A PAPER

ON

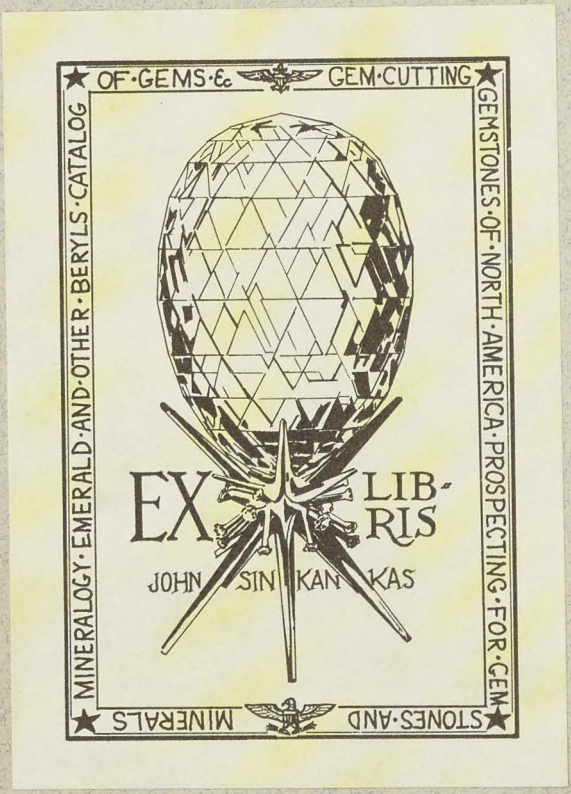
CORUNDUM AND ITS GEMS,

READ BEFORE THE

SOCIETY OF ARTS, TECHNOLOGICAL INSTITUTE,

DECEMBER 14, 1876,

BY CHARLES W. JENKS.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BOSTON:
PRESS OF JOHN WILSON AND SON.
1877.

It has seemed desirable to some gentlemen of scientific pursuits that the facts contained in the following paper be put into proper form for circulation and reference. One such expression of opinion is given herewith.

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117 Marlborough Street, Boston,
December 21, 1876.

Mr. C. W. Jenks, City.

Dear Sir, — I was sorry that ill health prevented my attendance at the meeting of the Society of Arts, last week, but I read with pleasure the report of your remarks in the "Advertiser."

I hope the paper you presented will be put into permanent form for future use; and, wishing you all success in the practical development of your discovery, I remain,

Yours very truly,

William B. Rogers.

A PAPER

UPON

CORUNDUM AND ITS GEMS,

READ BEFORE THE SOCIETY OF ARTS, TECHNOLOGICAL INSTITUTE, BOSTON, DEC. 14, 1876. PRESIDENT JOHN D. RUNKLE IN THE CHAIR.

MR. PRESIDENT AND GENTLEMEN, —

IT is due the distinguished gentleman who presides this evening, as well as to others present, eminent in the ranks of Science, that I should at the outset disclaim either the ability or the intention of treating the subject before us in a scientific manner.

What I propose is, to give the facts as to the discovery of Corundum *in situ* in this country, as they have fallen under my personal observation; with sketches of the locality, and specimens of the mineral and its gems, in the hope that the result of the effort shall contribute somewhat to the advancement of science, and greater progress in some departments of the mechanic arts.

Corundum, in its granular as well as gem forms, has been known to the world from a very early period. In the first, used as an abrasive, second

only in cutting qualities to the diamond; and in gems, as sapphire, ruby, asteria, &c., nine in number, some of which to-day outrank in value, as they have ever done, the costliest diamonds. I shall show you some of these this evening; specially one, locked up in its native matrix, which, could it be liberated and be perfectly cut as a gem, would in the market of London sell for five times the price of a diamond of the first water of the same size. In fact, it would, so far as is known, have but one competitor in Europe, according to Mr. Harry Emanuel, a great authority there in such matters, who says: "I know of but one corundum emerald now in existence: it is the rarest of all gems, and the most valuable." It is its extreme rarity, and the nature of its composition, pure alumina, giving it so much greater hardness and brilliancy, which gives it this great value. The emerald of commerce from Peru and Bogota is largely silica, of course softer and quite common. From a date as early as Solomon, the corundum-gem localities have been known and worked in Armenia, Bactria, India, Ceylon, and elsewhere. The extreme beauty of these gems early invested them with a powerful talismanic influence in the minds of their owners; and greed for their possession involved several of the Oriental nations in costly wars and much bloodshed.

