FAC-SIMILE OF MEDAL AWARDED TO THE MINERAL INDUSTRY

BY THE

SOCIÉTÉ D'ENCOURAGEMENT POUR L'INDUSTRIE NATIONALE DE FRANCE,

IN RECOGNITION OF

ITS SERVICES TO THE WORLD'S INDUSTRY AND COMMERCE.

THE MINERAL INDUSTRY,

ITS

STATISTICS, TECHNOLOGY AND TRADE

IN THE

UNITED STATES AND OTHER COUNTRIES

TO THE END OF

1899.

EDITED BY

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GEMS AND PRECIOUS STONES.

THERE was nothing new in the mining of precious stones in America during 1899. The glacial deposits of Wisconsin which have been found to contain diamonds have excited some interest from a purely scientific standpoint. Some prospecting has been done on them which has resulted in no new discoveries. The New Sapphire Mining Co., Ltd., continued to work the sapphire deposits of Yogo, Mont., and an attempt was made to consolidate the various turquoise interests of New Mexico.

Diamonds, Brazil.—(By J. C. Branner).—The diamonds of Brazil consist of brilliants and *carbonados* or black diamonds.

From the discovery of diamonds in Brazil in 1772 until the discovery of the South African diamond fields in 1865, the bulk of the world's supply came from there, but the development of the African mines practically abolished the industry. A considerable quantity of the Brazilian stones still appear in the market, but diamond mining is no longer carried on upon a large scale.

The diamonds are not of widespread occurrence, but are confined, so far as our present knowledge goes, to comparatively small districts within the States of Bahia, Mines Geraes, Goyaz and Matto Grosso. They occur for the most part in placers. Some diamond bearing deposits, however, are not stream gravels, but consist of the weathered and decomposed remains of metamorphic rocks. The stones are frequently found held fast in a conglomerate or pudding stone cemented by iron oxide. The beds of existing streams have furnished the greater part of the production.

Mining is carried on upon a small scale as a rule. The methods in use for diverting the streams, handling the gravel and separating the diamonds are of the same character as those employed in the early days of diamond washing. Opinions differ as to the development of the industry by modern methods and machinery. My own observations led me to conclude that modern machinery and methods can be made to pay only in case of the discovery of very large diamond bearing deposits, where separations can be carried on for a long time in a comparatively small area. Brazil is without good roads and without skilled labor, and machinery therefore is expensive to operate or to move readily from place to place. It has been possible to operate the diamond mines of South Africa by means of machinery because the deposits are very limited in area. In Brazil, on the other hand, the diamond bearing gravels spread over thousands

of square miles, and are only locally profitable. The *carbonados*, or black diamonds, are mined in the State of Bahia, and the output passes through the hands of a single firm in the city of Bahia. The finest of these *carbonados* come from Saloboro, in the Serra Itaraca, near Cannavieiras, in the southern part of the State of Bahia, and from Lencoes, Sincora and Santo Ignacio, 306 km. west and a little south of Bahia. There are mines in other parts of the State, some located within ten leagues of the city of Bahia. It is an interesting fact that the rich Salobro district, 70 km. from Cannavieiras, was only discovered as recently as 1881. In 1890 one mine in this district yielded 54,000 oitavos* or drachms of diamonds. The diamond bearing gravel is from 1 to 2 m. thick. The stream beds have not been mined.

The statistics of diamond production are necessarily difficult to collect. Even while the mines belonged to the Crown of Portugal, and all stones coming from them were supposed to pass through the hands of the *intendente* of the district, large numbers went illicitly into the European markets as contraband. The best available statistics show that the total output of Brazil from the discovery of diamonds up to, and including 1899, was 13,105,000 carats.

According to Ernest von Hesse-Wartegg, diamonds were discovered in ploughing, 19 miles to the S.E. of Itschoufu in the Province of Shantung, China. Some years ago United States Consul Fowler, in a statement to the Government,† reported that a correspondent of his considered these fields well worthy of intelligent exploitation. The natives believe, as they frequently find the diamonds after a rainstorm, that they are produced by the action of the rain itself, and will not wash for them, although they are found for some 8 miles in extent on a low sandy ridge.

The report of the De Beers Consolidated Mines, Ltd., of Cape Colony, for the year ending June 30, 1899, shows that the diamonds produced during that period were marketed for £4,038,421. The total expenditure amounting to £2,063,714, left a profit of £1,974,707, exclusive of other revenues. The average yield per load for the De Beers and Kimberley mines was 0·7 carats. The value per carat was 29s. 7·2d. The yield at the Premier mine (Wesselton) was 0·3 carats per load, and the value 22s. 10·1d per carat. There were 4,034,716 loads of blue ground and lump on the floors June 30, 1899. The contract with the syndicate for the disposal of their product expired April 1st of the current year, but it is anticipated that another one will be entered into on even more favorable terms. According to Cecil Rhodes, the holding of the De Beers Company in Chartered shares and in the Mashona land railway had been disposed of to the advantage of the company. The assets of the London & South African Exploration Co., which included the Dutoitspan and Bulfontein mines, had been purchased, as well as the properties of the Kimberley Diamond Mining Co. for a total consideration of £1,725,000. A dynamite factory is in course of erection, which it is anticipated will add to the company's products.

