, and iron buildings	7	123,500	6	229,000	......	....	......	....
Total	123	301,130	187	623,400	......	....	......	....

Number and value of the buildings for which permits were issued, etc.—Continued.

Cities.	1885.		1886.		1887.		1888.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
New Orleans, Louisiana:								
Frame buildings	......	......	......	......	......	......	......	......
Brick, stone, and iron buildings	......	......	......	......	......	......	......	......
Total	......	......	......	......	......	......	297	$1, 205, 509
Little Rock, Arkansas:								
Frame buildings	......	......	......	......	......	......	200	500, 000
Brick, stone, and iron buildings	......	......	......	......	......	......	60	500, 000
Total	......	......	......	......	......	......	260	1, 000, 000
Topeka, Kansas:								
Frame buildings	603	......	696	......	576	......	535	......
Brick, stone, and iron buildings	68	......	75	......	69	......	81	......
Total	671	$406, 671	771	$494, 291	645	$621, 596	616	761, 290
Evansville, Indiana:								
Frame buildings	......	......	......	......	324	......	322	214, 722
Brick, stone, and iron buildings	......	......	......	......	87	......	80	835, 780
Total	......	......	......	......	411	366, 273	402	1, 050, 502
Indianapolis, Indiana:								
Frame buildings	......	......	......	......	......	687, 377	......	......
Brick, stone, and iron buildings	......	......	......	......	......	401, 810	......	......
Total	......	......	......	......	......	1, 089, 187	1, 205	1, 089, 198
Cleveland, Ohio:								
Frame buildings	......	......	......	......	......	......	1, 101	1, 331, 399
Brick, stone, and iron buildings	......	......	......	......	......	......	79	2, 262, 610
Total	1, 932	1, 731, 960	1, 587	1, 564, 200	1, 537	1, 756, 273	1, 180	3, 594, 009
Columbus, Ohio:								
Frame buildings	......	......	......	......	......	......	......	......
Brick, stone, and iron buildings	......	......	......	......	......	......	......	......
Total	537	648, 058	804	916, 807	854	1, 086, 419	......	......
Toledo, Ohio:								
Frame buildings	......	......	436	324, 580	342	520, 000	......	......
Brick, stone, and iron buildings	......	......	108	298, 515	374	736, 000	......	......
Total	......	......	544	623, 095	716	1, 256, 000	......	632, 125
Detroit, Michigan:								
Frame buildings	1, 328	1, 437, 819	1, 533	1, 561, 864	1, 326	......	1, 945	......
Brick, stone, and iron buildings	563	2, 040, 500	520	2, 335, 350	687	......	477	......
Total	1, 891	3, 478, 319	2, 053	3, 897, 214	2, 013	3, 916, 973	2, 422	4, 292, 639
Marquette, Michigan:								
Frame buildings	8	19, 829	4	16, 492	10	34, 190	19	139, 600
Brick, stone, and iron buildings	6	53, 351	2	21, 600	4	98, 793	5	348, 109
Total	14	73, 180	6	38, 092	14	132, 983	24	487, 709
Milwaukee, Wisconsin:								
Frame buildings	......	......	......	......	......	......	302	612, 860
Brick, stone, and iron buildings	......	......	......	......	......	......	179	1, 251, 030
Total	......	......	......	......	......	......	481	1, 863, 890

Number and value of the buildings for which permits were issued, etc.—Continued.

Cities.	1885.		1886.		1887.		1888.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Chicago, Illinois:								
Frame buildings	...	...	...	...	...	...	...	...
Brick, stone, and iron buildings	4,638	$24,530,125	4,664	$21,324,400	4,833	$19,778,100	4,958	$20,360,800
Total	4,638	24,530,125	4,664	21,324,400	4,833	19,778,100	4,958	20,360,800
Minneapolis, Minnesota:								
Frame buildings	...	...	...	...	...	...	4,180	3,409,687
Brick, stone, and iron buildings	...	...	...	...	...	...	159	6,789,150
Total	3,075	7,718,668	4,485	9,179,522	4,620	9,731,068	4,339	10,198,837
Saint Paul, Minnesota:								
Frame buildings	2,964	2,238,026	3,017	2,488,271	3,780	6,452,807	4,276	6,963,265
Brick, stone, and iron buildings	385	1,921,182	553	3,567,571	675	6,486,407	616	7,724,656
Total	3,349	4,159,208	3,570	6,055,842	4,455	12,939,214	4,892	14,687,921
Fargo, Dakota:								
Frame buildings	11	35,500	17	29,000	13	31,300	8	14,600
Brick, stone, and iron buildings	4	120,000	4	49,500	2	104,000	2	12,000
Total	15	155,500	21	78,500	15	135,300	10	26,600
Omaha, Nebraska:								
Frame buildings	600	957,318	1,150	2,224,390	1,968	...	2,131	2,260,154
Brick, stone, and iron buildings	62	1,908,145	145	2,950,750	226	...	251	1,410,214
Total	662	2,865,463	1,295	5,175,140	2,194	9,000,000	2,382	3,670,368
Council Bluffs, Iowa:								
Frame buildings	...	...	...	...	...	...	...	...
Brick, stone, and iron buildings	...	...	...	...	...	...	...	...
Total	...	...	327	1,721,325	743	2,600,500	1,169	2,167,200
Des Moines, Iowa:								
Frame buildings	...	...	...	...	...	...	276	705,125
Brick, stone, and iron buildings	...	...	...	...	...	...	49	391,350
Total	...	...	...	...	...	...	325	1,096,475
Dubuque, Iowa:								
Frame buildings	...	...	...	...	...	...	...	...
Brick, stone, and iron buildings	...	...	...	...	...	...	...	...
Total	...	1,000,500	...	1,026,301	...	1,267,400	...	1,678,700
San Francisco, California:								
Frame buildings	...	...	...	...	...	...	...	...
Brick, stone, and iron buildings	...	...	...	...	...	...	...	...
Total	...	...	...	...	...	...	891	6,244,229

In the following table are the figures (taken from the foregoing table) showing the values for all cities, except those for which data are wanting, for 1887 and 1888, placed in parallel columns for the sake of comparison:

Total value of buildings erected in the principal cities of the United States during 1887 and 1888.

Names of cities.	1887.	1888.
Boston, Massachusetts	$10,262,006	$9,449,865
Fall River, Massachusetts	831,450	1,160,650
Salem, Massachusetts	406,000	230,000
Providence, Rhode Island	1,460,040	2,025,780
Brooklyn, New York	18,008,325	17,937,270
New York City	67,069,570	51,054,987
Wilmington, Delaware	548,340	648,450
Philadelphia, Pennsylvania	26,780,000	30,000,000
Pittsburgh, Pennsylvania	3,914,899	5,341,193
Baltimore, Maryland	3,244,750	3,613,480
Washington, District of Columbia	4,935,760	5,703,371
Richmond, Virginia	873,700	750,000
Louisville, Kentucky	1,487,602	1,223,047
Memphis, Tennessee	1,122,021	1,231,956
Nashville, Tennessee	795,212	935,619
Kansas City, Missouri	9,269,261	9,667,431
Savannah, Georgia	255,500	272,970
Evansville, Indiana	366,273	1,050,502
Indianapolis, Indiana	1,089,187	1,089,198
Topeka, Kansas	621,596	761,290
Cleveland, Ohio	1,756,273	3,594,009
Toledo, Ohio	1,256,000	632,125
Detroit, Michigan	3,916,973	4,292,639
Marquette, Michigan	132,983	487,709
Chicago, Illinois	19,778,100	20,360,800
Minneapolis, Minnesota	9,731,068	10,198,837
Saint Paul, Minnesota	12,939,214	14,687,921
Fargo, Dakota	135,300	26,600
Omaha, Nebraska	9,000,000	3,670,368
Council Bluffs, Iowa	2,600,500	2,167,200
Dubuque, Iowa	1,267,400	1,678,700
Total	215,855,303	205,943,967

It is evident, from this table, that for the thirty-one cities compared there was a total decrease of $9,911,336 in 1888, or 4.59 per cent. less. If New York City is left out there is a total gain of $6,103,247, or 4.1 per cent. gain.

In the report for 1887 a consideration of the kinds of building done and the kinds of materials used in quite a number of cities and towns in the United States was given. The following is a presentation of similar information in regard to other cities and towns, and also in cases where changes have been made apparent by increased activity in building. The same cities were treated of in the 1887 report.

ALABAMA.

Birmingham.—The amount of building done in this city in 1888 falls below that of 1887 very perceptibly; this decrease is due in part to the reaction which is a natural consequence of the excessive activity of two or three preceding years. Appearances, however, point to greater activity during 1889.

Locally quarried dark gray sandstone serves for all foundation work, while limestone from the Dixon quarry, Franklin county, Alabama, and granite from the Goodwater quarry, Coosa county, Alabama, supply the greater part of the demands for ornamental stone. The granite shows as the result of analysis 96 per cent. quartz, 3.3 per cent. feldspar and 0.7 per cent. mica. The brick for rough work is produced locally, but for first-class construction Montgomery and Riverside, Alabama, brick is preferred; front brick comes from Saint Louis, Missouri, and Zanesville, Ohio. Louisville, Kentucky, cement supplies most of the demand for that material, although Rosendale and English Portland are also in use.

Mobile.—Stone foundations in this city are practically unknown. Dixon, Alabama, limestone is occasionally used for superstructures. Most of the buildings erected are of wood. The common brick used is of local manufacture, unattractive in appearance, but durable in quality. Slate and cement are sparingly employed.

Montgomery.—There being no building stone within 70 miles of this city, foundations are constructed of brick, which is locally manufactured and of good quality.

Granite is procured from Stone Mountain, Georgia, sandstone from Blount county, Alabama, and limestone from the northern part of the State. More good taste in the use of ornamental materials is displayed than formerly, and the general character of the buildings is better. A very noticeable increase in the consumption of cement has taken place in the last eight years. Louisville cement, supplemented by a little English Portland and Rosendale, supplies the demand.

ARKANSAS.

Little Rock.—For foundations sandstone, obtained 2 miles west of the city, is the recognized material. Two miles south of the city large quantities of granite are quarried, and this stone is freely used for superstructures and is also freely shipped to other cities for paving blocks as well as for building purposes. The character of the building done is improving noticeably. The common brick is locally manufactured, but the fine brick comes from Memphis, Tennessee, Saint Louis, Missouri, and Zanesville, Ohio. Slate from Pennsylvania supplies the greater part of a limited demand. Slate of good quality exists about 6 miles west of the city, but it has not yet been satisfactorily developed.

CALIFORNIA.

Los Angeles.—Most of the foundations in this city are constructed of brick; but small quantities of granite from Riverside, 60 miles southeast, and sandstone from the Sespe quarries are sometimes applied to foundation construction. The above mentioned stones, and also sandstone from Flagstaff, Arizona, supply most of the demand for ornamental stone.

The residences are almost entirely frame structures, brick and stone being used in business buildings and blocks.

Slate is used on only one or two buildings; it came from Pennsylvania. English Portland cement supplies almost the entire demand for cement; it is brought over in English vessels landing at San Pedro.

Sacramento.—For foundation works brick is almost exclusively employed; but little stone is used for any purpose; the small demand is filled by sandstone from Amador county and a small quantity of granite. Brick is locally manufactured. Slate is very little used for roofing, but the future development of slate quarries known to exist at Placerville, Eldorado county, California, may stimulate the use of slate in this and other California towns. English Portland cement is quite liberally used; much of it comes as ballast in grain ships from England.

San Francisco.—The foundations of buildings in this city are largely constructed of brick. Sandstone from San José and Niles Cañon, California, and also from Arizona, and granite from localities in the Sierra Nevada mountains, are employed for superstructures.

The brick used in this city comes from San José, Pleasanton, San Rafael, San Quentin, and other points situated at distances of from 30 to 75 miles from the city. The opening up of the Placerville slate quarries will probably cause an increased consumption of slate, very little of which is used at present.

CONNECTICUT.

Bridgeport.—Two kinds of locally quarried stone of granitic character, but different in color, supply the needs for foundation work, while ornamental stone comes from Hurricane Islands and Westerly, Rhode Island, sandstone being brought from Long Meadow, Massachusetts, and Portland, Connecticut.

The absence of suitable clay for brick making necessitates the introduction of common brick from North Haven and Berlin, Connecticut, and fine brick from Philadelphia, Pennsylvania, and Trenton, New Jersey. Slate from Maine and Pennsylvania quarries is used on a fair proportion of the steep roofs erected. The use of cement mixed with lime in mortar is increasing, the proportions recommended by the best authorities being one part of lime to two parts of cement in summer, or in warm weather, and one of lime to one of cement in cold weather. Rosendale cement chiefly is used, but a considerable amount of imported Portland is also utilized.

GEORGIA.

Atlanta.—Stone mountain, at a distance of 16 miles from the city, furnishes granite for superstructures, ornamental work, and trimmings, while "native blue stone," locally so called, and quarried near the city, is the material used for foundations. In addition to these stones, marble from Pickens county, limestone from Alabama, Kentucky, and Indiana, and sandstone from Kentucky are also employed in ornamental work. Indiana oolitic limestone was used in the erection of the Georgia State capitol All brick is of local manufacture; slate is brought from Rock Mart, Georgia.

Savannah.—Alabama limestone, quarried at Netta, and granite from Stone mountain, Georgia, are now quite extensively used to supply demands for stone in building, and is replacing Connecticut brown stone, which was formerly very largely employed. Common brick is locally manufactured, while pressed brick for front work is brought from Macon and Atlanta. Rosendale and Georgia natural-rock cement, and also Portland cement, manufactured at Cement, Georgia, are in use.

Cement is also used in the manufacture of an artificial stone known as "tabby" from oyster shells and cement, giving a product satisfactory in appearance and strength.

IDAHO.

Boisé City.—Sandstone locally quarried is used for foundations, while Ohio freestone and Kentucky limestone are used in superstructures. There is a marked improvement in the style and taste displayed in the erection of buildings within the past few years. Common brick is made in the vicinity, while fine brick comes from Zanesville, Ohio, and Louisville, Kentucky. Slate from Virginia and Pennsylvania is used, and cement also comes into consumption.

ILLINOIS.

Aurora.—Limestone from local quarries is the foundation material while for superstructures and ornamental work Bedford sandstone and Joliet limestone are popular. Very little slate is used. Buffalo, New York, and Utica, Illinois, cements supply most of the demand for this material.

Chicago.—Probably no city in the Union makes use of a greater variety of building stones than Chicago. There is hardly an important quarry in any part of the country which does not supply stone to the market of this city. The slate used is principally from the quarries of Pennsylvania and Vermont, about 10,000 squares being annually consumed. Natural-rock cement comes chiefly from Milwaukee and Louisville, while probably all the varieties of Portland are in use.

INDIANA.

Indianapolis.—For foundation construction limestone from Decatur, Jennings, and Jefferson counties, Indiana, is commonly employed. Oolitic limestone from Monroe, Lawrence, Owen, and Harrison counties is most widely adopted for ornamental work in superstructures. The introduction of natural gas has stimulated building to a very marked extent within the past two years. This statement may be made indeed of all Indiana towns in which natural gas has made its appearance. The Bangor, Pennsylvania, slate quarries furnish most of the slate used. Cement for ordinary work comes from Louisville, Kentucky, Portland cement being used for the best grades of work.

IOWA.

Cedar Rapids.—Magnesian limestone from Anamosa, Jones county, and from Cedar Valley, Cedar county, is used for foundation construction. For superstructures and fine work generally, Bedford, Indiana, limestone is popular.

Slate as a roofing material is almost unknown. A little from the Lehigh Valley region of Pennsylvania has made its appearance. Milwaukee and Louisville cements, mixed with ordinary mortar, are used to a limited extent in walls which demand such mortar.

Des Moines.—Local limestone for foundation walls, and Missouri and Ohio sandstones for superstructures, are the building stones used.

Eighty per cent. of the buildings erected are frame structures; the rest are of brick, with more or less stone trimmings. More iron and terra cotta are used than formerly. Common brick is made locally; fine brick comes from Saint Louis. Slate from Maine, Vermont, and Virginia is employed for steep roofs. Milwaukee and imported Portland cement mixed with lime is used in mortar when circumstances demand it. The local lime is, however, quite strong and satisfactory.

KANSAS.

Hutchinson.—The discovery and development of large beds of rock-salt is an important factor in the stimulation of building operations in this town. The brick produced locally is of very poor quality, owing to a large admixture of sand in the clay. Three-fourths of the brick used comes from other places, notably Colwich, Lyons, and Topeka, Kansas, and Kansas City and Saint Louis, Missouri. Slate is practically unknown.

KENTUCKY.

Louisville.—A hard, flinty limestone, gray in color, and quarried near the city, is used for foundation construction, while the most popular ornamental stone appears to be the oolitic limestone from Bedford, Indiana. Red sandstone from the Lake Superior region is also in use. The concentration of the leaf-tobacco trade in this city seems to be a cause of a more active growth in 1888 than that which characterized 1887.

Nearly all the brick used in this city is locally manufactured; but for the finest grades Zanesville, Ohio, Saint Louis, Missouri, and Baltimore, Maryland, are drawn upon. Slate is popular, the well known sources of supply in Pennsylvania and Virginia being most liberally patronized, but some is brought from Vermont quarries.

The Louisville cement supplies all demands of ordinary work, and English Portland is used for finer grades. As compared with twelve years ago, the use of cement has very largely increased; this is due as in many other cities to the erection of high buildings and the demand for more substantial and durable work in building.

LOUISIANA.

New Orleans.—Stone is very little used either in foundations or superstructures in this city. Frame buildings are largely in the majority. Ordinary brick is freely used and is manufactured at yards in the city and the immediate vicinity; fine brick comes from Saint Louis, Missouri, and Baltimore, Maryland. Portland cement imported from England supplies most of the demand for cement.

MARYLAND.

Baltimore.—For foundations a trap rock locally known as Falls Road stone is in general use. For ornamental work and trimmings Baltimore county marble, Potomac sandstone, and Berea, Ohio, sandstone are most freely used; while granite from various sources is employed to a limited extent. The vast majority of the buildings erected in Baltimore are of the celebrated Baltimore brick, the ornamental varieties of which are in demand all over the United States. Comparatively little slate is used.

MASSACHUSETTS.

Boston.—For foundations Rockport and Quincy granites are in common use, but Roxbury pudding stone for the cheapest work is also employed. A large variety of building stones is used in superstructural work; the most prominent kinds are as follows: Granite from Rockport, Quincy, Concord, Dedham, and Milford; and Long Meadow and Ohio sandstone; marble from Vermont.

The brick used is mostly made at yards near the city. Slate comes almost entirely from Maine.

Much more cement is now used than formerly; the favorite brands are those of New York and New Jersey and imported Portland for the finest grades of work.

Holyoke.—Locally quarried sandstone is used in foundations. The buildings now erected are mostly of brick; the stone used for trimmings is Long Meadow sandstone, Vermont marble, and granite from East Dummerston, Vermont. All brick is locally made, and as frame structures are not allowed in the fire limits, is freely used. Rosendale and imported Portland cements supply the demand for this article, the proportionate consumption of which is increasing.

New Bedford.—Granite from local quarries is used for foundations, and Cape Ann granite and Long Meadow sandstone for ornamental purposes.

Frame buildings largely predominate as to number, and in value they are about double that of buildings made of other material. The greater part of the common brick comes from Taunton, Massachusetts, and some from Fisher's Island; pressed brick is brought from Danvers, Massachusetts. The use of cement in superstructures is regulated as in other places by the season—clear lime mortar in the spring and fall, and mortar of various proportions of lime and cement during the summer months.

Springfield.—Most of the foundations in this city are of brick. Sandstone from Long Meadow, and granite from Monson, Massachusetts, are the favorite stones for superstructures. Slate from Maine and Pennsylvania is quite freely used for roofing purposes.

MICHIGAN.

Detroit.—Foundations are generally of limestone taken from various places on the shores of Lake Erie, principally Marble Head and Kelly's Island. Michigan and Ohio sandstones supply most of the demand for ornamental work, trimmings, etc. Many handsome residences were built during the year, but the total money value of the buildings erected in 1888 is less than that of 1887. Michigan slate is extensively used, but some is also brought from Maine and Pennsylvania. Akron, Ohio, furnishes the cement for ordinary work, while the usual varieties of imported Portland cement are in use for the finer grades of work.

Grand Rapids.—For foundation work in this city field bowlders have generally been used, but as they are becoming scarce sandstone is largely taking their place. Berea and Amherst, Ohio, sandstone is the stone commonly used for superstructures. The great majority of all buildings erected are, however, frame structures. This predominance of frame buildings is likely to continue as long as lumber remains at the present prices. Very little slate is consumed for roofing purposes, being used only on the best class of dwellings and public buildings. Ohio and Louisville, Kentucky, cements supply the greatest portion of the demand. For the best work Portland cement is used.

MINNESOTA.

Minneapolis.—Blue limestone, which has been found locally in great abundance, suffices for all foundation purposes, but is not used at all for superstructures. The popular stone for superstructure and ornamental work is brown sandstone from the Lake Superior region and the buff sandstones from Amherst and Berea, Ohio. A small amount of Bedford, Indiana, oolitic stone has made its appearance. The materials which appear to be markedly increasing in general application are iron and steel in the form of steel beams. All common brick is locally manufactured. Pressed brick is brought from Saint Louis and Chicago. Milwaukee supplies most of the demand for cement, but other domestic cements from Louisville, Kentucky, and Utica, New York, are also in use. English Portland cement is used for the finest grades of work.

Saint Paul.—Locally quarried limestone is used for foundations, while for ornamental work, trimmings, etc., brown sandstone from Ashland, Wisconsin, red sandstone from Portage, Michigan, and Berea, Ohio, sandstone are in common use. The use of stone is much more general than it was a few years since. Common brick is brought from Chaska, Minnesota. Pressed brick comes from Anderson, Wisconsin, and Saint Louis, Missouri. Milwaukee supplies most of the demand for domestic cement.

MISSISSIPPI.

Vicksburg.—In this city economy is a very important factor in determining the choice of building materials generally. Stone is not used in foundations, brick being applied to that purpose. What little stone is used in superstructure comes largely from Chattanooga, Tennessee, and Dickson, Alabama. Hand-made brick of local manufacture, made of clay that is well adapted to the manufacture of brick, is the only brick used in any considerable quantity. The common lime mortar is not of a quality to stand well without the use of cement, which is used in all foundation work, but only to a limited degree in superstructures.

MISSOURI.

Kansas City.—Limestone taken from quarries in and around the city is used for foundation work, while for ornamental work and trimmings gray sandstone from Warrensburgh, Missouri, red sandstone from Colorado, and Lake Superior sandstone is used. Some brownstone from the Long Meadow, Massachusetts, quarries has been used. At present the tendency toward increased use of fire-proof materials is quite noticeable, brick and terra cotta being apparently quite popular. Common brick is of local manufacture, while pressed brick comes from Saint Louis. For steep roofs on buildings of the best class some slate, chiefly from Pennsylvania quarries, and a little from Vermont, is used. Louisville, Kentucky, cement is applied in all cases where the best hydraulic qualities are needed; that is, for foundations, but for superstructural work the Milwaukee, Wisconsin, and Fort Scott, Kansas, cements are of most general application. Local cement of fair quality is also made in the vicinity of the city, and this is used to a limited extent. During the last three or four years the standard of excellence in buildings has perceptibly risen in this city.

Saint Joseph.—No stone is used for foundation work, concrete and brick answering for this purpose. Warrensburgh, Missouri, sandstone and oolitic limestone from Bedford, Indiana, supply most of the demand for stone-work in superstructures. Most of the buildings erected are of brick, very few frame houses being constructed. The brick used is chiefly of local manufacture.

Saint Louis.—Local limestone, quarried in various parts of the city, supplies all demands for foundation stone in the smaller structures and dwelling houses. For the largest buildings limestone from Grafton, Illinois, is most extensively used. For superstructures a great variety of building stones is used. Granite from the Allen quarries on the Iron Mountain railroad, 70 miles south of the city, and red sandstone from the Lake Superior region, are the stones most freely used for ornamental work. Gray and blue sandstone from Warrensburgh is also used to some extent, and red sandstone from Dunreath, Iowa, has also made its appearance. The Saint Louis brick, which is gaining a high reputation all over the West for fine quality, durability, and appearance, supplies all demand for brick in this city. For all ordinary purposes, Louisville, Kentucky, cement supplies the demand. Imported English and German cements are used for the best classes of work. The slate, which is freely consumed, comes from Maine and Pennsylvania. The use of cement in rapidly erected tall buildings is customary, and in foundation work is very extensively used.

NEBRASKA.

Lincoln.—The limestone used for foundation work comes from the southeastern part of the State and from Kansas. Sandstone from Carroll county, Missouri, and from Cleveland, Ohio, is used for the best work in superstructures. Red sandstone from Colorado is also employed. The great majority of the buildings erected are frame structures. The building done in the past year is greater, so far as the number of buildings is concerned, than that which characterized the year 1887, but less money was invested in 1888. Lincoln is recognized as a local center of brick manufacture, and the brick used is of local manufacture, and large shipments are made to other places in the State. The clay used is difficult to work, but is of fine quality.

Omaha.—There is no good building stone quarried locally. The nearest is at a point 10 miles south of the city, where a hard limestone is found, and brick is therefore chiefly used for foundations. For ornamental work, however, sandstone from Missouri and from Berea, Ohio, is most popular. Sandstone from Colorado has also been freely used within the last few years. The amount of building done in 1888 hardly comes up to the figures for 1887, the strikes which have occurred in the last two years having produced quite a depressing effect on the building industry. Common brick is of local manufacture, while the best grades of pressed brick come from Chicago and Saint Louis. The foundations of buildings in Omaha are, in many cases, unreliable. This is due to the condition of the soil, which is, in some cases, quicksand or of soapy clay. On this account great care must be observed in laying the foundations of the larger buildings. The cement which is freely used in such walls comes mainly from Milwaukee and Mankato.

NEW JERSEY.

Jersey City.—Trap rock from Bergen Hill is the stone used for foundations, while Connecticut sandstone has long been and still continues the popular stone for superstructures. The buildings erected are about equally divided in number between brick and frame. The brick comes chiefly from the North river yards. The slate, comparatively little of which is used, comes from Pennsylvania.

NEW YORK.

Albany.—Limestone from Schenectady, New York, and also Howe's Cave, is most frequently used for rough work and foundations. Brown stone from Connecticut, and also from Long Meadow, Massachusetts, is the most popular sandstone. Some from Ohio is also employed.

Brooklyn.—Locally quarried stone is used for foundation work, while Connecticut brownstone and red sandstone from Ohio are the most popular for superstructural work. The value of the buildings erected in 1888 exceeds that of 1887, but the number erected is less, showing of course the erection of more expensive structures. Terra cotta, in connection with pressed brick, seems to be increasing in application more than any other ornamental material. Common brick comes from various places on the Hudson river, principally Haverstraw. The finest pressed brick comes from Philadelphia, Trenton, and Baltimore. Vermont slate is used extensively on steep roofs. Rosendale cement supplies most of the demand for this material.

Buffalo.—For foundation work a so called flint rock, locally quarried, is used. Local limestone and brown sandstone from Medina and vicinity, and sandstone from various localities in Ohio, are the most popular materials for ornamental work. Frame buildings are, however, largely in excess. The brick, mainly, is of local manufacture. Pennsylvania slate supplies the demand for slate roofing material. Akron, New York, cement is extensively used.

Ithaca.—Local bluestone of good quality and of uniform color is used for foundations. Red sandstone from Medina and sandstone from various points in Ohio are the most important stones used in superstructures. About 85 per cent. of the buildings erected are frame structures. The bulk of the brick used is of local manufacture, and is of good quality for all ordinary purposes. Maine and Pennsylvania slate and Rosendale cement supply the demand for these materials.

New York City.—All foundations in New York City are built of stone which, in many cases, is quarried on the site of the building. The stones used for superstructures, ornamental work, trimmings, etc., are of very great variety, coming from all parts of the United States. In addition to varieties which have long been in use in the city may be mentioned as recent innovations, oolitic limestone from Bedford, Indiana, and Salem, Ohio; also limestone from Bowling Green, Kentucky, and some imported from Nova Scotia and England. The choice of stone in this city is very largely a matter of taste, expense frequently being a matter of no consequence. The amount of building done in New York City was decidedly less in 1888 than in either 1885, 1886, or 1887, in which years there was, probably, an excess above immediate demands. All brick used in this city comes from points on the North and Hudson rivers, and from places in the vicinity of the city. In the consumption of slate the quarries of Pennsylvania and Vermont supply almost the entire demand. Slate cannot be regarded as generally popular in New York, as lighter materials are more generally called for. The rapid erection of tall and fine buildings calls for a very large consumption of cement. Of the domestic varieties the Rosendale is the most popular brand, while all kinds of imported cement are in use.

Rochester.—Limestone quarried locally supplies all the demand for foundation work. In many cases it is taken from the site of the building itself. Sandstone from Medina, New York, and from Long Meadow, Massachusetts, is the stone principally used for superstructures. The frame buildings erected are very greatly in the majority. The number of buildings constructed in 1888 was greater than that in 1887, but the money expended in building was less. There is at present a tendency to the increased use of fire-proof materials. This necessitates an increased use of iron in building. All common brick is of local manufacture, while the finest grades of pressed brick come from Trenton and Philadelphia. Maine slate supplies the demand. Cement from Buffalo and Akron is used, and also imported Portland cement. The tendency to mix cement with lime in common mortar is increasing from year to year.

Syracuse.—Foundations are built largely of Onondaga blue limestone, taken from quarries 7 miles south of the city. Gray limestone, taken from the same quarries, has been used for many years in superstructures, but in the finest ornamental work Ohio limestone and Long Meadow, Massachusetts, brownstone have been used to a large extent. Frame buildings outnumber brick or stone two to one. The amount of building done in 1888 was decidedly less than that of 1887. As in many other cities, the increased use of fire-proof materials is very noticeable. This necessitates the use of iron beams and girders, and terra-cotta blocks. The brick made from the local clay is not of the best quality. It does not stand frost well. The best brick comes from Philadelphia and Trenton. Slate is used only to a limited extent, most of the roofs being covered with iron, tin, or shingles. Portland cement, manufactured at Warner's, New York, is quite popular, the brand most used being Millen's.

Utica.—Sandstone, quarried about 3 miles east of the city, and limestone from quarries 15 miles to the north and south, supply all demands for foundation stone, while for superstructural work and trimmings Connecticut and Massachusetts brownstone has long been popular. Frame buildings are very largely in the majority. The amount of building done in 1888 falls far short of that accomplished in the preceding year. Common brick is of local manufacture, while fine brick from Philadelphia and Trenton is used to some extent. Very little slate is used, the whole demand being supplied by that from the Bangor, Pennsylvania, quarries. Akron and Rosendale cement are used for all ordinary purposes, and imported Portland cement for finer work is used with comparative freedom.

NORTH CAROLINA.

Wilmington.—Concrete and brick foundations are constructed in the majority of cases, very little stone being used for this purpose. Brownstone from Wadesborough, Anson county, North Carolina, and granite from quarries in South Carolina are used for ornamental work. The vast majority of buildings erected are frame structures. Much less building was done in 1888 than in 1887. Economy in building is a very important consideration and cheap edifices are the rule. Good common brick is locally manufactured. Some face brick comes from Philadelphia and Baltimore. Slate is used on steep roofs to a limited extent, and comes from Virginia.

OHIO.

Cleveland.—The sandstone obtained from quarries at Amherst, Berea, and Euclid are very freely used, not only in foundation work, but also in superstructures. Recently red sandstone from Pennsylvania and the Lake Superior region has been quite freely adopted. Eighty per cent. of the buildings erected are frame structures. The erection of fine residences is going on with great rapidity and with a decided improvement in taste over what characterized the city ten years ago. An increased use of fire-proof materials characterized the buildings erected for business purposes. Slate is quite freely used for residences. It comes uniformly from Pennsylvania and Maine. For all ordinary work cement from Akron, Ohio, and Louisville, Kentucky, is used.

