Precious Stones

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A BOOK OF REFERENCE FOR JEWELLERS

BY

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Preface

THE information herein is gathered and arranged for a book of ready reference for jewellers. The aim has been to avoid unnecessary detail, and to make facts useful to a dealer in precious stones conspicuous. Special attention has been given to stones unfamiliar to many jewellers, and for which there is a growing demand in this country.

Chief among the writers regarded in the compilation as authorities are Professor James D. Dana, on mineralogy; Mr. George F. Kunz, on American gems; Dr. Max Bauer and Mr. Edwin W. Streeter, on matters of general information.

W. R. CATTELLE.

TENAFLY, NEW JERSEY, November, 1902.

Contents

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I

GENERAL DESCRIPTION

WITH one exception, the pearl, which is the product of a shell-fish, precious stones are minerals possessing qualities which adapt them for personal adornment.

The product of marvellous processes and the most gigantic forces of nature, these beautiful creations lie hidden within the rocky crust of the earth or scattered among the débris which marks the paths of great cataclysms, their beauties half concealed under rough and time-worn exteriors. Found by treasure-seekers, their glories are unveiled by the art of cunning workmen, to fade no more until the eye of time grows dim.

Nothing in art or nature excites more admiration and desire; few things appeal so forcibly to the common human love of the beautiful.

Discovered first in the sensuous lands of the Orient, her dark-skinned potentates gathered them into their treasure-houses, both as an enduring form of wealth and for royal adornment. Men of all ages and classes have looked upon them with desire. Poets have sung of their beauties. Philosophers have speculated about them; scientists have studied them; princes have fought for them. They have ransomed kings and won the love of queens. The High Priest of the Jews wore them in his breast-plate. They radiate the power of monarchs from their crowns, and set as signs of victory in the hilts of the swords of conquerors. They have been the fondest expression of love in all ages, and when the Christian prophet John sought to wake imagination to the glories of the New Jerusalem, he made the gates of pearls and built her walls of precious stones.

And they endure. When, by the tricks and accidents of time, nothing remains of the noble sculptures of ancient Greece and Rome but mournful fragments, their jewels shine in pristine brilliancy; and the color of them will be still untarnished when the paintings of the great masters are long since black and seamed with age. Monarchs live and die; their dynasties endure for centuries, then disappear. Invaders pass over ancient landmarks and obliterate them in the passing. The borders of great countries are washed out of memory. Time destroys nations, and reduces their monuments to ashes, but the jewels remain. Never a stone was cut that more or less of romance did not gather about it; many have seen great tragedies, and there is not a string in the gamut of human emotions which has not sung at some time or place to their fascinations.

The qualities which make precious stones so desirable are beauty and durability combined. The limpid, sparkling dew-drop is beautiful, but while the sun's rays beautify, they devour it. The beauty of the diamond is the same, only it will tremble under the ardent glances of the sun, and flash its answers back undimmed for thousands of years. In the emerald one may see the unfading spring-time green of the fields forever. No clouds can hide the azure of the turquoise, and an aquamarine would hold in the sand-wastes of Sahara the light of the deep seas through all time.

The beauty of precious stones lies in their brilliancy or color, or both; the durability comes from a native hardness, which resists the abrasions of time and wear. Nature does not make them all fit for jewels. Many of the diamonds, rubies, and sapphires found lack the crystalline beauty or color necessary, and are valuable only for their hardness. These are used for mechanical purposes. Of many other stones, the greater quantity found is useless for any purpose.

The stones accounted precious are the diamond, ruby, pearl, sapphire, emerald, Oriental cat's-eye, opal, turquoise, alexandrite, and spinel.

Others lying on the border-land between precious and semi-precious, and, in fact, more valuable for natural qualities and as merchandise than some specimens of those rated precious, are the andalusite, aquamarine, golden beryl, hiddenite, olivine, tourmaline, zircon, and the finer varieties of amethyst, topaz, and garnet.

In order to express in definite terms the relative hardness of the various stones, a scale was devised by a German mineralogist named Moh, in numbers ranging from 1 to 10, the greater number representing the hardness of the diamond, that being the hardest substance known.