Moses, by divine command, enshrined them in permanent form over the heart of the Great High Priest, where their brilliant scintillations, in some

mode unknown to us, voiced the will of Jehovah himself.

In granular form, corundum was known to the Persians as Armenian stone; to the Chinese, as adamant; and to the people of India, as corundum, from the Hindoo word *korunda*, or cinnamon stone, so called from the resemblance in color to that article, of the variety found in that country. By this latter name, the mineral is now known from whatever locality it comes. It is widely scattered over the earth's surface; and yet, though for more than two thousand years used extensively as an abrasive, it has not, so far as I can ascertain, until the past five years, been legitimately mined. In the ravines of the mountains in Siberia, China, and Hindostan, it is gathered by the natives in small crystals after the rains; but it is not now, nor ever has, so far as we have evidence, been sought for, at much depth beneath the surface. In India, hitherto the chief source of supply, it is, like most of the industries there, of caste production; and of its localities, methods of development, and amount of product, it is very difficult to gain information. Sir Charles Greville of London, about the year 1798, in company with Count Bournon of Paris, prepared an elaborate paper for the Royal Society of London upon this subject. Sir Charles visited one of the localities in India, but nowhere saw the mineral in position, or in much quantity; the natives working in trenches, and finding scattered masses here and there, with no evidence of vein formation. The

gems have always been sought for by similar methods in the beds of streams or on the banks of the same. This is the character of the mining to-day for both classes of the mineral in all the noted localities of the old world.

Emery, one variety of corundum, as is well known to you, is extensively mined among the islands of the Ægean sea, in Asia Minor near Ephesus, and in an impure form at two or three points in our own country. A paper upon this mineral, and the first where it had received thorough scientific attention, was read some twenty-five years since, before the French Academy, by one of America's most distinguished scholars, — Dr. J. Lawrence Smith, of Louisville, Ky.

It has always seemed strange to me that so little was certainly known of corundum; long used, next the diamond in cutting power, and always in some of its forms more prized as an ornament than that so called "king of gems"!

In their size, brilliancy, color, and artistic execution, there are no modern precious stones of this mineral equal to those that have come down to us from an early age. May it not be possible, also, that, in its granular forms, its mining and uses have been among the "lost arts" so eloquently described by Phillips? During the first French empire, the emperor placed an obelisk from the banks of the Nile in the Place de la Concorde. Wishing to inscribe the date of its removal upon its base, his workmen destroyed, in their labors, several sets of

the best steel tools, but failed in their purpose. Yet the same column is covered with hieroglyphics from tip to base, by the skill of the workmen three thousand years ago. I believe there are but two — and those unimportant — well-authenticated instances of the occurrence of the harder metals, as found mid the ruins of Egypt by modern explorers. What were, then, the tools the ancients employed so skilfully? On the other side the Red Sea, whence came the harder monuments of the Nile valley, there has recently been found corundum, with all the indications of ancient workings. From this locality, may not those early artisans, "skilled in all the wisdom of the Egyptians," have found their tools, with which to execute thousands of square yards of exquisite workmanship with seeming ease, to imitate a few lines of which, successfully, exhausted the resources of the mechanics of Napoleon Bonaparte. Be this as it may, a workman in the near City of Worcester has invented a formula by which he has given us for exhibition this evening a wheel of corundum that will cut not only the granites of old Egypt, but even the diamonds of old Golconda!

It has been said in England that "a good mine of emery is worth more to a manufacturing people than many mines of gold." But emery is only valuable for its cutting properties: what gives it these is its possession of forty to fifty per cent of corundum. In the scale of hardness, with the diamond at the head as 10°, the best emery stands at 7°. But corundum stands 9°, but one degree below

the hardest known substance. There is a vast and constantly increasing field of labor, which the best emery can occupy but poorly, if at all; and the diamond, even with the great influx from South Africa, is much too expensive for general uses. Two-thirds of the gap between emery and the diamond is filled by the qualities of the mineral we are discussing; and the other third is being lessened by better modes of forming corundum for use, by rapid friction, and the immensely less cost of this abrasive for the uses of the larger industries.