Otto's Kopje Mine, Cape Colony, seemed on the eve of success when the war broke out. It was stated on the relief of Kimberley that the machinery was still in good order, and that work could be resumed quickly.

* Eight oitavos equal one ounce troy.

† Consular Report No. 198. March, 1897, p 384.

It is said that diamonds have been found in an extinct crater in the Witries Hock Mountains in Natal. Diamonds were discovered about 1872 in the stanniferous alluvial near Inverell, New South Wales. While the production has never been large, a maximum quantity of 20,000 carats having been obtained at Boggy Camp, there are possibilities of an increased output on systematic prospecting work.. The diamond bearing wash is covered by basalt, and in places the wash rests on very soft decomposed granite. Overlying the wash in various places, more especially where the basalt comes in contact with the wash, is a cemented gravel in which diamonds have been found imbedded. The opinion of H. N. Porter* is that this was an overflow of lava. The writer believes that an extinct crater in what he terms "carboniferous mudstone" was the center of volcanic activity, and the source of the diamonds found in the wash. The periodical flooding of the low lying crater doubtless prevented the consumption of many of the diamonds, which later would be expelled in the period of activity. The basalt itself he regards as a later flow.

Notwithstanding Mr. Porter's opinion, the Government Geologist does not believe that the original matrix of the diamonds was an eruptive rock. Samples of the alleged volcanic breccia from Bingara were pronounced to be of sedimentary origin. Nor in Mr. Jacquet's opinion was there anything found to suggest the occurrence of a volcanic pipe. A report furnished by Messrs. Thos. Davies, F.G.S., and R. Etheridge, Jr., refers to the quality of New South Wales diamonds as follows: (1) That the diamonds in New South Wales in their physical characters are more nearly allied with those of Brazil than any other country; (2) they have been largely sold in London as such; (3) as regards color they differ practically but little from those of other fields; (4) the general absence of cleavage and macles is a point in their favor; (5) that the greater hardness of New South Wales gems will probably raise the cost of cutting, but this will be compensated for by their extra brilliancy. The diamonds found in this Colony generally average from 5 to 6 to the caret, although gems of 2 to 2·5 carats are occasionally found, and one of 5·62 carats has been recorded. The number obtained per load varies greatly. The Round Mount Co. in 1886 washed 722 loads for 2,685 carats, and from six loads obtained an exceptional yield of 1,080 stones weighing 296 carats, which probably establishes a record as far as New South Wales is concerned.

The Lace Diamond Mining Co., Ltd., formed in 1899, worked the Farm Ruby, near Kroonstad, Orange Free State, which consists of 1,385 morgen, on which 400 claims at about the center of the farm have been taken up. The formation is said to be somewhat different from anything which has yet been found in South Africa. A portion of it was capped by basalt, which was considered an unfavorable feature, though later explorations have shown the occurrence of gems of very good weight and quality in the vicinity of this rock. This overflow, however, is by no means general and is considered to be float. The yellow ground was worked by the De Beers Consolidated mines, which held an option on the purchase of the property, and gave the following results: 5,683 loads yielded 652 carats, equal to about 8·5 carats to the 100 loads. The tailings showed a

* *Transactions of the Institute of Mining and Metallurgy*, Vol. VI.

further 13%, and, owing to the very crude machinery, it was anticipated that the re-treated tailings would show an equal amount. Since the company was formed blue ground was struck at the depth of 50 to 75 ft., though it has not yet been washed. Latest results show an average of about 16 carats per 100 loads of diamonds of fair quality. It was thought that when arrangements have been made for proper supervision of the boys that this yield will be increased, as at the present time they have unlimited opportunity for abstracting the largest stones. The mine is well situated for working, as it is 5 miles only from the Campbell coal mine, from which coal can be delivered at 15s. a ton. Water is abundant.

The chimney at the Monastery Farm mine in the Orange Free State, 30 miles south, in Winberg, is rather small, occupying from 5 to 12 acres. Blue ground was struck at the depth of 81 ft., and resembles in appearance and its mineral constituents the country rock of Kimberley.

The Jagersfontein mine reached its maximum production in July, during which month 22,219·75 carats, worth £45,908, were produced. The value per carat was extremely high.

The total production of the Transvaal, according to Charles E. Macrum, late United States Consul to Pretoria, was 22,843 carats, valued at $212,812·04, of which 12,283 carats of a value of $171,437·06, came from alluvial mines, while from the dikes 10,560 carats, valued at $41,374·98, were marketed. The river stones are generally larger and of better quality than those from the diamondiferous dikes. The average value of the diamonds found at Reitfontein is $3·89 a caret, which is much less than the average value of Kimberley diamonds, and less than half the value of those from Jagersfontein. The diamond bearing area of the Transvaal seems to be quite large.