Toledo.—Local limestone is used for foundation construction, and sandstone from Berea and Amherst, Ohio, quarries, together with some from Stony Point, Michigan, is popular for ornamental work. The widely known Bedford, Indiana, limestone has also come into use and is at present quite fashionable. The common brick used is manufactured in the immediate vicinity of the city. Slate from Michigan and also from Pennsylvania and Maine is used on all steep roofs. Cement comes from Louisville, Kentucky, and Milwaukee, Wisconsin.

PENNSYLVANIA.

Harrisburg.—For foundation construction limestone quarried in the city limits supplies the demand. For superstructures quite a variety of different stones is in common use, brown sandstone being the most prominent. It is quarried mainly at Hummelstown and Derry, Pennsylvania. Common brick is locally manufactured. Slate is used for steep roofs, and comes exclusively from the quarries in various parts of Pennsylvania.

Philadelphia.—Conshohocken stone is the most important foundation stone in use. Some from Leiperville and from Port Deposit, Maryland, is also in use. The most popular stone now used in ornamental work is the oolitic limestone from Bedford, Indiana. For this particular variety of stone Philadelphia is one of the most important markets. Hummelstown brownstone has long been used, and is very generally known throughout the city. Port Deposit granite is also quite freely used. Georgia marble for interior decoration has become quite popular in the last two or three years. The number of buildings annually erected in Philadelphia is larger than in any other city in the country. Very few tenement houses are in use, the large amount of territory covered by the city rendering it possible for every person, if he so desire, to occupy his own house. Many dwellings erected are quite small. At present an imitation of English brick is being used, and is generally recognized as an innovation. Pennsylvania slate is quite elaborately used on roofs that call for that material. Cement is making quite rapid strides in replacing lime in all buildings which are rapidly erected. This is brought about partly by the fact that the lime produced in the vicinity is not a first-class article, containing such a percentage of magnesia as to interfere with its good qualities.

RHODE ISLAND.

Newport.—Granite found near the city is used in stone foundations. For ornamental work Nova Scotia sandstone is quite popular. During 1888 strikes interfered to quite a marked extent with the amount of building done. Common brick is locally manufactured, but the finest kinds are obtained from Philadelphia. Vermont supplies most of the slate used.

SOUTH CAROLINA.

Charleston.—Stone is not at all used in foundations. The use of brick is universal. The use of stone is restricted to sills and steps and ornamental trimmings, but the total amount used for such purposes is very small. Owing to a lack of knowledge in the erection of brick buildings they are not popular in this city. The trouble encountered in brick buildings is their dampness, which is the natural result of plastering immediately on the brick wall without leaving an air space between. The vast majority of buildings erected are frame structures. The recent earthquake in this city has also had its effect in increasing the erection of frame buildings rather than those of other materials. The same cause has resulted in an increased use of cement in foundation work. Slate is not so much used for roofing purposes as in the past, light materials having the preference.

TENNESSEE.

Memphis.—Very little stone is used for foundation construction, and that little consists of Alabama limestone. This stone, together with Bowling Green limestone and Buena Vista, Ohio, freestone, supplies the demand for ornamental stone. The vast majority of all buildings erected are frame structures. The amount of building done in 1888 is very decidedly less than that of the preceding year. The brick is of local manufacture and of fine quality. What little slate is used comes from Virginia.

TEXAS.

Austin.—Magnesian limestone from the immediate vicinity of the city is used for foundations. This, together with granite from Burnet, supplies the greater part of the demand for superstructural stone. Brick buildings outnumber frame. The common brick used is of local manufacture and is of a straw color. The lime locally manufactured is of good quality, and for that reason is used to the exclusion of cement, which is in demand only for purposes requiring hydraulic material. Rosendale cement and various imported varieties are in general use. Some that has been obtained from San Antonio is found to compare favorably in quality with Rosendale cement, and it is therefore becoming quite popular.

Dallas.—No good stone is available for foundation work in this city, and for that reason brick is the material commonly used. For ornamental work and superstructures red sandstone from Colorado has long been popular. Granite from Burnet county has recently been used quite freely. The most of the dwellings erected are frame structures. Business blocks are chiefly of brick. The brick locally made is hard and strong but rather rough in appearance and irregular in size. Saint Louis pressed brick is used largely for fronts. Slate is very little used, but within the last two years its consumption for roofing purposes has increased. The so-called Alamo cement made at San Antonio is growing rapidly in public favor. It is regarded as being equal to the Rosendale cement in quality.

Galveston.—Foundations in this city are made of concrete and also of granite blocks from the central and western part of the State. Granite from Burnet county and magnesian limestone from various points in the central part of the State, with gray and brown sandstone from Brown and Leon counties, supply most of the demand for ornamental stone. The general character of the building done in 1888 is better than that of former years, but the number of buildings erected is less than in 1887. The common brick in use is of two kinds—red brick, weak in constructive strength but practically fire-proof, and a light brownish-gray brick very strong but incapable of resisting intense heat. The raw clay used is believed to be of good quality but the manufacture is defective. Pressed brick from Saint Louis and Philadelphia is used. Slate for steep roofs is quite popular; it comes largely from Virginia and some also from Pennsylvania quarries.

VERMONT.

Brattleboro.—So-called slate stone from local quarries, and to some extent granite, is used for foundations. For superstructures granite from East Dummerston, Vermont, sandstone from Long Meadow, Massachusetts, and marble from Rutland, Vermont, are the stones most used. Most of the buildings erected are frame structures. A limited supply of common brick is obtained from local yards. Large contracts are filled from yards at Greenfield and Montague, Massachusetts. Pressed brick comes from Boston and Philadelphia. Slate from Monson, Maine, and Bangor, Pennsylvania, supplies all demands for this roofing material. The lime locally produced gives good satisfaction without admixture of cement, and in exposed places above ground it is used by itself. The use of cement is confined to walls below the grade line.

VIRGINIA.

Lynchburgh.—Granite which exists in abundance in the immediate neighborhood is used for foundations. There are no stone buildings in the city. Trimmings are of Richmond granite and Baltimore marble. There is at present an increased tendency to indulgence in ornamental work. This consists chiefly of terra-cotta and stone. All common brick and a coarse variety of front brick are manufactured in the vicinity. James river cement manufactured at Balcony Falls, Rockbridge county, Virginia, is the only cement used in large quantities.

Petersburgh.—The granite which has recently been developed at quarries near the city is used not only for foundation work, but also for superstructure. The quality of this stone is very fine, being exceedingly hard and susceptible of high polish. In addition to the use of this stone, brick is also largely used for foundations. Nearly all the brick used is manufactured locally and is of good quality. Buckingham county slate and James river cement are in liberal use and supply practically all demand for these materials.

Richmond.—Granite from quarries in and around the city and brownstone from Alderson, West Virginia, are used for foundations and superstructures also. Ohio sandstone is also in use. The common brick is of local manufacture, the clay for this purpose being very good. Ornamental brick comes from Philadelphia and Baltimore. Buckingham county slate and James river cement supply all demands for these materials.

WASHINGTON.

Tacoma.—The year 1888 was a period of great operations in the erection of buildings in this city. The causes for this great increase are chiefly the results of efforts to develop the natural resources of this region and the large immigration resulting from the boom. The completion of the Cascade division of the Northern Pacific railroad is also a cause of increased prosperity. Brick of good quality is locally manufactured. Slate is not used at all. Imported Portland cement is exclusively used, being brought to the city as ballast in ships.

WISCONSIN.

Milwaukee.—Local limestone is used without exception in all foundations. For superstructures Ohio and Indiana limestones and sandstones from the Lake Superior region are generally used. The brick of local manufacture is buff in color, no red brick being made. All red brick is imported from other points. What little slate is used comes from Pennsylvania. Milwaukee cement supplies all demands for the domestic article. It is used in all good foundation work, but very little in walls above ground.

GRANITE AND ALLIED ROCKS.

The value at the quarries of the granite and allied rocks produced during 1888 is estimated at $8,000,000.

Following the plan already adopted in previous reports, tabular statements are presented below giving items of production and such other information as has been received from some of the granite producing localities.

The production of granite in 1888.

States.	Localities.	Value of product.	Remarks.
California	Los Angeles	$45,000	This is the value for San Diego, San Bernardino, and Los Angeles counties.
	Sacramento	12,000	This granite is quarried in Placer county, where there are about fifteen quarries. Two new quarries were developed at Lincoln, Placer county, during the year.
Connecticut	Greenwich	70,000	
	Sterling	20,500	
Georgia	Atlanta	467,000	
Maine	Addison Point	10,000	
	Biddeford	80,000	
	Deer Isle	150,000	
	Frankfort	175,000	
	Franklin	215,000	
	North Jay	87,500	
	Red Beach	40,000	A valuable ledge of black granite was discovered in this region in 1888, and it is expected that operations will be commenced during 1890.
	Round Pond	6,500	
	Wayne	1,100	
	West Sullivan	194,000	
Maryland	Baltimore	30,000	
	Ellicott City	19,250	
	Granite	65,000	
	Port Deposit	149,702	
Massachusetts	Fitchburg	100,000	
	Monson	....	At this place there were 33,460 tons quarried. This represents a gain of over 5,000 tons over 1887.
	Northbridge	60,000	
	Northfield	4,000	
	North Uxbridge	50,000	
	Quincy	500,000	
	Rockport	325,000	
	Sherborn	1,350	
	Westford	11,250	
	West Quincy	100,000	
	Worcester	600,000	
New Hampshire	Concord	80,000	
	Milford	14,800	
	Nashua	10,000	
New Jersey	Avondale	75,000	
New York	Brooklyn	30,000	
	New York City	75,000	
Pensylvania	Philadelphia	40,000	
Rhode Island	Diamond Hill	1.836	
	Niantic	160,000	
Vermont	Barre	276,000	
	Woodbury	3,000	
Virginia	Lynchburgh	45,000	
	Petersburgh	13,000	
Wisconsin	Berlin	65,000	
	Oshkosh	40,000	
	Washburn	125,000	

GRANITE.

New discoveries and developments.—Considerable activity has been shown during the past year in the development of new sources of granite not only for building, but also for ornamental purposes. The popularity of granite for quite a variety of purposes is increasing noticeably from year to year. Its use for tombstones and monuments, in the majority of which cases it is polished, is increasing in the most encouraging manner. In this connection the tendency is of course to replace marble for these purposes, but it can hardly be said that the marble industry is perceptibly affected by the competition of granite.

Arkansas.—The prospectus of the Arkansas Granite Company, of Little Rock, Arkansas, has recently been received. Judging from it, and also what has already been accomplished by this company, expectations of a very prosperous business in the production of granite seem amply justified. The quarries operated by this company are situated on the southern boundary of Little Rock. The granite is properly a syenite, and is known as the Fourche Mountain granite of Arkansas. The following is an analysis of this granite, made under the direction of Dr. John C. Branner, State Geologist:

Analysis of Fourche Mountain granite, Arkansas.

	Per cent.
Silica	60.03
Ferric oxide	4.01
Ferrous oxide	.75
Alumina	20.76
Lime	2.62
Magnesia	.80
Phosphoric acid	.07
Potash	5.48
Soda	5.96
Manganese	Trace.
Water 100° to 115° C	.06
Loss on ignition	.53
Total	101.07

This granite is well adapted not only for building stone, but more especially for monumental work. The quarries now operated have been opened only a short time. The originator of these operations was Mr. D. O. Keefe, whose connection with the granite-quarrying business dates back to 1858. For twelve years he was superintendent of quarries in New England. In 1880 he opened the Granite Bend quarries of Missouri and was in charge there of a working force of 250 men, shipping from 10 to 15 car loads of paving blocks to Saint Louis every day. He visited Little Rock in 1887. Recognizing the value of the Fourche granite, he opened the quarries now controlled by the Arkansas Granite Company. Although the operations of this company are of such recent date, the amount of business already done by it is quite considerable. It was awarded the contracts for furnishing paving blocks to the cities of Memphis and Louisville for the year 1889.

California.—During the year 1888 some very fine granite was taken from the quarries located in the foot hills near Pasadena. The future prospects of operations at this point are very good. The granite quarries at Victor, San Bernardino county, yield a very good granite for paving purposes. Operations are actively going on at quarries southwest of Colton. Operations at quarries situated 3 miles north of the Southern Pacific railroad, in the vicinity of Los Angeles, were commenced in March, 1887. Since that time over 75,000 cubic feet of stone have been shipped to Los Angeles and other places. The extent of the operations already conducted point unmistakably to future prosperity. The Pacific Granite Company has recently been organized at San Diego to work the granite quarry located in Temecula cañon.

Georgia.—The operations of the Venable Granite Company will be materially enlarged during the current year. The Central Railroad and Banking Company, with headquarters at Savannah, has recently purchased 55 acres of land, upon which it will quarry granite to be used in ballasting the main stem of its road from Savannah to Atlanta. A company has been organized to quarry granite on land situated near Rock Mart. In this connection it proposes to build a railroad from Douglasville to Rock Mart. The Georgia Quincy Granite Company, of Macon, has recently been organized with a capital of $200,000. Quarrying operations will probably be prosecuted during the coming year. The quarries are situated near Sparta. A granite quarry near Covington, Georgia, is to be developed by Mr. R. L. Simms. The Southern Granite Company, of Atlanta, will materially enlarge the plant at its granite quarry.

Maine.—A company known as the Booth Brothers and Hurricane Isle Granite Company, with a capital of $250,000, has been organized to carry on business in New York city and a number of other places for the purpose of quarrying granite. The operations in Maine will be conducted in Hancock, Knox, and Washington counties. The operations of the Mount Waldo Granite Company will be materially enlarged in the spring of the present year.

Maryland.—The Coulson granite quarries at Port Deposit have been leased by parties from Elkton, Maryland, for the purpose of producing granite. Mr. W. F. Weller, of Granite, Maryland, has recently leased a stone quarry there for the purpose of producing Belgian blocks. Extensive operations are expected for the latter part of the present year. A granite quarry has been discovered on the farm of Mr. W. V. Bouic, near Rockville, and it is the owner's purpose to develop the same.

Massachusetts.—A granite quarry, located at Treney, New Hampshire, has recently been purchased by capitalists of Worcester. It is to be developed during 1889. The active operations which have recently been conducted at quarries situated at East Bluehill have encouraged the opening of another quarry, from which stone will probably be taken during the present year.

New Hampshire.—The Granite State Stone and Slate Company has recently been organized at Portsmouth, with a capital of $300,000. The company proposes to operate granite and slate quarries.

North Carolina.—Messrs. Grant and Egan have leased land near Wadesborough, upon which they will open granite quarries for the purpose of filling a contract to place 100,000 tons of stone on the jetties at Charleston, South Carolina. The granite quarry near Kernersville has recently been purchased for the purpose of developing granite. The Mount Airy Granite Company, of Mount Airy, has recently been organized with Mr. J. A. Odell, of Greensborough, as president. The Gray Stone Granite Construction Company contemplates enlarging operations, as is indicated by the fact that its capital stock has been increased from $22,000 to $42,000.

South Carolina.—The Southern Construction and Quarry Company, of Kentucky, represented in Columbia by Mr. R. A. Stewart, has purchased the Granby quarry, situated 3 miles from Columbia. This company expects to develop the quarry and build a railroad to it.

Texas.—The granite quarry at Marble Falls, Burnet county, is now attracting considerable attention on account of the quality of the stone and the fact that this stone is to be found in the new capitol building at Austin. Quarrying operations in this region are increasing notably from year to year. The Texas Capital Granite Company, operating in Burnet county, has not yet closed its contracts for furnishing 27,000 car loads of granite. To facilitate the fulfillment of this contract the company expects to add $10,000 worth of machinery to the plant already existing at its quarries.

Vermont.—The Wetmore granite quarry at Barre has recently been purchased by a company of Montpelier capitalists. This property comprises 26 acres of land 4 or 5 miles from Barre village. Operations are to be started at this quarry during the present year.

Virginia.—The Glen Echo Granite Company, with a capital of $100,000, has recently been organized at Alexandria for the purpose of developing granite quarries in Montgomery county, Maryland.

COMMON LIMESTONE.

Production.—The value of the common limestone produced in the United States during 1888 is estimated at $6,250,000—*i. e.*, the same figure as for 1887. While there have been gains in production here and there, these have been offset by quite a considerable decrease in a number of important places, so that the total output is very little, if any, greater than that of 1887. The following tabular statements give the value of the limestone produced in some of the regions during 1888:

Production of the principal limestone regions in 1888.

States.	Localities.	Value of product.	Remarks.
Illinois	Alton	$2,700	
	Belleville	4,558	
	Grafton	4,500	
	Joliet and vicinity	450,000	This includes the whole of Will county. The production here was less than that for 1887.
	Kankakee	32,000	
	Lemont	427,250	
	Quincy	36,400	
	Rockford	6,000	
Indiana	Bedford	400,000	The demand for this stone is increasing markedly from year to year.
	Bluffton	10,000	
	Decatur	4,000	
	Ellettsville	54,795	
	Fort Ritner	30,000	
	Laurel	30,000	
	Logansport	5,000	
	New Point	40,000	
	Romona	77,000	
	Ridgeville	1,000	
	Saint Paul	100,000	This includes Decatur and Shelby counties.
	Wabash	14,000	
Iowa	Bedford	650	
	Burlington	13,500	
	Charles City	3,500	
	Davenport	10,000	
	Dubuque	54,174	
	Farley	7,125	
	Gilmore City	2,337	
	Iowa Falls	1,000	
	Mason City	9,000	
	Quarry	40,000	
	Stone City	127,200	
	Wapello	2,000	
Kansas	Augusta	11,250	
	Florence	40,000	
	Oketo	11,000	
	Winfield	81,750	
Kentucky	Warren county	60,000	
Michigan	Alpena	5,700	
	Dundee	8,000	
Minnesota	Duluth	100,000	
	Faribault	3,000	
	Kasota	110,000	
	Minneapolis	150,000	
	Red Wing	6,700	
Missouri	Marshall	6,500	
	Springfield	34,050	
Nebraska	Omaha	90,000	
New York	Auburn	1,950	
	Buffalo	47,600	
	Cobleskill	18,000	
Ohio	Bloomville	3,000	
	Bluffton	13,000	
	Cincinnati	75,000	
	Cleveland	1,250,000	This amount was produced by 60 quarrymen in the northern part of Ohio, near Cleveland.
	Covington	17,000	
	Columbus	6,000	
	Dayton	35,000	
	Greenfield	20,000	
	Kelly's Island	140,000	See statement for Cleveland.
	New Paris	5,400	
	Point Marblehead	36,000	
	Sandusky	6,250	
	Springfield	1,000	
	Sunbury	13,000	
	Tiffin	1,000	
	White House	11,250	

Production of the principal limestone regions in 1888—Continued.

States.	Localities.	Value of product.	Remarks.
Pennsylvania	Conshohocken	$60,000	
	Homewood	220,000	This includes a region of 10 miles in length in the Beaver valley.
Wisconsin	Chippewa Falls	5,000	
	Fountain City	2,750	
	Milwaukee	60,000	
	Neenah	2,000	
	Racine	55,000	
	Washburn	90,000	
	West DePere	9,000	This stone was quarried at Duck creek.

MARBLE.

Production.—The value of the marble produced in the United States during 1888 was $3,000,000. This figure falls short of that reported for 1887. Although gains in production characterized certain regions, in others business was not so good as in the preceding year. The year 1888 may be regarded pre-eminently as one of preparation for the future, considerable enterprise having been shown in the development of new marble lands, and in making important additions to existing plants.

The production of marble at some of the important producing centers is shown in the following table:

Production of marble in the principal regions in 1888.

States.	Localities.	Value of product.	Remarks.
California	Amador county	$5,000	This figure is the same as was given for 1887.
Georgia	Atlanta	125,000	The operations of quarrying in this region are discussed under the head of "New Developments."
	Tate	30,000	This is the value of the product thus far yielded in this locality; the work done in 1887 was of a preparatory nature. The future prospects are exceedingly good.
Maryland	Cockeysville	175,000	This figure is $15,000 greater than that for 1887. The product is largely used in Baltimore.
New York	Pleasantville	20,000	
	Tuckahoe	30,000	
Tennessee	Knox county	125,000	The marble business in this State is reported not so good as in 1887.
	Hawkins county	100,000	
Vermont	Brandon	200,000	
	Rutland county	2,000,000	Production in this region is increasing rapidly and substantially, and from present appearances the output of 1889 will show a very material increase.

New discoveries and developments.—An invention recently made in England by Messrs. Randall and Carter promises to be of some importance in rendering soft oolitic limestone impervious to the disintegrating action of the atmosphere. The process by which this is effected consists in treating the stone with a solution in which a strong acid plays an important part. This solution acts upon the stone to the depth of about half an inch. The product of the action becomes incorporated with the stone, closing up the pores and giving the surface a marble-like appearance and character, and rendering it impervious to moisture. It is claimed that great additional strength is thereby imparted to the stone, the face of which is so hard that it can be polished to a surface as smooth as that which can be produced on marble or granite. Some stone prepared by this process before it was perfected was used in building a church five years ago. It is stated that not the slightest sign of disintegration has yet made its appearance. The process is now being used by the Oolite Marble Company, of London. The future of this process will undoubtedly be regarded with considerable interest by those interested in stone construction. The additional cost involved in the application of this process adds less than 5 per cent to the original cost of the stone.

Although the quantity of marble produced in the year 1888 falls somewhat below the product of 1887, it is at the same time true that in no previous year have so many new developments, additions to quarrying capacity, etc., been made as in 1888. The prospects of a large output during 1889 are exceedingly good in all the large marble-quarrying centers.

Alabama.—The Chewacla Lime Works of Chewacla are making preparations to quarry marble, which has been found on their "Spring Villa" property. The examination of this stone which has thus far been made indicates that it is of fine quality. Marble quarries in the vicinity of Talladega are being investigated with a view to their future development.

Arkansas.—Large deposits of a gray marble, easily worked and susceptible of a high polish, have been discovered in Searcy county. Judging from the quality of the stone, its future development seems probable.

California.—During the first part of 1888 very little work was done in actual quarrying of marble at the Inyo marble quarries, situated near Owen's lake. The superintendent, Mr. I. V. Luce, visited eastern sources of marble for the purpose of studying recent improvements in machinery. It is proposed by the operators of these quarries to equip them with the most improved appliances for taking out the largest blocks demanded by the trade. Making use of an improved method of blasting, the Inyo Marble Company has found that it can split out large blocks of marble without injuring or destroying them. The method is similar to that used in large sandstone quarries, and consists in drilling a hole half through the block and then cutting notches on each side of this in the direction of splitting. A small quantity of black powder is poured loosely into the hole, a fuse inserted, and a piece of wadding then forced into the hole, leaving a considerable air space between that and the powder. On firing the blast the block is neatly split without injury. The openings already made in these quarries allow the extraction of blocks 25 feet in length by 10 or 12 feet in the other dimensions. The railroad has completed the new side track from the main line to the present works and the quarry dumps. Near Julian, in San Diego county, an immense ledge of white marble has been discovered. As soon as railroad facilities have been completed and the operations are under way, it is expected that quarrying operations will be commenced. Another ledge of marble has also been discovered in the San Gabriel mountains, in Los Angeles county. No developments are yet reported. A large deposit of unusually fine marble has also been discovered in the northern end of Death valley, San Bernardino county. The location is such that quarrying operations can be conducted without great cost.

Georgia.—Georgia marble continues to attract the attention which was bestowed upon it immediately after the commencement of the operations of the Georgia Marble Company. This marble is in great demand in a number of the largest cities of the country, particularly for the purposes of interior decoration. The Georgia Marble Company, of Tate, has been obliged to enlarge its plant and to introduce additional machinery for quarrying. A number of Wardwell & Ingersoll channelers have been purchased and put in operation. The American Marble Company, of Marietta, Georgia, will probably develop marble quarries during 1889, and ultimately it proposes to establish marble works. A quarry of black marble has been discovered at a distance of 2½ miles from Spring place and 9 miles from Dalton. It is proposed to develop these quarries at once.

North Carolina.—The Natla Consolidated Iron, Marble and Talc Company commenced operations at its quarries in the early spring of the present year. These quarries are situated at a distance of 5 miles from Murphy.

Tennessee.—The Tennessee Producers' Marble Company was incorporated, with a capital stock of $200,000, early in the spring of the present year. The operations of this company will undoubtedly be very considerable. It will operate quarries of its own as well as others to be leased from various parties. The Standard Marble and Stone Company, of Chattanooga, contemplates the development of marble quarries at Loudon. Operations, however, have not yet been commenced. A marble mill will probably be built during the present year near Rogersville. The operations will include quarrying as well as the manufacture of marble. The Knoxville Marble Company has recently been reorganized. The quarries of this company are near Knoxville. Additional machinery is to be employed. A marble quarry is to be developed near Clarksville during 1889. New quarries have also been opened at Madisonville.

Utah.—Apparently valuable marble quarries have been located in Iron county. Samples from these quarries have been examined, and the quality of the stone appears to be sufficient to justify operations, which, however, have not yet been commenced.

Virginia.—Quarries in the neighborhood of Roanoke will probably be developed during the summer of 1889.

Washington.—Four miles south of Rattle Snake springs an extensive ledge of landscape marble has been discovered. The stone is very attractive in appearance, but as yet no quarrying operations have been inaugurated.

SANDSTONE.

Production.—The value of the sandstone produced in the United States in 1888 is estimated at $6,750,000, a figure only $250,000 greater than the value of the product of 1887. While the gains in production in Ohio, Colorado, and one or two other western localities, were quite striking, they were offset by a falling off in production in New York State.

The developments in Colorado are very promising for an increased output in 1889. Sandstone production in Michigan and Wisconsin also bids fair to become quite considerable in the course of a few years.

The following items of information in regard to important localities are presented:

Production of sandstone in the principal localities in 1888.

States.	Localities.	Value of product.	Remarks.
Colorado	Denver	$50,000	
	Fort Collins	200,000	This was produced at Buckhorn, Lyons, Stout, and Fort Collins.
	Trinidad	30,000	
Idaho	Boisé City	2,160	
Iowa	Dunreath	106,300	
Kansas	Ritchie	1,000	
Michigan	Craig	175,000	
	Detroit	90,000	A part of this product was quarried at Grindstone City and Caseville.
	Marquette	160,000	
Minnesota	Duluth	32,000	
	Fond du Lac	35,000	
	Minneapolis	166,440	
	Pipe Stone	5,610	
	Winona	2,150	
New Jersey	Avondale	63,000	
	Martinsville	6,000	
	Newark	200,000	
	Stockton	125,000	
	Wilburtha	60,000	
New York	Albany	23,000	
	Atwater	3,300	
	Brooklyn	450,000	
	Cooperstown	410	
	Hulburton	100,000	
	Jamestown	5,250	
	Malden	1,100,000	This includes the value of all bluestone in this State.
	New York	900,000	This was produced by sixteen firms near North river. About 20 per cent. of this was used for building; the remainder for street purposes.
	Pond Eddy	600,000	
	Phœnicia	14,000	
	Saugerties	1,250,000	
	Schenectady	25,000	
	Walton	12,000	

Production of sandstone in the principal localities in 1888—Continued.

States.	Localities.	Value of product.	Remarks.
Ohio	Akron	$5,100	
	Bedford	3,000	
	Buena Vista	30,000	
	Cincinnati	51,000	
	Cleveland	700,000	This was produced by quarries situated in the northern counties of this State, chiefly Cuyahoga and Lorain. It does not include Buena Vista stone.
	Columbus	2,550	
	Elyria	100,000	
	Newark	7,980	
	Peninsula	7,500	
	Steubenville	6,000	
	Twinsburgh	2,900	
	Zanesville	13,750	
Pennsylvania	Meshoppen and vicinity.	50,000	
	Nicholson	88,000	
	Reading	18,600	
	Skinner's Eddy	80,000	
	Yardley	130,000	
Wisconsin	Ashland	125,000	See chapter on "New Discoveries and Developments."

New discoveries and developments.—The California Stone Company has recently been incorporated to work sandstone quarries in Kern county, California. The capital stock of the company is $25,000. The Wadesborough Brown Stone Quarry Company has recently added new machinery to its quarry plant, which is situated near Wadesborough, North Carolina. The development of sandstone quarries in Colorado continued during 1888 with undiminished activity. The quarries of this State are capable of supplying the very best quality of sandstone of all varieties of color. A large portion of this Colorado sandstone is shipped to the Missouri River valley, whence it goes to a large number of cities in the west, and south as far as New Orleans. The rapid rise of the sandstone business in Colorado has called forth many comments from persons interested in stone production.

The operations of the Cleveland Stone Company, working quarries at some fourteen or fifteen different localities, are at present regarded with much interest by those engaged in the sandstone business. One of the most important localities at which the operations of this company are conducted is Berea, Ohio. At this place large and very extensive quarries are being actively operated by a force of 600 men. In connection with the quarries are two plants for sawing and manufacturing the stone into flagging. A grindstone mill is also on the spot, from which grindstones of all sizes and thicknesses are rapidly turned out for shipment to all parts of the country. The quarrying operations are conducted with all the most modern improvements. The method of blasting is a patented process, and, briefly described, consists in drilling holes of the depth of about 6 feet at short intervals in the line along which the stone is to be split. In this line holes of less depth are drilled at intervals to determine the direction of the split. Into the deeper holes is placed a small charge of black powder. Above this, and inclosing a column of air below it, is placed a wad, which is then tamped in place. The edges of the hole containing the powder are then notched in the direction of the split. Upon firing the powder by means of an electrical fuse, the rock is split with perfect smoothness and without chipping or breaking along the intended line. This blasting process is only applied when very large blocks are to be taken out. In cutting the largest blocks into smaller sizes channeling machines are freely used. Still smaller blocks may be cut by means of wedges. The stone splits with the greatest ease and into quite thin slabs. All the quarrying operations are conducted with ease and certainty, as the structure of the stone is so perfectly uniform that safe predictions in regard to its conduct in the various operations may be made. The company has recently purchased a large amount of additional property situated in the town. A considerable amount of this property was used for residences of the inhabitants. On a part of it stands the Berea College, which is to be moved to give way to the quarrying operations. The demand for this stone is very great, and operations are limited only by the transportation facilities. As many as 78 car loads per day are shipped from the quarries. The earth lying above the stone is stripped by means of steam shovels, which operate with great rapidity. During the winter the entire force of men is employed in stripping operations to prepare for the quarrying of the coming season. A certain force, however, is employed the year round in stripping off the earth, which has an average depth of 25 feet. The stone itself is quarried to a depth of 40 feet, at which point it is found to be comparatively inferior in quality, and is therefore not quarried. It is the policy of the company to buy up only such property as will yield easily-quarried stone.

Within the last two years the Prentice Brown Stone Company has been operating sandstone quarries at Houghton, Bayfield county, Wisconsin. The main office of the company is at Ashland, Wisconsin. Branch offices are also located at the quarries and in New York City. The company has been incorporated under the laws of the State of Wisconsin, with a capital of $1,250,000. The property comprises 578½ acres of land, all underlaid with brown stone. The present plant includes five steam channelers, together with other machinery of the most improved character. Explorations have been liberally made, and there seems to be little doubt that the supply of this brown stone is practically inexhaustible, and it is believed to be only a question of men, machinery, and transportation facilities to furnish very large quantities of stone. The product of these quarries is already well known in the following cities: Chicago, Cincinnati, Saint Louis, Saint Paul, Minneapolis, Kansas City, and Omaha. The Chicago, Saint Paul, Minneapolis and Omaha railroad has extended side tracks to the quarries, and cars are now supplied immediately at the works and are rapidly loaded by means of machinery. The president of the company is Mr. Frederick Prentice, to whose energy and activity the magnitude of the present operations is due. The property operated by the company was purchased by Mr. Prentice thirty-four years ago with the idea of ultimately quarrying the brown stone which was known to exist there. The time appears to have come now when transportation facilities are sufficient for shipment to cities in the East as well as to the larger Western cities. The stone is easily quarried, and there is very little waste. The operations conducted previous to the year 1888 amounted to very little in comparison with the work done since that time. There are now about 60 acres cleared for quarrying purposes, and the operations of clearing away surface material are steadily going on. The ultimate prosperity of the company seems already entirely assured as well as the magnitude of the operations which it will carry on.