Among these industries, in granite, steel, the new alloys, &c., there is a call for a tool that will do the work of the diamond, but of moderate cost.

I have just cut from a scientific journal the following article: —

"With the new alloys for gun metal, rolls for paper-making machinery, the finishing more rapidly, plane surfaces in iron, steel, &c., there comes a demand for a new tool of harder material than any now in use. This demand has made itself known in Paris by an offer of three thousand francs as a prize from the 'National Society for the Encouragement of Industry,' the offer to hold good until the next great Exhibition in France in 1878."

In this connection allow also the reading of a brief extract from the "London Times" on the novelties and triumphs of American machinery as illustrated in the late International exposition.

"New agents have been wanted to give a true surface to chilled iron or hard cast-steel. They are to be seen in W. Sellers and Co.'s planers and drill-grinding contriv-

ances. The agent is the emery-wheel of the lapidary, not by the old hap-hazard system, but by well-defined movement. Their work, as a whole, should teach a lesson not to be forgotten to every competing nation."

These communications recognize the necessity of some new agent which, by its superior hardness and cutting power, shall add both speed and accuracy to execution. Any form of the diamond now known is altogether too expensive for extensive consumption. But very close upon it comes corundum, which can be supplied in quantity and but little above the price of emery, and in all the forms in which that mineral is used. Could the writer in the "Times" have seen the operation of the corundum wheel, in bringing to an even surface a chilled-iron calender for paper-making machinery, his surprise would have been great indeed; for it is difficult to conceive, even with the diamond, of more rapid or perfect execution. One form of tool has been spoken of as of recent invention. It is the wheel I now show you, — the work of Mr. F. B. Norton, of Worcester, Mass., made by him of nearly pure corundum, and which he calls the "Sapphire wheel." It runs and does its work equally well, wet or dry; water, heat, or acids having no perceptible effect upon it. It cuts cast iron, scale steel, chilled iron, any alloy, granite, &c., with much freedom. One of its best tests is the bringing of a steel tool rapidly to a cutting edge, without heat or loss of temper. This is due to its free cutting qualities, giving in the operation but little friction.

We have with us Mr. Samuel Reynolds of this city, I believe the oldest, and certainly one of the most intelligent as well as skilful, lapidaries of this country. His testimony as to corundum as an abrasive corroborates all I have said; and also, as to the execution of the "Sapphire wheel," he gives the same testimony, he having cut even the diamond with the wheel before us.

Put into the form of this wheel, or used in any other that lapidaries or workers in metals employ, corundum will do thirty per cent more work than the best emery, much work that emery cannot do at all, and not a small portion of the labor now done by diamonds in various forms.

I make this assertion with numerous indorsements, one of which I will give you, that of Col. J. G. Benton, commanding at the U. S. Arsenal Springfield, Mass., who says, —

"In one hundred days' work, corundum gives us a saving over the best emery of about forty-six per cent."

We have seen some of the uses and advantages of the mineral under consideration as an abrasive or cutting agent: a few words as to its gem characteristics, with a description of the mining locality where found, and I leave the matter in your hands for inquiry or discussion.

The corundum gems are nine in number. They are designated by the prefix "Oriental," because first known as coming from the East, their superior hardness and brilliancy, and because some gems of

the same name are of an entirely different mineral. They are called the Oriental sapphire, ruby, asteria, emerald, topaz, amethyst, girasol, chatoyant, and white or colorless sapphire, this last very often used in place of the diamond. These all of greater or less purity have been found in the locality we show you in this sketch, which is among the Blue Ridge Mountains in Western North Carolina.

This section of our country is exceedingly beautiful in its scenery, with a climate, even at the elevation of the mine — three thousand feet above tide-water — much like that of South Europe.