What may prove to be an important discovery was made at Hatherley, a few miles from Pretoria, where true diamondiferous ground is found 15 ft. from the surface. In general it may be said that much of the country surrounding Pretoria gives evidence of being diamond bearing.

A peculiar feature of the laws formulated in 1898 regulating the mining of diamonds and other precious stones in the Transvaal, was the limitation of the number of employees; not more than four white men being allowed to each owner. A license of £10 per head was imposed on those who intend to open up Government ground, and it was made obligatory to any one discovering precious stones to give notice to the Government within 24 hours under severe penalty. Stringent clauses were also included in the act against illicit diamond buying.

Claims have been made from time to time that diamonds existed in West Australia, and one company has been formed to work the alleged deposits. It went into liquidation the early part of 1899 without the shareholders or receiver being able to obtain much information.

J. Milne Curran* gives some practical hints on the identification of diamonds. While the article does not treat the matter so thoroughly as Mr. Leopold Claremont's contribution to THE MINERAL INDUSTRY, Vol. VII., the notes may be of benefit to prospectors to whom laboratory appliances are inaccessible.

* *Journal of the Royal Society of New South Wales*, 1897.

Zircon is commonly mistaken for diamonds, owing to the surface luster of these stones being often finer than that of a diamond. The test of cutting glass is frequently, though erroneously, relied upon, as a zircon used to advantage will scratch glass easily, while a true diamond will not mark glass if a rounded face is drawn along the latter. In a diamond bearing country the prospector should carry a small plate of sapphire and a splint of diamond mounted on the end of a short length of stout brass wire. The latter is known as a writing diamond and is inexpensive.

The supposed diamond is set in the end of a stick of sealing wax, and while the wax is softened by heat the stone can be so arranged that a sharp solid angle or an edge projects. This can be done after a little practice by heating the stone, and quickly transferring it to the wax. Holding the stick of sealing wax, the stone to be tested is rubbed with a gentle pressure round and round, on the polished face of the sapphire plate. Not more of the sapphire need be used than the space covered by a pin's head. After the friction is continued for half a minute, if the sapphire plate has lost its polish, and with a lens shows the point of contact "eaten into" or "burned," the stone being tested is a diamond, since the diamond is the only stone that can cut into a polished plate of sapphire.

The use of a writing diamond will, however, settle the matter at once. If a prospector draws a diamond over a smooth zircon and over an uncut diamond, the difference is apparent. Even with gentle pressure the writing diamond "catches" or "drags" on the zircon, and a dull cutting noise is made. When the writing diamond is gently rubbed on a real diamond, it (the writing diamond) does not "bite," but glances and splits off in every direction, no friction due to cutting being apparent, and the sound produced is metallic-like and sharp.

It may be well to remember that where zircons are found a considerable number of the stones are red, or some shade of red, and on heating these colored stones become white and remain white on cooling. Red or green diamonds are exceedingly rare. These rough-and-ready tests will also distinguish between small and water-worn topaz and diamond stones which are also confused by prospectors.

C. Margot proposes to distinguish real diamonds from the artificial by the property aluminum when in pencil form has of marking silicious substances, but not the true diamond. The surface of the gem under examination must be cleansed thoroughly, and freed from grease.

In the thirteenth annual report of the United States Commissioner of Labor* there is a comparison between the cost of cutting four three-carat diamonds by hand and by machinery. The cost by machine work was considerably higher than by hand, but time was considerably shortened. Thirty-nine hours' labor cut three four-carat diamonds when machines were employed, but 132 hours' hand labor was required. The cost, however, was $26·25 against $14·84.

Emeralds.—Emeralds are found in various parts of the Republic of Colombia. The famous mines of Muzo, near Bogota, which were worked before the Conquest (the uncut gems supplying a large part of the booty of the sixteenth-century pirates), have been continuously worked under Government leases since the year

* For the year 1898, p. 1288.

1568. No statistics of the output are available. The emeralds are found either in isolated crystals or together with uncrystallized corundum, imbedded in a mountain-side of limestone. The method of working is cutting away the barren surface-rock and then opening reservoirs to sluice off the débris until the limestone is laid bare, when the stones are broken out by expert laborers.*

There was considerable excitement in Bogota during 1899, owing to a local boom in the price of emeralds, although the mines in the vicinity of that city, according to the English company which owns them are unproductive. There was a considerable quantity of uncut gems held by various people. The excitement rose to a great pitch, and these stocks were brought out. The prices mounted rapidly and sales were made at from three to four times the former value of the gems. The craze, however, subsided suddenly, and many unfortunate purchasers were left with stones which they had purchased at absurdly high prices.

The English company's lease of the emerald lands expires during the present year, and as yet no arrangements have been made for its continuation.