It should be understood, however, that these numbers attached to the various stones do not designate absolute degrees of hardness, but are approximate. All stones vary slightly. Some forms of diamond, carbonado, for instance, are harder than others; some of the same form are harder. The black diamonds of Borneo are harder than the Australian; the Australian are harder than those of India and Brazil, and these, again, are harder than the African; and there are knots in the grain of some specimens harder than the other parts of the stone.

But as these variations are slight, and no other stone at its hardest approaches the softest diamond, its hardness is always expressed by the number 10.

The known variations of the ruby are quoted as 8.8 to 9 in the scale; the garnet ranges in its many varieties from 6 to 8.

The readings of specific gravity and the chemical composition of stones should be made with a like understanding.

Although nature always follows certain laws, her productions from the materials at hand are so many and varied, her similitudes so interwoven, that the classifications, and the standards created by which to judge them, cannot be absolute. For reasons and from causes too involved and intricate for the mind of man to disentangle and detail them, all the features of the different stones are at one time or another changed or modified. The proportions in the chemical compositions vary; the crystallization presents different forms; the specific gravity varies slightly; one coloring matter has been used now, another then; at one time, conditions being favorable, more perfect work has been done than at another. For these reasons, all tables of hardness, specific gravity, composition, etc., are theoretical, and while they represent conditions approximately, and serve to define the relations and differences existing between one mineral and others, no stone is always exactly as tabulated, and must be recognized by a general conformity to the descriptions given, which are composite, not individual photographs of the things of which they treat.

Under the superficial qualities patent to every eye these individual and combined characteristics which differentiate the various precious stones have provoked the scientist to many discoveries, and a knowledge of them serves to increase the wonder and admiration of men for these beautiful productions of nature.

They are found in crystallized or amorphous conditions. The plans of crystallization are,—

1. Those having the axes equal, as the isometric, or cubic. This includes the diamond, garnet, and spinel.

2. Those having only the lateral axes equal, as the tetragonal or pyramidal, and hexagonal or rhombohedral, and comprise the amethyst, aquamarine, emerald, rock crystal, ruby, sapphire, topaz, tourmaline, and zircon.

3. Those having the axes unequal, as the orthorhombic

or trimetric, monoclinic, and triclinic, of which are the alexandrite, andalusite, cat's-eye, chrysoberyl, hiddenite, labradorite, malachite, moonstone, olivine, sphene, and sunstone.

These forms of crystallization are not often clearly defined, and are generally rendered difficult to recognize in the stone as it is found, by the modifications occasioned by the conditions surrounding it during existence. The natural form of the diamond, for instance, is that of two four-sided pyramids, united at their bases, or octahedron, but there are many outward variations. It is also commonly found as a rhombic dodecahedron, bounded by twelve lozenge-shaped faces or rhombs. Sometimes it is found as a six-faced octahedron, and as the faces are generally more or less curved, the forty-eight faces make it almost spherical. It has been found quite globular in form, upon the surface of which not the slightest appearance of a natural facet could be discovered. So also with the ruby: although it is naturally a six-sided prism, it is usually found as a rolled fragment, become so by the processes which released and transported it from the matrix in which it was born. Though harder than the surrounding elements through which it ground its way to discovery during the centuries of its existence, like all other things, the ruby seldom escapes the hand of time scatheless; its own angles become rounded, its rough places are made smooth, the outward features of its crystallization are worn away, and the crystal emerges as a rolled pebble, worn by softer opponents, as a rock is worn away by water.

The amorphous are those found in veins within a matrix. Of these are the opal, turquoise, and obsidian.

Many precious stones have a grain or cleavage, along the lines of which they can be split as wood is; and, as with woods, the cleavage is much more perfect in some than in others. It is for this reason that hard stones sometimes break so easily.

Except in a few cases, the fracture, or break across the grain, is conchoidal. In some it is even, and in a few, uneven.

The optical qualities of precious stones when cut and polished are various. Among them is the power of reflection; that is, when a ray of light reaches the surface of one, part of it passes through, and part is thrown back or reflected. This power to reflect light is possessed by the various gems in different degrees, and the amount of light reflected varies not only with the stone, but increases in proportion to the obliquity of the ray as it falls upon it, according to the stone. The great brilliancy of the diamond is due to the fact that a ray striking an inner facet at a greater angle than 24° 13′ is totally reflected. It is for this reason that precision of cutting is so necessary in order to secure a maximum of the reflective power of the gem.