In the old-world localities, corundum in massive form and the gems, are not found in the same neighborhood. It has been the generally entertained opinion among men of science that the geological and mineralogical conditions of the two forms of the mineral were so unlike, that it was not probable they would anywhere be found together, or near each other. Nature in our hemisphere shows a different development, certainly in North Carolina, where we find both forms in the same mountain.

All the gem localities of the East where colored corundums are looked for, are, as has been said, in the beds of the streams, or in the banks on and near them. This is the case in India, Ceylon, Bactria, the Ural, China, &c. In fact, so uniform had the experience been in this direction that authorities, from Pliny to the present date, were quite united in the view these stones were to be looked for only in the secondary formations, and as water-worn gems.

Count Bournon, Cuvier, Buffon, Häuy, Sir Jas. Bruce and others give this view. Sir Samuel Baker and Judge Mitford, British judge of Ceylon, both of whom have resided many years in that island, and mined extensively for sapphires, use, in their recently published works, this language: "It is our opinion the sapphires were created in the peculiar secondary formations, where they are always found as water-worn pebbles, in a conglomerate of blue and white clay," &c.

I have never found a lapidary in Europe or this country, who had seen the corundum gems in any form not subjected to water action; and I have never seen in any cabinet, here or abroad, corundums of pure color and sharp angles from any locality but the North Carolina mine.

We shall show you some of these gems which have been found there on the surface, in the beds of the streams, and at depths of from ten to seventy-five feet, yet three thousand feet above the sea level. Some were in their native matrix of ripidolite, between hanging and foot walls of serpentine, apparently undisturbed, and yet with all the appearance of water action; some as clear perfect crystals, with outlines as sharp as though created but yesterday; others as transparent nodules in a matrix of laminated corundum, which, had they been exposed to water action, undoubtedly would have disintegrated and have left the pure gem nodule, as found in Ceylon and elsewhere; others were found singly or in groups locked up in geodes of chlorite, from

the size of a hen's egg to a fifty-pound shot; and others still in pockets of partially changed or decaying schists of mica and talc. In a pocket of this latter, the workmen one morning uncovered a crystal perfectly terminated, sapphire at one end and ruby at the other, opaque to be sure, but yet beautiful and of very perfect formation, which weighed three hundred and twelve pounds. It is five times larger than any other corundum crystal, in either hemisphere yet uncovered, and would be a centre of attraction in any collection of minerals. It was purchased by Professor Shepard, and is in his collection at Amherst College.

A comparison of the associate minerals of the ruby of Pegu and the sapphire of Ceylon with those of the North Carolina locality gives the same companions, numbering more than a dozen varieties, many of them of great interest. A microscopical examination for structure and color matter made in my presence by Mr. H. C. Sorby, F.R.S., of Sheffield, England, and considered the best authority, showed an exact conformity to the gems of the Orient in all particulars, the color matter being due to the presence of chromium and uranium. These examinations go to prove the geological and mineralogical conditions of the corundum formations in both hemispheres are alike. While prospecting heavily in one part of the mountain, certain indications led me to reflect if it might not be possible to find geodes or nodules of chlorite carrying gems or crystals of corundum, similar in formation to the

quartz geodes of Lake Superior, which in many cases are hollow, and lined internally with groups of beautiful amethysts. My thought was ultimately realized, with this difference ; the nodules of chlorite were solid, yet some of them carrying crystals of brilliant color, though opaque like this specimen. I know of no reason why these geodes may not be found of the same character as those of quartz formation, and I will be greatly obligated to any scientific gentleman present if he will give us his views on this point.

You see upon the wall sectional drawings of the mine and its workings, with a general view of the locality.

The aspect of the ridge is somewhat barren, like that of all the corundum and emery localities with which I am acquainted in any part of the world. The granitic rocks which make up the principal masses of the mountains in this locality have been fissured here with a large dyke of chrysolite and serpentine in which the corundum-carrying veins are found. These veins traverse the dyke, and are mainly composed of chlorite and chloritic minerals, carrying with them corundum in massive and crystal forms. The veins are five in number, dip to the north-west at an angle of forty-five degrees, and contain the mineral in size from microscopic crystals, to lamellar crystalline masses of from one to five hundred pounds. The two varieties of chlorite known as ripidolite and jefferesite form the usual vein gangue or matrix of the mineral.