The most important occurrence of this gem in New South Wales is at the Emerald Proprietary Co.'s mine at Emmaville. Emeralds were found in the tin drift for many years, but in 1890 they were discovered *in situ*. At this mine emeralds were found on the surface in disintegrated feldspathic material, slate rock and quartz, not very far from the slate and granite. On opening the ground it was seen that a reef or vein of silicious materials occurred in slate-rock or claystone. The reef travels or trends in a northeastern direction, dipping at a high angle to the southeast. At various points, proved to a depth of 100 ft., shoots or pockets occur, containing quartz, topaz, tinstone, arsenical pyrites, fluorspar and kaolin. The shoots almost always carry emerald or beryl associated with the minerals named. Again some shoots consist for the most part of emerald and beryl only.

The greater bulk of the marketable stone did not cut to a greater size than one caret. Some gems realized as much as £10 per caret; the ordinary ones bring much less, being rather light in color and resembling aquamarine. An analysis of a specimen by Mr. James Petrie showed H_2O, 0·62%; SiO_2, 65·20%; Al_2O_3, 17·80%; BeO, 14·40%; CaO, 1·0%; MgO, 0·64%; Na_2O, 0·34%. These mines are now shut down, as the hardened formation encountered in depth does not contain the same quantity nor the same quality of emeralds as was found in the more decomposed rocks.

A considerable quantity of emeralds has been found along the banks of the Tokova River, 50 miles from Ekaterineburg in Russia. Those of superior quality are discovered on the surface, while those found deeper are inferior.

Opal.—The White Cliffs Opal Mining Co., Ltd., still controls the opal region in the vicinity of Wilcannia, New South Wales. The company has found it advisable to increase the percentage to its tributors from 50 to 75%. It is expected that when the percentage was based on the lower rate much of the most valuable mineral was disposed of privately by the tributors. The company has not been able to work satisfactorily on the wages system, and this was finally abandoned. Working here will always be expensive, as there is a lack of water,

* Grainger and Treville, *Transactions of the American Institute of Mining Engineers*, Vol. XXVII.

and the local sanitary conditions are extremely bad. The Paranga opal fields, a few miles distant from White Cliffs, have been practically abandoned. About 350 men are employed on the leases of the White Cliffs Opal Co., Ltd. A considerable number of men are working on abandoned ground, and are there working to as deep as 50 ft. Good opal has been found at 40 and even 50 ft. Local prices have varied according to quality as well as market demand. In the case of special samples $100 an ounce has been obtained.

Here the opal is found in Upper Cretaceous Sandstone, lining joints and filling fissures both vertical and horizontal. The matrix is so friable that it is easily removed, and the gem released. Opal has been found in a strip of country nearly two miles wide and 12 to 16 miles long. In this area miners blindly sink shafts with the hope of finding opal seams. Experience has shown, however, that the probabilities of finding good stone are confined to certain localities that show no especially distinctive features. The opal is not confined to any single level, though appearance would indicate that the conditions under which the opal is found, ceases at a depth of from 50 to 60 ft. from the surface. The matrix is feldspathic and much of it contains sufficient lime carbonate to effervesce with cold hydrochloric acid, and may be classified as a marl.

An extremely large block of opal was found in the earlier part of the year at Opaltown, Queensland. It was 15 in. wide and 11 ft. long. It is stated that $60,000 was offered for it.

Rubies and Sapphires.—The Burma Ruby Mines, Ltd., managed for the first time in its history to pay a dividend of 5%, though their richest mine at Shebontha was drowned out. The books showed a total profit for the year ending February 28, 1899, of £4,322, which was increased to £9,893 by a remission of royalties amounting to 2 lakhs of rupees. The Indian Government has determined to remit the 4 lakhs of arrears still due under the original lease, and to reduce the yearly net rental for a term of years from Rs. 3,15,000 to Rs. 2,00,000, subject to an increase in the Government share of the net profit from 20 to 30%. The agreement is to last for five years and is subject to reconsideration at the end of that term. The mines have been worked by electricity since September 5, 1898. The installation which has reduced working expenses by £500 a month, will shortly be doubled in size. The mine showed a mining profit of £11,470 as compared with a loss of £360 for the same period of 1898.

Sapphires of every known shade from white to royal deep blue, have been found in New South Wales. At Tumberumba it is obtained chiefly in working recent alluvial deposits for gold. Associated with the sapphires there is spinel, topaz, andalusite, and garnet. The spinels are of excellent size and color. Sapphire is also found throughout the alluvial drifts of the tin districts of New England. While sapphires are abundant the production of good gem stones is exceedingly small, and when compared with good gems the New England stones show a want of life.

J. Milne Curran believes that basalt is the original matrix of sapphire, as basaltic areas can always be found in the vicinity of localities where sapphires occur.

H. Warington Smyth, F. G. S.,* describes the ruby and sapphire deposits of Siam. The workings are partly alluvial in river beds, and partly by drifting in layers of a decomposed basalt rock, of which there are frequently two. Basalt is the general country rock, though no gems have been found in it when in an unaltered condition. Poor sapphires, corundum, topaz, zircon, and ilmenite, and at some points garnets occur in the ruby layers. On the upper Mekong River sapphires are found but no rubies of any account. Here also the gems are found in stream beds, and in a definite layer 12 to 20 ft. below the surface.

