

# THE MINERAL INDUSTRY,

ITS

STATISTICS, TECHNOLOGY AND TRADE

IN THE

UNITED STATES AND OTHER COUNTRIES

TO THE END OF

1901.

FOUNDED BY THE LATE

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## GEMS AND PRECIOUS STONES.

THE progress of the gem and precious stone industries in the United States during 1901 was mainly in the great activity displayed in the turquoise mines of New Mexico and in the emerald-beryl mines of North Carolina, owing to the increased use of the matrix as well as the gems for jewelry. The sapphire mines in Fergus County, Mont., also were actively developed by two mining companies.

**DIAMONDS.**—*United States.*—The diamond deposits in the United States were fully described by William H. Hobbs, *THE MINERAL INDUSTRY*, Vol. IX., 1900, p. 301. The production in diamonds for the year 1901, for the United States amounted to but \$100 in value. The only new discovery of diamonds of interest in 1901 was the finding of a solitary gem in Lee County, Ga., the first ever found in that region.

*Africa.*—The report of the De Beers Consolidated Mines, Ltd., for the fiscal year ending June 30, 1901, shows that diamonds to the value of £4,628,845 were sold by the company during the year. After deducting expenditures of £2,194,207, the profit balance for the year was £2,434,639, from which dividends to the amount of £1,579,582 were paid. The average yield per load of blue ground and lumps from the De Beers and Kimberley mines for the fiscal year was 0.76 carats, at an average value per carat of 39s. 7d. The average yield per load for the Premier mine, at Wesselson, was 0.295 carats valued at 27s. 4d. each. During the year the De Beers Co. purchased the claims of Mr. Leopold Herz in the Dutoitspan mine for £12,000; this mine now belongs wholly to the De Beers Co., except for the claims owned by the Griqualand West Diamond Mining Co., which are leased to the De Beers. A new contract for the sale of the diamonds has been entered into which gives the De Beers Co. a share in the profits of sale, as well as a higher price than formerly for the diamonds. During the latter part of the year the capital stock of the company was changed from £3,950,000, divided into £5 shares, to an issue of £4,500,000 divided into 800,000 shares of preferred stock at £2 10s. par value, and 1,000,000 shares of common stock of the same par value. The preferred stock will be entitled to dividends of 40% annually. Ten thousand preferred shares are held in the treasury and the life governors accept 160,000 shares to cancel their rights which entitled them to 25% of all profits made in excess of 36% on the stock. It is reported that negotiations for the purchase by the De Beers Co. of the Jagersfontein mine were completed in 1901. American

electrical machinery to the amount of \$135,000 was ordered, which included two Westinghouse-Parsons steam turbines of 1,000 kw. each, two 1,000 kw. direct-connected alternating current generators, all to be built by the Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa. In the early part of the year a canary-colored diamond weighing in the rough 600 carats was found. As cut in 64 facets it weighs 207·75 carats, is absolutely flawless and has a very brilliant luster. It was exhibited at the Pan-American Exposition at Buffalo, in 1901.

The Orange Free State & Transvaal Diamond Mines, Ltd., capitalized at £550,000 in £1 shares, owns, in the Orange River Colony, approximately 12,000 acres, comprising the Kaal Vallai and Dirksburg freehold farms. The company also has leases of diamondiferous land east of Pretoria in the Transvaal. The company's machinery is capable of handling 5,000 loads of clay per day, and 250,000 tons of blue clay have been weathering on the floors during the Boer war. The Lace Diamond Mining Co., Ltd., capitalized at £250,000 in £1 shares, discovered diamonds on its property of 5,000 acres in 1898. From February to October, 1899, 47,017 loads of yellow ground were washed for a yield of 9,888·5 carats, or 21·03 carats per 100 loads. Before the war machinery capable of treating 1,000 loads per day of 12 hours was erected, and a duplicate of this plant is expected to be in operation by July, 1902. It is estimated that the company has three years of work in the yellow ground in sight before reaching the bed of blue clay known to exist in the lower levels of the property.