Among other interesting features of this locality, three seemed to me as of special interest to mineralogists. The finding of seemingly water-worn pebbles firmly bedded in the vein gangue some distance under ground.

The discovery of the finest gem in color at the bottom of the deepest shaft, its form a clearly defined crystal with perfect faces.

And the fact that crystals an inch in diameter from a depth of fifty feet could, when first brought to the surface, be broken like pipe-stems between the thumb and finger; but which, exposed to the sun and air for a few days, became firm and tough like those upon the surface.

One of the most striking features of this mine is, that I have never met any variety of corundum in granular or crystal form that I could not duplicate in all its peculiarities from the product of this locality.

This discovery of corundum in place in this country has elicited much interest among scientific circles abroad. As evidence of this, in closing, I wish to read from communications made to me by Dr. Percy, Professor Robert Hunt, Professor Maskelyne, Superintendent of the British Museum and others, — two from gentlemen well known in America, and to some present. These gentlemen are Professor Warrington W. Smythe of the School of Mines, Jermyn Street, London, and Mr. David Forbes, F.R.S., also of London, who, as a practical mining engineer, stands second to no man in Europe. He was the

authority consulted by American capitalists in the Arizona diamond excitement, and his opinion and advice exploded that bubble and saved some millions to the men who sought his counsel.

Professor Smythe says, —

"I doubt whether, in England, you will add to the practical knowledge you are now possessed of in the mining of corundum. The results of your explorations, thus far, are so much in advance of previous knowledge in this mineral, you have the field entirely to yourself. This is true both of the gems and granular formations. I can see no reason, certainly, why with so much perfection found as to the former, you may not reasonably look for the richest results in your future efforts."

I handed Mr. Forbes the communications of Professors Smythe and Maskelyne, with my specimens; in his reply he said: —

"I have mined in many minerals, in many parts of both hemispheres; but, so far as my observation goes, these specimens of corundum are without precedent from any locality. The observations of Messrs. Smythe and Maskelyne seem to me certainly correct. I differ from one of them as to his opinion these are 'altered rocks,' but that in no way affects their character as likely to yield the mineral you are in search of; it must be there in great quantity and richness. Commercially, as an abrasive, you know its value as well as myself, no material but the diamond being comparable to it; in fact, could it be had in quantity and at reasonable price, it would be without rivalry for general abrasive purposes.

"As to the gems of ruby, sapphire, &c., I should feel justified in going farther than the gentleman whose views

you have given me. Were the property mine, I should feel in its development not only a 'probability' they might be found, but I should work in the confident and certain expectation of uncovering the most valuable stones of corundum. I have seen some valuable gems of this mineral. One specially, valued at and doubtless worth sixty thousand pounds. Nothing is wanting, in the best specimens you have shown me, but freedom from lamination, to ensure the highest value. This peculiarity is a characteristic of all corundum localities known. But you have this advantage over all others, — your gems *are in place;* you have them in the vein rock, an occurrence I have no knowledge of heretofore. All the indications are thus in your favor; and I shall not be surprised at any success in this direction, but on the contrary disappointed if it turn out otherwise. You are fortunate in the vein rock also, it being the soft ripidolite and jefferesite most favorable for perfect gem formation. So much am I charmed by your discovery, that, were I not already greatly overburthened, I would go out to America myself, and push the matter to what must be a successful issue. Certainly, I envy you your future explorations."

Gentlemen, I shall now be most happy to answer any inquiries for further information on this subject.

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OFFICE, 11 PEMBERTON SQUARE.

Boston, Mass., 25th April 1877

Prof Raphoie Pumpelly

Newburgh N. Y.

Dear Sir

I must ask you excuse
y a paper, not by one as you
recently, in this City — I am
my anxious for information
as to whether I may not
hope to find Geodes, Rolled,
such as are found at Lapeer,
Is there any thing in science
that militates against Alumina
in Rolled Geode form, as well
as Silica? Would you kindly
give me any light that may

and me in a discovery of new
facts, in the direction of my
researches in Canada.

I am very much obliged
Yours truly
C. M. Seelig

P. O. Box 5153
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