The ruby and sapphire mines at Pailin, in the Battombong Province of Siam, are held by the Siam Exploring Co., Ltd., one of the affiliated companies of the Siam Co., Ltd. The mines are worked by Shans and Laos, licensed by the company, who are allowed to dispose of the stones themselves. The prices obtained for the stones were poor, but recently have improved.

Turquoise.—Mr. Gustav Eisen, of the California Academy of Sciences, describes the result of archæological investigations of the turquoise mines near Manvel, San Bernardino Co., Cal. The best mines are found in an area of 15 miles long by 3 miles wide. The region is covered with volcanic overflows from a central group of craters. These overflows extend for many miles in all directions. Between the basaltic ridges are found small rounded hills of decomposed rocks traversed at times by dikes of crystalline rocks and quartzites. On the sides of these are pits from 15 to 30 ft. across, and of half that depth. Prospectors have found good stones of good color and quality in these half filled excavations, while ordinary ones are common.

Caverns which have been the habitations of some prehistoric race, indicate that these mines were actively worked at one time. Hammers and axes made from hard basalt or trap, are frequently found. Some of the rock carvings indicate that these mines were known to the Aztecs, but others are unlike any previously described. It is believed, and the conjecture is supported by existing traditions, among the Mojave Indians, that these mines were worked by a tribe which came from the south and had communication with ancient Mexico.

While turquoise has been found widely distributed through Southern California and Nevada, no stones of extreme value have been discovered as yet, though one weighed 107 carats and another 64·5. They were from a point about 18 miles east of Vanderbilt, Cal., and in Nevada. The turquoise is found in what is described as a trachyte or white soft conglomerate through which blue-green streaks and veins pass, here and there expanding into nodules.

Turquoise was discovered in 1894 near Bodalla, New South Wales. Much of the stone is found to be porous and not as compact as it should be. The green tint of most of the stone is objectionable also. A few picked stones are, however, of excellent quality. According to J. Milne Curran it occurs in this locality as (1) thin crust-like seams filling horizontal joints in the slate; (2) in rounded marble-like balls in vugs of the slate; (3) as concretionary matter in similar vugs; (4) in thin lenticular plates in black streaks associated with iron pyrites. The slate rock is dark in color, and is charged more or less with pyrites containing 2 dwt. of gold per ton. An analysis showed H_2O, 21%; SiO_2, 0·5%; CuO, 7·45%; Al_2O_2, 36·23%; Fe_2O_3, 1·26%; CaO, 1·7%; B_2O_5, 31·9%.

* *Five Years in Siam*, 2 volumes, London, John Murray, 1898.

The Cutting and Polishing of Precious Stones.

By Leopold Claremont.

Precious stones were originally used as ornaments in their natural or uncut state by the ancient races and were valued more for amulets and their supposed magic and medicinal qualities than for their beauty. Subsequently the natural crystallographic faces of the gems were roughly polished to enhance the luster and for centuries later they were treated in this way and used for the embellishment of goblets, tankards, idols, thrones, etc., as well as for personal adornment.

As time went on the ancients acquired the means of increasing the number of faces found on many gems, and in this crude way gems were not only polished but received additional faces which are now called facets.

From specimens of precious stones thus crudely cut it is apparent that the one object of the ancient lapidaries was to retain the size of the gems upon which they operated. Therefore no matter in what shape they were found or in what degree they were flawed or otherwise faulty, they were merely covered with polished surfaces without regard to symmetry, brilliancy or quality of color. The gems also were generally drilled through the center in order that they might be strung, sewn on to a robe, or dangled from a pendant or turban. Not infrequently they were beautifully and elaborately carved—as is still done by the natives of many parts of Asia—and in this way many magnificent gems were almost ruined. When they are placed upon the gem market of to-day, which is by no means an uncommon occurrence, it is found that in order to remove the carving and drilling—work done at a gigantic expenditure of labor and energy—so great a loss of weight is incurred before the stones can be made suitable to the requirements of modern jewelry, that they are of considerably less value than rough stones of the same quality and weight.

There is no record of precious stones being cut with any regular system until as late as 1285, when a record occurs of a guild of gem polishers and cutters established in Paris. Records of diamond polishing toward the end of the fifteenth century have been found.

Gem cutting was also an established industry at Nuremberg in 1370, where the lapidaries were termed "table polishers" and gained some distinction in their craft. It was not, however, until nearly 100 years later, 1456, that diamonds were cut in a regular system of faceting.

A Frenchman named Louis de Berquem, a resident of Bruges, was the first to discover a method of so arranging the facets upon a diamond that the reflection and refraction of the light were so greatly increased that he soon became famous throughout Europe. A guild of diamond cutters and lapidaries was established in Bruges in 1470, and many large diamonds which have figured conspicuously in history were entrusted to Louis de Berquem to recut.

The pupils of Louis de Berquem dispersed to different cities, and formed new fields for the industry. Amsterdam, Antwerp and Paris became the centers of the diamond polishing industry and the cutting of colored gems flourished in Lisbon. In Paris the art for a time—notably under the influence of Cardinal Marzarin—progressed with rapid strides, owing doubtless to the reckless grandeur of the French Court. It gradually declined, however, and finally

disappeared from this city during the troubled times toward the end of the eighteenth century.