That part of an oblique, impinging ray which enters the stone does not pass straight on and through, but, coming into the domain of another government, is bent or refracted, and the extent of this refraction varies with the different gems. Again the diamond is superior to all others, its refractive power being very great, and, in consequence, its magnifying power also, which is said to compare with that of plate-glass in the ratio of 8 to 3.

Most precious stones are doubly refractive. This means that one part of the ray which enters the stone is bent or refracted at one angle, and the other diverges to a greater or less degree according to the stone. These stones are dichroic, and when examined by means of the dichroiscope, show two images of different colors. This phenomenon is not absolute, however, as there is a direction, called the optic axis, in which the light can be transmitted through a doubly refractive gem without being divided, in which case it acts simply as an ordinary medium of single refraction. On the other hand, diamonds, which are singly refractive, have been known to be doubly refractive, owing to some disturbing foreign element within them, producing abnormal conditions. The three isometric stones, diamond, spinel, and garnet, are normally, like glass, singly refractive.

Dispersion is the power which decomposes a ray of common white light in its passage through a transparent medium, and splits it up into the various colors of which it is composed. This power is very high in the diamond, and gives to it the fire which makes the stone so fascinating. By holding a diamond to receive the direct rays of the sun, and a sheet of white paper at an angle to catch the reflected light from it, the prismatic colors will appear.

The lustre of the various stones is differently described. Most of the transparent are vitreous. The diamond and zircon are adamantine. The hematite is metallic. Of the opaque, translucent, and semitransparent, some are said to be waxy, as the turquoise; silky, as the crocidolite; pearly, as the moonstone; subvitreous or glassy, as the opal.

It is a curious fact that the powder of a mineral does not always correspond with it in color. The color of its powder is called the streak-powder, and the color of the surface from which it was abraded, the streak. The streak of the ruby is white; of the diamond, gray or blackish gray. That of most colored stones is uncolored.

One of the distinguishing differences between stones is the weight relative to the bulk. A ruby of the same bulk as an emerald would weigh more, a zircon would be still heavier, and a microlite or cassiterite heavier yet. This relation is found by comparing the weight of objects with that of another substance containing the same volume of matter, and is called specific gravity. For instance, if a stone weighing fifteen carats, upon being weighed in distilled water only weighed ten carats, its specific weight would be ten carats, and the loss of weight, five carats, would be the weight of the volume of water displaced by the stone and equal to its bulk. Dividing the absolute weight of fifteen carats by the loss by displacement of five carats, and the result, 3, would be the specific gravity of the stone. Thus, absolute weight, fifteen carats; specific weight, ten carats; loss, five carats: $15 \div 5 = 3$, specific gravity.

All minerals are electric. Some acquire electricity by heating, some by friction, others by either method. Some display positive, and others negative, electricity. Although the diamond is a non-conductor, it becomes positively electric by friction, and it differs from other stones in that it is electric in the rough also. And the different stones vary in their power to retain electricity: some can do so for a few minutes only; others for many hours.

Those minerals which become electric by heating are said to be pyro-electric, from the Greek *πυρ*, fire, and electric. The tourmaline, when heated, shows positive electricity at one end of the prism, and negative at the other. The other hemihedrally modified prisms (topaz, for instance) have the same peculiarity.

The chrysolite and several forms of garnet possess the power to act on the magnetic needle. The tourmaline and others, after friction, will attract and hold small bits of paper and the like; and the Brazilian topaz, made electric by friction or heating, will affect the electric needle after many hours.

Many precious stones become distinctly phosphorescent by exposure to sunlight, or by the application of heat, or other electrical and mechanical methods. This is true of the diamond, rock crystal, ruby, zircon, and fluorite. Some diamonds are much more phosphorescent than others. There are diamonds which assume a deep violet hue under the arc light. Upon experimenting with stones of this character, Mr. George F. Kunz found that they displayed phosphorescence to an unusual degree, possessing the quality of storing up sunlight and electric light, and emitting the same in the dark. He also observes that these stones are generally slightly opalescent, and attributes the phenomenon to the presence of a hydrocarbon, which he named "Tiffanyite."