*Australasia.*—The estimated production of diamonds for the year 1901 is valued at £9,756. The diamond output for New South Wales was much restricted in 1900 owing to the extended and protracted drought. The production being but 9,828·5 carats valued at £5,663 against 25,874 carats valued at £10,349 for 1899. The mines of the Inverell Diamond Field Co., Ltd., at Copeton (formerly Boggy Camp) were closed during the greater part of the year pending a reconstruction of the company. The quantity of wash dirt treated during the year was 4,275 loads for a yield of 3,546·5 carats of diamonds, valued at £1,063. The Soldiers Hill Diamond & Tin Mining Co. recovered, from May, 1899, to December, 1900, diamonds to the weight of 5,887·5 carats valued at £4,256. The Elliot Diamond & Tin Mining Co. during 1900 treated 140 loads of wash for a yield of 637 carats of diamonds and one short ton of tin. Operations were commenced November 1, 1900. The diamonds average 3 or 4 to the carat and have been sold locally for 16s. per carat. During 1900 the Australian Diamond Fields Co., of Copeton, treated 422 loads of wash for a yield of 466 carats of diamonds valued at £350. The Malacca mine treated 70 loads of wash for a yield of 202·5 carats of diamonds valued at £160. Other small holdings of the Copeton field produced 2,400 carats of diamonds valued at £1,583. The Bingara mining division produced almost nothing during the year owing to the great scarcity of water, the nearest stream being four miles away. Diamonds are reported at Watson's creek, in the Bendemeer division and at Beryl, on the Cudgegong river, in the Mudgee mining district. At Nullagine, in West Australia, 230 tons of conglomerate were treated for a yield of 25 small diamonds valued at £24, and 77·7 oz. of gold.

*South America.*—The principal diamond mining States of Brazil are Bahia

and Minas Geraes. The districts of Diamantina, Jequitinhonha, Abaíthe, Bagagem, and Saccado Veados, in Minas Geraes are the principal regions where mining is carried on. Diamantina is divided into the localities of Sopa, Boa Vista, Curalinho, and Lavras, the latter the richest diamond deposit in all Brazil. In the State of Bahia the most prominent districts are Sincova, Cannavieivas, and Salobro. The last-named district was supposedly exhausted in 1891, but recent investigations may lead to a revival of diamond mining there. The workings in this district were confined to the beds of the streams and shallow holes on the benches. The diamonds occurred in the naturally concentrated gravel beds, in pockets, with no regular system of occurrence. The lower diamondiferous strata was not explored owing to the limited resources of the miners and the frequent and disastrous floods. The exports of precious stones for the first seven months of 1901 from the State of Minas Geraes amounted to almost \$250,000 in value.

*British Guiana.*—During 1901 a large number of prospectors and mining companies were operating in the Mazaruni diamond fields. The route to the fields follows the coast for 20 miles from Georgetown, thence 50 miles up the Essequibo river to Bartica, from there to San-San-Kopai Landing about 1.5 miles above Putareng creek on the left bank of the Mazaruni river. Navigation is difficult on account of the numerous rapids and cataracts, and prospecting expeditions are costly to outfit. The expense of outfitting for three months for an expedition of eight men and transporting them from Georgetown to the diamond fields is \$1,000. The principal diamond diggings are five miles back from the Mazaruni river. Among the prominent companies operating in the district are: The British Guiana Diamond Syndicate; the Fogel-Armeny Syndicate, at Saranamoo; the Stripp, Menzies, and Morris Syndicate, on Jasper creek; the Marshall Syndicate; the Nascimento Syndicate; the Wieting Syndicate, between Putareng and Saranamoo creeks; the Barnard Syndicate, on Saranamoo creek; the Forbes Syndicate; the Ho-a-Hing Kenswall Syndicate; the Harrison-Richter Syndicate; and the Biallostowski Syndicate, on Putareng creek. Some of the larger syndicates have their own boats plying between the diamond fields and Georgetown. The production of diamonds for the first three months of 1902 was 3,426.5 carats, valued at \$41,062 in contrast with a production for the same period of 1901 of 326 carats valued at \$4,656.