In Holland the diamond cutting industry took the firmest root, and to this day it remains the staple business of Antwerp and Amsterdam. Until the beginning of the seventeenth century all the colored gems of any note were cut in Lisbon, and the beautiful work of the old Portuguese lapidaries is still to be found in many family jewels. The trade, however, like many other artistic crafts, was entirely in the hands of the Jews, and when they were expelled from the country at the end of the sixteenth century they betook themselves to other cities. Most of them settled in London, and their immigration into England has caused the finest colored stones to be cut in London, and Hatton Garden to be the principal gem market to-day.

There is little record to be found of the methods employed in bygone times for polishing and cutting precious stones, but as the tools and machinery used

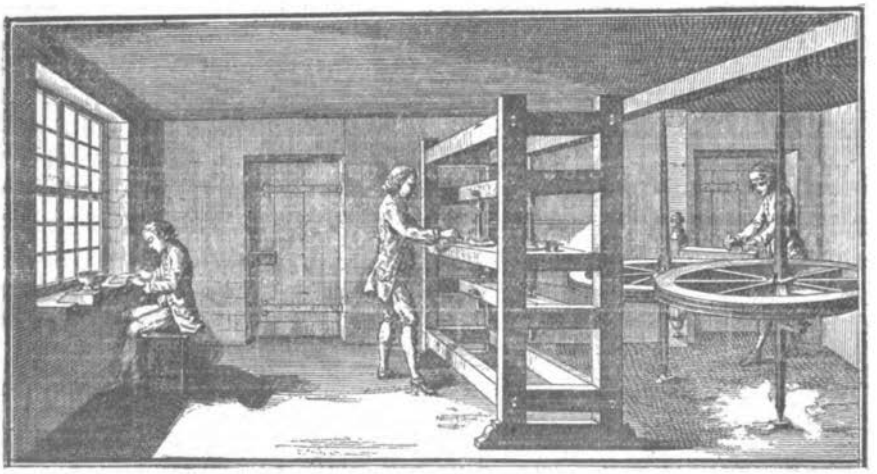

FIG. 1.—OLD METHOD OF CUTTING AND POLISHING GEMS.

by modern gem cutters are of the simplest character, it is probable that little change has taken place in the process with the exception of the introduction of motive power; at all events, during the last 100 years. The method of polishing diamonds before the introduction of steam is shown in Fig. 1, a description of which will be found unnecessary.

The art of the modern gem cutter consists in so manipulating the rough stone as to produce a finished gem of the greatest value. With this end in view he first studies the rough stone, carefully noticing any flaws or other imperfections, which it is his aim to remove, either entirely or partially; or, in the event of this being impossible, to hide as far as lies in his power. At the same time he bears in mind that the desired proportion and as much weight as possible is retained; and in the case of colored stones, the color must be reduced, retained, or adjusted according to the requirements of each individual stone upon which he works. When it is remembered that in nature no two gems occur identical

FIG. 2.—"BRUTING" AND "CLEAVING" DIAMONDS.

FIG. 3.—PREPARING THE HOLDER OF SEMI-MOLTEN METAL FOR EACH STONE TO BE CUT.

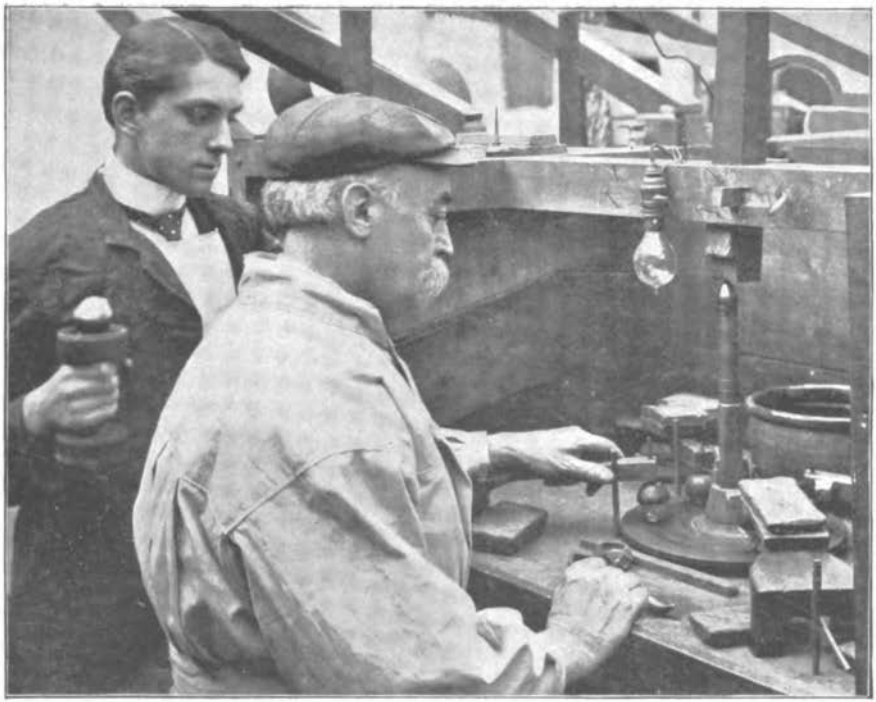

FIG. 4.—POLISHING DIAMONDS.