SLATE.

Product.—The following table shows the product of slate for the years 1884 to 1888, inclusive:

Product of roofing slate in all sections during the years 1884 *to* 1888.

[Squares of 100 square feet each.]

Sections.	1884.	1885.	1886.	1887.	1888.
Bangor and Pen Argyl region, Pennsylvania	195, 505	196, 832	215, 341	230, 000	260, 000
Slatington region, Pennsylvania	104, 000	108, 000	109, 000	112, 000	114, 000
Chapman's, Pennsylvania	29, 499	26, 328	24, 464	28, 439	42, 000
Peach Bottom, Pennsylvania	10, 000	14, 500	12, 000	20, 000	19, 000
Maine	41, 000	34, 000	36, 000	37, 000	37, 000
Michigan	7, 000	10, 000	12, 000	7, 200	7, 000
Vermont	85, 000	130, 000	111, 385	120, 000	160, 000
Virginia	9, 000	17, 300	16, 600	19, 000	17, 400
New Jersey	......	....	....	....	6, 000
Total	481, 004	536, 960	536, 790	573, 639	662, 400

Total yearly product of roofing slate from 1879 *to* 1888, *inclusive.*

Years.	Number of squares.	Average price per square, delivered on cars.	Value.
1879	367, 857	....	....
1880	382, 867	....	....
1881	454, 070	....	....
1882	501, 000	....	....
1883	506, 200	....	....
1884	481, 004	$3. 85	$1, 851, 865
1885	536, 960	3. 07	1, 648, 467
1886	536, 790	3. 00	1, 610, 370
1887	573, 439	3. 00	1, 720, 317
1888	662, 000	3. 10	2, 053, 440

The above table shows the year 1888 to have been the most prosperous one, so far as product is concerned, of all the years considered. The average price also, while not coming up to that of 1884, is higher than for any other year since 1884.

The demand for slate is extending from year to year not only in regions which have long employed it as a roofing material, but also in sections of the country, particularly in the West and South, where its use is almost, if not entirely, new. There appears to be among architects no prejudice against slate, while the same statement can by no means be made of roofing tiles.

Prices.—The prices of slate in New York for different times are given in the following table, which shows a decidedly more encouraging condition of business than last year:

Comparative prices of roofing slate at New York January 1.

	1885.		1886.		1887.		1888.		1889.	
Purple	$6.00 to	$7.00	$6.00 to	$7.00	$5.00 to	$6.00	$5.00 to	$6.00	$6.00 to	$7.50
Green	6.00	7.00	6.00	7.00	5.00	6.00	5.00	6.00	6.00	7.50
Red		15.00		15.00		10.00		12.50	12.00	15.00
Black	4.50	5.00	4.50	5.00	3.50	4.00	3.50	5.00	4.25	5.50

Exports.—The exports of roofing slate from New York show a very large gain, as indicated by the following tables. The increase in the amount exported to British Australia is particularly noticeable, the figure for 1887 being 2,303,551 pieces, while for 1888 it is 4,125,858. This favorable competition with England in one of her own provinces must be very gratifying to American producers, as it probably means an advantage in quality as well as in price.

Exports of roofing slate from New York for 1888.

Destinations.	Pieces.	Value.
South America	68,600	$2,700
West Indies	68,490	2,739
Africa	12,600	351
New Zealand and Tasmania	78,067	2,244
British Australia	3,898,101	108,085
Total	4,125,858	116,119

Exports of roofing slate from the port of New York from 1876 *to* 1888, *inclusive.*

Years.	Tons.	Pieces.	Value.
1876	19,475	646,985	$377,233
1877	25,565	2,895,428	646,272
1878	12,320	1,834,225	308,852
1879	4,792	3,085,124	166,220
1880	11,267	1,698,522	220,292
1881	2,927	3,522,527	138,904
1882	864	4,337,801	153,318
1883	187	1,488,226	54,063
1884	50	2,776,236	90,262
1885		4,113,204	115,206
1886		2,825,246	79,064
1887		2,303,551	62,052
1888		4,125,858	116,119

Exports of manufactured slate from the port of New York, 1876 to 1888, inclusive.

Years.	Cases.	Value.	Years.	Cases.	Value.
1876	10,612	$87,500	1883	8,943	$40,674
1877	8,675	68,437	1884	12,189	53,021
1878	13,274	88,215	1885	10,573	49,965
1879	17,505	74,251	1886	9,498	40,804
1880	15,674	76,709	1887	9,433	39,560
1881	14,414	62,109	1888	11,538	46,142
1882	14,625	68,150			

Exports of all kinds of slate from the port of New York, 1876 to 1888, inclusive.

Years.	Value.	Years.	Value.
1876	$464,733	1883	$94,737
1877	714,709	1884	143,283
1878	397,067	1885	165,171
1879	240,471	1886	119,868
1880	297,001	1887	101,612
1881	201,013	1888	162,261
1882	221,468		

The consumption of slate for purposes other than roofing or building is becoming greater every year, as its adaptability to new uses becomes apparent. In Vermont alone about 2,000,000 square feet, 1 inch thick, are worked up into various mill products. This amount is valued at from $350,000 to $400,000.

New discoveries and developments.—A discovery of slate which bids fair to be of considerable importance was incidentally made by the Eldorado Big Tunnel and Mining Company, while prosecuting the driving of a tunnel 3,400 feet in length on their mining property. At a distance of 470 feet from the mouth of the tunnel a large mass of superior slate was met with. Its quality, according to the opinions of experts, is very fine. Operations of quarrying the slate have already begun, and it is probable that the report for 1889 will show a record of production during that year.

Preparations made by the State of Maine Slate Company in adding considerably to their plant at the Blanchard quarry indicate a decidedly increased output for 1889.

In the Vermont slate region during the past year a slate combination, otherwise known as the "slate trust," was formed. Each member was required to deposit 10 cents for every square of slate sold, as a guaranty that he would not violate the rules or deviate from the schedule of prices established by the organization. After an existence of ten months these deposits aggregated about $12,000, which amount was then divided among the members, all having been faithful to the terms of agreement. The formation of this combination doubtless had much to do with the better prices which have prevailed during the past year. Similar combinations have been formed in other slate regions.

During the year a stock company was formed to devolop slate property in Blount county, Tennessee; it is probable that an output will be reported for the year 1889.

Developments of slate property in the vicinity of Rock Mart, Georgia, were also under way during the year.

Slate deposits at Tellico Plains, Tennessee, were examined by experts during 1888, and the quality was found to be such as to justify quarrying operations, which may be prosecuted during the current year.

Marble imported and entered for consumption in the United States, 1867 *to* 1883, *inclusive.*

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other, in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	....	....	....	....	....	$192, 514	$2, 540	$51, 978	$247, 032
1868	....	....	....	....	....	309, 750	4, 403	85, 783	399, 936
1869	....	....	....	....	....	359, 881	3, 898	101, 309	465, 088
1870	....	....	....	....	....	332, 839	3, 713	142, 785	479, 337
1871	$5, 973	$168	$77	$44	$28	400, 158	1, 134	118, 016	525, 598
1872	3, 499	1, 081	452	....	318	475, 718	4, 017	54, 539	539, 624
1873	3, 124	21	....	....	....	396, 671	4, 148	69, 991	473, 955
1874	1, 837	....	....	....	....	474, 680	2, 863	51, 699	531, 079
1875	1, 456	427	96	....	....	527, 628	1, 623	72, 389	603, 619
1876	595	126	203	87	....	529, 126	1, 151	60, 596	591, 884
1877	2, 124	....	....	....	....	349, 590	1, 404	77, 293	430, 411
1878	198	11	8	....	....	376, 936	592	43, 915	421, 660
1879	184	....	....	....	....	329, 155	427	54, 857	384, 623
1880	....	....	....	....	....	531, 908	7, 239	62, 715	601, 862
1881	339	....	....	....	....	470, 047	1, 468	82, 046	553, 900
1882	655	....	....	....	....	486, 331	3, 582	84, 577	575, 145
1883	619	....	....	....	....	533, 096	2, 011	71, 905	607, 631

During the calendar years ending December 31, from 1886 to 1888, and fiscal years ending June 30 for 1884 and 1885, the classification has been as follows:

Classification.	1884.	1885.	1886.	1887.	1888.
Marble:					
In blocks, rough or squared, of all kinds.	$511, 287	$429, 186	$408, 895	$355, 648	$357, 220
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles	12, 941	43, 923	96, 625	142, 405	107, 957
All manufactures of, not specially enumerated	67, 829	54, 772	44, 053	31, 880	69, 086
Total	592, 057	527, 881	549, 573	529, 933	534, 263

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1888, inclusive.

Years.(a)	Value.	Years.(a)	Value.
1872	$1,229	1881	$709
1873	4,571	1882	4,848
1874	1,928	1883	490
1875	3,428	1884	3,420
1876	13,371	1885	14,406
1877	8,475	1886	2,251
1878	3,448	1887	3,738
1879	6,364	1888	6,174
1880	6,816		

a Calendar years ending December 31 from 1886 to 1888; previous years end June 30.

CEMENT.

Production.—The following table shows the product of the natural rock cements in the leading districts during 1888:

Production of cement from natural rock in the leading districts in 1888.

Localities.	Barrels of 300 pounds.	Localities.	Barrels of 300 pounds.
Rosendale, Ulster county, N. Y.	2,262,984	Howes Cave, New York	49,256
Akron, New York	715,000	Eastern Ohio	80,000
Louisville, Kentucky	1,214,000	Onondaga, New York	250,000
La Salle, Illinois	332,055	Kansas City, Missouri	50,000
Mankato, Minnesota	160,000	Cement, Georgia	20,000
Milwaukee, Wisconsin	400,000	Virginia, Texas, and New Mexico	180,000
Lehigh Valley, Pennsylvania	400,000		
Potomac River	100,000		
Fort Scott, Kansas	40,000	Total	6,253,295

The average price per barrel of the above natural rock cement was 72½ cents, making a total of $4,533,639 as the value of the product of 1888.

The following tables show the product for the past seven years:

Product of cement made from natural rock in the United States from 1882 to 1888.

Years.	Barrels of 300 pounds.	Average price per barrel.	Total value.
1882	3,165,000	$1.10	$3,481,500
1883	4,100,000	1.00	4,100,000
1884	3,900,000	.90	3,510,000
1885	4,000,000	.80	3,200,000
1886	4,350,000	.85	3,697,500
1887	6,692,774	.77½	5,186,900
1888	6,253,295	.72½	4,533,639

Estimated product of American Portland cement from 1882 to 1888.

Years.	Barrels of 400 pounds.	Average price per barrel.	Total value.
1882	85,000	$2.25	$191,250
1883	90,000	2.15	193,500
1884	100,000	2.10	210,000
1885	150,000	1.95	292,500
1886	150,000	1.95	292,500
1887	250,000	1.95	487,500
1888	250,000	1.95	487,500

The total product of all kinds of cement during the past six years was about as follows:

Total product of all kinds of cement in the United States from 1882 to 1887.

Years.	Barrels.	Value.
1882	3,250,000	$3,672,750
1883	4,190,000	4,293,500
1884	4,000,000	3,720,000
1885	4,150,000	3,492,500
1886	4,500,000	3.990.000
1887	6,942,744	5,674,400
1888	6,503,295	5,021,139

Imports of cement at New York, in casks of 400 pounds.

Years.	From Great Britain.	From European continent.	Total casks.	Cost on pier per cask.	Total value.
1877	47,632	10,818	58,450	....	....
1878	51,477	19,040	70,517	....	....
1879	80,834	25,212	106,046	....	....
1880	120,833	45,080	165,913	....	....
1881	149,486	73,186	222,672	....	....
1882	171,202	190,924	362,126	$2.60	$941,528
1883	158,602	143,363	301,965	2.70	815,306
1884	155,477	201,085	356,562	2.50	891,405
1885	187,955	250,860	438,815	2.05	899,571
1886	261,464	301,887	563,351	....	....
1887	432,327	385,903	818,230	....	....
1888	501,958	399,798	901,756	....	....

Cement imported and entered for consumption in the United States, 1868 to 1888.

Years. (*a*)	Quantity.	Value.	Years. (*a*)	Quantity.	Value.
	Barrels.			*Barrels.*	
1868	....	$10,168	1879	....	$212,719
1869	....	9,855	1880	....	373,264
1870	....	18,057	1881	....	441,512
1871	....	52,103	1882	370,406	683,684
1872	....	172,339	1883	456,418	862,294
1873	....	209,097	1884	(*b*)585,768	825,095
1874	....	286,429	1885	554,396	874,070
1875	....	261,741	1886	915,255	962,689
1876	....	247,200	1887	1,514,095	1,470,846
1877	....	201,074	1888	1,835,504	1,731,456
1878	....	184,086			

a Calendar years ending December 31 from 1886; previous years end June 30.
b Classed simply as cement; kind not specified since 1883. It is probable, however, that about 95 per cent. of the total imports is Portland cement.

Comparative prices per barrel of cement in New York January 1, 1885 to 1889.

	1885.		1886.		1887.		1888.		1889.	
Rosendale		$1.00	$1.10 to	$1.25	$1.20 to	$1.25	$1.15 to	$1.20	$1.15 to	$1.20
Portland	$2.50 to	3.00	2.25	2.50	2.00	2.25	2.25	2.50	2.10	2.35
Roman	2.75	3.50	2.75	3.25	2.65	2.85	2.65	2.85	2.65	2.85
Keene's common.	5.00	6.00	4.50	6.00	4.50	5.50	4.50	5.50	4.50	5.50
Keene's fine	9.50	10.00	9.00	10.00	7.50	8.50	7.00	8.25	7.00	8.25

New developments.—The Catasauqua Cement Company established a new mill at Catasauqua, Lehigh county, Pennsylvania. The capacity of the mill is estimated at an annual product of 100,000 barrels.

A new mill, capacity 400 barrels per day, was established in the Louisville, Kentucky, cement region during 1888; also one at Fort Scott, Kansas, with an annual capacity of 150,000 barrels.

A new discovery of cement rock was made during the year at Llewellyn, Lane county, Oregon. The material, when burned, yields a product of very satisfactory properties, and there are indications that the deposit will be developed.

Cement rock, which upon analysis showed very satisfactory composition, was discovered during the year at some point between Ogden and Provo City, Utah Territory. Efforts were being made during the year to form a company to develop and manufacture it.

A suggestion was made in the latter part of 1888 to make use of materials, suitable for the manufacture of Portland cement, which are to be found in large quantities in the vicinity of Charleston, South Carolina. It remains yet to be seen, however, whether the suggestion is to be carried out.

Cement tests.—At a meeting of the Engineers' Club of Philadelphia, Mr. A. Marichal read a paper upon the testing of cements, calling the attention of the club to the waste of money resulting from the incomplete knowledge of the properties of cements. Some engineers spend many hundred dollars to test their cement; yet the mortar used in their work is not worth a penny. The author noted the following points: If masonry work is made under contract, the specifications should state the required properties of the mortar and not of the cement. A cement may give splendid results when tested by itself, and yet the mortar may be of the poorest kind. Tests of pure cement alone are entirely useless. When the object is to determine the relative value of different brands of cement, tests should be made with different proportions of sand in order to ascertain which is the most economical cement. These tests should be made under similar conditions: the temperature, the manipulation, the quality of sand, the speed and uniformity in applying the load, etc., are all important factors. They should be constant; otherwise the results will not be reliable. The compressive strength is of the greatest importance in ordinary construction. Unfortunately it cannot be ascertained with any degree of accuracy. The cement is injured before it is crushed.

It was observed that an expansion of 4 per cent. was taking place in a cement pavement. It was due to the hydration of magnesia contained in excess in the cement. As a test, mortar should be placed in a glass tube and some water poured on top. If the glass breaks, the cement is unfit for work exposed to dampness, and should be analyzed.

Magnesia cement.—The *London Engineer* says: Attention is being directed to the use of magnesia as a cement. The need of finding some use for the refuse magnesia salts arising as by-products in the manufacture of potash at Stassfurt has caused the subject to attract attention again. The question is of all the more importance in that the other compounds, the chlorides combined with the magnesia at Stassfurt, are valuable for the production of bleaching powder and hydrochloric acid. When Sorel pointed out, in 1867, that a cement could be produced by mixing chloride of magnesium and magnesia, it was hoped that good results would ensue. The composition of this cement was based upon much the same principle as the white stopping used by dentists, made of zinc oxide and chloride of zinc. This cement of Sorel, in spite of many attempts to use it, proved a failure in consequence of a tendency, often noticed also in calcareous cements, to swell and blow, owing to deferred hydration. Dr. Grundmann, of Hirschberg, has recently invented a new method of treating the magnesia, for whereas formerly the material was merely calcined and made up with water, he now carefully slakes the calcined magnesia, and subsequently exposes the compound or casting to the action of carbonic-acid gas, much in the same way that builders have been in the habit of drying and hardening plastered rooms by confining the air and burning coke in them, so as to liberate carbonic-acid gas. The natural carbonate of magnesia, known as magnesite, is a mineral of great hardness and density, and the similar substance obtained by the above treatment resembles magnesite in its hardness and in its capacity for taking a good polish. Grundmann also employs the magnesia as a cementing agent for various materials. For instance, by the use of marble dust an artificial dolomite is obtained. The magnesia can also be improved by adding to it soluble silicates of the nature of water glass, and it can be used as a stucco for building purposes.

LIME.

The product of lime in the United States during 1888 is estimated at 49,087,000 barrels, valued at $24,543,500.

The following table shows the product and value of lime for the past seven years:

Estimated product of lime in the United States from 1882 to 1888.

Years.	Barrels of 200 pounds.	Average value at kiln.	Total value.
1882	31,000,000	$0.70	$21,700,000
1883	32,000,000	.60	19,200,000
1884	37,000,000	.50	18,500,000
1885	40,000,000	.50	20,000,000
1886	42,500,000	.50	21,250,000
1887	46,750,000	.50	23,375,000
1888	49,087,000	.50	24,543,500

Following the plan pursued in the report for 1887, the following is a presentation of statistics and other information relative to the lime production of a number of localities in the United States:

Product of lime in selected districts of the United States.

States.	Localities.	Production, barrels of 200 pounds.	Remarks.
California	San Francisco	147,000	This figure represents the lime consumed in San Francisco during the year. It was produced at kilns in Santa Cruz, El Dorado, and Kern counties.
Connecticut	Canaan	102,000	This is the output of four operators; three in Canaan and one in Clayton, Mass., two miles from Canaan.
	Danbury	45,000	This includes the output of Danbury, Redding, and Brookfield.
	Fairfield county (entire).	50,000	
District of Columbia	Washington	100,000	
Illinois	Alton	46,620	One new kiln; capacity, 180 bushels per day.
	Anna	3,000	
	Kankakee	16,000	
	Port Byron	110,000	
	Quincy	250,000	
Indiana	Huntington	371,000	
	Markle	72,800	
Iowa	Maquoketa	152,500	
	Wilton Junction	100,000	
Maine	Knox county (entire).	1,750,000	
	Rockland	1,215,884	This figure is of course included in the above figure for Knox county. Two new kilns at Rockland were built during the year, combined capacity of 1,500 barrels per week.
	Rockport	200,000	Including Camden.
Maryland	Baltimore	230,000	
	Buckeystown	245,000	
	Cockeysville	227,000	
	Lime Kiln	262,500	
	Texas	....	Included in report for Cockeysville.
Massachusetts	Adams	60,000	
	New Lenox	19,035	
	North Adams	100,000	
Michigan	Detroit	73,100	
Minnesota	Red Wing	120,000	
	Saint Paul	6,400	
Montana	Helena	80,000	
Missouri	Ash Grove	320,875	This figure includes the products of Ash Grove, Springfield, and Phenix.
	Cape Girardeau	15,000	

Product of lime in selected districts of the United States—Continued.

States.	Localities.	Production, barrels of 200 pounds.	Remarks.
Missouri	Carthage	350, 000	This includes South Springfield.
	Hannibal	300, 000	
	Pierce City	70, 000	
	Saint Louis	275, 757	
	Springfield	90, 000	This figure is also included in that given for Ash Grove.
New Jersey	Califon	40, 950	
	Clinton	70, 000	
New York	Buffalo	100, 000	
	Elmira	14, 000	
	Rochester	80, 215	
	Sodus Centre	42, 000	
	Tomkins Cove	57, 862	
	Troy	16, 800	
Ohio	Canton	8, 750	
	Casey	29, 750	
	Cincinnati	33, 250	
	Cleveland and vicinity	600, 000	This includes Kelly's Island and Sandusky.
	Fremont	60, 000	
	Gibsonburgh	100, 000	
	Marion	262, 500	Including the whole of Marion county.
	Owen's Station	119, 700	
	Rocky Ridge	74, 000	
	Sandusky	375, 000	This is included also in figures for Cleveland.
	Springfield	255, 500	A part of this was produced at Cedarville and Yellow Springs.
	Woodville	37, 192	
	Yellow Springs	17, 500	
Pennsylvania	Allentown	70, 000	
	Annville	105, 000	
	Bellefonte	180, 000	One new establishment, capacity 900 bushels per day, was erected this year.
	Easton	59, 500	
	Erie	12, 611	
	High Spire	35, 000	
	Keystone Junction	70, 000	
	Philadelphia	1, 218, 093	This amount was manufactured in the following places: Philadelphia, Plymouth Meeting, Norristown, Bridgeport, and Fort Washington.
	Pittsburgh	26, 618	
	Plymouth Meeting	318, 500	
	Scranton	26, 250	
	Wampum	146, 300	This includes Duck Run on P. and W. R. R.
	Winfield	56, 000	Including Penny's Store and Shamokin.
Tennessee	Erin	100, 000	
Texas	Austin	128, 975	
	San Antonio	500	
Vermont	Leicester	50, 000	
	Plymouth	2, 500	
	Plymouth Union	4, 000	
	Saint Albans	157, 500	One new kiln, capacity 100 barrels per day, was erected during the year.
Virginia	Middletown	14, 000	
	Richmond	156, 000	This includes Indian Rock and Riverton.
	Riverton	72, 000	
	Tonis Brook	26, 880	
Wisconsin	Mayville	145, 000	
	Milwaukee	2, 060, 000	This includes Oshkosh, Eden, Sheboygan, Waukesha, Mayville, Ketcham, Cedarburgh, Appleton, and Racine.
	Sheboygan	5, 500	See Milwaukee.

Comparative prices per barrel of eastern lime at New York on January 1, 1878 to 1889, inclusive.

Years.	Common.	Fine.	Years.	Common.	Fine.
1878	$0.80	$1.00	1884	$1.00	$1.20
1879	.80	.90	1885	1.00	1.20
1880	.85	1.00	1886	1.00	1.20
1881	.90	1.00	1887	1.00	1.20
1882	1.25	1.40	1888	1.00	1.10
1883	1.10	1.40	1889	1.00	1.20

Lime and cement of domestic production exported from the United States, 1864 *to* 1888.

Years. (*a*)	Quantity.	Value.	Years. (*a*)	Quantity.	Value.
	Barrels.			*Barrels.*	
1864	....	$86,386	1879	60,657	$74,097
1865	....	94,606	1880	41,989	52,584
1870	31,175	61,490	1881	57,555	83,598
1871	27,575	51,585	1882	67,030	100,169
1872	39,686	69,218	1883	74,687	120,156
1873	27,873	52,848	1884	65,768	108,437
1874	41,349	69,080	1885	79,627	127,523
1875	64,087	98,630	1886	83,247	123,687
1876	53,827	77,568	1887	63,520	97,771
1877	78,341	97,923	1888	100,070	147,309
1878	82,507	98,334			

a Calendar years ending December 31 from 1886 to 1888; previous years end June 30.

BRICK.

Production.—The year 1888 was not an active one in the production of brick. This fact is due to a variety of causes, one of which was over-production in 1887, and another, which was felt in quite a number of producing centers, namely, bad weather during the brick season. The value of the brick and drain tile produced in the United States in 1888 is estimated at $48,213,000. There was a falling off in production at a number of the most important sources of supply, while for the whole country the total figure represents a gain. This gain is due to the regularly increasing number of plants rather than to increased production at the leading localities.

The following table gives the production of a number of localities in the United States:

Condition of the brick industry in 1888.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Alabama	Choccolocco	7,000,000	The output in 1888 was greater than in the preceding year, but the value was less.
	Eufaula	4,000,000	This figure represents an increase of 1,000,000 over 1887.
	Davisville	300,000	
	Montgomery	15,000,000	One new yard of the annual capacity of 4,000,000 was established during 1888. The output of 1888 is less than that of 1887.
	Selma	1,600,000	The outlook for 1889 is encouraging.

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Arkansas	Little Rock	12,000,000	This figure is 20 per cent. above that for 1887.
California	Oakland	80,000,000	
	Santa Ana	5,000,000	One new yard, capacity 1,000,000, was established during the year.
Colorado	Brookside	200,000	
	Cañon City	1,680,000	There is not much clay of a quality suitable for making brick in Fremont county.
	Denver	85,000,000	The year was characterized by a brisk demand for brick in this city, and few were carried over at the close of the season.
	Fort Collins	5,000,000	
	Golden	2,000,000	
	Greeley	1,600,000	This figure covers Greeley and region for 25 miles.
Connecticut	Berlin	11,100,000	
	Hartford	13,000,000	
	Middletown	3,700,000	This figure represents an increase of about 1,000,000 over 1887.
	New Britain	9,500,000	
	New Haven	36,000,000	
	North Haven	37,500,000	One new yard, with a capacity of about 3,000,000, was established during the year.
	Thompsonville	2,400,000	
	Wapping	4,000,000	
	Wauregan	6,000,000	
Dakota	Aberdeen	2,400,000	
District of Columbia.	Washington	120,000,000	
Florida	Lake City	240,000	The brick manufacture has made its appearance here, and future developments are regarded with interest.
	Sorrento	2,000,000	The pressed brick made in this place are the first made in Florida.
Georgia	Albany	3,000,000	
	Atlanta	22,000,000	Preparations for an increased output for 1889 were made during the year.
	Augusta	15,000,000	A flood, which occurred in this city during September, did considerable damage to brick manufacture.
	Columbus	12,000,000	The production here increased about 20 per cent.
	Dublin	1,500,000	
	Fort Gaines	500,000	
	Macon	25,000,000	Some addition to producing capacity in this region was made during the year. The value of the brick was less than during 1887.
	Milledgeville	1,600,000	
	Rome	15,000,000	A considerable increase in production was made here during the year.
Idaho	Osburn	250,000	
Illinois	Abingdon	560,000	Brick for street paving were shipped to Burlington, Iowa.
	Albion	300,000	
	Anna	1,050,000	
	Arenzville	400,000	
	Ashland	450,000	
	Ashmore	300,000	
	Assumption	200,000	
	Atwood	290,000	
	Belle Flower	10,000	
	Bloomington	13,200,000	
	Blue Mound	250,000	
	Bowenburgh	90,000	
	Bushnell	1,100,000	
	Casey and vicinity	1,200,000	
	Charleston	1,000,000	
	Chester	3,618,000	
	Chicago	458,000,000	
	Creston	300,000	
	Dixon	600,000	
	Evanston	5,000,000	
	Fairmount	400,000	

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Illinois	Farmer City	1,000,000	
	Forest	150,000	
	Galesburgh	8,000,000	
	Galva	480,000	
	Gilman	200,000	
	Golconda and vicinity	2,000,000	This includes Pope, Saline, Hardin, Gallatin, Williamson, and Johnson counties.
	Grayville	600,000	
	Homer	250,000	
	Hudson	500,000	
	Illiopolis	800,000	
	Iroquois	50,000	
	Kenney	250,000	
	La Salle	5,750,000	One new yard, capacity 3,000,000, was established during the year.
	Lewistown	1,000,000	
	Lincoln	5,500,000	One new yard, capacity 1,500,000, was established during the year.
	Lostant	275,000	
	Lombard and vicinity	1,000,000	
	Mahomet	300,000	
	Macomb and vicinity	2,200,000	
	Mannon	100,000	
	Mattoon	1,500,000	
	Metropolis	3,000,000	
	Moline	2,500,000	
	Monticello and vicinity.	2,000,000	
	Morris and vicinity	5,000,000	
	Mount Carmel	850,000	
	Mount Palatine	110,000	
	Moweaqua	300,000	
	Newman	449,000	
	Niantic	900,000	
	Plainfield	100,000	
	Potomac	300,000	
	Quincy	10,360,000	A decided increase in production was made during the year.
	Rochelle	100,000	
	Rock Island	4,000,000	
	Rushville	300,000	
	Sandwich	300,000	
	Scottville	40,000	
	Sheldon and vicinity	1,500,000	
	Sidney	300,000	
	Springfield	14,300,000	
	Stillman	90,000	
	Sullivan	418,000	
	Table Grove	300,000	
	Tice	230,000	
	Towanda	500,000	
	Urbana and vicinity	5,000,000	
	Vermont and vicinity	430,000	
	West Salem	150,000	
	White Hall	150,000	
	Woodland	2,000,000	
Indiana	Anderson	4,106,000	
	Carlisle	600,000	
	Crawfordsville	4,500,000	
	Elwood	2,000,000	
	Elkhart	4,600,000	
	Evansville	23,000,000	One new yard, with a capacity of 8,000,000, was established during the year.
	Hobart	3,000,000	
	Indianapolis	35,000,000	
	Muncie	3,850,000	Two new yards, with a combined capacity of 1,000,000, were established during the year.
	Nappanee and vicinity	6,200,000	This includes Goshen, Elkhart, Breman, and Milford.
	Noblesville	2,100,000	
	South Bend	9,000,000	
Iowa	Clermont	300,000	
	Columbus Junction	400,000	

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Iowa	Council Bluffs	12, 600, 000	One new yard was established; capacity, 800,000.
	Cresco	400, 000	
	Corning	600, 000	
	Davenport	3, 000, 000	
	Des Moines	8, 000, 000	
	Iowa Falls	3, 000, 000	This includes Webster City, Eldora, Ackley, and Shellsburgh.
	Logan	3, 000, 000	
	Macedonia	550, 000	
	Marshalltown	2, 800, 000	
	Mount Pleasant	800, 000	
	Muscatine	4, 050, 000	The production at this point was less than in 1887.
	Nevada	303, 000	
	Newell and vicinity	1, 200, 000	This includes Sioux Rapids and Storm Lake.
	North English	1, 500, 000	
	Rock Rapids	800, 000	
	Sergeant Bluff	9, 000, 000	
	Sigourney	900, 000	
	Sioux City	17, 000, 000	
	Woodbine	2, 500, 000	This includes Dunlap, Missouri Valley, and a part of Logan.
Kentucky	Covington	15, 000, 000	
	Lexington	7, 000, 000	
	Louisville	58, 000, 000	
Louisiana	Baton Rouge	5, 000, 000	
	Hammond	12, 000, 000	
	Kentwood	14, 000, 000	
	New Orleans	20, 000, 000	
	Slidell	13, 000, 000	This includes Bayou Lacombe, and Covington, Louisiana.
	Tangipahoa	11, 000, 000	
Maine	Bangor	2, 700, 000	
	Biddeford	7, 000, 000	This includes Saco.
	Brewer	8, 700, 000	
	Eliot	6, 000, 000	
	Ellsworth	1, 150, 000	
	Houlton	500, 000	
	New Castle	8, 500, 000	This includes Damariscotta and Edgecomb.
	Orland	3, 850, 000	
	Penobscot	6, 000, 000	Including North Castine.
	Portland	8, 000, 000	This product is less than that of 1887.
	Saco	4, 000, 000	See Biddeford, above.
	South Penobscot	12, 050, 000	This includes North Castine, Penobscot, and Orland.
	Waterville	7, 000, 000	This includes Kennebec county.
	Woolrich and vicinity	3, 000, 000	This includes Wiscasset.
	York	2, 500, 000	
Maryland	Baltimore	120, 000, 000	
	Frederick	1, 500, 000	
	Salisbury	3, 000, 000	
Massachusetts	Boston and vicinity	42, 800, 000	
	Bridgewater and vicinity.	9, 000, 000	
	East Brookfield and vicinity.	8, 500, 000	One new yard was established here during the year.
	Fitchburg and vicinity.	12, 200, 000	
	Middleborough and vicinity.	14, 000, 000	This includes a part of Taunton and Bridgewater.
	Northampton and vicinity.	5, 300, 000	This includes Easthampton and vicinity.
	Revere	5, 000, 000	
	Taunton	19, 000, 000	
Michigan	Bridgeport	3, 500, 000	
	Brookfield	300, 000	
	Buchanan	300, 000	
	Caro and vicinity	1, 500, 000	This includes Unionville, Vassar, and Bad Axe.
	Detroit	80, 000, 000	This figure includes the product of Leesville.
	Dundee and vicinity	10, 000, 000	This includes Petersburgh and Monroe.