In the quality of transmitting light, precious stones are divided into four kinds,—opaque, as jasper; translucent, as the opal and carnelian; semitransparent, as rose-quartz; transparent, as the diamond, etc. Not all stones of the transparent varieties are transparent, however. Carbonado and bort, which are forms of diamond, are opaque and semitransparent respectively. Many crystals of ruby, emerald, tourmaline, and others are almost opaque. Nature brings but little of her handiwork to an ideal condition. Some stones, like the sphene, are seldom found clear enough to cut as gems. Probably not one carat in ten thousand emerald crystals taken from a mine in North Carolina was transparent.

In some respects, precious stones are constant; they resist or are subject to heat or acids after their own invariable fashion. The diamond is always infusible, but at a great heat will burn to dioxide of carbon. Many stones are infusible before the blow-pipe, but melt with a flux. Heat changes the color of the amethyst and topaz. The beryls melt with salts of phosphorus. Rock crystal is soluble in fluohydric acid. Obsidian melts under the blow-pipe. And although crystals of the same mineral may occur with many modifications, the prisms longer or shorter, thinner or thicker, some planes enlarged, others obliterated,—whatever the distortion, the angles remain constant, the inclination is the same.

As the colors of different stones are often identical, it is sometimes difficult to decide, after cutting, what they really are, especially when the softer stone is finely cut. Even the tests for hardness and specific gravity are apt to fail in inexperienced hands, as the processes require experience to arrive at the exact results necessary where distinctions are so fine. An instinctive judgment which rarely errs comes with long acquaintance. There is a certain hard look which distinguishes a yellow sapphire from a topaz, or a purple sapphire from a purple spinel. A lustrous yellow zircon of fine color may bear a puzzling resemblance to a canary diamond, yet there is a perceptible difference, hard to explain, and it feels heavier in the handling.

The difference between an Oriental and a quartz cat's-eye is unmistakable after the first introduction: the texture of the Oriental appears finer, the colors softer, the lustre harder.

The green of the emerald is not approached by any other stone, though there are some remarkable imitations made. The doublet imitations of this stone are not good; the color is dark and murky.

No red stone approaches the velvet of the ruby. There are, however, two forms of manufactured ruby which are dangerous. The first of these to appear was called the "reconstructed ruby." It can be distinguished from the natural ruby by the confused bubbles which appear in the body of the stone, as though it had congealed while boiling. Another and later production, termed the "scientific ruby," is much more perfect. The color is usually very beautiful, and many of the stones are quite clear. Close observation, however, will discover a series of fine lines in irregular waves, impossible to the natural grain of a crystal.

Tourmaline and some of the fine green diopsides found in New York State may be confounded, but as few of the latter come into the market, confusion is not liable to occur.

The distinction between ruby and sapphire is simply one of color. The red stone is a ruby. As it pales, it finally reaches a point where it is termed a pink sapphire, unless the color is free from a decided tinge of blue, when it is called a pink, or Ceylon, ruby. Blue in various shades is the ordinary sapphire; all other colors in corundum are known as "fancy" sapphires.

Olivines and green garnets have been so confounded that the latter have come to be known commercially as olivines, and the olivine of mineralogy has become peridot.

There is also much confusion as to the difference between sard and sardonyx, although the name is suggestive. The sard is a solid color stone similar to the carnelian, only of a darker, brownish-red color; the sardonyx is the same stone with underlying strata of a lighter or other colors, similar to the onyx.

As many of the features by which a mineral is recognized in the natural state are obliterated in the cutting, and the tests for hardness and specific gravity are not always possible to the dealer, he must rely very largely on the instinctive judgment which comes of familiarity, and a few simple facts which serve to guide him. A chapter has been devoted to the differences existing between stones similar in color and general appearance when cut, and tables appended, showing the various methods by which their identity may be established.

II

CELEBRATED STONES

Of the diamonds celebrated for their size or historical association, the genuineness of two is questioned. The "Braganza," of sixteen hundred and eighty carats, found in the diamond-mines of Brazil, and now among the crown jewels of Portugal, is said to be a white topaz. As a critical examination is not permitted, there is no certainty about it.