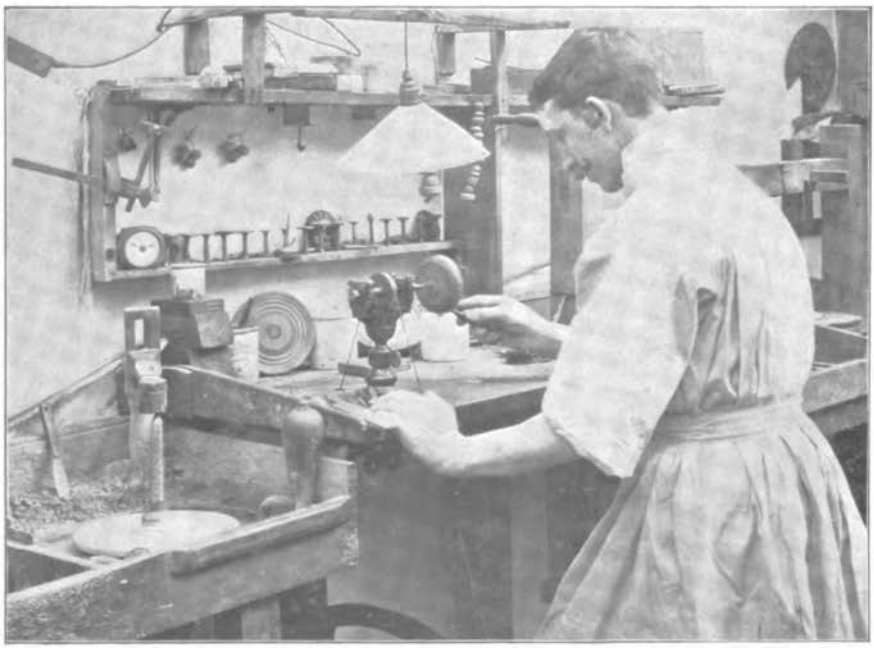

FIG. 11.—POLISHING TURQUOISES.

in every respect, it is obvious that the work of the lapidary is purely and simply one of skill, practice and judgment as the tools and apparatus with which the work is done are very simple. The manipulation of every stone requires brain work, and for this reason machines for cutting and polishing gems are utterly useless.

The method of cutting diamonds is quite different from that of other precious stones. It consists of three processes: "bruting," "cleaving" and "polishing."

Bruting consists in rubbing two diamonds together in such a way that by continual friction each can be made to assume a desired shape. (See Fig. 2.) Each diamond is cemented to one end of a stick or holder about 1 ft. in length, and one is held in each hand of the operator. The stones are then pressed one against the other with a rubbing motion over a trough containing a very fine sieve for catching the dust produced by the rubbing. The holders rest against small projections at the sides of the trough and considerable leverage is brought to bear upon the stones. The dust, called "diamond powder," is collected in a box below the sieve and is used in other parts of the process as a polishing medium. By these means the diamonds are modeled into the required shape and they leave the hands of the bruter shaped in the form in which they are destined to be used as gems minus the flat polished surfaces known as facets, which are subsequently formed by polishing.

It is sometimes necessary to divide a diamond into halves or to remove a small part from a stone which can afterward be cut into a gem as well as the larger piece from which it has been severed. When this is to be done advantage is taken of the natural tendency of the diamond to divide along certain directions (parallel to the faces of the octahedron) and the operation of "cleaving" takes place.

The cleavage of diamonds is a responsible and difficult task and requires a very intimate knowledge of the crystallographic forms in which the stones occur. It is performed in the following way. (Fig. 2.) Upon the end of a wooden holder the diamond is cemented in such a position that the plane of cleavage to be used in the operation is parallel to the length of the holder. The holder is held firmly in position by being fixed into the center of a leaden weight which projects from the bench in front of the operator. The edge of a steel blade somewhat resembling a razor is held upon the diamond with the left hand and with the right hand a sharp blow with a slender rod is then delivered upon the back of the blade. The diamond divides along the plane of cleavage at a single blow and the operation is at an end in a few moments. While this is apparently quite easily performed, in reality it requires the greatest amount of skill. When the diamonds leave the hands of the bruter they are handed to an attendant who is seated at a bench in front of two flaring argand burners. (Fig. 3.) Small brass cups called *"dops"* ranging from the size of a tea cup to that of an egg cup are placed in the flames and a mixture of two parts of lead to one part of tin is placed in them. This soft metal quickly becomes semi-molten and by means of a pair of soft iron tongs the contents of each cup is fashioned into the shape of a cone, upon the apex of which a gem is embedded. Each iron cup filled with soft metal thus forms a holder for the

diamond which is now ready for polishing. From time to time, however, it is returned to the solderer for readjustment, as it is only possible to work upon the small part of a stone projecting from the metal. It is therefore necessary to remelt the metal and replace the stone with a different part of it projecting, until the polishing of the gem is finished.