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Michigan	Flint and vicinity	3,000,000	This includes Davidson Station, Grand Blanc, and Flushing. One new yard near Grand Blanc was established during the year.
	Holton and vicinity	2,000,000	
	Hancock	2,000,000	
	Lansing	5,100,000	
	Leesville	10,000,000	See Detroit, above.
	Ludington	1,800,000	
	Mullet	1,000,000	
	Petersburgh	1,170,000	See Dundee, above.
	Pent Water	3,105,000	
	Pontiac	2,000,000	
	Paines and vicinity	21,000,000	This includes Bridgeport, Bay City, and Saginaw.
	Reed City	1,250,000	
	Rockwood	500,000	
	Saginaw	11,300,000	See Paines, above.
	Saint Clair and vicinity.	8,180,000	This includes Crosswell, Ruby, and New Baltimore.
	Sault de Ste. Marie	3,000,000	This is an estimated production of an area covering 100 miles. These yards were started during 1888.
	Zeeland	6,000,000	
Minnesota	Anoka	6,000,000	
	Belle Plaine and Blakeley.	3,300,000	
	Byron and vicinity	2,000,000	This includes the whole of Olmstead county.
	Carver	6,500,000	
	Chaska	30,000,000	One new yard, capacity 3,000,000, was established during the year.
	Dresbach	3,500,000	
	Minneapolis	37,000,000	
	Rochester	1,500,000	
	Saint Paul	11,000,000	
Mississippi	Osyka	8,500,000	Including Kentwood and Tangipahoa, both in Louisiana. An increase of about 1,000,000 was made during 1888.
Missouri	Brunswick	900,000	
	De Soto	700,000	400,000 increase over 1887.
	Kansas City	120,000,000	Two new firms commenced business during 1888. The brick business at this point is in a flourishing condition.
	Macon county	2,000,000	
	Marshall and vicinity	1,000,000	
	Saint Louis	150,000,000	
	Washington	1,300,000	
Nebraska	Elkhorn	700,000	
	Grand Island	3,800,000	
	Lincoln	20,000,000	One new plant, capacity 75,000 per day, was established during the year.
	Omaha	80,000,000	Three new yards, combined capacity of 5,000,000, were established here during 1888.
	Phillipsburgh	4,000,000	
New Hampshire	Barrington	3,800,000	
	Brentwood	18,000,000	This figure includes the product of West Brentwood, Epping, Gonic, and East Barrington.
	Dover	22,000,000	Two new yards were established here during the year.
	Dover Point	8,000,000	
	Durham	4,500,000	
	Exeter and vicinity	4,500,000	Including East Kingston.
	Hookset	16,000,000	This includes Suncook and Pembroke. This product is less than that of 1887.
	Pembroke	21,000,000	This product includes Hooksett, Concord, and Suncook.
	Rumney and vicinity	2,200,000	400,000 of this product was made at Weirs.
	Woodsville	650,000	
New Jersey	Bridgeton	3,000,000	
	Cliffwood and vicinity	13,000,000	

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
New Jersey	Hackensack	70, 000, 000	The product of this region is less than that of 1887.
	Matawan and vicinity.	30, 000, 000	Including Key Port. One new yard, capacity 3,000,000, was established here during the year.
	Millville	2, 600, 000	800,000 of this estimate was produced at Belle Plain.
	North Plainfield	10, 600, 000	
	Passaic	800, 000	
	Somerville	7, 000, 000	
	Tom's River	3, 750, 000	Including Whiting and Herbertsville.
	Woodstown	1, 800, 000	
	Yorktown and vicinity	1, 100, 000	600,000 of this estimate was made at Pentonville.
New York	Athens	10, 000, 000	
	Breesport and vicinity.	15, 000, 000	This includes Elmira and Horseheads. Whole of Chemung county.
	Buffalo	56, 750, 000	
	Camillus	4, 500, 000	
	Crugers	30, 000, 000	Part of this was produced at Montrose.
	Dutchess Junction and vicinity.	70, 000, 000	Including Fishkill.
	Fishkill	14, 000, 000	See Dutchess Junction.
	Glasco	38, 000, 000	The production at this point was less in 1888 than in 1887.
	Haverstraw	350, 000, 000	
	Ithaca	3, 000, 000	
	Jamestown	4, 000, 000	
	Jonespoint	2, 500, 000	
	Lancaster	2, 680, 000	
	Erie county (entire)	33, 000, 000	
	Lockport	900, 000	
	Lyons	1, 000, 000	
	Newburgh	38, 000, 000	
	New Windsor	40, 000, 000	This includes Newburgh.
	Oneida	900, 000	
	Port Ewen	11, 000, 000	
	Rochester	30, 000, 000	This is an increase of 5,000,000 over 1887.
	Rome	1, 800, 000	
	Rondout and vicinity.	136, 000, 000	This product is for the whole of Ulster county.
	Stony Point and vicinity.	87, 000, 000	Including Jonespoint and Grassy Point.
	Verplanck	60, 000, 000	
North Carolina	Asheville	4, 000, 000	
	Elizabeth City	1, 000, 000	
	Goldsborough	3, 500, 000	
	Statesville	275, 000	
Ohio	Akron	7, 500, 000	
	Arlington	300, 000	
	Bryan	3, 000, 000	
	Carysville	150, 000	
	Cleveland	65, 000, 000	
	Cincinnati and vicinity	75, 000, 000	
	Columbus Grove	1, 500, 000	
	Covington	3, 100, 000	Including Piqua, Tippecanoe, Troy, and Ludlow Falls.
	Crestline	450, 000	
	Defiance	2, 050, 000	
	Fostoria	1, 300, 000	
	Fremont	2, 000, 000	
	Galion	800, 000	
	Gallipolis	1, 875, 000	
	Germantown	450, 000	
	Gordon	400, 000	
	Groveport	200, 000	
	Liberty Centre	400, 000	
	Malta	300, 000	
	Malvern	1, 800, 000	
	Miamisburgh	770, 000	
	Millersburgh	410, 000	
	Mingo Junction	500, 000	
	Middletown	4, 000, 000	
	Monclova	200, 000	
	Nelsonville	300, 000	
	New Knoxville	312, 000	

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Ohio	North Robinson	3,000,000	
	New Richmond	15,500,000	
	Portage	1,200,000	
	Ravenna	1,100,000	
	Salem	1,500,(00	
	Steubenville	4,500,000	
	Toledo	27,500,000	
	Van Wert	2,700,000	
	Wingston	400,000	
	Zanesville	23,000,000	The brick produced in this town are known all over the country.
Pennsylvania	Allegheny City	100,000,000	
	Allentown	13,000,000	One new yard, capacity 2,000,000, was established during the year.
	Auburn	1,900,000	
	Blair Station	4,500,000	
	Bowmanstown	1,000,000	
	Brandt	2,500,000	
	Carlisle	1,600,000	
	Catasauqua and vicinity.	22,300,000	This product covers the region from Mauch Chunk to Easton in Lehigh valley. Three new yards, aggregate capacity of 12,000,000, were started during the year.
	Chambersburgh	1,500,000	
	Chester	26,000,000	Two new yards, with combined capacity of 4,000,000, were started this year.
	Conshohocken	2.500,000	
	Corry	1,400,000	
	Denver	220,000	
	Easton	500,000	Included in statement for Catasauqua.
	Harrisburg	12,000,000	Three new yards, with an aggregate capacity of 5,000,000, were started during the year.
	Meadville	2,900,000	
	Milton	1,200,000	One new yard, with capacity of 800,000, was established during the year.
	Philadelphia	350,000,000	In addition to the number given for Philadelphia, about 40,000,000 are shipped to the city from yards outside the city limits.
	Pittsburgh	40,000,000	
	Reading	20,500,000	
	Sharon	1,300,000	
	Shippensburgh	1,070,000	
	Steelton	3,700,000	
	Thurlow	11,500,000	
	Washington	125,000	
	Water Cure	20,000,000	The following places are included in this statement: Batesville, New Brighton, Beaver Falls, Vanport, and Philipsburgh.
	Wilkes Barre	9,550,000	Including Kingston, Parsons, Plymouth, Pittston, and Nanticoke.
	York	8,000,000	
South Carolina	Enoree	1,273,000	
	Greenville	5,000,000	One new yard was established in 1888.
	Pelzer	3,000,000	
	Piedmont	5,000,000	
Tennessee	Chattanooga	21,000,000	One new yard was established during 1888, capacity 7,000,000.
	Clarksville	5,000,000	Two new yards were established during 1888.
	Memphis	37,300,000	One new yard was established during the year.
	Nashville	30,000,000	
Texas	Dallas	20,000,000	Two new yards were established during 1888, with an aggregate capacity of 2,000,000.
	Laredo	12,000,00'	
	Paris	4,000,000	
	San Antonio	4,500,000	
	Texarkana	2,500,000	
	Waco	8,000,000	
Vermont	Rutland	1,200,000	
Virginia	Berkley	2,500,000	

Condition of the brick industry in 1888—Continued.

States.	Towns.	Number of bricks made in 1888.	Remarks.
Virginia	Norfolk	12,000,000	Two new yards, with a combined capacity of 2,000,000, were established during the year.
	Suffolk	1,500,000	
	Richmond	28,000,000	This includes Manchester.
	Roanoke City	7,000,000	Two new yards, combined capacity 800,000, were established during the year.
Washington Territory.	North Yakima	1,855,000	
	Seattle	9,000,000	Four new plants, with an aggregate capacity of 4,000,000, were established during the year.
	Tacoma	10,000,000	Two new yards, capacity 2,000,000, were established during 1888.
West Virginia	Charleston	3,000,000	
	Parkersburgh	2,800,000	
	Wheeling	4,000,000	
Wisconsin	De Pere	7,000,000	Two new yards were established in 1888.
	Marshfield	150,000	
	Menomonee	20,000,000	One new yard, with a capacity of 4,000,000, was established during the year.
	Milwaukee	58,000,000	
	Sheboygan	7,250,000	
	West De Pere	9,000,000	
	Wheeler	1,000,000	

New developments.—Although the production of brick in the United States for the year 1888 is only slightly in advance of that of 1887, there seems to have been as large an increase in the number of new establishments in that interval as in any previous year. The great improvements which have been made within the last few years in brick machinery undoubtedly have a great deal to do with the activity in the establishment of new yards. The manufacture of brick has now become so automatic that to learn the brick-making business is not so serious a matter as it has been in former years. Another cause for the establishment of numerous new yards is of course the universal distribution of suitable clay for brick making. Furthermore, the cost of the necessary plant is not, comparatively speaking, very great. Transportation expenses are so materially lessened by the wider distribution of brick yards that we may well look to this fact for a further explanation of the large increase in number of establishments which makes itself apparent from year to year. In the South, particularly, the erection of new plants for brick manufacture has made itself felt within the last two years. A few years ago almost all the brick used in Florida were shipped there from neighboring States, particularly Georgia. It may now be said, however, that the brick industry in Florida is fairly established, although that State is still dependent upon its neighbors for a large portion of its total consumption. In Alabama the advances made in brick manufacture apply especially to fire-brick; but, as will be seen from the following statement in regard to new yards, the manufacture of common brick is by no means neglected. In California the most important advances made are in the establishment of a terra-cotta and pressed-brick plant at Vallejo. The raw material to be used is known as clay shale, which is regarded as valuable material for the manufacture of fine brick. A company has been incorporated, and the erection of the necessary buildings has been put under way. The plant is expected to be very complete. The most improved forms of machinery have been selected for this enterprise. Fire-brick produced in Colorado has already acquired quite a reputation and the supply has hardly yet been equal to the demand.

New brick yards have either been actually established or are contemplated for the immediate future in the following places:

States.	Towns.
Alabama	Ensley, Florence, Dillburgh, Choccolocco, Decatur, Bessemer, Sheffield, Fort Payne, Talladega, Walnut Grove, Birmingham, Riverside, Staunton, Huntsville, Anniston, Jasper, and Oxford.
Arkansas	Camden, Helena, Perry Grove, Texarkana, Ozark, Hot Springs, Forest City, Mammoth Spring, and Fort Smith.
Florida	Tampa, Fort Meade, Whitney, Madison, De Leon Springs, Fort Mason, Hot Springs, Tallahassee, and Chattahoochee.
Georgia	Atlanta, Midland, Rome, Cartersville, Augusta, Tallapoosa, Huntsville, Cedartown, Americus, Rock Mart, Summerville, La Fayette, Columbus, Waynesville, Montezuma, New Albany, Macon, and Thomasville.
Illinois	Utica, Aurora, Chenoa, Carbon Cliff, and Ottawa.
Indiana	Collinsville, Etna Green, and Portland.
Kentucky	Louisville, Enterprise, Lewisport, Middlesborough, Stanford, Clay City, Troy, Rockfield, Shepherdsville, Covington, and Walton.
Louisiana	Baton Rouge, Slidell, Houma, Lake Charles, and Plaquemine.
Maine	Columbia Falls and Walpole.
Mississippi	Meridian, Gold Port, Bay Saint Louis, Winona, and West Point.
Missouri	Saint Louis and Kansas City.
New Hampshire	Gonic, Troy, Keene, and Rochester.
North Carolina	Lexington, Concord, Elkin, Thomasville, Wadesborough, Salisbury, Winston, and Asheville.
Ohio	Bridgeport, New London, and East Liverpool,
Pennsylvania	Wilkes Barre, Greensburgh, Philadelphia, Springboro, Reading, New Brighton, and Lancaster.
South Carolina	Graniteville, Darlington, Anderson, and Newbury.
Tennessee	Iron City, Nashville, Chattanooga, Covington, Cleveland, Memphis, Rogersville, Bristol, Clarkesville, Colliersville, Jackson, Knoxville, Gordonsville, Winchester, Johnson City, Athens, McMinnville, and Sparta.
Texas	Denison, New Birmingham, Weatherford, Bexar, San Antonio, Dallas, Waco, Fort Worth, and Clear Creek.
Virginia	Alexandria, Roanoke, Bockstown Gap, Lynchburgh, Lovely Mount, and Farmville.
West Virginia	Short Creek, Thornton, Charleston, Wellsburgh, and Wheeling.

Fire-brick.—The product of fire-brick in the United States in 1888 amounted to 248,457,000, valued at $3,992,226. Of the total amount above given 60,000,000 consisted of paving brick made of second-grade fire-clay and valued at $600,000; the remainder, 188,457,000, were valued at $3,392,226.

The following table shows the distribution of the fire-brick by States:

Condition of the fire-brick industry in 1888.

States.	Towns.	Number of fire-brick made in 1888	Remarks.
California	Alameda	400,000	
	San Francisco	400,000	
Colorado	Golden	4,000,000	
Connecticut	New Milford	40,000	
	Stanford	20,000	
Illinois	Anna	1,000,000	
	Carbon Cliff	2,000,000	
	Chicago	10,000,000	Including Ottawa and Utica.
	Ottawa	2,000,000	
Indiana	Montezuma	1,000,000	
Maine	Portland	600,000	
Maryland	Baltimore	1,000,000	
	Frostburgh	25,000,000	This estimate covers Mount Savage and Ellerslie.
Massachusetts	Boston	6,000,000	This includes Taunton and Somerset.
	Taunton	1,500,000	Including Somerset.
Michigan	Jackson	200,000	
North Carolina	Pomona	75,000	
New York	Buffalo	25,000,000	
New Jersey	Camden	60,000	
	South Amboy	3,500,000	The region indicated in this estimate is all of that part of Middlesex county south of the Raritan river.
Ohio	Calumet	40,000,000	A part of this was produced at Empire and Toronto.
	Canal Dover	3,000,000	
	Cincinnati	14,000,000	
	Cleveland	1,537,500	
	Coal Grove	5,000,000	
	East Liverpool	337,000	
	Empire	30,000,000	See Calumet above. This also includes Toronto and Calumet.
	Ironton and vicinity	4,300,000	Including Petersburgh, 5 miles above Ironton.
	Malvern	1,500,000	
	Niles	2,500,000	This includes Trumbull and Mahoning counties.
	Oak Hill	3,300,000	
	Portsmouth	25,000,000	A part of this was produced at South Webster, Oak Hill, and Ironton. (See above.)
	Sciotoville	7,000,000	
	Toronto	35,000,000	Including East Liverpool.
	Walker's	10,000,000	
	Youngstown	800,000	
	Zanesville	400,000	
Pennsylvania	Allentown	4,500,000	
	Black Lick Station	2,496,000	
	Bolivar	3,500,000	
	Clearfield	21,000,000	This product includes Woodland, Wallaceton, Philipsburgh, Retort, and Sandy Ridge.
	Freedom	3,000,000	
	Harrisburg	1,000,000	
	Lockport	8,000,000	Including Johnstown, Bolivar, and Black Lick Station. (See above.)
	New Brighton	22,000,000	This includes Rochester, Beaver, Water Cure, and Freedom.
	Philadelphia	25,250,000	
	Pittsburgh	5,000,000	
	Reading	4,000,000	In Berks county.
	Sligo	414,500	
	Sharon	3,000,000	
Texas	Athens	200,000	
	San Antonio	12,000,000	
West Virginia	New Cumberland	65,000,000	

The application of fire-clay to the manufacture of paving brick is one which is just now engaging the attention of the leading citizens of many of the most important cities in the United States. Experiments in paving material have been made without limit with almost all materials which could possibly suggest themselves for such purpose. Failures in the selection of paving material have been numerous, and in some cases extremely expensive. Even the fine, smooth asphalt pavements of Washington, D. C., and of a few other cities are found to be quite injurious to horses. This is probably on account of the highly unyielding character of such pavement and its almost absolute lack of elasticity. The results of many of these experiments with different paving materials are fresh in the minds of those who take an interest in the subject, and a consideration of what is being done in a number of places with fire-brick as a paving material can hardly fail to be of interest to those who have given any attention to this highly important subject. The fire-clay used in the manufacture of paving brick is not what is known as first-grade clay, but is an article of far less purity. There is as yet apparently some doubt among recognized authorities in the matter of brick generally as to just what clay is best for the manufacture of paving brick, but the bulk of the evidence seems to be in favor of second-grade fire-clay. Paving brick of this clay has been in use for six years in Wheeling, West Virginia, and Steubenville, Ohio. It is still without flaw or fault. It has received the approval and favorable recommendation of more than forty visiting committees from as many towns or cities from every section of the country, and their experience is added to that of Wheeling and Steubenville to give the vitrified clay block the first position in the commercial list of paving materials. The clay which has been referred to above as best adapted for the manufacture of paving brick is found in what is known as the Ohio valley. To make a good furnace brick the fire-clay must be free from iron or it will melt under the intense heat to which it is subjected; but to make a good paving brick it should contain a good percentage of iron, which, when vitrified, makes it as hard and durable as flint, and this is the property which makes the Ohio fire-clay desirable for the manufacture of paving-brick. This quality of fire-clay is quite widely distributed, being found in probably much more than half of the States of the Union. In selecting fire-clay for the manufacture of paving brick care must be taken that it be entirely free from limestone, and, as this is very commonly found near fire-clay and sometimes in the same vein, the necessity for care is apparent. Particles of lime in brick will expand under the influence of moisture and cause breakage. It is regarded by high authorities as a great mistake to use common hard-burnt red brick for paving purposes, although such brick makes a smooth handsome pavement which under light usage will last for a number of years. Still, under the influence of moisture and severe frosts disintegration is inevitable in the end; nor will such brick sustain constant heavy wear aside from climatic influences. Brick made of proper fire-clay, however, will stand the severest frosts. Results of crushing tests have shown it to be equal to granite. The mode of laying this brick is three alternate layers of sand and brick, the sand being on the bottom. All the brick is set on edge. In Columbus the process is to make a round bed of 10 or 12 inches of broken stone, then a layer of dry sand, and afterward wet sand on top, and this is then rolled down. Brick is then put on. This process, however, hardly seems so substantial and solid as the one first given. Another method of laying the brick is as follows: The brick is laid endwise on edge with broken joints in the sand. Afterward it is pressed down with a heavy roller and boiling tar is poured over it so as to make a compact mass as well as to exclude water. A layer of sand is thrown over the tar before cooling. A very smooth solid road-bed is the result, and it is comparatively noiseless.

Paving brick made from fire-clay has already asserted itself as valuable paving material to such an extent that in all large cities it is being tried to a greater or less extent. Probably the only material which is regarded as a worthy competitor is the Belgian paving block. Much of the fire-clay of West Virginia is well adapted to the manufacture of paving brick. Great increase in the production of such brick has marked the output of fire-brick works in these regions during the last three or four years.

Prejudice has always existed until recently against the manufacture of fire-brick by machinery. This prejudice has arisen probably from the numerous failures which have followed the attempts to use machinery in this connection. It may be stated, however, that recent attempts to manufacture such brick by machinery have resulted in a product which is claimed to be superior, if anything, to the hand-made article.

New discoveries and developments.—The increased demand for fire-brick in the erection of iron furnaces at various points in the South and the recent application of fire-brick to paving purposes are causes which have been active in stimulating a demand for new sources of good fire-clay. In former times the manufacture of fire-brick was confined to certain localities both in England and in the United States. This is due simply to the fact that little effort to discover and develop new sources of this material was made. Fire-brick in the past has been transported long distances at great freight cost. Within the last two years quite a number of new discoveries of fire-clay have been made. In Carter county, Kentucky, deposits of very fine fire-clay, apparently inexhaustible in amount, have been opened up within the past three years. Developments are steadily going on and the future of these deposits looks bright. The clay is very fine grained, white in color, and of the most refractory character. The following is an analysis of this clay:

Analysis of fire-clay from Carter county, Kentucky.

	Per cent.
Silica	46.75
Alumina	38.17
Peroxide of iron	.29
Lime	.57
Magnesia	.12
Alkalies	.07
Water	14.03
Total	100.00

In Boyd county, Kentucky, just across the river from Lawrence county, Ohio, there is a small deposit of clay of fair character, but so far as it has been opened the amount appears to be too small to be worked profitably. The active development of fire-clay deposits in West Virginia is now under way, and even greater activity appears probable in the next two or three years. Much of the fire-clay in this region of West Virginia is well adapted to the manufacture of paving brick. In addition to this, however, is other clay suitable for the manufacture of the most refractory articles made from fire-clay. All these varieties of fire-clay are found principally in Hancock, Braxton, Marion, Monongalia, Taylor, Preston, Barbour, Fayette, Kanawha, Logan, Wayne, and Clay counties, West Virginia—in short, in almost all of the localities in the Coal Measures. In Hancock county developments are most actively prosecuted. Twenty firms in this county are engaged in the manufacture of furnace and paving bricks. Their combined capacity is over 45,000,000 brick per annum. The brick used in paving the city of Wheeling was manufactured in this county. A syndicate composed of gentlemen in Grafton, West Virginia, is preparing to construct an extensive plant opposite Nuzum's mills, on the Tygarts Valley river. At Thornton, in Taylor county, a vein of fire-clay 12 feet in thickness and underlying several thousand acres of land is to be developed. This fire-clay is especially well adapted to the manufacture of paving brick. Rich deposits have also been found near Morgantown on the line of the Fairmount, Morgantown and Pittsburgh railroad. In Kanawha county the fire-brick industry is comparatively in its infancy. The clay obtained there is well adapted to the manufacture of furnace brick used in the construction of coke ovens. The industry in this county bids fair to be of great importance, as the coke business furnishes a heavy demand for the product. The following analysis of fire-clay from property near Nuzum's mills, Marion county, was made by Prof. Edgar Richards, chemist of the United States Treasury Department:

Analysis of fire-clay from near Nuzum's mills, Marion county, West Virginia.

	Per cent.
Moisture	1.33
Silica	59.25
Alumina	32.26
Undetermined lime, etc	7.16
Total	100.00

At Chattanooga, Tennessee, a single firm manufacturing fire-brick has put in six new kilns during the past year, increasing their capacity about one-fourth. The clay mine operated by this firm is one of the largest in the South. Prospects for future trade in fire-brick are good. At Florence, Alabama, a company has been formed with $100,000 capital to establish fire-brick works. At Fort Payne, Alabama, the development of a deposit of fire-clay has been commenced during the past year. Analyses and practical tests of this clay show it to be a fine quality for the manufacture of refractory material. The name of the company carrying on this enterprise is the Fort Payne Fire Brick Works. Mr. W. G. Taylor, until recently superintendent of the Mount Savage Fire Brick Works, has been engaged as superintendent and manager of the new works, and he is engaged in pushing the completion of the plant. The establishing of pottery works at Fort Payne is also contemplated, some portions of the clay being regarded as of sufficiently good quality for pottery manufacture. Fire-brick works are also to be established during the present year at Columbus, Georgia. A new and extensive plant for the manufacture of sewer pipe, terra cotta and fire-brick has just been established at South Riverside, California. It is believed that products equal in quality to those manufactured in Ohio can be produced at this point. The enterprise promises to be of considerable importance to southern California.

Five miles from Socorro, New Mexico, a well-defined, large and uniform vein of fire-clay has been discovered. The quality of the clay appears to be unusually good. It has been tested practically as well as in the laboratory, and the above statement in regard to its quality appears to be amply justified. Efforts have recently been made to stimulate local manufacture of fire-brick and other refractory products from this clay. Judging from appearances, an enterprise of this kind would meet with success, inasmuch as all articles constructed of fire-clay or kaolin are now shipped to this point from the East at very heavy transportation expenses.

Fire-brick imported for consumption in the United States, 1884 *to* 1888, *inclusive.*

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Number.
1884	1,524,000
1885	3,401,449
1886	4,904,675
1887	5,836,500
1888	6,093,491

Building brick and fire-brick exported from New York from 1877 to 1888, inclusive.

Calendar years.	Building brick.		Fire-brick.	
	Number.	Value.	Number.	Value.
1877	13, 603, 475	$70, 629	45, 000	$2, 185
1878	4, 471, 980	29, 457	118, 994	3, 148
1879	1, 381, 775	9, 371	94, 976	6, 867
1880	921, 654	7, 486	80, 000	3, 208
1881	971, 500	8, 663	181, 359	8, 361
1882	778, 000	7, 026	269, 810	9, 843
1883	2, 642, 625	21, 737	358, 616	11, 039
1884	1, 702, 850	14, 148	300, 100	9, 042
1885	973, 000	8, 894	....	12, 059
1886	977, 500	9, 075	223, 010	7, 838
1887	580, 500	5, 785	294, 250	9, 566
1888	497, 000	5, 135	255, 060	8, 929

POTTERY.

The past year has shown a material falling off in the quantities of kaolin, flint, and feldspar used by potters in the United States. Prices of these materials have also declined. The following statement gives the quantities and values of the raw materials used in the manufacture of pottery in the United States during 1888:

Amount and value of potters' materials used in the United States in 1888.

	Quantity.	Value.
	Tons.	
Kaolin, or china clay	18, 000	$189, 000
Ball clay	5, 250	31, 500
Fire clay	13, 500	40, 500
Ground flint	16, 250	138, 125
Ground feldspar	8, 700	95, 700

The total value of the output of the American potteries is estimated at from 15 to 20 per cent. less than the figures for 1887. The proportion of decorated wares is about 40 per cent. of the whole product. The following figures give the value of the products of the United States potteries in 1888:

Value of the products of the potteries of the United States in 1888.

	Value.
Ware for domestic table and toilet use (*a*)	$7, 000, 000
For plumbers' use (*b*)	900, 000
For all other purposes	750, 000

a Forty per cent. of this was decorated and the remainder white.
b A small percentage of this was decorated.

New discoveries and developments.—Although the figures given for the raw products consumed in the manufacture of pottery do not indicate a remarkably successful year for this industry, still, the various plans on foot to erect new establishments and to add to the plants already in existence, indicate that the future prospects of the pottery industry as a whole are by no means bad. A company known as the Delmont Kaolin Deposit Company, whose operations are to be carried on in the town of Oyster Bay, Queens county, New York, has filed articles of incorporation at Albany. The objects of this company are to take, acquire by purchase or otherwise, and to hold and sell real estate containing deposits of kaolin, pottery clay, and accompanying materials; also to manufacture, deal in, and sell the same and the products thereof. The amount of the capital stock is placed at $300,000. It is reported that pottery works are to be established at Fort Payne, Alabama. Kaolin deposits have already been purchased. A company of capitalists of East Liverpool, Ohio, and Kittanning, Pennsylvania, has purchased a 5-acre tract along the Valley road north of Kittanning, and contracts for kilns, buildings, etc., to cost about $30,000, were let during the early spring of the present year. It is expected that operations will be commenced in September. It is expected also that at the start about 60 hands are to be employed. During the year an 8-foot vein of kaolin was discovered at Golden, Colorado. No developments have, however, as yet been reported.

IMPORTS AND EXPORTS.

As will be seen from the following tables, there is a considerable importation of clay and its products, especially china, porcelain, etc., and a small export trade:

Value of earthenware and stoneware of domestic manufacture exported from the United States from 1790 to 1888, inclusive.

Years ending—	Value.	Years ending—	Value.	Years ending—	Value.
Sept. 30, 1790	$1,990	June 30, 1846	$6,521	June 30, 1868	$29,528
1791	1,984	1847	4,758	1869	19,213
1826	1,958	1848	8,512	1870	42,120
1827	6,492	1849	10,632	1871	37,383
1828	5,595	1850	15,644	1872	48,941
1829	5,592	1851	23,096	1873	53,909
1830	2,773	1852	18,310	1874	59,494
1831	7,378	1853	53,685	1875	92,253
1832	6,333	1854	33,867	1876	73,846
1833	12,159	1855	32,119	1877	87,355
1834	12,745	1856	66,696	1878	98,035
1835	16,427	1857	34,256	1879	80,898
1836	13,391	1858	36,783	1880	106,724
1837	14,249	1859	47,261	1881	123,177
1838	12,019	1860	65,086	1882	180,773
1839	11,645	1861	40,524	1883	227,547
1840	10,959	1862	32,108	1884	236,247
1841	6,737	1863	88,244	1885	135,385
1842	7,618	1864	67,591	Dec. 31, 1886	203,699
June 30, 1843 (9 mos)	2,907	1865	93,258	1887	221,282
1844	4,884	1866	31,616	1888	138,502
1845	7,393	1867	29,308		

Earthenware and china imported and entered for consumption in the United States, 1867 *to* 1888, *inclusive.*

Years ending—	Brown earthen and common stone ware.	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, 989	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, 201, 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

Value of tiles imported for consumption in the United States, 1868 *to* 1888, *inclusive.*

Years ending—	Encaustic.	Roofing and paving.	Total.
June 30, 1868	$11, 423	....	$11, 423
1869	7, 599	$1, 443	9, 042
1870	8, 549	875	9, 424
1871	4, 771	884	5, 655
1872	8, 083	31, 453	39, 536
1873	18, 717	51, 772	70, 489
1874	14, 193	51, 010	65, 203
1875	15, 401	45, 360	60, 761
1876	15, 267	29. 903	45, 170
1877	16, 787	42. 143	58, 930
1878	13, 112	41, 032	54, 144
1879	17, 355	31, 177	48, 532
1880	16, 896	34, 063	50, 959
1881	21, 106	43, 717	64, 823
1882	27, 729	46, 562	74, 291
1883	16, 459	83, 777	100, 236
1884	16, 011	115, 770	131, 781
1885	10, 312	99, 258	109, 570
Dec. 31, 1886	11, 055	75, 436	86, 491
1887	11, 768	67, 388	79, 156
1888	11, 218	59, 612	70, 830

Value of clay exported from the United States, 1865 *to* 1888, *inclusive.*

Years ending—	Value.	Years ending—	Value.
June 30, 1865	$29, 975	June 30, 1878	$8, 384
1869	5, 065	1879	6, 314
1870	2, 354	1880	8, 355
1871	10, 904	1881	8, 762
1872	5, 275	1882	17, 458
1873	4, 970	1883	17, 790
1874	8, 146	1884	7, 725
1875	13, 933	1885	8, 225
1876	4, 325	Dec. 31, 1886	9, 978
1877	5, 493	1887	16, 774
		1888	15, 964

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* 1888; *previous year ends June* 30.