*Dutch East Indies.*—Diamonds are found in Dutch Borneo near the sources and along the courses of the Martapoera, Riam Kiwa, Riam Kanan, and Bandjoe Irang rivers. The Bandjoe Irang field, formerly the most important, together with the region of Tjampaka, is worked out. All the fields are in the southeastern portion of Borneo, and still produce stones in small quantity but of good quality.

*India.*—In 1900 Central India produced 169 carats of diamonds valued at \$350.

**EMERALDS.**—Emeralds are mined in Mitchell County, N. C., and in Blackburg, S. C. The emeralds from Mitchell County are cut in the matrix, polished, and sold in quantities.

The Muzo and Coscuez emerald mine in Colombia is the only one in the world which is worked continuously. The mine is very crudely worked, but the emeralds are of fine color and excellent quality. The mine is located 50 miles from

Bogota, very near the route of the Inter-Continental railway. The Government of Colombia leases the mines to an English syndicate, which has made millions from its profits of operation.

The firm of Streeter & Co., of London, has a concession from the Egyptian Government to prospect for emeralds in the region of the Red Sea coast until 1904. In the winter of 1899-1900 an expedition was sent out by Streeter & Co. to explore the ancient emerald mines of Jebel Zabara, about 80 miles south of Um Rus, and 25 miles from the harbor of Sherm Sheik, on the Red Sea. In ancient times the emeralds of Zabara were noted for their fine quality and the large quantity produced. The emeralds occur in a matrix of mica schist together with large quantities of beryl. The zone of schist extends from beneath the Nubian sandstone to the westward of Jebel Nihari, south of the Hamesh gold mines, and thence eastward to Jebel Zabara and the sea. Another zone of micaceous and talcose rock in which emeralds might be discovered lies to the north of Eridia, eastward of Keneh.

A discovery of emeralds is reported during the latter part of 1901, in the vicinity of Corocoro, Bolivia.

Emeralds are found in the Balkan Mountains, Russia, but the annual output is small and the finds are irregular.

OPAL.—Mining for opals in New South Wales is confined to White Cliffs, in the Wilcannia district, the search being limited to shallow depths. From September, 1899, there has been a steady decline in the population of White Cliffs, the estimate for August, 1899, being 2,500, while December, 1900, showed but 1,400 persons, due to the overproduction of the poorer quality of opals and the consequent restriction of mining operations. In 1900 a comparative scarcity of first-class opals was reported, buyers being unable to purchase as much as desired. During 1900 the White Cliffs Opal-Mining Co., Ltd., had 400 tributors working on the company's leases. The estimate of the value of the output of 1900 is £80,000. The declared value of the parcels weighing about 51,260 Troy oz. consigned through the postoffice was £44,417, with no estimate for amounts forwarded by coach or taken personally. The value of the production of opals for the year 1901 for the White Cliffs field is estimated at £120,000 an increase over 1900 of £40,000, which is due to the large number of men attracted to the field by the depression in the Broken Hill and Cobar mining divisions.

The principal opal mining district in Mexico is in the State of Queretaro, near La Esperanza, where large quantities are produced and cut annually of the noble opal, fire opal, harlequin, and lechosos (the latter showing red and deep-green flashes of color). The State of Hidalgo produces from Zimapan valuable quantities of the fire opal annually. At Huitzucó and San Nicolas del Oro, in the State of Guerrero the opals are transparent and streaked with red, green and blue. Opals valued at about \$10,000 are said to be exported annually by one mine owner from this State. Large quantities of noble opals are mined in Central America, and opals are also mined in Arizona and New Mexico, U. S. A.