One man working diligently should be able to solder for six polishers.

The polishing process is an arduous and delicate one. (Fig. 4.) The craftsmen are seated in front of revolving cast-iron wheels, very porous, which turn in a horizontal position at the rate of 2,000 revolutions per minute. The metal cup containing the diamond is held firmly against the surface of the wheel with a heavily weighted iron clamp. Each operator is able to manipulate four of these clamps at once, first examining one diamond and then another, occasionally plunging them into cold water to prevent friction heat from unsol-

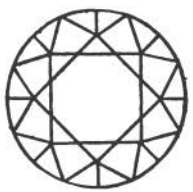

FIG. 5.

FIG. 6.

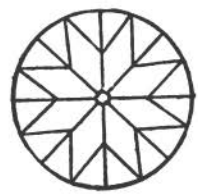

FIG. 7.

FIGS. 5, 6 AND 7.—TOP, SIDE AND BACK VIEWS OF THE "BRILLIANT" CUTTING.

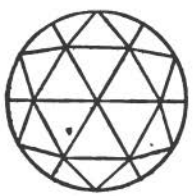

FIG. 8.

FIG. 9.

FIGS. 8 AND 9.—TOP AND SIDE VIEWS OF THE "ROSE" CUTTING.

FIG. 10.

FIG. 10.—VIEW OF THE "BRIOLETTE" CUTTING.

dering the stone, which would damage it considerably. Diamond dust which has been prepared for the purpose is mixed with a little olive oil and smeared upon the wheels. This together with the dust which comes from the gems themselves, gets into the pores of the cast-iron wheels and forms an erosive surface which polishes the facets of the diamond. As the metal cups are frequently too hot to be handled with comfort, wooden holders are used to carry them.

There are several forms in which diamonds are cut (see Figs. 5 to 9), and a short description of each is as follows: The "Brilliant" is the usual form, shown in Fig. 5. In the center is a large octagonal facet termed the "Table" surrounded by 32 smaller facets which extended from the table to the edge of the stone, comprising what is known as the "Girdle." Fig. 7 shows the back of a "brilliant" cut diamond shaped to a pyramid, the top of which forms a small

facet known as the "Culette" or "Culet," and there are 24 facets reaching from the Culet to the girdle. Fig. 6 shows the side view of a brilliant.

The "Rose" (Figs. 8 and 9) is another form, used only for small thin stones which would not make brilliants. It consists of a number of triangular facets so arranged as to cover the front of the stone completely. The back of the rose is quite flat and not worked into an apex. The "Briolette" (Fig. 10) is pear-shaped and has no girdle, table or culet, but is covered with facets like those on the front of a rose. They are generally used for pendants.

The working of all other precious stones is very different from that of the diamond. The gems are cut upon a copper disk into the surface of which diamond powder is continually pressed. The operator holds in the right hand a slender holder of ebony or ivory about the size of a pen-holder, upon the end of which the gem is cemented. A conical rest is used to steady the other end of the holder, thus causing the stone to press upon the wheel at any desired angle. The wheel is rotated by a crank operated by the left hand.

When the gem leaves the cutter every thought and judgment necessary for the successful development of a gem from the rough stone has been bestowed upon it, and while all the facets have been accurately placed thereon, it is dull and lusterless and has to be polished.

It is the work of the polisher to apply carefully every cut facet to the surface of a revolving wheel upon which is spread rotten stone or other polishing material. The wheels are made of various metals, copper, tin, lead, gun-metal, bell-metal, brass, pewter, etc., to suit the specific hardness of the gems and an electric motor is used as power. Gems with a smooth convex surface are cut upon a lead wheel upon which emery dust is spread. They are subsequently polished on a metal wheel, or, if they are very soft—as opal or turquoise—wheels are used composed of wood, flannel, leather and silk. These wheels vary in size from 2 to 15 in. in diameter; they revolve vertically and are adjustable to a lathe head. Fig. 11 shows the process of polishing turquoises in this way.

For carving gems very small disks and wheels the extreme edges of which are primed with diamond powder, are used in a lathe, and to divide a stone a small tin disk as thin as paper is used, on the principle of the circular saw. The description of the process of cutting and polishing precious stones sounds very simple, and it even appears simple to a casual observer watching it in progress, but the amount of skill, dexterity and judgment required by a successful gem cutter is very great. A gem of almost priceless value might be completely ruined in a careless or thoughtless moment.

It is greatly to be regretted that thousands of magnificent gem-stones are still cut by ignorant persons without any regard whatever to the study of optics, physics, mineralogy or crystallography, which is quite necessary for the production of high-class lapidary work. It pays to recut stones which have been thus badly treated, for the loss of weight necessarily incurred in the operation is amply repaid by the increased brilliancy secured.