The "Mattam" has been pronounced rock crystal, but some think that an imitation of the real stone only was examined. Fig. 2, Plate XVIII., is a drawing of this stone. It weighs three hundred and sixty-seven carats, and was found, about 1760, at Landak, in the Island of Borneo. It belongs to the Rajah of Mattam, in Borneo.

What has become of the "Great Mogul" is unknown. It was seen by Tavernier in 1665, who says it was found in Kollur, some time between 1630 and 1650. Mr. Edwin W. Streeter, however, thinks it came from Wajra Karur. In either case it was an Indian stone and weighed in the rough seven hundred and eighty-seven and one-half carats. By unskilful cutting it was reduced to one hundred and eighty-eight carats. A drawing of it can be found in Plate XVII.

There has been much speculation and disputing about the fate of this stone. Some writers endeavor to show that the "Orloff" is the same; others think the "Koh-i-noor" is. Imagination and unauthenticated statements have been drawn upon to support either theory. At the time Tavernier saw it the weights of Eastern and European countries varied very considerably, and where weights are recorded, we are without definite knowledge of the exact equivalent in our weights of to-day. Taking into consideration the character of the people who had the handling of the stone, the utter inability of tracking anything with certainty through the net-work of secrecy and deceit common to Oriental courts, and the similarity of the "Orloff," both in shape, size, and cutting to the "Mogul," as reported by Tavernier, together with the fact that the "Mogul" was reduced from between seven and eight hundred carats in the rough to less than two hundred after cutting, without any apparent reason in the style of cutting for such a loss, it appears to the writer that the "Orloff" is identical with the "Great Mogul," and that the "Koh-i-noor" was a large cleavage from the same crystal, taken when the cutter reduced it about five hundred carats by simply faceting it to a high-domed rose. This theory would reasonably account for the unnecessary loss of weight and the confusion of traditions, which in varying proportions have been attached alike to all three stones. The drawings of them, Plates XVII. and XIX., appear corroborative.

Welding the histories given of the three into one, it would be as follows:

The "Great Mogul," found in Kollur or Wajra Karur (Tavernier calls them the Gani Mines in the Kingdom of Golconda) probably between 1630 and 1650, came into possession of the Moguls of the Tamerlane or Timur dynasty. It weighed seven hundred and eighty-seven and one-half carats (Tavernier says seven hundred and ninety-three and five-eighths carats). It was cut and weighed after cutting, according to Tavernier, by whom it was seen in 1665, during the reign of Aurungzebe, two hundred and seventy-nine and nine-sixteenths carats. Later writers claim that he erred in the matter of weight, by wrongly computing the equivalent of the ratis by which it was weighed in the Mogul's country. In 1739, Mohammed Shah, a successor of Aurungzebe, was besieged by and surrendered to Nadir Shah, formerly Kouli-Khan, king of Persia, who carried off the treasures of Delhi, the great diamond among them, to Khorassan. All accounts of the "Great Mogul" diamond from that time are speculative. In 1747 Nadir Shah was assassinated.

There is no authentic account of the "Orloff" until it appeared in Amsterdam in 1791 and was sold to Count Orloff. From that time it has been among the Russian crown jewels.

Tavernier mentions having seen a diamond at Golconda in 1642, weighing two hundred and forty-two and five-sixteenths carats. (The "Great Mogul" had probably been cut at this time.) It was in the hands of merchants who asked five hundred thousand rupees (about two hundred and fifty thousand dollars) for it. This was similar in shape but apparently uncut and larger than the "Koh-i-noor" as it came into the hands of the English.

In 1739 Nadir Shah carried off the treasures of Delhi to Persia. In 1747 he was assassinated by his subjects, partly from jealousy of the Afghans, who were in great favor with him. One of these, Ahmed Shah, who had been Nadir's treasurer, fleeing with his countrymen, took with him the "Koh-i-noor." He founded a new empire in Cabul. The diamond was among his jewels when he died in 1793. It remained with his successors until Shah Zemaun was driven from the throne by his half-brother Mahmood. He carried it with him in his flight, and, though captured, succeeded in concealing the diamond. By a later revolution Zemaun was released and the stone was brought from its hiding-place. In 1808 it was seen upon the person of Shuja, of the same dynasty, by Mr. Elphinstone, British envoy to the king of Cabul. In 1813 Runjeet Singh, chief of the Sikhs, obtained it from Shuja and brought it to Lahore. After the murder of Shir Singh, one of the successors of Runjeet, it remained in the Lahore treasury until the annexation of that country by the British government. The treasury and property of that country were then confiscated to the East India Company, in part payment of a debt due to them by the Lahore government, a stipulation being made that the "Koh-i-noor" should be given to the queen. It was taken from Bombay, April 6, 1850, surrendered to the officials of the East India Company in London, July 2, and on the following day presented to Queen Victoria.