RUBY.—The report of the Burma Ruby Mines, Ltd., for the fiscal year ending February 28, 1901, shows total receipts including rubies sold, interest, etc., amounting to £110,626; the expenses amounted to £70,781, leaving a net

balance of £39,845. Deducting the percentage payable to the Government of India for rental, amounting to £12,440, there remained a net profit of £27,405, which, including the balance brought forward from the previous fiscal year, yielded a sum available for distribution of £36,286. The directors recommended a dividend of 17·5% equal to £26,162, and carried forward £10,124. During the fiscal year 947,444 loads of ruby earth were washed at an average cost of 10·29d. per load, against 888,135 loads at 10·39d. for the previous fiscal year. The erection of a two-pan washing machine at Padansho, near Kyouklongyi, was completed, enabling the output for this mine to be doubled, and the surface stripping for the opening of the new mine at Choungzone was begun. A third electric installation for the working of this mine was received at Mogok. The Burma rubies occur in beds of coarse gravel mixed with graphite, garnet, and spinel. The Burma rubies more nearly approach the pigeon-blood color than those found elsewhere, and consequently the output is more valuable proportionately. The New Kabue Gold Mines of Siam, Ltd., although inactive in the gold field during 1900, took over the lease of the sapphire and ruby mines at Pailin. The company does not engage directly in mining but grants licenses to native diggers, and leases out the various surface rights. Bo Wen and Taphan Hin, in the Province of Chantaboon, Siam, yield the greatest output of rubies, although the Bo Yan and Navong mines, in the Province of Krat, produce large quantities annually. The Siamese rubies are much darker in color than the Burmese ones and have a tendency toward a purplish color. Occasionally the famous pigeon-blood rubies are found in the valleys and water-courses surrounding Ratnapura and Rakwena, Ceylon. While the Ceylon rubies are limpid in brilliancy and pale in color, they are not so valuable as Burmese or Siamese rubies. The total production of rubies for 1900 in India amounted to 214,856 carats. A ruby worth when cut barely £1 was found in 1900, at Beatrice creek, in the Jordan creek gold fields, Queensland, Australasia.

**SAPPHIRES.**—Sapphires of high quality and variegated colors and tints are found at Rock creek, in Missoula County, Mont.; on the Missouri river, between Cañon Ferry and American Bar the sapphires are bluish-green, blue, and white, and are mined in large quantities; in Deer Lodge County, on Cottonwood creek, sapphires of variegated colors are found, and at Yogo, in Fergus County, are the mines operated by the American Gem Mining Co. and the New Mines Sapphire Syndicate, of London, which last produced in 1901 about 100,000 carats of gems, and 5,000 oz. of stones, which are ground and mixed with diamond dust for use in polishing gems. The Yogo gems occur in an igneous dike, which extends for some five miles through bodies of massive gray limestone. The stones are recovered by ground-sluicing and hydraulicking; the matrix of the stones disintegrating either in the sluices or by weathering, in similar manner to the blue clay matrix of the South African diamond fields. The output of the New Mines Sapphire Syndicate is shipped to Europe for cutting, and the product of The American Gem Mining Co. is cut by lapidaries in Helena, Mont. The Yogo sapphires are equal in quality and in value to the best Ceylon and Burma product. A further account of Montana sapphires, written by W. H. Weed, will be found

later in this section. In Cowee township, Macon County, N. C., sapphires are found in seams or layers in an altered hornblende gneiss.

At Anakie, in the Clermont district, Queensland, Australasia, sapphires to the value of £900 were mined in 1900. The stones are found under boulders in a wash not more than 3 ft. deep. The deepest workings do not exceed 14 ft. The wash is screened and sluiced and the stones recovered on tables by hand picking. The Withersfield Sapphire Co., Ltd., holds 240 acres of ground, which is expected to be actively developed in 1901. The production of sapphires for 1900 came from chance prospecting over a wide area of ground. The output of sapphires for 1900 in India amounted to 7,239 carats. In that year the New Kabue Gold Mines, Ltd., took over the lease of the sapphire mines at Pailin, Siam. The company leases the surface rights to native diggers.