Kinds.	1885.		1886.		1887.		1888.	
	Long tons.	Value.	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	18,150	$102,050
All others:								
Unwrought.........	9,736	76,899	13,740	113,875	17,645	139,405	20,604	152,694
Wrought	3,554	29,839	1,654	20,730	2,187	22,287	6,832	53,245
Total	23,916	190,460	31,984	257,698	43,318	303,052	45,586	307,989

Value of brick, etc., of domestic production exported from the United States.

Year ending—	Brick and lime.	Brick, lime, and cement.	Fire-brick and fire-tile.	Brick other than fire.	Total.
Sept. 30, 1826	$6,075				$6,075
1827	3,365				3,365
1828	4,573				4,573
1829	3,717				3,717
1830	2,482				2,482
1831	4,412				4,412
1832	3,502				3,502
1833	3,866				3,866
1834	4,294				4,294
1835	4,133				4,133
1836	6,829				6,829
1837	29,626				29,626
1838	31,322				31,322
1839	16,298				16,298
1840	16,949				16,949
1841	14,064				14,064
1842	5,728				5,728
June 30, 1843 (9 mos.)	3,883				3,883
1844	12,833				12,833
1845	8,701				8,701
1846	12,578				12,578
1847	17,623				17,623
1848	24,174				24,174
1849	8,671				8,671
1850	16,348				16,348
1851	22,045				22,045
1852	13,539				13,539
1853	32,625				32,625
1854	33,194				33,194
1855		$57,393			57,393
1856		64,297			64,297
1857		68,002			68,002
1858		103,821			103,821
1859		160,611			160,611
1860		154,045			154,045
1861		93,292			93,292
1862		83,385			83,385
1863		99,313			99,313
1864		49,106			49,106
1865		64,105			64,105
1866		146,874			146,874
1867		102,324			102,324
1868		140,338			140,338
1869		83,229			83,229
1870			$4,483	$25,091	29,574
1871			18,471	9,279	27,750
1872			10,233	14,305	24,538
1873			14,651	10,632	25,283
1874			22,365	11,290	33,655
1875			14,476	12,120	26,596
1876			20,348	18,035	38,383
1877			9,892	25,571	35,463
1878			13,900	254,446	268,346
1879			11,096	51,714	62,810
1880			12,027	36,299	48,326
1881			12,290	27,989	40,279
1882			30,649	50,870	81,519
1883			47,120	56,227	103,347
1884			41,012	60,702	101,714
1885			31,058	41,181	72,239
Dec. 31, 1886			55 119	49,605	104,724
1887			46,165	34,378	80,543
1888			47,911	24,859	72,770

ABRASIVE MATERIALS.

Buhrstones.—The total value of the buhrstones produced during the year 1888 is estimated at $81,000.

A noticeable decline in this industry continued during the year 1888, and while it is difficult to procure exact figures of production at the various localities, it is evident that the demand for domestic millstones is steadily decreasing. At the quarries near Kyserike, New York, where the so-called Esopus stone is quarried, there was a slight decrease in production, the value of that product being $60,000, or $1,500 less than in 1887. About fifty men are employed at this locality. The Cocalico millstone quarries, near Durlach, Pennsylvania, showed also a decrease in production, the value being $1,000, against $5,000 for the previous year. These quarries are owned by private individuals, and are worked only when orders for stones are received. The statements from Parkewood, North Carolina, indicate that the quarrying of the stone known as North Carolina grit progressed without any noteworthy change, the value of the product being $20,000.

Buhrstones and millstones imported and entered for consumption in the United States 1868 to 1888, inclusive.

Years ending—	Rough.	Made into mill-stones.	Total.	Years ending—	Rough.	Made into mill-stones.	Total.
June 30, 1868...	$74, 224	....	$74, 224	June 30, 1878 .	$87, 679	$1, 928	$89, 607
1869...	57, 942	$2, 419	60, 361	1879 ..	101, 484	5, 088	106, 572
1870...	58, 601	2, 297	60, 898	1880...	120, 441	4, 631	125, 072
1871...	35, 406	3, 698	39, 104	1881...	100, 417	3, 495	103, 912
1872...	69, 062	5, 967	75, 029	1882...	103, 287	747	104, 034
1873...	60, 463	8, 115	68, 578	1883...	73, 413	272	73, 685
1874...	36, 540	43, 170	79, 710	1884...	45, 837	263	46, 100
1875..	48, 068	66, 991	115, 059	1885...	35, 022	455	35, 477
1876 ..	37, 759	46, 328	84, 087	Dec. 31, 1886 ..	29, 273	662	29, 935
1877...	60, 857	23, 068	83, 925	1887...	23, 816	191	24, 007
				1888...	36, 523	705	37, 228

Grindstones.—During 1888 the product of grindstones in the United States amounted to 41,000 long tons, valued at $281,000, being a slight increase over that for the previous year. Of the above amount, about three-fifths was produced by the Cleveland Stone Company of Ohio and Michigan, and the balance by eight or nine companies operating in Ohio.

The following table shows the value of the importations:

Grindstones imported and entered for consumption in the United States, 1868 to 1888, inclusive.

Years ending—	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	....	....	....	....	86,286
1885	....	....	....	....	50,579
Dec. 31, 1886	....	....	....	....	(a)39,149
1887	....	....	....	....	(a)50,312
1888	....	....	....	....	(a)51,755

a Classed as unfinished.

Corundum.—During 1888 the product of corundum amounted to 589 short tons, valued at $91,620. The mines at Laurel creek, Georgia, and at Cullasaja, North Carolina, remain the sources of supply.

Emery imported and entered for consumption in the United States, 1867 to 1888, inclusive.

Years ending—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total.
	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	*a* 144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287	....	....	8,743	118,246

a To June 30 only; since classed with grains.

Exports of manufactured emery from 1878 to 1888, inclusive.

Years ending—	Value.	Years ending—	Value.
June 30, 1878	$813	June 30, 1884	$3,565
1879	1,608	1885	99,232
1880	1,265	Dec. 31, 1886	39,616
1881	1,312	1887	39,668
1882	1,242	1888	25,108
1883	1,857		

INFUSORIAL EARTH.

The deposit of infusorial earth near Dunkirk, Calvert county, Maryland, known as the Lyons Creek mine, continues to be the principal source from which infusorial earth is obtained; in fact, it might be called the only producing locality in the United States, as the reports indicate that the deposits elsewhere have either been abandoned or have come to a standstill, on account of a limited demand for the product and the lack of transportation facilities. About $35,000 have been invested in the Lyons Creek plant, which is operated by the New York Silicate Company, employing 20 to 25 men. The product is shipped by water, principally to New York City, at a cost of $1.66 per ton by sailing vessels, and $2 per ton by steamers. The amount produced during the year 1888 was 1,500 short tons, at a spot value of $7,500.

Norwegian infusorial earths.—Recent discoveries of siliceous earths have been made on the south coast of Norway, in the upland lakes surrounding the several fjords in the neighborhood of the town and shipping port at Farsund. Numerous analyses of both German and Norwegian infusorial earths show that they contain from 77 to 91 per cent. of silica in their raw state, and when washed and calcined, up to 96.40 per cent., with from 1 per cent. to 2 per cent. of alumina, the remainder being harmless alkalies and lime, with less than 1 per cent. ferric oxide. Owing to their scarcity, it is only within the last few years that infusorial earths have been employed to any appreciable extent except in the manufacture of dynamite, lithofracteur, and the other nitro-glycerine class of explosives, 25 per cent. of which is infusorial earth. They are now, however, coming rapidly into extensive use for a variety of purposes in the arts and manufactures. That the demand is likely to increase will be readily understood from a short description of their composition and the state in which these siliceous earths are found.

In the trade pamphlets of the Hamburg houses dealing in this commodity in 1884 these earths are specified as being employed in 39 different manufactures. Two years later (1886) they had increased to 54, while in 1887 circulars gave 61 leading uses to which they are applied. The raw material ranges in price at Hamburg from 50*s.* to 120*s.* per ton, according to quantity and color. The discoveries which have been made in the lakes mentioned, under the exceptional circumstances referred to, must unquestionably, not only cause a revolution in the existing business in this commodity, but, owing to the great abundance in which the material is found and the trifling price at which it can be put free on board in vessels of any size, are destined to capture the entire trade, hitherto monopolized by Germany. These lakes also afford almost unlimited water power for any purpose to which it can be made available for the mechanical manipulation and manufacture of their product. These earths are so abundant, and the facilities for getting, manufacturing, and shipping are so great, that in conjunction with their peculiarly valuable properties they will no doubt be obtained so cheaply as to enable all kinds of fire-resisting articles—enamel bricks, terra-cotta, fancy tiles and quarries, and glazed ware goods—to be manufactured on the spot at a highly remunerative rate.

PRECIOUS STONES.

By George F. Kunz.

No systematic mining for precious stones was carried on during 1888, although two small crystals of emerald, valued at about $100, were found at the mines at Stony Point, Alexander county, North Carolina.

Diamonds.—Considerable excitement prevailed during the spring at Morris Station, 13 miles south of Atlanta, Georgia, where the diamond described on page 558 of Mineral Resources for 1887 was found; and much was said at the time as to the resemblance of this locality to that of other diamond-producing districts; but no further discoveries have been reported, although there was every reason to believe, from the statement of the local newspapers, that extensive working would be carried on. During the summer of 1888 a small elongated hexoctahedral crystal of diamond, weighing seven-sixteenths of a carat, was reported to have been found by Mr. C. O. Helm on the farm of Mr. Henry Burris, about 300 yards from the Cabin Fort creek, Russell county, near Adair county, Kentucky. While walking through an old field Mr. Helm observed a small, bright stone in the gravel. On investigation it proved to be a diamond, octahedral in form, with curved faces, lustrous, but slightly off color. The rock in the vicinity is said to be composed of granite dikes, slates and quartz, feldspar, magnetic iron ore, flint, garnets, etc., scattered through hills of clay.

Beryl, phenacite, and topaz.—During the summer of 1888 prospecting was carried on near the top of Mount Antero, Colorado, at an altitude of from 12,000 to 14,000 feet above the level of the sea, and several pockets of crystals of blue beryl and phenacite were found. The blue beryls resembled those from Mourne mountain, Ireland, except that they were very curiously etched and partly eaten out. From the crystals, perhaps a hundred in number, material was obtained which furnished cut gems weighing from 1 to 12 carats. They were of good blue color, although often containing the characteristic beryl striations. The crystals and gems together brought about $600 or $700. The phenacites were found implanted on quartz and beryl, and crystals valued at more than $500 were obtained, although none of them were suitable for cutting. On January 12, 1888, near Little Robinet's store and Little River church, in the vicinity of Russell Gap road, Alexander county, North Carolina, a farmer, while plowing, found a crystal of dark, sea-green beryl, weighing 28 ounces, parts of which would furnish gems weighing from 1 to 20 carats each. This beryl resembles that variety found at the Stony Point emerald mine, 10 miles distant, and at the Miller farm, 12 miles distant, and also that found in Alexander county. This stone would furnish larger gems than any previously found in North Carolina. During May, 1887, Mr. E. D. Andrews discovered a deposit of crystals of topaz and phenacite on Bald mountain, North Chatham, New Hampshire. The crystals were transparent, light blue, and sherry colored, the larger specimens measuring over 2 inches in length. None of the phenacites were more than half an inch in diameter and all were very primitive in habit. The find was worth about $700.

Garnet.—During the past year considerable attention has been paid to the gathering of the blood-red garnets, the so-called "Arizona and New Mexico rubies." The Navajo Indians have collected and sent from their reservation several hundred pounds of these, among which were some fine gems. Three splendid ones were valued at $75, $50, and $35, respectively. Some of these garnets are believed to have been pounded from what is evidently a peridotite rock. This theory requires verification, as no Government survey has been made of the locality. Of the variety of spessartite garnet found in the Allen mica mines at Amelia Court House, Virginia, mentioned in Mineral Resources for 1887, page 459, a number of irregular masses with a crystalline exterior were obtained, which on cutting furnished fine gems very similar in color and luster to the essonite or hyacinth of Ceylon. The cut stones varied from 1 to 100 carats in weight.

Epidote.—Specimens of epidote in brilliant crystals, 1 inch in length and one-half inch in diameter, apparently dark or black, but perfectly transparent, showing a deep grass green and brownish yellow when viewed in different directions, have been found by Rev. C. D. Smith, 1 mile from Rabun Gap, Rabun county, Georgia. They occur in single simple crystals and twins, identical in habit with those from Unter Sultzbachthal, Tyrol. They were found in veins of pink granite rock on the south slope of the Blue Ridge mountains. The locality promises to afford crystals as fine as the famous Tyrolese gems, although the size may be smaller.

Agatized wood.—Large quantities of the agatized and jasperized wood from Arizona, for which the name "shinarump" (the name used by the Indians) has been suggested as appropriate by Maj. J. W. Powell, have been taken from the locality, and have been cut into sections and polished for table tops, tiles, and for other ornamental purposes. Some of these have been prepared for exhibition at the Paris exposition. One monster stump, weighing $2\frac{1}{10}$ tons, was sent to New York City, and when polished had a surface of $40\frac{1}{2}$ by 36 inches—as large a polished surface of so hard a substance as is known.

Fire opal.—A specimen of fire opal, $1\frac{1}{2}$ by 1 by $\frac{1}{2}$ inch, evidently a water-worn fragment, was found near John Davis river, in Crook county, Oregon. It is transparent, grayish white in color, with red, green, and yellow flames. The play of colors equals in beauty that of any Mexican material, and it is the first opal found in the United States that exhibits color. Undoubtedly better material exists in the locality where this was found.

Dumortierite.—About the same time that Messrs. Riggs and Diller found that the blue mineral supposed to be indicolite was identical with dumortierite in Harlem, New York, masses of quartz were discovered in Yuma county, Arizona, heavily impregnated with dumortierite and of an indigo-blue color, and which when polished resembled the blue lapis lazuli, and would serve the same purpose in jewelry, as the quartz is harder than lapis lazuli.

Tourmaline.—Among some very interesting minerals found by Messrs. C. E. Beecher and S. A. Robinson, at Newcomb, Essex county, New York, were some remarkable specimens of brown tourmaline. The crystals, although not so fine as those from Gouverneur, New York, were frequently sufficiently transparent to offer material for at least one hundred gems, weighing from 1 to 10 carats. They varied from golden brown to topaz-yellow in color.

Rhodonite.—This mineral, which has been known to occur in bowlders near Cummington, Massachusetts, has been traced to the ledge. Fine masses, weighing several hundred pounds, have been blasted out, and efforts will be made during the coming year to introduce this as an ornamental stone, it being as beautiful as the Siberian variety, which is so extensively used for table tops, mantel pieces, paper weights, etc., in Russia.

Turquois.—Considerable mining of a desultory character has been carried on at the turquois mines near Cerrillos, New Mexico, by the Indians and hunters, who obtained the turquois in a primitive manner by building fires against the wall rock and then cracking off large masses by throwing water on it. This method, however, invariably destroys the color. Some of the material sent from this locality during the past year was in form of thin veins entirely free from rock. In color it was almost equal to the poorer Persian material, and should find a ready use as an ornamental or decorative stone. The recent releasing of the property is likely to prevent the existing method of working the locality. A new deposit of turquois was opened during the year in the Holy Cross mining district, 30 miles from Leadville, Colorado, which is very similar to the variety from Arizona and New Mexico, the color being, if anything, a better blue. At this locality there was no evidence of prehistoric mining. Until recently the impression in the vicinity was that the turquois was an ore of copper.

Gadolinite.—This stone admits of a high polish, and is of a deep velvet-black color. During the last year large quantities of it were obtained near Bluffton, in Llano county, Texas, 22 miles from Burnet. The occurrence of this gadolinite was somewhat similar to that of allanite in Amherst county, Virginia. It has more than ordinary interest from the fact that it contains from 40 to 50 per cent. of yttria. About 1,000 pounds were found in a single pocket, associated with xenotime, fergusonite, and euxenite. One crystal weighed 11 pounds, another 13 pounds, and a single group weighing 40 pounds was obtained. The productions of this locality exceeded in quality and size anything yet obtained.

Fluorite.—About four years ago a small vein of fluorite was discovered in the Archaean limestones in the town of Macomb, Saint Lawrence county, New York. It was worked irregularly from time to time until last summer, when the vein suddenly widened, breaking through into an opening or cavity 22 feet in length and varying in width from 8 to 18 feet. The top, bottom, and sides were lined with a magnificent sheet of crystals, varying from 1 to 6 inches in diameter, and each in turn forming part of larger composite crystals. Between the floor and the walls was a layer of partly-decomposed calcite, which was readily removed, so that groups of crystals weighing from 10 to several hundred pounds each, and one of them measuring 2 by 3 feet, were easily detached. The cavity contained at least 15 tons of fluorite. The habit of the crystals is, in nearly every instance, that of the simple cube, but slightly-developed faces of the octahedron are often present. Almost all the crystals have on the surface a small, botryoidal elevation, an even coating of brown hydrodolomite, which is readily removed with diluted hydrochloric acid. The crystals are well colored, but the surfaces are dull. The fluorite is of a uniform light sea-green color, except where it is attached to the gangue, or at the junction of the crystals. Here there are small spots of a rich emerald-green from 1 to 2 inches in diameter. This find is strikingly like that of the famous Muscallonge lake localities of forty years ago, except that the crystals are of a finer color and occur in larger groups. The occurrence of a second deposit in this county leads the hope that fluorite may exist here in commercial quantity available for the arts.

Amber.—For the last fifteen or twenty years travelers have occasionally brought specimens of a remarkable amber from some locality in southern Mexico. The information that has been gained concerning it is brought to the coast by natives, who say that it occurs in the interior so plentifully as to be used by them for making fires. The color of this amber is a rich golden yellow, and when viewed in different positions it exhibits a remarkable fluorescence, similar to that of uranine when dissolved in water, which it also resembles in color. A specimen now in the possession of Mr. M. T. Lynde, of Brooklyn, New York, measures 4 by 3 by 2 inches, is perfectly transparent, and is even more beautiful than the famous so-called opalescent or green amber found in Catania, Sicily. This material would be extremely valuable for use in the arts. It is believed that an expedition has started for the locality in the interior where it is found.

New developments in foreign localities.—The Burmese ruby mines were leased to a powerful London syndicate in November, and machinery was immediately sent to Mandelay, Burmah, for the purpose of prospecting and working the mines. From all appearances active explorations will take place during 1889, and within a short time it will be definitely known whether or not these mines are exhausted.

Estimated production of precious stones

Species.	1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	....	$800	$800	....	....	....
Sapphire gems	$250	1,500	1,750	....	$500	$500
Chrysoberyl	25	....	25	....	....	....
Topaz	200	300	500	$1,000	250	1,250
Beryl	300	400	700	250	500	750
Phenacite	....	....	....	....	....	....
Emerald	....	....	....	3,000	200	3,200
Hiddenite	....	....	....	500	2,000	2,500
Tourmaline	1,500	500	2,000	500	100	600
Smoky quartz	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	3,000	4,000	200	2,500	2,700
Anthracite	....	2,500	2,500	....	2,500	2,500
Pyrite	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000	....	10,000	10,000	....	10,000
Arrow points	1,000	....	1,000	....	2,500	2,500
Trilobites	500	....	500	....	1,000	1,000
Sagenitic rutile	500	500	1,000	....	250	250
Hornblende in quartz	500	100	600	....	300	300
Thompsonite	250	500	750	250	500	750
Diopside	....	....	....	100	....	100
Agate	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500	....	....	....
Turquois	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500	....	....	....
Sunstone	250	200	450	250	100	350
Fossil coral	500	250	750	....	....	....
Rutile	....	....	....	750	....	750
Total	54,275	28,550	82,825	39,300	30,550	69,850
Gold quartz	40,000	100,000	140,000	40,000	100,000	140,000

in the United States from 1884 *to* 1888.

1886.			1887.			1888.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
	$60	$60						
$250	500	750		$500	$500		$500	$500
1,000		1,000	$1,500	500	2,000	$500	100	600
	5,500	5,500	500	3,000	3,500	300	500	800
						650		650
3,000	200	3,200				100		100
3,500	1,000	4,500						
3,500	2,000	5,500	300	200	500			
2,000	5,000	7,000	1,500	3,000	4,500	1,000	3,000	4,000
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,150	11,150
500	1,000	1,500	35,000	1,000	36,000	1,000	15,000	16,000
1,250	2,000	3,250	2,500	1,000	3,500	2,000	1,500	3,500
	2,500	2,500	2,000		2,000	1,500		1,500
1,500	500	2,000	2,000	500	2,500	2,000	500	2,500
2,000	250	2,250	1,500	200	1,700	1,500	200	1,700
10,000		10,000	5,000		5,000	5,000		5,000
	2,500	2,500		1,500	1,500	1,500		1,500
1,000		1,000	500		500	500		500
1,750		1,750						
200		200		100	100			
100	300	400	250	500	750	300	200	500
			50		50			
1,000	1,000	2,000	3,000	1,000	4,000	3,000	1,000	4,000
500	500	1,000	300	500	800	300	500	800
1,000	2,000	3,000	1,000	1,500	2,500	1,500	1,500	3,000
1,000	1,000	2,000	200	750	950	200	750	950
2,000	100	2,100	2,000	100	2,100	2,200	300	2,500
						100		100
200	100	300	50	100	150			
1,000		1,000	1,500	500	2,000	2,500	500	3,000
750		750						
49,000	29,510	78,510	70,650	17,950	88,600	37,650	27,200	64,850
		40,000			75,000			75,000

FERTILIZERS.

SOUTH CAROLINA PHOSPHATE ROCK.

While the vicinity of Charleston and Beaufort has been the steady source for practically all the phosphate used in commercial fertilizers for years, and while the amount of the product has increased annually with only moderate fluctuations, the industry, taken as a whole, has been exceptionally subject to such periods of alternating depression and prosperity as to make it more irregular than many others which are affected by the competition of diverse sources of production. This is in part due to the natural conditions of mining. The deposits are worked by open cuts and only to a moderate depth, making the total cost of production small and inviting the competition of many producers within a small area. Further, the price to be obtained after the phosphate rock is mined and converted into fertilizers depends largely upon the yield of the season's crops, and the consequent purchasing ability of farmers who work without reserves. This last condition and less competition, or rather direct combination among the miners of land rock, resulted favorably during 1888, and a prosperous year was the result. Mr. Paul C. Trenholm has collected the statistics of the phosphate rock produced. It amounted to 448,567 long tons in 1888, against 480,558 long tons in 1887; but the total value of the product in 1888 was $2,018,552, against $1,836,818 in 1887. The average price of land phosphate rock in 1888 was $4.75, and for river rock $4.25, a general gain of about 50 cents per ton over 1887. The distribution of this and previous years is given in the table to follow. The area of the land near Charleston underlaid by phosphate rock at a reasonable depth for mining is tolerably well known. In this area a new opening was made by the Horseshoe Mining Company on the line of the Charleston and Savannah railroad and by Mr. E. J. Hanrahan on Cooper river. The former is quite a large tract. The price of phosphate land has, in general, risen remarkably during the past year. Some land has been sold as high as $250 per acre, and much land favorably located could not be bought for that price. This advance is entirely out of proportion to the increase in phosphate rock, and is the result of efforts to put the known reserve in fewer hands. Further, English capital was freely offered for the purchase of land and mining plants, and it is probable that the active speculation in rock still under ground will be a more important factor in future prices than scarcity of labor, which is complained of. Concerning the commercial fertilizer trade of South Carolina in 1888, Mr. E. Willis writes that it was good during January and February, but then became dull; and although shipments kept up, the prices declined so that at one time the manufacturers declined to name prices. But from the result of the last year's crops the demand increased again very rapidly during the spring and the total shipments for the season were heavier than ever. All the companies sold all they manufactured, giving their mills such a clearing out as had not been known before. It is believed that every one of the companies paid dividends, besides taking advantage of the "clean-up" to overhaul and repair the plant. The South Carolina companies virtually controlled their own market. Foreign imports were very small, and even the northern companies placed their products more in the western States. Naturally the extended business has led to negotiations for locating new manufactories in South Carolina, and particularly from English producers. The latter are in favor of substituting pyrites for Sicilian sulphur in making sulphuric acid.

Production of phosphate rock in South Carolina during the calendar year 1888.

Destinations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
From Charleston, South Carolina.							
Domestic, crude:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Baltimore	4,228	4,457	6,903	7,428	9,655	6,625	6,010
Philadelphia	....	1,575	735	3,671	4,714	1,231	2,990
New York	700	....	741	1,795	810	1,281	598
Newtown Creek, New Jersey	1,120	....	487	652	1,290	....	....
Seaford, Delaware	....	....	....	....	602	....	....
Wilmington, Delaware	....	....	....	....	403	580	....
Orient, Long Island	....	....	....	....	1,210	....	800
Wilmington, North Carolina	....	1,724	1,255	539	909	890	95
Barren Island, New York	....	750	392	1,150	....	....	625
Boston, Massachusetts	....	....	....	....	....	....	....
Weymouth, Massachusetts	1,425	720	2,265	1,827	852	720	1,406
Richmond, Virginia	....	676	675	....	682	1,098	....
Elizabethport, New Jersey	....	1,350	1,752	1,050	....	....	700
Mantua Creek, New Jersey	....	....	....	672	....	807	705
Booth Bay, Maine	....	....	820	....	....	....	....
Coopers Creek, New Jersey	....	....	....	....	512	....	....
Petersburgh, Virginia	....	....	....	....	....	....	....
South Carolina railroad	497	1,150	1,715	1,874	1,215	1,132	433
Charleston and Savannah railroad	1,183	1,278	3,863	2,164	328	1,948	2,364
Northeastern railroad	....	....	....	176	77	185	398
Total domestic, crude	9,153	13,680	21,603	22,998	23,259	16,497	17,124
Domestic, ground:							
New York	100	....	400	200	....	....	1,075
Newtown Creek, New Jersey	....	....	....	....	....	....	....
Total domestic, ground	100	....	400	200	....	....	1,075
Foreign:							
Liverpool	800	....	....	....	....	....	....
United Kingdom	520	....	....	50	....	....	....
Genoa	....	60	....	80	....	....	....
Barcelona	....	100	....	....	....	....	....
Total foreign, crude	1,320	160	....	130	....	....	....
Beaufort, South Carolina, and vicinage (c).							
Domestic	....	....	850	1,455	812	393	2,033
Foreign	8,757	13,273	21,287	16,435	24,180	4,893	11,571
Total foreign and domestic, 1888	8,757	13,273	22,137	17,890	24,992	5,286	13,604

Production of phosphate rock in South Carolina, etc.—Continued.

Destinations.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
From Charleston, South Carolina.						
Domestic, crude:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Baltimore	1,655	4,470	7,405	5,665	7,145	71,646
Philadelphia	600	2,795	2,845	550	3,555	25,261
New York	1,164	.....	2,477	2,325	982	12,873
Newtown Creek, New Jersey	....	701	....	....	500	4,750
Seaford, Delaware	...	....	601	....	....	1,203
Wilmington, Delaware	1,125	....	....	1,000	560	3,668
Orient, Long Island	....	....	....	....	135	2,145
Wilmington, North Carolina	200	....	100	....	160	5,872
Barren Island, New York	757	760	....	761	....	5,195
Boston, Massachusetts	....	....	....	....	500	*a*500
Weymouth, Massachusetts	900	705	1,600	....	2,437	14,857
Richmond, Virginia	....	....	....	1,401	680	5,212
Elizabethport, New Jersey	....	720	810	....	....	6,382
Mantua Creek, New Jersey	....	....	....	600	....	2,784
Booth Bay, Maine	....	....	....	....	....	820
Coopers Creek, New Jersey	....	....	....	....	....	512
Petersburgh, Virginia	....	500	....	*b*500	....	1,000
South Carolina railroad	1,588	373	711	1,149	1,485	13,322
Charleston and Savannah railroad	3,129	3,127	2,904	2,141	2,435	26,864
Northeastern railroad	420	134	....	174	278	1,842
Total domestic, crude	11,538	14,285	19,453	16,266	20,852	206,708
Domestic, ground:						
New York	1,609	1,167	172	....	....	4,723
Newtown Creek, New Jersey	....	....	....	....	647	647
Total domestic, ground	1,609	1,167	172	....	647	5,370
Foreign:						
Liverpool	....	....	340	....	200	1,340
United Kingdom	....	1,350	....	....	....	1,920
Genoa	....	....	60	51	....	251
Barcelona	....	....	....	....	....	100
Total foreign, crude	....	1,350	400	51	200	3,611
Grand total from Charleston	....	....	....	....	....	215,689
Beaufort, South Carolina, and vicinage (c).						
Domestic	826	1,066	5,795	891	6,283	20,404
Foreign	11,217	4,846	2,919	....	5,096	124,474
Total foreign and domestic, 1888	12,043	5,912	8,714	891	11,379	144,878
Grand total from Beaufort	....	....	....	....	....	144,878

a In port for shipment to Weymouth, Mass.
b Lost.
c Domestic ports, except that mined in the marshes, on which no royalty is paid, and not cleared through the customhouse.

SUMMARY.