Thus the rough crystal of the "Great Mogul," weighing nearly eight hundred carats, was found between 1630 and 1650 (some say 1550). It was cut for the Mogul to a stone of about two hundred carats, similar in shape, size, and style of cutting to that now known as the "Orloff," and seen by Tavernier in 1665.

Tavernier saw a large diamond of two hundred and forty-two and five-sixteenths carats at Golconda in 1642. This could have been a part of the "Great Mogul" crystal.

The "Great Mogul" was carried to Persia in 1739, after which there is no definite knowledge of it.

In 1747 Ahmed Shah, the Afghan, took with him to Cabul from Persia, the "Koh-i-noor." It remained with his dynasty until 1813, when Runjeet Singh carried it off to Lahore.

In 1791 the "Orloff" was sold in Amsterdam to Count Orloff.

In 1850 the English took the "Koh-i-noor" from Lahore to England.

	Carats.
"Great Mogul," rough (weight unauthenticated)	$787\frac{1}{2}$
"Great Mogul," cut (exact weight disputed)	188 to $279\frac{9}{16}$
"Orloff"	$194\frac{3}{4}$
Diamond seen by Tavernier in Golconda	$242\frac{5}{16}$
"Koh-i-noor" when brought from the East	$186\frac{1}{2}$

Cut as they were, the "Orloff" and the "Koh-i-noor," at the greatest weights given, could have been easily obtained from the "Great Mogul" crystal.

As stated, the origin of the "Koh-i-noor" is a matter of speculation. At the time of the Sikh mutiny it fell into the hands of the British troops, and was presented to Queen

Victoria, July 3, 1850. It weighed one hundred and eighty-six and one-half carats, but was afterwards recut to one hundred and six and one-fourth carats. It is a beautiful stone, but not of the finest color or quality. Drawings of it are in Plates XVI. and XIX.

The "Orloff" is a fine, clean, and very brilliant stone of one hundred and ninety-four and three-fourths carats, set in the sceptre of the Russian emperor. It is said to have been at one time the eye of a Brahmin statue, and is thought by some to be the "Koh-i-noor" of Hindoo legends and tradition. Tradition says it was stolen by a French soldier in the early part of the eighteenth century and carried to Europe. It was finally sold at Amsterdam, in 1791, to Count Orloff for the Empress Catherine II., of Russia, for one million four hundred thousand Dutch gulden. (Plate XVII.)

Another Russian crown diamond of one hundred and twenty carats is often confounded with the "Orloff." It was purchased by the Empress Catherine of an Armenian named Schafras, in 1774, for four hundred and fifty thousand rubles, a life pension of four thousand rubles (Mawe says four thousand pounds), and a patent of nobility. This stone belonged to Nadir Shah, Sultan of Persia, and is said to be flawless, of a flattened ovoid, the size of a pigeon's egg. Mawe quotes the weight at one hundred and ninety-three carats, but he probably confounded it with the "Orloff."

The "Great Diamond Table" seen by Tavernier in Golconda, India, in 1642, has disappeared. (Plate XVIII.) Weight, two hundred and forty-two and three-sixteenths carats.

The "Shah" (Plate XVIII.) was presented to the Emperor Nicholas, of Russia, by the Persian Prince Cosroes, son of Abbas Mirza, in 1829. It is a stone of fine color and quality, and before recutting had the names of three Persian kings engraved upon it. It weighed eighty-six carats.

The Nizam of Hyderabad possesses a fine stone of two hundred and seventy-seven carats, said to have been originally four hundred and forty carats. It was found on the ground by a child in the region of Golconda.

The Shah of Persia possesses two magnificent rose-cut stones of very fine quality, the "Darya-i-nur," or "Sea of Light," weighing one hundred and eighty-six carats, and the "Taj-e-mah," or "Crown of the Moon," of one hundred and forty-six carats.