**TURQUOISE.**—During 1901 seven mining companies were engaged in mining and marketing turquoise, mainly from the Cerrillos Mountains of New Mexico. The value of the total production from the United States during 1901 (most of which was provided by New Mexico) being \$118,000. Among the mines of New Mexico are the Blue Bell, situated 2.5 miles north of Cerrillos, and the Old Castillian, owned and operated by Tiffany & Co., of New York City. Other deposits of turquoise are in the Hatchitas and Cow Spring Mountains, near Silver City, N. M. The Silver City Turquoise Co. is operating a mine 1.5 miles northeast of Burros, Grant County, N. M. It is reported that an old turquoise mine situated about 62 miles northeast of Manvel, San Bernardino County, Cal., is being operated with a small force of men by a New York company. Turquoise in some quantity and of good quality is reported from the Tonapah district of Nevada, at about 12 miles from Crow's Springs. The turquoise mines at Wady Maghara, in the peninsula of Sinai, which were again started in 1900 by the Egyptian Development Syndicate, produced a small quantity of turquoise of good quality during 1901.

**TOURMALINE.**—The disturbances in China caused the closing of the tourmaline mines in Mongmit, a Shan State, during all of 1901, for there is little or no demand for tourmaline outside of China. The jade mines of Myit-Kyina district, in Upper Burma were closed during the year for the same cause, although a little mining was done. The tourmaline mines of Mesa Grande, San Diego County, Cal., provided nearly all of the production of tourmaline in the United States during 1901, which amounted to a value of \$15,000. A new deposit of tourmaline a short distance from the older one promises an increased output for 1902.

### MONTANA SAPPHIRES.

BY WALTER HARVEY WEED.

EARLY in Montana's history, when the "bars" of the Missouri river, near Helena, the terraces and side hill deposits of river gravels were being washed for gold, the riffles in the sluice boxes sometimes held pale greenish stones which were unnoticed at first, but identified later as sapphires. The discovery awakened but little interest at a time when gold alone was the object of search. From these early days to the present the river bars have been intermittently worked by nomadic



placer miners. About 1893 the locality was visited by European gem experts, who were impressed by the brilliancy of the stones and wrote most flattering reports, which confidently predicted that despite their unconventional color, they would become popular and highly prized gems. Heavily capitalized companies, which were organized abroad, acquired large tracts of land along the Missouri, and Montana was heralded as the new Golconda. Unfortunately these expectations were not realized. The stones were abundant and of high brilliancy, but their pale greenish color did not meet with popular favor, and Montana sapphires were a drug on the market. In 1895, as a result of placering for gold, the new Yogo field was accidentally discovered, and, as the stones were of the much-prized cornflower-blue color, they met with a ready sale. The property is to-day not only the most valuable gem mine in America, but the only place where sapphires are mined in the original matrix in which they were formed, resembling in this respect the Kimberley diamond mines of South Africa.

The Missouri river localities are located 12 to 18 miles from Helena. The different bars have received names—Ruby Bar, Spokane Bar, etc., and the gravels all contain sapphires as far up stream as Emerald Bar. These gravels are from 10 to 50 ft. thick, and situated at varying elevations above the stream (130 ft. at Emerald Bar). The gems are found in situ in a dike of igneous rock 3 miles below Cañon Ferry.

As investments these bar deposits have not been remunerative because the stones are chiefly of a pale greenish yellow color, and though very brilliant, are not highly esteemed by the public. Blue and red stones of fine color are extremely rare, and the pink and yellow ones not common enough to be counted upon in washing the gravel. The Missouri river bars are therefore not now worked, and the heavily capitalized corporations formed to mine the gems are financial failures.

The Rock creek locality is about 30 miles west of Anaconda and the same distance southwest of Phillipsburg, in Granite County. The sapphires occur in the gravels of several small streams forming the central headwaters of Rock creek. These placer claims have been extensively worked in the past three years, yielding several hundred thousand carats of rough stones, of which about 6% are fit for cutting. The gems occur only in stream gravels, but a few specimens are found in the original matrix of igneous rock. The gems from this locality, though greenish or blue-green, are deeper colored than those from the Missouri Bars, and meet with a ready sale in Montana, where they bring prices but little less than those of the blue stones.

The Cottonwood creek locality is about 10 miles east of Deerlodge, on the headwaters of the stream that flows through the town. The gems occur only in stream gravels, are of the usual pale greenish color, and the deposits have as yet been but little worked.