		Long tons.
From Charleston (domestic, 212,078; foreign, 3,611)		215,689
From Beaufort and vicinage (domestic, 20,404; foreign, 124,474)		144,878
Estimated consumption at Charleston		75,000
Estimated consumption at Beaufort		13,000
Grand total shipped from and consumed in South Carolina in 1888		448,567
Grand total shipped from and consumed in South Carolina in 1887		480,558
Decrease		31,991
Increase in shipments from Charleston		24,031
Decrease from Beaufort and vicinage		61,022
Charleston shipments:		
Increase, domestic	30,160	
Decrease, foreign	6,129	
Net increase as above		24,031

		Long tons.
Beaufort shipments:		
Increase, domestic	4,499	
Decrease, foreign	65,521	
Net decrease as above		61,022
Total decrease		36,991
Increase in consumption at Charleston		5,000
Net decrease for South Carolina		31,991
Crude rock shipments from Charleston increased this year over last		24,880
Ground rock shipments from Charleston decreased this year over last		849
Net increase shipments as above		24,031

The following statement shows the annual product of phosphate rock in South Carolina since it became an industry. The figures for 1886, 1887, and 1888 are for calendar years; the previous years are trade years, ending May 31:

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
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
1885 (June 1 to December 31)	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

The details concerning the disposition of these phosphates are given in the following table, the years ending May 31, except 1886, 1887, and 1888:

Detailed statement of total foreign and coastwise shipments and local consumption since July 1, 1874.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Other points.	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	
	Domestic ports	7, 000	25, 560	....	32, 560	122, 790
	Consumed	....	19, 684	....	19, 684	
June 1, 1875, to May 31, 1876.	Foreign ports	50, 384	25, 431	....	75, 815	
	Domestic ports	9, 400	28, 831	....	38, 231	132, 896
	Consumed	....	18, 850	....	18, 850	
June 1, 1876, to May 31, 1877.	Foreign ports	73, 923	28, 844	....	102, 767	
	Domestic ports	6, 285	40, 768	....	47, 053	163, 220
	Consumed	....	13, 400	....	13, 400	
June 1, 1877, to May 31, 1878	Foreign ports	100, 619	21, 123	....	121, 742	
	Domestic ports	8, 217	60, 729	....	68, 946	208, 323
	Consumed	....	17, 635	....	17, 635	
June 1, 1878, to May 31, 1879.	Foreign ports	97, 799	21, 767	....	119, 566	
	Domestic ports	8, 618	52, 281	....	60, 899	199, 365
	Consumed	....	18, 900	....	18, 900	
June 1, 1879, to May 31, 1880.	Foreign ports	47, 157	14, 218	....	61, 375	
	Domestic ports	13, 346	94, 002	....	107, 348	190, 763
	Consumed	....	22, 040	....	22, 040	
June 1, 1880, to May 31, 1881.	Foreign ports	62, 200	8, 568	....	70, 768	
	Domestic ports	65, 895	91, 929	....	157, 824	266, 734
	Consumed	....	38, 142	....	38, 142	
June 1, 1881, to May 31, 1882.	Foreign ports	89, 581	22, 905	....	112, 486	
	Domestic ports	57, 465	111, 314	7, 875	176, 654	332, 077
	Consumed	....	42, 937	....	42, 937	
June 1, 1882, to May 31, 1883.	Foreign ports	94, 789	28, 251	....	123, 040	
	Domestic ports	36, 175	150, 545	26, 000	212, 720	378, 380
	Consumed	....	42, 620	....	42, 620	
June 1, 1883, to May 31, 1884.	Foreign ports	132, 114	20, 539	....	152, 653	
	Domestic ports	34, 711	181, 363	6, 329	222, 403	431, 779
	Consumed	5, 800	50, 923	....	56, 723	
June 1, 1884, to May 31, 1885.	Foreign ports	111, 075	11, 495	....	122, 570	
	Domestic ports	30, 963	161, 700	13, 170	205, 833	395, 403
	Consumed	12, 000	55, 000	....	67, 000	
June 1, 1885, to Dec. 31, 1885.	Foreign ports	105, 761	8, 581	....	114, 342	
	Domestic ports	16, 321	112, 126	....	128, 447	277, 789
	Consumed	5, 000	30, 000	....	35, 000	
Jan. 1, 1886, to Dec. 31, 1886.	Foreign ports	153, 443	5, 926	....	159, 369	
	Domestic ports	14, 622	187, 558	....	202, 180	430, 549
	Consumed	9, 000	60, 000	....	69, 000	
Jan. 1, 1887, to Dec. 31, 1887.	Foreign ports	189, 995	9, 740	....	199, 735	
	Domestic ports	15, 905	181, 918	....	197, 823	480, 558
	Consumed	13, 000	70, 000	....	83, 000	
Jan. 1, 1888, to Dec. 31, 1888.	Foreign ports	124, 474	3, 611	....	128, 085	
	Domestic ports	20, 404	212, 078	....	232, 482	448, 567
	Consumed	13, 000	75, 000	....	88, 000	

Phosphates imported and entered for consumption in the United States, 1868 to 1888, inclusive.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	99, 668	$1, 336, 761	....	$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	....	165, 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
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

Guano brought from islands, rocks, and keys appertaining to the United States, 1869 *to* 1888, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Long tons.			*Long tons.*	
1869	15, 622	$253, 545	1879	8, 733	$95, 137
1870	14, 318	356, 830	1880	12, 795	147, 051
1871	14, 154	340, 235	1881	16, 883	179, 882
1872	4, 209	60, 865	1882	15, 249	160, 016
1873	11, 014	161, 690	1883	7, 873	92, 130
1874	6, 877	100, 345	1884	9, 333	106, 431
1875	7, 269	122, 012	1885	12, 100	86, 166
1876	14, 785	192, 972	1886	5, 770	38, 839
1877	6, 060	79, 822	1887	8, 226	55, 671
1878	17, 930	211, 239	1888	5, 765	41, 226

Prices.—Land rock opened in January, 1888, at $4 per ton for crude and $5 for kiln-dried rock. In February the formation of a combination among producers of land rock, called the Land Miners' Exchange, and the co-operation of the three principal river companies under one management, had a tendency to strengthen and gradually advance prices to $5 and $6 per ton in August for crude and kiln-dried respectively. These prices held to the end of the year. River rock also opened at about $4 and $5 for crude and dried, and remained so for several weeks, and then, influenced by the above causes, it gradually advanced to $4.75 and $5.75 and continued so to the end of the year. There was, however, the usual objection to naming prices, and some sales of crude river rock were made late in 1888 at $4.50, delivered to manufacturers in Charleston. Ground rock—about 99 per cent. of it land rock—opened at $6.50 per ton, and also advanced, reaching $7.50 in August and $8 in December.

Other States.—The use of North Carolina phosphate rock is increasing slowly, principally by the extension of the production of the North Carolina Phosphate Company, of Raleigh and Castle Hayne, and Messrs. French Brothers, of Rocky Point. The use of phosphatic marl is increasing more rapidly.

Phosphate rock of apparently high grade was discovered in 1886 on Peace river, Florida, where the Arcadia Phosphate Company and other operators are developing the rock exposed in the river bed. Mr. E. W. Parker, special agent of the Eleventh Census, has inspected the region and reports that about 3,000 tons were shipped to Atlanta, Georgia, from Arcadia, Florida, during 1888. Development work has been quite active, and included a permanent bridge, drying kilns, hoisting machinery, and screens. A mill for preparing the rock is projected. The richest rock is in the form of coarse sand from a bar in the river. The year 1888 developed an entirely different class of deposits of phosphate of lime, probably of great value to the State, and even of enough importance to cause much interest among Charleston producers and dealers in fertilizers all over the United States. At the close of 1888 Mr. Albert Vogt, living near Dunnellon, a village on the Withlacoochee river, in Marion county, found fossil sharks' teeth in a white subsoil. On some of this white soil being submitted to a chemist for analysis, it was found to contain a large proportion of phosphate of lime. This soil was soon found to extend, in a more or less "pockety" belt, over a district some 6 miles wide by 30 miles long from northeast to southwest. Active exploration has been begun, and the known area of the beds is being extended rapidly, and with the usual speculative course of such discoveries. Much has been written on the subject, but it is impossible to determine the area covered by the deposits, or to decide as to their actual value on account of their irregular character. The best description has been written by Prof. Albert R. Ledoux and published in the *Engineering and Mining Journal*, to which the reader is referred. He states that an area 30 miles in diameter, including Dunnellon on the north and Floral City on the south, and roughly bisected by the Withlacoochee river and covering Citrus, Marion, and Hernando counties, will show phosphate almost anywhere. In no pit or opening which he visited in that section did he find it entirely absent. Outside of this region, north, south, and east, there are undoubtedly large beds of undetermined extent. They lie in lenticular beds upon the "limestone," although this is rarely hard enough to be called rock. The deposits are covered by a sandy soil and clay sub-soil, rarely cropping out at the surface. Professor Ledoux has found the small white grains thrown up in ant-hills and around gopher holes to be a good indication of the existence of phosphate below. The phosphate is found at varying depths below the surface, sometimes within 2 feet and sometimes 10 or 12 feet down. In sinking a pit it is sometimes difficult to tell where the clay ends and the phosphate begins. They shade into each other at times gradually; at other times the clay is entirely absent, the sand being the only thing between the surface and the valuable mineral. When wet the phosphate is dark or light yellow, but usually quite white when dry. The thickness of the bed varies greatly, and there is nothing at the surface to indicate the thickness. It may be a few inches, or it may be 10 to 16 feet of solid phosphate. The surface indication, which is considered of value by some experts as indicating the presence of phosphate below the soil, is flint or siliceous rock protruding in masses above the surface. In a number of cases large percentages of alumina and iron have been found in the phosphate. Nevertheless, these very specimens have yielded superphosphate which dried easily and did not revert with the usual rapidity of superphosphates containing alumina and iron. Professor Ledoux suggests that this is because the alumina in these cases is in the form of clay and not of aluminum phosphate. In other cases the deposits appear to be entirely aluminum phosphate. The principal companies interested in developing these beds are the Dunnellon Phosphate Company, of Dunnellon, Florida, and the Baldwin Fertilizer Company, of Ocalla, Florida. There is also a company called the Peruvian Phosphate Company, of Tampa, Florida, operating a deposit on the Alafia river near Peru, Hillsborough county.

Manufactured fertilizers.—Good crops in 1887 in the region using commercial fertilizers left farmers able to give unusually large orders for 1888, and the result was a very prosperous season with good prices. The fact that previous low prices had closed several works, leaving the competition among fewer producers, also aided the advance. The total amount consumed is estimated at 1,213,000 tons, valued at $20,000,000. Of the total product one-half was acid phosphate, worth $12 per ton in Baltimore or Charleston, as sold by the manufacturers to large dealers. Of the remainder more than one-half is standard ammoniated phosphate, worth $20 per ton, and the rest principally dissolved bone, worth $22 per ton.

The following tables give the shipments of fertilizers from Charleston since 1879, and also a list of the manufacturers of fertilizers. It is probable that the output of 1889 will materially exceed that of 1888:

Statement of manufactured fertilizers shipped from Charleston since 1879.

[Calendar years.]

By—	1879.	1880.	1881.	1882.	1883.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
South Carolina railway:					
January	6, 559	17, 449	14, 930	18, 391	17, 721
February	14, 445	17, 368	18, 523	19, 837	32, 618
March	12, 044	10, 814	18, 721	12, 107	21, 626
April	2, 513	2, 761	3, 599	1, 711	2, 971
May	53	707	189	548	720
Northeastern railroad:					
January	285	1, 381	2, 186	2, 424	5, 430
February	3, 231	3, 366	3, 256	5, 362	9, 708
March	2, 731	3, 382	4, 939	7, 285	9, 091
April	634	977	3, 044	955	1, 638
May	48	201	28	198	216
Charleston and Savannah railway:					
January	1, 016	1, 102	951	690	2, 059
February	1, 791	1, 249	1, 155	1, 272	2, 888
March	1, 444	476	2, 375	594	1, 003
April	675	203	629	100	225
May	5	9	50	14	33
Georgetown, Pedee, Santee, and Edisto steamers:					
January to June	1, 364	2, 560	2, 950	2, 002	3, 517
Total five months	48, 838	64, 005	77, 525	73, 490	111, 464
For remainder of year	11, 162	15, 995	25, 000	29, 000	20, 000
Grand total	60, 000	80, 000	102, 525	102, 490	131, 464

By—	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
South Carolina railway:					
January	21, 443	23, 299	16, 037	16, 937	23, 647
February	29, 171	27, 175	26, 836	26, 632	29, 300
March	18, 118	26, 846	25, 840	23, 953	26, 556
April	5, 019	4, 813	2, 974	3, 756	6, 374
May	441	210	381	430	337
Northeastern railroad					
January	5, 194	7, 070	4, 847	5, 316	10, 651
February	12, 318	11, 398	12, 771	13, 104	14, 663
March	7, 822	10, 570	11, 620	10, 487	13, 839
April	2, 413	2, 001	1, 620	1, 776	4, 502
May	220	119	183	240	570
Charleston and Savannah railway:					
January	4, 196	3, 435	1, 897	3, 760	6, 918
February	5, 373	4, 457	3, 827	4, 280	10, 203
March	3, 525	2, 466	3, 379	1, 899	7, 141
April	1, 234	640	201	355	1, 351
May	20	27	817	98	292
Georgetown, Pedee, Santee, and Edisto, Beaufort and Florida steamers:					
January to June	6, 309	6, 869	5, 400	6, 300	5, 439
Total five months	122, 816	131, 395	118, 630	119, 323	161, 783
For remainder of year	17, 184	18, 605	24, 370	12, 477	22, 000
Grand total	140, 000	150, 000	143, 000	131, 800	183, 783

The following table, compiled from various sources, gives an estimate as to amount of manufactured fertilizers consumed in the various States:

Estimated consumption of manufactured fertilizers from 1885 to 1889, inclusive.

[Years ending April 30.]

States.	1885.	1886.	1887.	1888.	1889.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	45,000	40,000	38,000	40,000	45,000
Delaware	20,000	15,000	16,000	18,000	20,000
Florida	10,000	5,000	6,000	5,000	6,000
Georgia	180,000	160,704	160,000	150,000	175,000
Illinois	7,500	7,500	8,000	10,000	10,000
Indiana	10,000	7,500	10,000	10,000	15,000
Kentucky	10,000	8,000	8,000	8,000	10,000
Louisiana	5,000	10,000	8,000	8,000	12,000
Maryland	75,000	75,000	70,000	65,000	85,000
Michigan	5,000	10,000	10,000	15,000	15,000
Mississippi	10,000	5,000	5,000	10,000	15,000
Missouri	5,000	....	....	....	70,000
New York	35,000	30,000	30,000	40,000	40,000
New Jersey	45,000	50,000	40,000	50,000	60,000
New England States	100,000	100,000	75,000	75,000	100,000
North Carolina	90,000	95,000	90,000	90,000	105,000
Ohio	20,000	30,000	30,000	30,000	40,000
Pennsylvania	100,000	115,000	100,000	100,000	120,000
South Carolina	100,000	107,927	100,000	105,000	110,000
Tennessee	15,000	10,000	15,000	20,000	20,000
Virginia and West Virginia	100,000	100,000	75,000	75,000	100,000
Western States	30,000	25,000	40,000	40,000	40,000
Total	1,017,500	1,006,631	934,000	964,000	1,213,000

Marls.—The use of marls has increased notably in North Carolina. About 500 tons were produced in the neighborhood of Croatan. Increased production is also noted in Alabama, Mississippi, and Florida from deposits adequately described in former reports. In New Jersey a special examination of the marl beds was made Mr. Jefferson Middleton, of the United States Geological Survey, for the purpose of more accurately determining the total product, especially among farmers who dig and use the marl without selling it. His results follow:

Production of New Jersey marls.—The product in 1888 was about 300,000 tons, valued at $150,000, which is a decrease from 1887, owing to the extended use of manufactured fertilizers and the opinion of the farmers that land when thoroughly marled does not require an application for several years. But the decrease is not so great as is indicated by the difference between the total for 1888 and that published for 1887; evidently the statement for 1887 was too large. The prospects for increased production in the future seem good, as it is evident to users that the marl gives more permanent results than manufactured fertilizers. Monmouth county leads all the other New Jersey counties in the production of marl, over 100,000 tons being produced there last year Burlington county was second, with a product of 50,000 tons.

The marl is found in an oblong strip of land extending from Raritan bay and the Atlantic ocean southwest to the Delaware river. The strip is 20 miles in width at Raritan bay and narrows to 10 miles at the Delaware. The only deposit outside of this strip is at Shiloh, Cumberland county, where calcareous marl is mined to some extent.

The deposits are from a few inches to 20 feet or more from the surface, the earth intervening being termed "overlay." The beds themselves are from a few feet to 25 feet in thickness. In opening a pit the overlay is removed and the marl excavated to the bottom of the deposit. The overlay is then dumped into the pit to aid in making a roadway in continuing the excavation.

Marl is used wherever a fertilizer is needed. It seems especially adapted to grasses and cereals, and is used to some extent on tubers. A popular way of using it is in the form of a compost with barn-yard manure. The proportions of the compost are variable, but generally about one-third, by bulk, of marl to two-thirds manure. From 10 to 20 tons, and in some cases even more, are used to the acre. The method of application varies with the crop for which it is used; with some it is broadcast, with others it is drilled in, and with tubers it is placed in the hill.

Some years ago the Fostertown Marl Company made an attempt to dry and grind its marl, in the hopes of finding a market for it as a base for manufactured fertilizers. The drying and grinding were successful, but the market could not be found at the necessary price, and the attempt was abandoned. It is now used to a slight extent in its natural state as a base for manufactured fertilizers.

Apatite.—In Canada the production of apatite continued at about the average for several years past. Mr. E. Coste reports the product at 22,485 short tons, worth $242,285. Of this total, 20,396 tons came from Ottawa county, Quebec, and 2,089 tons from Ontario mines. The product for the past eleven years is shown below.

Product of Canadian apatite from 1878 to 1888, inclusive.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1878	3,701	1884	22,143
1879	11,927	1885	24,290
1880	7,974	1886	20,495
1881	15,601	1887	23,690
1882	17,181	1888	22,485
1883	17,840		

SALT.

BY WILLIAM A. RABORG.

The product of salt in the United States during the year 1888 amounted to 8,055,881 barrels, valued at $4,374,203.

In Michigan, New York, West Virginia, and Utah there was a slight falling off in the production as compared with that of the previous year. The total amount of salt produced in the United States, however, shows an increase over 1887 in quantity of 223,919 barrels, and in value of $280,357, owing chiefly to the production of the new wells in Kansas, which were operated during the year with an output of 155,000 barrels, valued at $189,000.

The amount and value of the salt produced in the United States during the year 1888 is shown, by States and Territories, in the following table:

Quantity and value of salt produced in the United States during the year 1888.

States and Territories.	Production.	Value.
	Barrels.	
Michigan	3, 866, 228	$2, 261, 743
New York	2, 318, 483	1, 130, 409
Ohio	380, 000	247, 000
West Virginia	220, 000	143, 000
Louisiana	394, 385	134, 652
California	220, 000	92, 400
Utah	151, 785	32, 000
Kansas	155, 000	189, 000
Nevada, Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	350, 000	143, 999
Total	8, 055, 881	4, 374, 203

The following table has been compiled to show the product and value of salt made in the United States, by States and Territories, from 1883 to 1888, inclusive:

Product and value of salt in the United States, by States and Territories, from 1883 *to* 1888, *inclusive.*

States and Territories.	1883.		1884.		1885.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*	
Michigan	2, 894, 672	$2, 344, 684	3, 161, 806	$2, 392, 536	3, 297, 403	$2, 967, 663
New York	1, 619, 486	680, 638	1, 788, 454	705, 978	2, 304, 787	874, 258
Ohio	350, 000	231, 000	320, 000	201, 600	306, 847	199, 450
West Virginia	320, 000	211, 000	310, 000	195, 000	223, 184	145, 070
Louisiana	265, 215	141, 125	223, 964	125, 677	299, 271	139, 911
California	214, 286	150, 000	178, 571	120, 000	221, 428	160, 000
Utah	107, 143	100, 000	114, 285	80, 000	107, 140	75, 000
Nevada	21, 429	15, 000	17, 857	12, 500	28, 593	20, 000
Kansas	....	....	....	....	....	....
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	400, 000	377, 595	400, 000	364, 443	250, 000	243, 993
Total	6, 192, 231	4, 251, 042	6, 514, 937	4, 197, 734	7, 038, 653	4, 825, 345

Product and value of salt in the United States, etc.—Continued.

States and Territories.	1886.		1887.		1888.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*	
Michigan	3,677,257	$2,426,989	3,944,309	$2,291,842	3,866,228	$2,261,743
New York	2,431,563	1,243,721	2,353,560	936,894	2,318,483	1,130,409
Ohio	400,000	260,000	365,000	219,000	380,000	247,000
West Virginia	250,000	162,500	225,000	135,000	220,000	143,000
Louisiana	299,691	108,372	341,093	118,735	394,385	134,652
California	214,285	150,000	200,000	140,000	220,000	92,400
Utah	164,285	100,000	325,000	102,375	151,785	32,000
Nevada	30,000	21,000	....	....	....	....
Kansas	....	....	....	....	155,000	189,000
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	240,000	352,763	250,000	150,000	350,000	143,999
Total	7,707,081	4,825,345	8,003,962	4,093,846	8,055,881	4,374,203

MICHIGAN.

Michigan retained its prominence in the list of salt-producing States during the year 1888, with a product of 3,866,228 barrels, valued at $2,261,743, which was nearly one-half of the entire amount produced in the United States. These figures show, however, a decrease in quantity of 78,081 barrels, and in value of $30,099, as compared with those for the previous year. Of the counties producing salt, five are in the eastern part of the State, bordering on Lake Huron and Saginaw bay; two in the middle and two in the western part, bordering on Lake Michigan.

The following table gives the location of each salt-producing district and the number and capacity of the works:

SALT-PRODUCING DISTRICTS OF MICHIGAN.

Location of each salt-producing district and the number and capacity of the works.

Districts.	Counties.	Companies operating.	Steam blocks.	Pan blocks.	Covers.	Producing capacity.
						Barrels.
No. 1	Saginaw	52	46	12	4,000	1,400,000
No. 2	Bay	29	32	....	500	1,300,000
No. 3	Huron	9	4	5	....	250,000
No. 4	Saint Clair	12	10	2	....	600,000
No. 5	Iosco	9	9	....	....	300,000
No. 6	Midland	3	2	1	....	100,000
No. 7	Manistee	9	10	1	....	900,000
No. 8	Mason	3	2	1	....	300,000
No. 9	Gratiot	1	1	....	....	15,000
Total	....	127	115	22	4,500	5,165,000

The Michigan Salt Association.—The sales of the association during 1888, as shown by the books of Secretary Holland, were 3,300,000 barrels as against 3,201,537 barrels in 1887 and 2,685,989 barrels in 1886. The total amount of salt on hand at the close of the year's business was 1,884,000 barrels as against 1,870,000 barrels for the previous year. The price received for the salt was slightly in advance of that of the year 1887. During December the net price paid to producers was 60 cents per barrel, 3 cents in excess of the price of salt at a corresponding period in 1887, and the highest paid for six months.

The salt inspected in Michigan since 1869 is shown in the following table:

Grades of salt produced in Michigan as reported by the inspectors from 1869 to 1888, inclusive.

Years.	Fine.	Packer's.	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, 702	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

Product of Michigan salt in 1888, by districts.

Districts.	Fine salt, bulk.	Fine.	Common coarse.	Packer's.	Second quality.	Solar.	Total.
	Bbls.	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*
No. 1, Saginaw county	215, 849	804, 051	1, 272	460	3, 059	25, 574	1, 050, 265
No. 2, Bay county	246, 272	523, 231	509	893	34, 329	600	805, 834
No. 3, Huron county	19, 650	139, 115	....	483	3, 961	....	163, 209
No. 4, St. Clair county	45, 263	272, 153	93	7, 534	573	....	325, 616
No. 5, Iosco county	....	346, 369	....	....	....	....	346, 369
No. 6, Midland county	500	39, 971	....	....	3, 366	....	43, 837
No. 7, Manistee county	56, 749	747, 023	9, 758	8, 756	28, 097	....	850, 383
No. 8, Mason county	6, 407	257, 716	2, 283	....	14, 309	....	280, 715
No. 9, Gratiot county	....	....	....	....	....	....	....
Total	590, 690	3, 129, 629	13, 915	18, 126	87, 694	26, 174	3, 866, 228

Increased and decreased inspection per district in 1887 and 1888.

Districts.	1887.	1888.	Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*
No. 1, Saginaw county	1, 115, 169	1, 050, 265		64, 904
No. 2, Bay county	891, 462	805, 834		85, 628
No. 3, Huron county	176, 582	163, 209		13, 373
No. 4, St. Clair county	328, 699	325, 616		3, 083
No. 5, Iosco county	309, 008	346, 369	37, 361	
No. 6, Midland county	41, 256	43, 837	2, 581	
No. 7, Manistee county	871, 575	850, 383		21, 192
No. 8, Mason county	208, 489	280, 715	72, 226	
No. 9, Gratiot county	2, 069			2, 069
Total	3, 944, 309	3, 866, 228	112, 168	190, 249
Net decrease				78, 081

NEW YORK.

The returns from the Onondaga salt reservation and the Warsaw district give a product of 11,592,367 bushels, valued at $1,130,409. for the State of New York during the year 1888, being 175,430 bushels less than the output of 1887.

The following table gives the product of salt at the Onondaga reservation and Warsaw district for the years 1883 to 1888, inclusive:

Product of salt in New York for the years 1883 to 1888, inclusive.

	1883.	1884.	1885.	1886.	1887.	1888.
	Bushels.	*Bushels.*	*Bushels*	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	7, 497, 431	6, 942, 270	6, 934, 299	6, 101, 757	5, 695, 797	5, 657, 367
Warsaw district	600, 000	2, 000, 000	4, 589, 635	6, 056, 060	6, 072, 000	5, 935, 000
Total	8, 097, 431	8, 942, 270	11, 523, 934	12, 157, 817	11, 767, 797	11, 592, 367

Salt inspected at the Onondaga wells in 1888.

Districts.	Solar.	Fine.	Solar ground.	Ground dairy.	Aggregate.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Syracuse	861, 729	708, 623	167, 757	113, 059	1, 851, 168
Salina	161, 566	570, 572		1, 583	733, 721
Liverpool	911, 503	24, 610			936, 113
Geddes	1, 012, 759	899, 246		224, 360	2, 136, 365
Total	2, 947, 557	2, 203, 051	167, 757	339, 002	5, 657, 367

Product of the Onondaga district, 1797 to 1888, inclusive.

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797		25,474	25,474	1843	318,105	2,809,395	3,127,500
1798		59,928	59,928	1844	332,418	3,671,134	4,003,552
1799		42,704	42,704	1845	353,455	3,408,903	3,762,358
1800		50,000	50,000	1846	331,705	3,507,146	3,838,851
1801		62,000	62,000	1847	262,879	3,688,476	3,951,355
1802		75,000	75,000	1848	342,497	4,394,629	4,737,126
1803		90,000	90,000	1849	377,735	4,705,834	5,083,569
1804		100,000	100,000	1850	374,732	3,894,187	4,268,919
1805		154,071	154,071	1851	378,967	4,235,150	4,614,117
1806		122,577	122,577	1852	633,595	4,288,938	4,922,533
1807		175,448	175,448	1853	577,947	4,826,577	5,404,524
1808		319,618	319,618	1854	734,474	5,068,873	5,803,347
1809		128,282	128,282	1855	498,124	5,584,761	6,082,885
1810		450,000	450,000	1856	709,391	5,257,419	5,966,810
1811		200,000	200,000	1857	481,280	3,830,846	4,312,126
1812		221,011	221,011	1858	1,514,554	5,518,665	7,033,219
1813		226,000	226,000	1859	1,345,022	5,549,250	6,894,272
1814		295,000	295,000	1860	1,462,565	4,130,682	5,593,247
1815		322,058	322,058	1861	1,884,697	5,315,694	7,200,391
1816		348,665	348,665	1862	1,983,022	7,070,852	9,053,874
1817		408,665	408,665	1863	1,437,656	6,504,727	7,942,383
1818		406,540	406,540	1864	1,971,122	5,407,712	7,378,834
1819		548,374	548,374	1865	1,886,760	4,499,170	6,385,930
1820		458,329	458,329	1866	1,978,183	5,180,320	7,158,503
1821		526,049	526,049	1867	2,271,892	5,323,673	7,595,565
1822		481,562	481,562	1868	2,027,490	6,639,126	8,666,616
1823		726,988	726,988	1869	1,857,942	6,804,295	8,662,237
1824		816,634	816,634	1870	2,487,691	6,260,422	8,748,113
1825		757,203	757,203	1871	2,464,464	5,910,492	8,374,956
1826		811,023	811,023	1872	1,882,604	6,048,321	7,930,925
1827		983,410	983,410	1873	1,691,359	5,768,998	7,460,357
1828		1,160,888	1,160,888	1874	1,667,368	4,361,932	6,029,300
1829		1,129,280	1,129,280	1875	2,655,955	4,523,491	7,179,446
1830		1,435,446	1,435,446	1876	2,308,679	3,083,998	5,392,677
1831		1,514,037	1,514,037	1877	2,525,335	3,902,648	6,427,983
1832		1,652,985	1,652,985	1878	2,788,754	4,387,443	7,176,197
1833		1,838,646	1,838,646	1879	2,957,744	5,364,418	8,322,162
1834		1,943,252	1,943,252	1880	2,516,485	5,482,265	7,998,750
1835		1,209,867	1,209,867	1881	3,011,461	4,905,775	7,917,236
1836		1,912,858	1,912,858	1882	3,032,447	5,307,733	8,340,180
1837		2,167,287	2,167,287	1883	2,444,374	5,053,057	7,497,431
1838		2,575,033	2,575,033	1884	2,353,860	4,588,410	6,942,270
1839		2,864,718	2,864,718	1885	2,439,332	4,494,967	6,934,299
1840		2,622,305	2,622,305	1886	2,772,348	3,329,409	6,101,757
1841	220,247	3,120,520	3,340,767	1887	3,118,974	2,576,823	5,695,797
1842	163,021	2,128,882	2,291,903	1888	3,115,314	2,542,053	5,657,367

As in 1887, the strength of the brines obtained in the Syracuse region in 1888 was lower than usual, as is shown in the following table:

Average strength of Onondaga brines.

Years.	Syracuse.	Salina.	Liverpool.	Geddes.	Average.
1865	66.17	66.47	60.65	66.17	64.86
1866	65.90	65.81	58.34	65.90	63.98
1867	64.44	64.35	64.35	63.95	64.27
1869	60.98	60.36	60.36	59.02	60.18
1870	59.49	58.94	58.94	59.34	59.17
1871	63.00	62.35	62.35	63.82	62.88
1872	65.10	66.00	67.00	66.20	66.07
1873	63.43	65.33	65.43	67.52	65.43
1874	63.80	66.15	66.15	67.15	65.81
1875	63.88	66.38	66.38	69.50	66.54
1876	66.75	67.70	67.70	69.33	67.87
1877	68.94	69.19	69.19	69.59	69.23
1878	69.93	70.58	70.58	70.02	70.27
1879	66.61	67.47	67.47	67.16	67.17
1880	66.13	67.10	67.10	67.55	66.97
1881	67.02	66.68	66.68	68.21	67.14
1882	67.75	67.24	67.24	68.63	67.71
1883	66.67	68.30	68.30	69.34	68.15
1884	67.88	71.58	71.58	70.10	70.28
1885	67.63	70.99	70.99	69.25	69.72
1886	68.27	73.84	73.84	72.46	72.10
1887	67.30	70.77	70.77	72.20	70.26
1888	67.91	69.95	69.95	72.41	70.05

An interesting epitome of the salt business has been prepared by Dr. Englehardt, showing just what it is necessary to do in order to produce salt from a brine of given strength. It is given in the table below:

Relations between salinometer strength, specific gravity, solid contents, etc., of brines of all strengths.