The Yogo mines, situated in the eastern footslopes of the Little Belt Mountains, are near the junction of Yogo creek with the Judith river, 15 miles from Utica, which is the nearest town, and accessible by stage from the terminus of the Montana railroad or from Great Falls. The gems occur in a dike of dark gray igneous rock, forming the sapphire vein, which has been traced for a distance of nearly five miles from the meadows of the Judith river across barren limestone hills

to the cañon walls of Yogo gulch and beyond. This remarkable dike, for the vein is a true dike of igneous rock, cuts white limestones (Carboniferous) and the red clays and dark shales which overlie them to the east. The gems occur in corroded forms and in well-defined crystals somewhat sparsely distributed throughout the rock. The dike rock is, when unaltered, of a very dark gray color and dotted with white and pale green inclusions. It consists of brown mica (biotite) and green pyroxene (diopside) and is classed as a basic *minette*. The inclusions consist of fragments of limestone or shale altered to calcite diopside and quartz.

The present workings consist of great open cuts, one of them 700 ft. long and 90 ft. deep, another 1,200 ft. long and 20 to 50 ft. deep, besides tunnel and shaft workings. Much of this open cut work has been done by hydraulic mining wherever the slope of the hillside permitted one end of the cut to reach the surface. The upper part of the vein consisted of a coarse breccia composed of fragments of altered limestone and shale in a yellow clay. These fragments diminish in amount in depth, and the mass of the dike is a yellowish brown clay, but this changes at 20 to 50 ft. in depth to a blue clay in which there are boulders and masses of the still fresh and undecomposed igneous rock. This blue clay, like that of the Kimberley diamond fields, is a product of the alteration of the igneous rock. It is a very important factor in the economical working of the mines, as it would be all but impossible to extract the gems from the original rock itself, whereas the blue clay disintegrates readily on weathering.

This material is worked by washing it into sluice-boxes similar to those used in ordinary placer mining for gold. The boxes are set with less fall than for gold and the riffles made slightly higher, as the sapphires are not so heavy as the gold, and hence would wash away. The "dirt" mined in the open cuts is screened and the fine material carted to the sluice-way to be washed, while the lumps are gathered in heaps to slowly disintegrate through weathering. This process is hastened by occasional wetting, which, with the freezing incident to the usual and almost nightly frosts of this altitude, aid the process. This disintegrated material is subsequently washed in the sluice-boxes. The material caught in the riffles is "cleaned up" and treated in an ordinary gold rocker fitted with three screens of different mesh. This eliminates much of the waste, and the resulting concentrate is panned by hand. The residual material consists of small irregular lumps of pyrite and the sapphires, and from this the gems are picked by hand. Formerly the small chips were rejected, but there is now a market for all the material, not only the larger gems, but also for the smaller ones for watch jewels. The stones are mostly small, a large proportion being flat discs showing the triangle (the so-called signature of the sapphire) in relief. Gems of 4 to 5 carats are rare. The largest stones found weighed from 11 to 12 carats and cut to gems of 5 to 6 carats. These larger stones are valued at \$75 a carat, but the smaller ones sell at retail at \$30 to \$40 per carat, according to the stone. In 1901 the output was about 150,000 carat of cuttable material.

*Origin of Sapphires.*—From the foregoing brief description it will be seen that the gems occur in dikes of igneous rock, both at Yogo and near Helena. The dike rock is different in the two localities, being a basic *minette* composed of only pyroxene and biotite at Yogo and an altered augite-mica-syenite in the Mis-

souri river locality. These are both very basic rocks, thus emphasizing the resemblance to the occurrence of diamonds in Africa. Sapphires have been formed artificially from alumina dissolved in molten glass, from which crystals separated out in cooling.<sup>1</sup> There is therefore no reason to doubt that the Montana gems originate from fragments of shale gathered from the walls of the fissure and carried upward as the liquid igneous magma filled the crack. These fragments dissolved in the liquid rock which then became extremely rich in alumina, which element, upon cooling, crystallized out as sapphires. It also seems certain that corundum is sometimes an original constituent of igneous rock.

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<sup>1</sup> Morozewicz, *Zeitschrift fuer Krystallographie*, Vol. XXIV., 1895, p. 281.