Salinometer, degrees.	Baumé, degrees.	Specific gravity.	Per cent. of salt.	Weight of a gallon of this brine in pounds of 7,000 grains each.	Pounds of salt in a gallon of brine of 231 cubic inches.	Gallons of brine required for a bushel of salt.	Pounds of water to be evaporated to produce a bushel of salt.	Pounds of coal required to produce a bushel of salt, 1 pound of coal evaporating 6 pounds of water.	Bushels of salt that can be made with a ton of coal of 2,000 pounds.
1	.26	1.002	.265	8.347	.022	2,531.45	21,076.07	3,512.67	.569
2	.52	1.003	.530	8.356	.044	1,264.47	10,510.03	1,751.67	1.141
3	.78	1.005	.795	8.372	.066	841.30	6,988.02	1,164.67	1.717
4	1.04	1.007	1.060	8.389	.088	629.72	5,227.03	871.17	2.295
5	1.30	1.009	1.325	8.406	.111	502.77	4,170.41	695.06	2.877
6	1.56	1.010	1.590	8.414	.133	418.56	3,466.01	577.66	3.462
7	1.82	1.012	1.855	8.431	.156	358.06	2,962.87	493.81	4.050
8	2.08	1.014	2.120	8.447	.179	312.68	2,585.50	430.91	4.641
9	2.34	1.016	2.385	8.464	.201	277.39	2,292.00	382.00	5.235
10	2.60	1.017	2.650	8.472	.224	249.41	2,057.20	342.86	5.833
11	2.86	1.019	2.915	8.489	.247	226.29	1,865.09	310.84	6.434
12	3.12	1.021	3.180	8.506	.270	207.02	1,705.00	284.16	7.038
13	3.38	1.023	3.445	8.522	.293	190.72	1,569.54	261.59	7.645
14	3.64	1.025	3.710	8.539	.316	176.76	1,453.43	242.23	8.256
15	3.90	1.026	4.975	8.547	.339	164.81	1,852.80	225.46	8.870
16	4.16	1.028	4.240	8.564	.364	154.21	1,264.75	210.79	9.488
17	4.42	1.030	4.505	8.581	.386	144.86	1,187.06	197.84	10.108
18	4.68	1.032	4.770	8.597	.410	136.54	1,118.00	186.33	10.733
19	4.94	1.034	5.035	8.614	.433	129.11	1,056.21	176.03	11.361
20	5.20	1.035	5.300	8.622	.457	122.54	1,000.60	176.76	11.992
21	5.46	1.037	5.565	8.639	.480	116.47	950.28	158.38	12.627
22	5.72	1.039	5.830	8.656	.504	110.96	904.54	150.75	13.266
23	5.98	1.041	6.095	8.672	.528	105.93	862.78	143.79	13.908
24	6.24	1.043	6.360	8.689	.552	101.33	824.50	137.41	14.554
25	6.50	1.045	6.625	8.706	.576	97.09	789.28	131.54	15.203
26	6.76	1.046	6.890	8.714	.600	93.26	756.77	126.12	15.856
27	7.02	1.048	7.155	8.731	.624	89.64	726.66	121.11	16.513
28	7.28	1.050	7.420	8.747	.649	86.27	698.71	116.45	17.173
29	7.54	1.052	7.685	8.764	.673	83.14	672.69	112.11	17.838
30	7.80	1.054	7.950	8.781	.698	80.21	648.40	108.06	18.507
31	8.06	1.056	8.215	8.797	.722	77.48	625.67	104.27	19.179
32	8.32	1.058	8.480	8.814	.747	74.92	604.37	100.72	19.855
33	8.58	1.059	8.745	8.822	.771	72.58	584.36	97.39	20.535
34	8.84	1.061	9.010	8.839	.796	70.31	565.53	94.25	21.218
35	9.10	1.063	9.275	8.856	.821	68.17	547.77	91.29	21.906
36	9.36	1.065	9.540	8.872	.846	66.15	531.00	88.50	22.598
37	9.62	1.067	9.805	8.889	.871	64.24	515.13	85.85	23.294
38	9.88	1.069	10.070	8.905	.896	62.44	500.10	83.35	23.983
39	10.14	1.071	10.335	8.922	.922	60.72	485.84	80.97	24.699
40	10.40	1.073	10.600	8.939	.947	59.09	472.30	78.71	25.407
41	10.66	1.075	10.865	8.925	.973	57.54	459.41	76.56	26.120
42	10.92	1.077	11.130	8.972	.998	56.07	447.14	74.52	26.837
43	11.18	1.079	11.395	8.989	1.024	54.66	435.44	72.57	27.558
44	11.44	1.081	11.660	9.005	1.050	53.32	424.27	70.71	28.283
45	11.70	1.083	11.925	9.022	1.075	52.04	413.60	68.93	29.013
46	11.96	1.085	12.190	9.039	1.101	50.82	403.39	67.23	29.747
47	12.22	1.087	12.455	9.055	1.127	49.64	393.61	65.60	30.486
48	12.48	1.089	12.720	9.072	1.154	48.52	384.25	64.04	31.229
49	12.74	1.091	12.985	9.089	1.180	47.44	375.26	62.54	31.977
50	13.00	1.093	13.250	9.105	1.206	46.41	366.64	61.10	32.729
51	13.26	1.095	13.515	9.122	1.232	45.42	358.34	59.72	33.487
52	13.52	1.097	13.780	9.139	1.259	44.46	350.38	58.39	34.247
53	13.78	1.100	14.045	9.164	1.287	43.50	342.71	57.11	35.015
54	14.04	1.102	14.310	9.180	1.313	42.62	335.35	55.89	35.783
55	14.30	1.104	14.575	9.197	1.340	41.77	328.21	54.70	36.560
56	14.56	1.106	14.840	9.214	1.367	40.95	321.35	53.55	37.341
57	14.82	1.108	15.105	9.230	1.394	40.16	314.74	52.45	38.126
58	15.08	1.110	15.370	9.247	1.421	39.39	308.34	51.39	38.917
59	15.34	1.111	15.635	9.264	1.448	38.66	302.17	50.36	39.712
60	15.60	1.114	15.900	9.280	1.475	37.94	296.21	49.36	40.512
61	15.86	1.116	16.165	9.297	1.502	37.26	290.43	48.40	41.317
62	16.12	1.118	16.430	9.314	1.530	36.59	284.84	47.47	42.129
63	16.38	1.121	16.695	9.339	1.559	35.91	279.42	46.57	42.945
64	16.64	1.123	16.960	9.355	1.586	35.29	274.18	45.69	43.765

Relations between salinometer strength, specific gravity, solid contents, etc.—Continued.

Salinometer, degrees.	Baumé, degrees.	Specific gravity.	Per cent. of salt.	Weight of a gallon of this brine in pounds of 7,000 grains each.	Pounds of salt in a gallon of brine of 231 cubic inches.	Gallons of brine required for a bushel of salt.	Pounds of water to be evaporated to produce a bushel of salt.	Pounds of coal required to produce a bushel of salt, 1 pound of coal evaporating 6 pounds of water.	Bushels of salt that can be made with a ton of coal of 2,000 pounds.
65	16.90	1.125	17.225	9.372	1.614	34.68	269.10	44.85	44.591
66	17.16	1.127	17.490	9.389	1.642	34.10	264.18	44.03	45.423
67	17.42	1.129	17.755	9.405	1.670	33.53	259.40	43.23	46.260
68	17.68	1.131	18.020	9.422	1.697	32.98	254.76	42.46	47.102
69	17.94	1.133	18.285	9.439	1.725	32.44	250.26	41.71	47.949
70	18.20	1.136	18.550	9.464	1.755	31.89	245.88	40.98	48.802
71	18.46	1.138	18.815	9.480	1.783	31.39	241.63	40.27	49.662
72	18.72	1.140	19.080	9.497	1.812	30.90	237.50	39.58	50.526
73	18.98	1.142	19.345	9.514	1.840	30.42	233.47	38.91	57.397
74	19.24	1.144	19.610	9.530	1.868	29.96	229.56	38.26	52.272
75	19.50	1.147	19.875	9.555	1.899	29.48	225.76	37.62	53.153
76	19.76	1.149	20.140	9.572	1.927	29.04	222.05	37.00	54.041
77	20.02	1.151	20.405	9.589	1.956	28.62	218.44	36.40	54.934
78	20.28	1.154	20.670	9.614	1.987	28.17	214.92	35.82	55.834
79	20.54	1.156	20.935	9.630	2.016	27.77	211.49	35.24	56.739
80	20.80	1.158	21.200	9.647	2.045	27.38	208.14	34.69	57.650
81	21.06	1.160	21.465	9.664	2.074	26.99	204.88	34.14	58.568
82	21.32	1.163	21.730	9.689	2.105	26.59	201.70	33.61	59.471
83	21.58	1.165	21.995	9.705	2.134	26.23	198.60	33.10	60.421
84	21.84	1.167	22.260	9.722	2.164	25.87	195.57	32.59	61.359
85	22.10	1.170	22.525	9.747	2.195	25.50	192.61	32.10	62.301
86	22.36	1.172	22.790	9.764	2.225	25.16	189.72	31.62	63.250
87	22.62	1.175	23.055	9.789	2.256	24.81	186.89	31.14	64.206
88	22.88	1.177	23.320	9.805	2.286	24.48	184.13	30.68	65.168
89	23.14	1.179	23.585	9.822	2.316	24.17	181.44	30.24	66.137
90	23.40	1.182	23.850	9.847	2.348	23.84	178.80	29.80	67.113
91	23.66	1.184	24.115	9.864	2.378	23.54	176.22	29.37	68.096
92	23.92	1.186	24.380	9.880	2.408	23.24	173.69	28.94	69.085
93	24.18	1.189	24.645	9.905	2.441	22.93	171.22	28.53	70.086
94	24.44	1.191	24.910	9.922	2.471	22.65	168.80	28.13	71.086
95	24.70	1.194	25.175	9.947	2.504	22.36	166.44	27.73	72.105
96	24.96	1.196	25.440	9.964	2.534	22.09	164.12	27.35	73.114
97	25.22	1.198	25.705	9.980	2.565	21.82	161.85	26.97	74.140
98	25.48	1.201	25.970	10.005	2.598	21.55	159.63	26.60	75.172
99	25.74	1.203	26.235	10.022	2.629	21.29	157.45	26.24	76.212
100	26.00	1.205	26.500	10.039	2.660	21.04	155.32	25.88	77.259

Product of salt in the Warsaw district, New York.

Sub-districts.	Bushels.
Warsaw	3,275,000
Mount Morris	600,000
Silver Springs	460,000
Le Roy	475,000
Pifford .... Conesus Lake .... York	1,125,000
Total	5,935,000

OHIO.

This State is recovering slightly from the disastrous competition with Michigan, and the total product shows a slight gain in 1888. The fact that the brines are richer in bromides than in other States will be borne in mind as the use for bromine increases. The product in recent years is as follows:

Estimated product of salt in Ohio from 1882 to 1888, inclusive.

Years.	Barrels.	Value.
1882	400,000	$300,000
1883	350,000	231,000
1884	320,000	201,600
1885	306,847	199,450
1886	400,000	260,000
1887	365,000	219,000
1888	380,000	247,000

WEST VIRGINIA.

With a slightly decreased product a slightly higher price made the year at least as favorable as 1887. The total product is as follows:

Estimated product of salt in West Virginia from 1882 to 1888, inclusive.

Years.	Barrels.	Value.
1882	400,000	$300,000
1883	320,000	211,200
1884	310,000	195,300
1885	223,184	145,070
1886	250,000	162,500
1887	225,000	135,000
1888	220,000	143,000

LOUISIANA.

The product of rock salt is increasing rapidly, as might be predicted from the fact that the salt is unusually pure. The following table shows the total product of each grade:

Product and price per grade of Petite Anse, Louisiana, salt during the year 1888.

Grades.	Production.	Total value.
	Short tons.	
Lump	5,442	$20,406
Crushed	8,863	19,943
Fish	1,444	3,249
Coarse	30,454	68,524
Fine	8,832	22,081
Table	179	449
Total	55,214	134,652

Product of the Petite Anse mine from 1882 to 1888, inclusive.

Grades.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Lump	20	405	1,485	3,267	3,268	2,393	5,442
Crushed	5,995	10,595	7,550	11,038	12,789	12,824	8,863
Fish	....	....	....	....	....	2,361	1,444
Coarse	16,595	22,480	15,750	20,585	18,873	20,522	30,454
Fine	2,940	3,625	6,280	6,958	6,967	9,540	8,832
Table	....	25	290	50	60	110	179
Total	25,550	37,130	31,355	41,898	41,957	47,750	55,214

PACIFIC COAST.

California.—About 30,800 tons of salt, with an estimated value of $92,400, were produced in California during the year 1888.

From the California State Mining Bureau it is ascertained that the salt industry continues to be an important business on the eastern shore of San Francisco bay, in the neighborhood of Alvarado and Mount Eden. Two methods are employed for the recovery of the salt. One is by complete natural evaporation and gathering the residue; the other by allowing tanks of sea water to evaporate until a saturated solution is obtained, from which the salt is recovered as it crystallizes.

The works at the above localities have been running for 20 years, with an output of 2,500 to 3,000 tons per annum. The crude material is shipped from the works to San Francisco, where it is ground into the finer grades of salt by the American Salt Company. In their works the salt is placed in galvanized iron driers, heated by steam, each having a capacity of 22 tons per day. When thoroughly dried it is ground in buhr mills to various degrees of fineness, for dairy and household use.

UTAH.

The product from Great Salt Lake in 1888 was as follows:

Product of salt in Utah in 1888.

	Short tons.	Value.
Deseret Salt Company	10,000	$15,000
Inland Salt Company	5,000	8,000
Hot Springs Salt Company	1,000	1,500
Syracuse Salt Company	3,000	4,000
All others	2,000	3,000
Total	21,000	31,500

In addition to the above, the rock-salt quarry at Nephi produced about 100 tons, valued at $2 per ton; and the salt beds at Salina about 150, with the same value per ton, making 21,250 tons of salt as the total for the Territory, valued at $32,000.

The production of salt from Salt Lake has been carried on in a small way since the Mormon settlement of the Territory. The product was small, and only intended to satisfy the local demands for table salt and for stock. By 1883 the production had increased so that several salt farms covering a considerable area were in fairly good condition on the borders of the lake. In this year the extension of a spur of the Utah Central branch of the Union Pacific railroad to the lake, to establish a bathing resort, induced the Deseret Salt Company to invest about $20,000 in a plant for producing salt on a large scale, and to supply the mills. This plant consisted of several large ponds separated by wide banks from the lake. The bottoms of these ponds must be prepared very carefully, so that they will be hard when the salt is scraped off and gathered into heaps. A steam pump is used to force the water from the lake over into the ponds. A railroad siding is laid on an embankment running lengthwise through the ponds. The product of 1883 from all the ponds was about 15,000 tons, valued at $100,000. In the subsequent years other producers arranged ponds, and the resulting increased production reduced the price to $4 in 1884, from which it fell to $2 in 1886 and 1887, and now ranges from $1 to $2 per ton, according to the quality of the salt and its accessibility. The plant of the Deseret Salt Company described above is neither the most elaborate nor the crudest arrangement for making salt, but is the most economical plant for producing the grade for which there is most sale, namely, for chloridizing silver ores. The principal items of expense in making the salt include fuel, soft coal from Wyoming or Pleasant Valley, Utah, costing $6 per ton, delivered, 12 tons of which are used in pumping the brine for 10,000 tons of salt, and an engineer at $75 per month, making the cost $1,000 for putting the brine in ponds for making 10,000 tons of salt. The cost of "gathering" the salt—that is, shoveling the dry salt into barrows and wheeling to the pile—varies greatly with the thickness of the salt, but the usual contract price is 40 cents per ton where the salt is about six inches thick. This is probably as cheap as salt can be made at Salt Lake, even under quite favorable conditions. At the works of the Inland Salt Company the expenses are greater on account of several costly items of handling which are avoided at some other works. The brine is pumped into a series of ponds which are six or seven feet above the level of the lake at its present state. The salt is allowed to crystallize partly, and the mother liquor is then run off to the lake again, leaving, it is claimed, salt containing less sulphate of sodium. The salt is gathered in the usual way into hand cars and stacked by a conveyor. Part of it is then dried by a steam-drier and ground for table use.

The plant at this place cost in the neighborhood of $100,000.

At the lowest cost given it seems that the market price is sufficient to assure a reasonable profit in the salt business, but the variation in the seasons is so great, even in this dry climate, as to make the business somewhat hazardous. It is impossible to predict the close of the dry season far enough in advance to know just when to gather the salt, and, as the close of the season approaches, sudden violent rains, amounting to cloud bursts, have dissolved the work of the season in a single night. Furthermore, there may be sufficient rain to prevent the formation of more than 1½ to 2 inches of salt, which it does not pay to gather. The chances of a crop of salt are therefore uncertain until it is finally gathered into solid piles, when it will stand exposure to rain and snow for several winters without material loss. Piles of salt at least three years old can now be seen on the shore of Salt Lake. By comparing the product of 1887 with that of 1888 a decrease is noticed, part of which is, however, apparent only, for if the salt which remained ungathered at the end of the year were included, as has been done frequently in previous statistics, the product would equal 1887. In the figures for 1888 no allowance has been made for the salt, in some cases 6 inches thick, which was not gathered.

KANSAS.

With the introduction of Kansas as an important salt-producing State, there was during 1888 an output of 155,000 barrels of salt, valued at $189,000. The following statement regarding the salt industry in Kansas has been obtained from Prof. Robert Hay:

Kansas has for many years been in the list of salt-producing States. Brine has been obtained from wells near the mouth of the Solomon river, in Saline county, at a depth of 100 feet, and manufactured into an excellent quality of salt since 1867. The works have a capacity of 50,000 bushels of salt per annum, but it does not appear that more than 18,000 bushels (56 pounds each) have been produced in one year. The brine strength by the salinometer is 45°, but a deeper well is now being drilled to obtain stronger brine. The process is solar evaporation, which is continued about eight or nine months in the year, in pans having a total evaporating surface of 370,000 square feet. The salt produced is of good quality, and is said to be much desired by farmers for home-curing meat. In 1880 Kansas produced 13,000 bushels, and in 1888 took her place among the large producers. Rock salt is the main source of supply, though other sources are to be utilized soon. It was struck first at Ellsworth, at a depth of 730 feet, in August, 1887; at Hutchinson, south of the river, a little later, at a depth of 450 feet; at Kingman, at a depth of 665 feet; on December 2, at Lyons, at a depth of 785 feet; a little later at Anthony, at a depth of 925 feet, and in

1888, at Nickerson, Great Bend, and Sterling. The thickness of salt besides the saline shales appears to be as follows:

Thickness of rock salt in Kansas.

At—	Feet.
Ellsworth	140
Lyons	250
Hutchinson	250
Kingman	200
Anthony	75
Great Bend	125
Sterling	198

The thicknesses at other places are not as certainly known, but would appear to be considerable. At Wellington, water from the town supply runs down the well and comes up almost a completely saturated solution (90° to 100° by the salinometer). The salt is similarly treated at Hutchinson with a like result. Kingman has two evaporating companies in operation. All the towns named are either producing salt or are in the earlier stages of erecting "salt blocks" (the name used for the entire buildings and plant), or organizing companies for salt production.

At Hutchinson most progress has been made. The first company at work was the firm of Gouinlock & Humphrey, from Warsaw, New York, which commenced to make salt on March 15, 1888. The company has two wells which go through the salt strata, which are situated at from 450 to 750 feet deep. The works, which are modified from those so successful in England, consist of six elevated storage tanks, which are each 50 feet long, 20 feet wide, and 8 feet deep, into which the brine is pumped from the wells. Next are four wrought-iron evaporating pans, 70 feet long, 24 feet wide, and 12 inches deep. These are below the level of the bottom of the storage tanks, so that the brine will flow by gravity from tank to pan. Under each pan are three furnaces at one end, and these open into a large chamber, where the rest of the pan is supported by square stone pillars, and the heated air escapes by a huge iron smokestack, one for each pan. The brine from the tank enters the pan at the end nearest the smokestack and gradually passes to the hotter parts over the furnaces, and as it reaches the saturation point by the rapid evaporation the salt crystals form and sink, and are raked out upon a sloping platform at the side of the tank, whence, after draining for some time, they are passed into cars at a lower level and taken to the packing warehouse, where, being sufficiently dried and otherwise treated for removal of adhering impurities, the salt is put in barrels, for which storage is provided to the number of 12,000. With these appliances the quantity made in a day is about 600 barrels. Coal is supplied to the furnaces from a railway switch passing in front of them, and another switch runs up to the warehouse and carries away the salt for export. The actual outlay of capital, exclusive of that required for wages and other current expenses, is over $80,000. The works occupy over 3 acres of land. The description of these works is substantially that of all the works which evaporate by boiling the brine, except in the matter of slight variations in number or size of pans. There are two works at Hutchinson which use the "grainer" process, in which the brine in evaporating pans is heated by steam pipes which pass through them. Two works also use solar evaporation. The following table will show the rapid growth of the salt industry:

Table giving the names of the Kansas salt companies and the capacities of their works.

Names of companies and location of works.	Wells.	Depth of wells.	Date of first production of salt.	Number and dimensions of evaporating pans.		Employés.	Total daily capacity of the works.	Annual output of salt up to November 30, 1888.
				No.	Dimensions.			
HUTCHINSON.								
		Feet.					*Barrels.*	*Barrels.*
Gouinlock & Humphrey	2	800	Mar. 15, 1888	4	70x25	40	600	70,000
Hutchinson Salt and Manufacturing Company.	2	450	Oct. 4, 1888	2	115x26	28	200	10,000
Crystal Salt Works	1	796	Oct. 15, 1888	2	115x26	25	300	820
Riverside Salt Company	2	775	Nov. 1, 1888	....	100x26	40	600	(*a*)17,500
New York Salt Company	1	786	Nov. 23, 1888	2	115x26	17	400	1,000
Hutchinson Solar Salt Company.	1	830	Not commenced.	500	16x16	....	200	... .
Hutchinson Salt Company (grainer process).	1	800	....do	2	90x26	15	250	....
Western Salt Company	2	700	....do	4	115x26	50	500	....
Diamond Salt Company	1	765	Oct., 1878	2	125x26	30	400	(*a*)20,000
Pennsylvania Salt Company.	1	806	Not commenced.	2	125x26	22	450	....
Bartlett Salt Company (grainer process).	1	700	....do	1	90x26	11	150	....
Vincent Salt Company	2	750	Dec., 1888	4	100x25	5	750	....
OTHER PLACES.								
Anthony Salt Company	1	1,000	Dec., 1888	4	80x25	....	600	....
Globe Manufacturing Company, Anthony.	1	100	Not commenced.	2	85x25	....	350	....
Nickerson Salt Company	1	800	....do	2	....	25	350	....
Solomon Solar Salt Works.	2	200	——, 1867	Area, 370,000 feet.		6	(*b*)10,000	....
Sterling Salt Company	1	916	Not commenced.	2	90x22	25	400	....
Wellington Salt and Mining Company.	1	290	Dec. 3, 1888	1	70x26	11	158	(*a*)3,100
Great Bend Salt Company	2	1,400	Not commenced.	2	84x25	30	400	....

a To December 31, 1888. *b* Per annum.

The Hutchinson salt is slightly less compact than that from Michigan, so that the barrels have to be about an inch larger in height and diameter to hold the orthodox 5 bushels of 56 pounds each. Of these barrels the table shows us that a single firm has shipped 700 car loads, reckoning 100 barrels per car. It is, therefore, indicated that the railway traffic in this article from the salt towns will be something great, and work will be given to additional railway employés. It has become already necessary for the railway companies to agree on a salt freight tariff.

IMPORTS AND EXPORTS.

Salt imported and entered for consumption in the United States, 1867 to 1888, inclusive.

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	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.*		
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	288,479,287	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	110,249,440	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	529,361,042	658,068	133,395,065	144,347	2,044,958
1882	329,969,300	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
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	620,435	272,650,231	246,022	113,459,083	111,120	977,577

Salt of domestic production exported from the United States from 1790 to 1888, inclusive.

Fiscal years ending September 30 until 1842, and June 30 since.	Quantity.	Value.	Calendar years ending December 31 from 1886 to 1888; previous years end June 30.	Quantity.	Value.
	Bushels.			*Bushels.*	
1790	31,935	$8,236	1858	533,100	$162,650
1791	4,208	1,052	1859	717,257	212,710
1830	47,488	22,978	1860	475,445	129,717
1831	45,847	26,848	1861	537,401	144,046
1832	45,072	27,914	1862	397,506	228,109
1833	25,069	18,211	1863	584,901	277,838
1834	89,064	54,007	1864	635,519	296,088
1835	126,230	46,483	1865	589,537	358,109
1836	49,917	31,943	1866	670,644	300,980
1837	99,133	58,472	1867	605,825	304,030
1838	114,155	67,707	1868	624,970	289,936
1839	164,337	64,272	1869	442,947	190,076
1840	92,145	42,246	1870	298,142	119,582
1841	215,084	62,765	1871	120,156	47,115
1842	110,400	39,064	1872	42,603	19,978
1843 (nine months)	40,678	10,262	1873	73,323	43,777
1844	157,529	47,755	1874	31,657	14,701
1845	131,500	45,151	1875	47,094	16,273
1846	117,627	30,520	1876	51,014	18,378
1847	202,244	42,333	1877	65,771	20,133
1848	219,145	73,274	1878	72,427	24,968
1849	312,063	82,972	1879	43,710	13,612
1850	319,175	75,103	1880	22,179	6,613
1851	344,061	61,424	1881	45,455	14,752
1852	1,467,676	89,316	1882	42,085	18,265
1853	515,857	119,729	1883	54,147	17,321
1854	548,185	159,026	1884	70,014	26,007
1855	536,073	156,879	1885	a4,101,587	26,488
1856	698,458	311,495	1886	4,828,863	29,580
1857	576,151	190,699	1887	4,685,080	27,177
			1888	5,359,237	32,986

a Pounds from 1885.

Customs districts and ports into which salt was imported during the fiscal year ending June 30, 1888.

Districts.	Quantity.	Value.
	Pounds.	
Aroostook, Maine	484, 160	$1, 424
Baltimore, Maryland	67, 854, 072	108, 146
Bangor, Maine	5, 140, 880	5, 598
Bath, Maine	2, 160, 777	2, 403
Boston and Charlestown, Massachusetts	102, 703, 330	133, 769
Brazos de Santiago, Texas	6, 287	26
Brunswick, Georgia	1, 016, 960	691
Champlain, New York	35, 460	281
Charleston, South Carolina	7, 166, 922	5, 572
Chicago, Illinois	31, 797, 520	79, 500
Cincinnati, Ohio	224, 000	608
Cuyahoga, Ohio	1, 738, 400	4, 353
Detroit, Michigan	235, 940	1, 610
Duluth, Minnesota	458, 800	3, 163
Fairfield, Connecticut	680, 083	735
Galveston, Texas	15, 372, 794	19, 996
Gloucester, Massachusetts	59, 465, 800	58, 665
Huron, Michigan	2, 395, 680	13, 168
Indianapolis, Indiana	6, 820, 776	18, 502
Kansas City, Missouri	3, 178, 560	8, 249
Key West, Florida	33, 086	57
Milwaukee, Wisconsin	924, 000	6, 536
Mobile, Alabama	851, 200	1, 002
New Haven, Connecticut	2, 617, 644	2, 547
New Orleans, Louisiana	24, 309, 545	39, 588
New York, New York	193, 966, 104	352, 578
Niagara, New York	100	1
Norfolk and Portsmouth, Virginia	14, 817, 600	27, 940
Oregon	401, 370	1, 072
Oswegatchie, New York	192, 768	2, 057
Paso del Norte, Texas, and New Mexico	446, 196	1, 882
Passamaquoddy, Maine	3, 510, 543	7, 138
Pensacola, Florida	784, 000	617
Philadelphia, Pennsylvania	54, 231, 674	82, 438
Portland and Falmouth, Maine	10, 517, 742	17, 407
Portsmouth, New Hampshire	311, 040	427
Providence, Rhode Island	6, 108, 872	7, 124
Puget Sound, Washington	747, 000	2, 120
Richmond, Virginia	1, 471, 544	2, 698
Saint Johns, Florida	644, 428	1, 070
Saint Louis, Missouri	237, 120	1, 596
San Diego, California	1, 920	19
San Francisco, California	11, 735, 162	38, 360
Savannah, Georgia	13, 004, 232	13, 232
Vermont, Vermont	134, 480	1, 212
Willamette, Oregon	6, 661, 882	20, 417
Wilmington, North Carolina	7, 532, 000	10, 460
Yorktown, Virginia	19, 839, 933	42, 739
All other customs districts	5, 375, 880	6, 169
Total	690, 346, 266	1, 156, 962

Imports of salt, by countries, during the fiscal year ending June 30, 1888.

Countries from which imported.	Quantity.	Value.
	Pounds.	
France	12, 571, 178	$13, 905
Germany	123, 104	511
England	366, 404, 515	800, 369
Scotland	2, 200	7
Gibraltar	560, 000	448
Nova Scotia, New Brunswick, and Prince Edward's Island	5, 766, 103	10, 654
Quebec, Ontario, Manitoba, and the Northwest Territory	11, 456, 482	33, 053
British Columbia	1, 200	30
British West Indies	94, 984, 022	106, 537
Italy	106, 387, 985	102, 177
Mexico	675, 186	2, 411
Dutch West Indies	16, 570, 189	19, 237
Portugal	39, 386, 560	30, 028
Spain	30, 354, 312	29, 691
Cuba	200	4
Porto Rico	5, 103, 030	7, 900
Total	690, 346, 266	1, 156, 962

Exports of salt, by countries, during the fiscal year ending June 30, 188[illegible].

Countries to which exported.	Quantity.	Value.
Central American States:	*Pounds.*	
Costa Rica	123, 816	$1, 298
Guatemala	2, 010	18
Honduras	45, 736	464
Nicaragua	97, 245	1, 266
San Salvador	100	2
Danish West Indies	300	3
French West Indies	560	9
French Guiana	217	2
French possessions, all other	95, 100	520
England	400	4
Nova Scotia, New Brunswick, and Prince Edward's Island	7, 200	74
Quebec, Ontario, Manitoba, and Northwest Territory	78, 580	299
British Columbia	525, 205	2, 815
Newfoundland and Labrador	19, 480	213
British West Indies	82, 950	884
British Honduras	1, 500	23
British possessions in Australasia	38, 900	452
Hawaiian Islands	886, 570	3, 395
Hayti	4, 345	68
Japan	200,400	785
Liberia	200	2
Mexico	98, 467	1, 402
Dutch West Indies	13, 602	161
Dutch Guiana	280	3
Azore, Madeira, and Cape Verde Islands	5, 800	47
Russia, Asiatic	1, 974, 360	7, 113
San Domingo	13, 169	189
Cuba	222, 242	1, 462
Spanish possessions in Africa and adjacent islands	2, 240	40
United States of Colombia	674, 695	8, 288
Venezuela	12, 061	177
Total	5, 227, 730	31, 478

BROMINE.

The total product increased from 199,087 pounds in 1887 to 307,386 pounds in 1888. The price remained practically uniform at 31 cents per pound in manufacturers' hands.

Product of bromine in the United States, 1883 to 1888, inclusive.

Sources.	1883.	1884.	1885.	1886.	1887.	1888.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Pomeroy, Ohio	171, 116	159, 881	110, 000	111, 866	59, 312	20, 470
Tuscarawas valley, Ohio	23, 334	21, 710	15, 000	15, 000	45, 350	44, 070
West Virginia	106, 650	99, 509	85, 000	126, 391	16, 425	61, 609
Pennsylvania			60, 000	49, 549	78, 000	100, 113
Michigan			40, 000	125, 528		81, 124
Total	301, 100	281, 100	310, 000	428, 334	199, 087	307, 386

During the calendar year 1886 the imports of bromine amounted to 44,189 pounds, valued at $12,008. In 1887 the imports were 66,307 pounds, valued at $16,216. There have been no other importations before or since so far as known.

The use of bromine as a disinfectant assumed more important proportions in 1888 than ever before in this country; 6,800 pounds were used at Johnstown after the flood. It will also probably be used to some extent in gold extraction in place of chlorine.

MICA.

Production.—In 1888, 48,000 pounds of sheet mica were produced. Its total value was $70,000—a very considerable decrease from 70,500 pounds, worth $142,250, the product in 1887. The amount in 1888 is slightly more than that in 1886, but the total value is the same for the greater quantity owing to decreased price.

Product of mica from 1884 *to* 1888, *inclusive.*

	1884.	1885.	1886.	1887.	1888.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
North Carolina	100,000	60,000	24,000	50,000	20,000
Valencia mine, New Hampshire	25,000	29,000	7,500	....	
Other mines in New Hampshire	3,260	1,000	5,000	17,000	
Cribbensville mines, New Mexico	1,000	2,000	1,400	....	28,000
Black Hills	18,150	....	600	....	
Virginia	....	....	1,500	3,500	
Total	147,410	92,000	40,000	70,500	48,000

Unmanufactured mica imported and entered for consumption in the United States, 1869 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Value.	Years.	Value.
1869	$1,165	1879	$9,274
1870	226	1880	12,562
1871	1,460	1881	5,839
1872	1,002	1882	5,175
1873	498	1883	9,884
1874	1,204	1884	28,284
1875	....	1885	28,685
1876	569	1886 (*a*)	56,354
1877	13,085	1887 (*a*)	49,085
1878	7,930	1888 (*a*)	57,541

a Including mica waste.

Price.—It will be seen from the above table of product that the decrease was entirely in North Carolina. In this State the industry is much depressed on account of low prices. Many mines have been entirely abandoned, or at least have closed for a time. With higher prices they would probably be worked again. There are several causes for this depression in the price. Most important is the increase in the quantity imported from India. From the table already given it is seen that the imports have increased from an insignificant proportion, until in 1889 they more than equaled the domestic product. Another important reduction in the price of mica has followed the change in stove patterns by which smaller sheets of mica are used. The increased use of furnaces instead of fire-place heaters has also lessened the use of mica. Meanwhile a large demand for mica for use in the construction of dynamos has sprung up. Strips of mica of various dimensions, but usually 1 inch wide and 8 inches long, are made part of the insulating material in building up the armatures. But this new use has had little effect upon domestic mica. It is entirely a feature of the import trade, as the manufacturers prefer the foreign material on account of its superior cleavage. There is no doubt that mica which will split into thin and exactly even pieces can be found in the United States, but there is also no doubt that some imported mica has proved more suitable than the usual grade of the domestic material.

The consumption of ground mica waste is increasing steadily, particularly as an addition to lubricants, and it is believed that this feature, which concerns about 90 per cent. of the product of the mines, will add greatly to the stability of the industry.

The reader is referred to page 661 of Mineral Resources, 1887, for a description of the mica mining methods.

MINERAL PAINTS.

White lead.—The total product was 84,000 short tons, which shows a significant increase of 14,000 tons over 1887, more perhaps than would be accounted for by the growth of population, although the producers claim that the consumption of white lead usually shows an increase quite accurately related to the increase of population.

During the first part of 1888 the white-lead industry was depressed. The price followed to some extent the fluctuations in pig lead, but sharp competition between manufacturers and the cutting of prices by jobbers were the chief causes of the unusually low quotations. In September the manufacturers organized the American Corroders' Association, the object of which was to stop the fierce competition among themselves, and by offering large discounts and rebates to jobbers to induce them to maintain fixed prices. The National Lead Trust, which had been formed by a few firms in October, 1887, had not yet acquired sufficient strength or importance to control the market. The Corroders' Association fixed its price at 7 cents per pound for lots of 500 pounds or over, which, less the discounts for cash and the rebate allowed for purchases of a quantity, made the net price about 6.01 cents per pound, or about three-quarters of a cent per pound above the average price of the earlier month of the year. For the balance of the year the market was fairly steady, but the influence of the corroders was not strong enough to prevent entirely the cutting of prices by jobbers.

Red lead and litharge.—The market for these products, being subject to the same conditions affecting white lead, was unsettled and prices were low during the first nine months of the year. When the American Corroders' Association was formed in September, the price was fixed at 6¾ cents for red lead and 6½ for litharge, less a rebate of half a cent per pound for cash in sixty days and an additional discount of 2½ per cent. for cash in fifteen days.

Red lead, white lead, and litharge imported from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Red lead.		White lead.		Litharge.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1867	926, 843	$53, 687	6, 636, 508	$430, 805	230, 382	$8, 941
1868	1, 291, 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, 089	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, 844	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, 389	1, 222
1881	212, 423	10, 009	1, 068, 030	60, 132	63, 958	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
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

Zinc white.—In 1886 and 1887 the total product was 18,000 short tons, valued at $1,440,000. In 1888 a very careful canvass shows an increase to 19,000 short tons. The price remained at 4 cents per pound. The market being controlled by an agreement among the manufacturers, the price of American oxide of zinc remained steady throughout the year, at 4¼ to 4¾ cents, according to quality. The price of imported zinc white is regulated by the Vielle Montagne Company, a French syndicate, and is not affected by market quotations in this country.

Zinc white (zinc oxide) imported from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	1, 569, 322	$91, 330	1878	2, 451, 060	$140, 157
1868	1, 954, 485	95, 518	1879	2, 274, 935	117, 886
1869	1, 819, 208	105, 844	1880	2, 288, 604	123, 113
1870	2, 064, 234	113, 254	1881	2, 044, 778	106, 990
1871	2, 075, 898	103, 492	1882	2, 538, 090	125, 599
1872	3, 660, 091	193, 448	1883	1, 877, 804	93, 987
1873	3, 530, 465	233, 421	1884	3, 259, 919	148, 817
1874	1, 974, 469	136, 281	1885	2, 331, 694	96, 405
1875	2, 800, 998	181, 455	1886	2, 606, 177	104, 109
1876	2, 460, 144	161, 944	1887	3, 618, 582	138, 512
1877	2, 668, 729	130, 719	1888	2, 919, 041	189, 722

Barytes.—The production of crude barytes in 1888 was 20,000 long tons, valued at $110,000, as shown by exact returns from every known producer. The increase from 15,000 in 1887 was well distributed among the different producing regions, particularly in Missouri.

The production of barytes in Canada in 1887, as given in the report of the Geological and Natural History Survey of Canada, was 400 tons, valued at $2,400, while in 1886 the product was 3,864 tons, valued at $19,270, and in 1888 it was 1,100 tons, worth $3,850.

The market was steady throughout the year at $16 to $18 per ton for ordinary sulphate and $30 to $32 per ton for that which has been refined by the floating process. The growth of consumption has kept pace with the increased output, but entirely within the ordinary channels.

Imports of blanc-fixe, satin white, enameled white, lime white, and all combinations of barytes with acids or water from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	445, 310	$12, 615	1878	4, 955	$1, 047
1868	177, 995	5, 876	1879	1, 993	329
1869	182, 984	6, 292	1880	4, 400	752
1870	97, 643	4, 072	1881	11, 330	2, 027
1871	147, 464	5, 910	1882	52, 364	1, 781
1872	70, 469	5, 091	1883	28, 525	1, 231
1873	119, 972	4, 457	1884	71, 059	1, 871
1874	118, 384	4, 079	1885	28, 538	588
1875	145, 728	4, 899	1886	89, 776	2, 065
1876	15, 744	2, 091	1887	83, 445	1, 682
1877	4, 500	809	1888	22, 508	466

Ocher.—The list of localities where ocher is found is very considerable, and new deposits of more or less value are continually found. The chief producers remain nearly the same as in the previous year. They are: The Bermuda Ocher Company, John W. Masury, the Oxford Ocher Company, Henry Irwin, the Bonne Fortune Ocher Mines, E. & F. King, Boston, three small mines at Bennington, Vermont, a mine at Luzerne, Pennsylvania, J. A. Matteson & Co., and several mines in the San Joaquin valley in California. Returns from these producers show that the product was 10,000 tons, an increase of 2,000 tons over 1887.

The Canadian product in 1886 amounted to 350 tons, valued at $2,350. In 1887, 385 tons of ocher were produced, worth $2,233.

The market prices for ocher vary greatly, being dependent upon quality and brand. They are, however, subject to little or no fluctuation in the course of a year, and during 1888 quotations were not changed. The average price for a good grade of domestic ocher, suitable for grinding in oil for painters' use, was 1¼ cents per pound, while the inferior grade used as filling for oil-cloth sold at $8 to $10 per ton, according to quality and coloring power.

Ocher imported from 1867 to 1883, inclusive.

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	1,524,989	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 1888, inclusive.

Calendar years ending December 31 from 1886 to 1888; previous years end June 30—	Dry.		Ground in oil.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
1884..	6,164,359	$63,973	108,966	$4,717
1885..	4,983,701	51,499	79,666	3,616
1886..	4,939,183	53,593	112,784	6,574
1887..	5,957,200	58,162	54,104	7,337
1888..	6,574,608	64,123	43,142	9,690

Metallic paints.—The use of metallic paints is increasing for several reasons. Ferric oxide reds have become fashionable and the paints have proved very durable, so that a considerable extension of the industry is probable; indeed, the returns for 1887 showed a considerable increase, the product being 12,000 long tons, valued at $235,000. In 1888 careful returns from all producers gave 14,000 long tons, worth $280,000. In 1888 the product of metallic paint in Canada was 397 tons, valued at $7,900, while in 1887 it was only 100 tons, worth $1,500.

As the production and sale of metallic paints are controlled by comparatively few firms, market prices are easily kept on a steady basis. The three shades, brown, red, and yellow, were quoted throughout the year at $27.50 to $32.50 per ton, the lower price being for car-load lots and the higher by the single ton.

Umber.—The market value of this article fluctuates according to the condition of supplies. In 1888 the average price for the crude lump Turkey umber was 1½ cents per pound and of the burnt lump 3½ cents per pound. The brown ocher, commercially known as American umber, sold at an average rate of 1¼ cents per pound for either burnt or raw, powdered.

Imports of umber from 1867 to 1888, inclusive.

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	2,147,342	$15,946	1878	1,038,880	$8,302
1868	345,173	2,750	1879	986,105	6,959
1869	570,771	6,159	1880	1,877,645	17,271
1870	708,825	6,313	1881	1,475,835	11,126
1871	470,392	7,064	1882	1,923,648	20,494
1872	1,409,822	18,203	1883	785,794	8,419
1873	845,601	8,414	1884	2,946,675	20,654
1874	729,864	6,200	1885	1,198,060	8,504
1875	513,811	5,596	1886	1,262,930	9,187
1876	681,199	7,527	1887	2,385,281	16,536
1877	1,101,422	10,213	1888	1,423,806	14,684

Cobalt oxide.—The industry shows almost no change except a higher price, due to less competition. The product was 7,491 pounds, exclusive of 1,000 pounds contained in ores shipped from Lovelock Station in Nevada. Including this, the total value of the product was $15,782.

The total product of cobalt oxide in late years is given in the following table:

Production of cobalt oxide in the United States from 1869 to 1888, inclusive.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
1869	811	1876	5,162	1883	1,096
1870	3,854	1877	7,328	1884	2,000
1871	5,086	1878	4,508	1885	8,423
1872	5,749	1879	4,376	1886	8,689
1873	5,128	1880	7,251	1887	5,769
1874	4,145	1881	8,280	1888	7,491
1875	3,441	1882	11,653		

It is probable that the product will be still smaller in future years, as it is a by-product of the nickel industry, and the future supply of nickel will mainly come from ores containing practically no cobalt.

Cobalt oxide imported and entered for consumption in the United States, 1868 to 1888, inclusive.

Fiscal years ending June 30—	Oxide.		Fiscal years ending June 30—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
1868	....	$7,208	1879	7,531	$15,208
1869	....	2,330	1880	9,819	18,457
1870	....	5,019	1881	21,844	13,837
1871	....	2,766	1882	17,758	12,764
1872	....	1,920	1883	13,067	22,323
1873	1,480	4,714	1884	25,962	43,611
1874	1,404	5,500	1885	16,162	28,138
1875	678	2,604	1886	19,366	29,543
1876	4,440	11,180	1887	26,882	39,396
1877	19,752	11,056	1888	27,466	46,211
1878	2,860	8,693			

The price of cobalt oxide during 1888 varied from $1.78, less 5 per cent., to $3.50 per pound, according to the quantity and quality taken. The greater part sold at $1.90. The variations in price were due to the fact that some contracts were made at the end of 1887 and the market had not felt the effect of the combination of the manufacturers in Europe, and because some producers were not held by the combination. The supply of this oxide was ample for the demand, and prices would have been very low had not the European producers combined and fixed the price at $2.60, less 5 per cent.

Imports of whiting and Paris white from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Whiting and Paris white, dry.		Years.	Whiting and Paris white, dry.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
1867	8, 168, 123	$40, 879	1878	1, 871, 374	$7, 903
1868	5, 530, 042	19, 390	1879	1, 365, 867	5, 976
1869	3, 438, 396	17, 289	1880	1, 803, 577	7, 503
1870	5, 650, 728	27, 293	1881	1, 974, 913	7, 806
1871	5, 219, 396	24, 710	1882	1, 722, 711	6, 675
1872	6, 392, 717	31, 464	1883	2, 216, 018	8, 396
1873	6, 197, 017	32, 622	1884	3, 910, 829	15, 189
1874	3, 749, 122	24, 734	1885	1, 401, 783	6, 157
1875	4, 170, 569	22, 491	1886	770, 248	3, 547
1876	2, 605, 332	13, 270	1887	907, 281	2, 999
1877	2, 390, 333	11, 269	1888	407, 065	1, 679

Terra alba.—The consumption is steadily increasing, and notwithstanding the large importations in 1888 the spot supply was often extremely light. As a result, the price of the best grade advanced from 70 cents to 85 cents per 100 pounds.

Imports of terra alba from 1869 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Not aluminous.		Aluminous.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
1869	....	$7 002. 00	....	....
1870	....	7, 911. 00	....	....
1871	....	133, 028. 00	....	....
1872	....	6, 444. 00	....	....
1873	....	2, 235. 00	....	$44, 994. 00
1874	....	1, 029. 00	....	56, 821. 00
1875	....	....	....	45, 726. 00
1876	....	27, 897. 00	....	20, 876. 00
1877	....	45, 471. 00	....	344. 75
1878	....	33, 509. 00	....	683. 46
1879	....	33, 250. 00	....	7, 081. 30
1880	....	34, 718. 00	....	14, 737. 08
1881	....	30, 186. 00	....	9, 796. 56
1882	283, 946	1, 572. 00	12, 008, 101	30, 522. 37
1883	149, 782	800. 00	10, 592, 552	19, 533. 00
1884	....	....	10, 066, 496	25, 187. 89
1885	....	....	20, 510, 540	41, 378. 21
1886	....	....	15, 988, 807	33, 223. 00
1887	....	....	10, 824, 749	29, 809. 00
1888	....	....	20, 899, 516	40, 761. 00

Quicksilver vermilion.—This color continued to feel the effect of the competition of the so-called "eosin vermilion" (orange mineral, the color of which is heightened with eosin), owing to the much lower cost of the latter. Early in the year the price declined from 70 cents per pound to 65 cents, and subsequently, in March, there was another reduction of 5 cents per pound. During the balance of the year the price remained at 60 cents. Fluctuations are mainly caused by changes in the price of quicksilver in London, the market for quicksilver vermilion being controlled by the five American manufacturers, who are bound by a written agreement to maintain uniform prices. Imported vermilions have been almost entirely displaced in American markets by the home product, Chinese vermilion being now used only for fine decorative work and other foreign kinds for special purposes.

Imports of quicksilver vermilion from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$123,506	1878	9,843	$5,772
1868	....	90,648	1879	11,382	6,105
1869	247,382	145,665	1880	11,952	5,997
1870	104,523	57,262	1881	14,243	7,391
1871	79,195	43,935	1882	12,496	6,214
1872	120,067	49,237	1883	19,549	8,795
1873	87,008	65,796	1884	....	10,472
1874	42,324	39,443	1885	....	8,244
1875	9,460	10,831	1886	....	11,016
1876	18,981	17,679	1887	....	16,542
1877	23,315	14,660	1888	....	9,342

Ultramarine.—In December, 1887, the three American manufacturers consolidated, establishing a central sales office, but each manufacturer retaining control of his own factory. In 1888 the effect of this change from excessive competition and overproduction was seen in the uniform prices and the steady extension of trade. The product for 1889 will reach 2,781,000 pounds, which is considerably in excess of the product of 1888, owing to overproduction in 1887. Prices, however, were not materially advanced, for fear of inviting increased competition from abroad.

Imports of ultramarine from 1867 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$78,490.00	1878	1,279,297	$162,486.55
1868	....	96,638.00	1879	1,020,003	131,762.14
1869	....	72,101.00	1880	1,214,770	162,653.41
1870	....	92,174.00	1881	913,935	127,352.37
1871	....	92,142.00	1882	906,684	122,988.32
	170,947	23,674.00	1883	819,625	105,654.00
1872	670,839	85,997.00	1884	1,015,875	114,227.00
1873	1,037,949	136,908.00	1885	999,128	97,486.00
1874	1,257,637	165,634.00	1886	802,542	78,992.00
1875	1,468,487	203,773.00	1887	581,006	54,478.00
1876	1,394,697	191,606.00	1888	615,003	54,492.00
1877	1,559,027	203,762.73			

MINERAL WATERS.

Bw

By A. C. Peale.

The list for 1888 of the mineral springs of the United States of which the waters are used commercially includes a total of 198 springs, instead of 215, as published for 1887. All the springs from which no reports have been received for several years have been taken from the list, except in a few cases where it is well known that the water is on sale. The springs actually reporting give increased figures, and according to these the number of gallons sold in 1888 was more than 2,000,000 greater than in 1887, with an increased value of over $600,000, while the number of springs was 17 less. The estimate for the fifty-two springs not reporting has been kept comparatively low. The total product as footed up is 1,319,039 gallons more for 1888 than for 1887, and the increased value $417,829.

The number of springs reporting in the North Atlantic States is 42, as compared with 40 for 1887, although the total for the section is less than then stated.

The number of gallons sold and the value both show a considerable increase. Four springs not hitherto included in the lists have been added, viz: Alburgh Sulphur and Lithia springs, at Alburgh Springs, Vermont, and the following at Saratoga Springs, New York: Imperial spring, Patterson spring, and the Royal spring.

In the South Atlantic States the following have been added to the list: Osceola Lithia water, Harrisonburgh, Virginia, Triplet springs, Willow Island, West Virginia, and the Lincoln Lithia spring of Lincolnton, North Carolina. Notwithstanding these additions, the total for the section is less than a year ago, and the number actually reporting is two less. The product, however, has more than doubled, with a large increase in value.

The list for the Southern Central States is decreased by 1, but the number reporting falls from 29 to 19; consequently there is for this section a considerable decrease in both the product and its value.

The Northern Central States show a very large increase in the product and its value, while the number of springs reporting remains the same as for the previous year. One addition has been made to the list—Sanicula springs, Ottawa, Illinois; but notwithstanding this the total for the section is less by four than it was in 1887.

The Western States and Territories also show a large increase in the product and a corresponding increase in its value. The list also is larger by 2 springs, both of which are in California, viz: Bartlett springs and Ætna springs.

The imports for 1888, both of the artificial and the natural mineral waters, show a decrease from the importation of 1887.

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.
	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	1,399	....	....	....	....	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

It appears from the foregoing table that previous to 1883 natural mineral waters were not distinguished from the artificial waters. Since 1884 the artificial waters have not been classified according to the receptacles in which they have been imported.

Imports for the fiscal years 1884 *to* 1888, *inclusive.*

[Calendar years ending December 31 from 1886 to 1888; previous years end June 30.]

Years.	Artificial mineral waters.		Natural mineral waters.	
	Gallons.	Value.	Gallons.	Value.
1884	29,366	$4,591	1,505,298	$362,651
1885	7,972	2,157	1,660,072	397,875
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

EXPORTS.

Exports of natural mineral waters, of domestic production, from the United States.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1875	$162	1881	$1,029
1876	80	1882	421
1879	1,529	1883	459
1880	1,486	1884, 1885, 1886, 1887, and 1888	None.

The amount of artificial mineral waters exported is also trifling.

PRODUCTION.

Natural mineral waters sold from 1883 to 1888, inclusive.

	Springs reporting.	Gallons sold.	Value.
1883.			
North Atlantic States	38	2, 470, 670	$282, 270
South Atlantic States	27	312, 090	64, 973
Northern central States	37	1, 435, 809	323, 600
Southern central States	21	1, 441, 042	139, 973
Western States and Territories	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 States	38	3, 345, 760	328, 125
South Atlantic States	27	464, 718	103, 191
Northern central States	37	2, 070, 533	420, 515
Southern central States	21	1, 526, 817	147, 112
Western States and Territories	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 States	51	2, 527, 310	192, 605
South Atlantic States	32	908, 692	237, 153
Northern central States	45	2, 925, 288	446, 211
Southern central States	31	540, 436	74, 100
Western States and Territories	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 States	49	2, 715, 050	177, 969
South Atlantic States	38	720, 397	123, 517
Northern central States	40	2, 048, 914	401, 861
Southern central States	31	822, 016	58, 222
Western States and Territories	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 States	40	2, 571, 004	213, 210
South Atlantic States	34	614, 041	147, 149
Northern central States	38	1, 480, 820	208, 217
Southern central States	29	741, 080	87, 946
Western States and Territories	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 States	42	2, 856, 799	247, 108
South Atlantic States	32	1, 689, 387	493, 489
Northern central States	38	2, 002, 373	325, 839
Southern central States	19	426, 410	71, 215
Western States and Territories	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

Alabama.—Two of the well known springs of Alabama failed to report for 1888, and the total for the State is therefore materially less than for 1887. The following are the springs reporting: Healing springs, Healing Springs, Washington county; Star of Bethlehem springs, Greenville, Butler county; White Sulphur springs, Sulphur Springs, De Kalb county.

Arkansas.—Only three springs of Arkansas report sales, and the total number of springs commercially used from the State is reduced to five. The name of Boyd springs has been changed to Arkansas Lithia springs. The following report sales for 1888: Arkansas Lithia springs, Hope, Hempstead county; Potash Sulphur springs, Potash Sulphur, Garland county; Mountain Valley springs, Mountain Valley, Garland county.

California.—The total number of springs for California is increased from seven in 1887 to nine in 1888, and all report sales. The two springs new to the list are Ætna springs and Bartlett springs. The following is the complete list of those reporting sales for 1888: Ætna springs, Lidell post-office, Napa county; Azule springs, San José, Santa Clara county; Bartlett springs, Bartlett Springs, Lake county; Castalian Mineral Water, Inyo county; Geyser Soda springs, Litton's, Sonoma county; Litton Seltzer, Litton's, Sonoma county; Napa Soda springs, Napa Soda Springs, Napa county; Pacific Congress springs, Saratoga, Santa Clara county; Tolenas Soda springs, Fairfield, Solano county.

Colorado.—Colorado shows no change in the number of springs reporting, although there is an increase in both the amount and value of the sales. The springs are: Manitou springs, Manitou Springs, El Paso county; Springdale Seltzer spring, Springdale, Boulder county.

Connecticut.—Three of the springs for this State report, with increased figures. These are: Aspinock springs, Putnam Heights, Windham county; Bozrah springs, Bozrah, New London county; Oxford chalybeate springs, Oxford, New Haven county.

Georgia.—Two springs report for 1888, with figures largely increased over those of 1887. The springs are: Catoosa springs, Catoosa Springs, Catoosa county; Ponce de Leon springs, Atlanta, Fulton county.

Idaho.—The one commercial water of Idaho is represented in the list for 1888 with largely increased sales and a new name, as follows: Idanha springs, Soda Springs, Bingham county.

Illinois.—One new spring is added to the list of commercial waters for Illinois, namely, Sanicula springs. Three springs in all report sales for 1888, as follows: Glen Flora springs, Waukegan, Lake county; Perry springs, Perry Springs, Pike county; Sanicula springs, Ottawa, La Salle county.

Indiana.—Five springs report for 1888, as follows: Hosea's New Point Comfort springs, Blue Lick, Clark county; Indian springs, Indian Springs, Martin county; King's mineral spring, Muddy Fork, Clark county; Lithium spring, Attica, Fountain county; West Baden springs, West Baden, Orange county.

Iowa.—Iowa is represented on the list for 1888 by the three springs usually reporting. They are: Dunbar's mineral spring, College Springs, Page county; Old M. C. spring, Colfax, Jasper county; Ottumwa mineral springs, Ottumwa, Wapello county.

Kansas.—The representation of Kansas for 1888 is increased to five from the three of 1887. The springs reporting are: Blasing's artesian mineral wells, Manhattan, Riley county; Conway springs, Conway Springs, Sumner county; Geuda springs, Geuda Springs, Cowley county; Iola mineral well, Iola, Allen county; Topeka mineral wells, Topeka, Shawnee county.

Kentucky.—Only one spring from this State reports its sales for 1888, namely: Lower Blue Lick springs, Blue Lick Springs, Nicholas county.

Maine.—Six springs of this State report for 1888. They are: Boothbay medicinal spring, East Boothbay, Lincoln county; Hartford cold spring, Hartford, Oxford county; Poland spring, South Poland, Androscoggin county; Scarborough spring, Scarborough, Cumberland county; Summit spring, Harrison, Cumberland county; Underwood spring, Falmouth Foreside, Cumberland county.

Maryland.—No reports have been received from any Maryland springs.

Massachusetts.—The same number of springs report for 1888 as for 1887, but with increased sales: Allandale springs, West Roxbury, Suffolk county; Crystal spring, Stoneham, Middlesex county; Commonwealth spring, Waltham, Middlesex county; Echo Grove spring, Lynn, Essex county; Everett crystal spring, Everett, Middlesex county.

Michigan.—The only spring in Michigan reporting for 1888 is the Mount Clemens mineral spring, of Mount Clemens, Macomb county.

Minnesota—Is represented in the list by the Inglewood spring, of Minneapolis, Hennepin county.

Mississippi.—Three springs report for 1888, as follows: Castalian springs, Durant, Holmes county; Cooper's well, Raymond, Hinds county; Godbold mineral well, Summit, Pike county.

Missouri.—Six springs report for 1888, with increased figures over those of 1887. The springs reporting are: Akesoon spring, Sweet Springs, Saline county; El Dorado springs, El Dorado Springs, Cedar county; Mooresville mineral springs, Mooresville, Livingston county; Randolph springs, Randolph, Clay county; Reiger springs, Mercer county (post-office address, Lineville, Wayne county, Iowa); Sweet springs, Sweet Springs, Saline county.

New Hampshire.—Two springs report for 1888, as follows: Bradford springs, East Washington, Merrimack county; Milford (Ponemah) springs, Milford, Hillsborough county.

New Mexico.—Ojo Caliente, in Taos county, is the only spring in the Territory that reports sales.

New York.—More than half of the commercially used mineral springs of New York report for 1888. Among the seventeen that send reports are three new to our list, namely, the Patterson spring, the Royal spring, and the Imperial spring, all of Saratoga. The Royal replaces the Old Putnam spring. The springs reporting are: Artesian Lithia spring, Ballston, Saratoga county; Avon springs, Avon, Livingston county; Deep Rock springs, Oswego, Oswego county; Massena springs, Massena, Saint Lawrence county; Oak Orchard Acid springs, Alabama, Genesee county; Carlsbad spring, Saratoga Springs, Saratoga county; Champion spring, Saratoga Springs, Saratoga county; Hathorn spring, Saratoga Springs, Saratoga county; High Rock spring, Saratoga Springs, Saratoga county; Imperial spring, Saratoga Springs, Saratoga county; New Putnam spring, Saratoga Springs, Saratoga county; Patterson spring, Saratoga Springs, Saratoga county; Royal spring, Saratoga Springs, Saratoga county; Vichy spring, Saratoga Springs, Saratoga county; Verona springs, Verona, Oneida county; Victor spring, Darien Centre, Genesee county; White Sulphur springs, Sharon Springs, Schoharie county.

North Carolina.—The Leinster Poison springs change their name to Barium springs, and one new spring is added to the list, which, as completed, includes the following: Barium springs, Barium Springs, Iredell county; Lincoln Lithia springs, Lincolnton, Lincoln county; Panacea springs, Panacea Springs, Halifax county; Park's Alkaline spring, Caswell county (post-office address, Danville, Virginia); Seven springs, Seven Springs, Wayne county; Thompson's Bromine-Arsenic springs, Crumpler, Ashe county.

Ohio.—There is a decrease of one on the list of springs for Ohio. The springs reporting are: Electro-Magnetic springs, Fountain Park, Champaign county; Green spring, Green Spring, Seneca county; Len-a-pe spring, Delaware, Delaware county; Odevene spring, Delaware, Delaware county; Ohio Magnetic spring, Magnetic Springs, Union county.

Oregon.—Only one report has been received from Oregon. It is from McCallister's springs, Lake creek, Jackson county.

Pennsylvania.—Three springs give figures for 1888. They are: Black Barren springs, Pleasant Grove, Lancaster county; Minnequa springs, Minnequa, Bradford county; Ponce de Leon springs, Meadville, Crawford county.

Rhode Island.—The two springs of Rhode Island report increased sales for 1888. The springs are: Holly springs, Woonsocket, Providence county; Ochee springs, Providence, Providence county.

South Carolina.—Only one of South Carolina's localities reports for 1888. It is Chick's springs, Chick's Springs, Greenville county.

Tennessee.—Four springs report. They are: Idaho springs, Clarksville, Montgomery county; Red Boiling springs, Red Boiling Springs, Macon county; Rhea springs, Rhea Springs, Rhea county; Tate springs, Tate Springs, Grainger county.

Texas.—Reports have been received from five springs, as follows: Crabtree's sour wells, Sour Springs, Hopkins county; Hynson's iron mountain spring, Marshall, Harrison county; Palo Pinto mineral wells, Mineral Wells, Palo Pinto county; Texas sour springs, Luling, Caldwell county; Wootan wells, Wootan Wells, Robertson county.

Vermont.—Four of Vermont's seven localities report sales for 1888. They are: Alburgh springs, Alburgh Springs, Grand Isle county; Brunswick White Sulphur springs, Brunswick, Essex county; Clarendon springs, Clarendon Springs, Rutland county; Elgin spring, Vergennes, Addison county.

Virginia.—One new spring, the Osceola Lithia, is added to the list, and seventeen springs in all report for 1888, as follows: Bear Lithia springs, Elkton, Rockingham county; Blue Ridge springs, Blue Ridge Springs, Botetourt county; Buffalo Lithia springs, Buffalo Lithia Springs, Mecklenburgh county; Chase City mineral water, Chase City, Mecklenburgh county; Farmville Lithia springs, Farmville, Prince Edward county; Healing springs, Healing Springs, Bath county; Hunter's Pulaski alum springs, Sassin, Pulaski county; Massanetta springs, Massanetta Springs, Rockingham county; Osceola Lithia water, Harrisonburgh, Rockingham county; Rockbridge alum springs, Alum Springs, Rockbridge county; Rock Enon springs, Rock Enon Springs, Frederick county; Rockingham springs, McGaheysville, Rockingham county; Seven springs, Abingdon, Washington county; Shenandoah alum springs, Shenandoah Alum Springs, Shenandoah county; Stribling springs, Stribling Springs, Augusta county; Wallawhatoola alum water, Millborough Springs, Bath county; Wolf Trap Lithia water, Wolf Trap, Halifax county.

Washington.—Medical Lake, Spokane county, reports increased sales for 1888.

West Virginia.—One addition is made to the West Virginia list in the Triplet springs. Six report as follows: Capon springs, Capon Springs, Hampshire county; Irondale springs, Independence, Preston county; Red Sulphur springs, Red Sulphur Springs, Monroe county; Salt Sulphur springs, Salt Sulphur Springs, Monroe county; Triplet springs, Willow Island, Pleasants county; White Sulphur springs, White Sulphur Springs, Greenbrier county.

Wisconsin.—Nine springs report for 1888. They are: Arcadian spring, Waukesha, Waukesha county; Bethesda spring, Waukesha, Waukesha county; Gihon spring, Delavan, Walworth county; Horeb mineral spring, Waukesha, Waukesha county; Mineral Rock spring, Waukesha, Waukesha county; Prairie du Chien artesian wells, Prairie du Chien, Crawford county; Sheboygan mineral water, Sheboygan, Sheboygan county; Shealtiel springs, Waupaca, Waupaca county; Siloam spring, Waukesha, Waukesha county.

Summary of reports of mineral springs for 1888.

	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	6	1	7
New Hampshire	2	2	4
Vermont	4	2	6
Massachusetts	5	1	6
Rhode Island	2	0	2
Connecticut	3	2	5
New York	17	13	30
New Jersey	0	0	0
Pennsylvania	3	1	4
SOUTH ATLANTIC STATES.			
Delaware	0	0	0
Maryland	0	1	1
District of Columbia	0	0	0
Virginia	17	5	22
West Virginia	6	1	7
North Carolina	6	0	6
South Carolina	1	2	3
Georgia	2	0	2
Florida	0	0	0
SOUTH CENTRAL STATES.			
Kentucky	1	5	6
Tennessee	4	2	6
Alabama	3	2	5
Mississippi	3	0	3
Louisiana	0	0	0
Texas	5	2	7
Indian Territory	0	0	0
Arkansas	3	2	5
NORTH CENTRAL STATES.			
Ohio	5	2	7
Indiana	5	1	6
Illinois	3	1	4
Michigan	1	0	1
Wisconsin	9	3	12
Minnesota	1	0	1
Iowa	3	0	3
Missouri	6	0	6
Dakota	0	0	0
Nebraska	0	0	0
Kansas	5	0	5
WESTERN STATES AND TERRITORIES.			
Alaska	0	0	0
Wyoming	0	0	0
Montana	0	0	0
Colorado	2	0	2
New Mexico	1	0	1
Arizona	0	0	0
Utah	0	0	0
Nevada	0	0	0
Idaho	1	0	1
Washington	1	0	1
Oregon	1	1	2
California	9	0	9
Total	146	52	198

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