The "Florentine" belongs to the Emperor of Austria. It is cut like a double rose, though shaped something after the fashion of a briolette. It is very brilliant, and of a yellowish tint. It is said to have been cut for Charles the Bold, Duke of Burgundy, and lost by him at the battle of Granson. Various accounts are given of its later history until it came into the possession of the Austrian crown, but none are well authenticated. (Plate XVIII.) Its weight is one hundred and thirty-three and one-fifth carats.

One of the finest diamonds known is the "Regent," or "Pitt," of the French crown jewels. (Plate XVI.) It is an Indian stone, and is supposed to have been found in the Gani-Parteal locality in 1701. Governor Pitt, of Fort St. George, Madras, bought it for £20,400, and sold it in 1717 to the Duke of Orleans for two million francs. It was recut in London from four hundred and ten to one hundred and thirty-six and seven-eighths carats, and was valued in 1791 at twelve million francs. It was stolen in 1792, with other crown jewels of France, but later restored. Napoleon I. wore it in the pommel of his sword. He used it during his wars as a means of raising money, but it was finally redeemed, and remains in the possession of France. The cutting is said to have taken two years, and the cost is variously reported to have been £2000 and £5000.

The "Sancy," said to be owned at present by an Indian Maharajah, has a number of legends attached to it, gathered probably from the mention, in history, of various stones which have been known by that name. It is supposed to have been cut for Charles the Bold; found on his body after the battle of Nancy, by a soldier, and carried to Portugal; sold to the Baron Sancy, of France, and by him sold to Elizabeth of England in 1600. The consort of Charles I., of England, brought it to France in 1649 and pawned it to Cardinal Mazarin, by whom it was bequeathed to Louis XIV. With others it was stolen during the revolution of 1792. Ten years later it was among the Spanish crown jewels. From 1828 to 1865 it belonged to Prince Demidoff, by whom it was sold for £20,000. It was exhibited at the Paris Exposition in 1867. (Plate XVI.) It weighs fifty-three and three-fourths carats.

The "Hope" is a beautiful sapphire-blue diamond, weighing forty-four and three-eighths carats. In its present condition it has been known since 1830. A London banker, Mr. Henry Thomas Hope, bought it for £18,000. Tavernier brought from India a stone of that color for Louis XIV., of France. In the rough it weighed one hundred and twelve and three-sixteenths carats, and was cut to sixty-seven and one-eighth carats. This was stolen with other jewels of the French crown in 1792, and was never found. Mr. Edwin W. Streeter, of London, bought a small stone of the same color, weighing about one carat, for £300. Another drop-shaped stone of the same color, weighing thirteen and three-fourths carats, was sold at Geneva in 1874 for seventeen thousand francs, from the collection of the Duke of Brunswick. As the weights and shapes of these three stones, after allowing for the loss by cutting, would bring them to the original weight and size of Tavernier's diamond, Mr. Streeter thinks they are parts of it, especially as the very rare color of all is the same. The "Hope" was lately bought by a New York diamond importer, and is at present in New York. (Plate XVI.)

The "Piggott" is a shallow stone brought from India to

England in 1775. It is said to have been sold by lottery for £30,000, and later bought by Rundell & Bridge for £6000. It was afterwards sold to Ali Pasha, of Egypt, for £30,000. Since then all track of it has been lost. By some the weight is given as eighty-one and one-half carats, but Mawe, who saw it before it was sold to Ali Pasha, gives the weight as forty-nine carats. (Plate XVII.)

The "Nassak," or "Nassac," was so named because it was formerly held for a long time in a temple at Nassak. After passing through various hands, jeweller Emanuel, of London, acquired it in 1831. It was sold soon after to the Marquis of Westminster for £7200 and is still owned by that family. It weighed originally eighty-nine and one-half carats (Plate XVII.), but was recut to seventy-eight and five-eighths carats. (Plate XIX.)

The "Eugénie" is a fine brilliant of unknown origin. It weighs fifty-one carats, and was presented by Catherine II., of Russia, to her favorite, Potemkin. It remained in that family until Napoleon III. bought it for his bride Eugénie. After her dethronement it was sold to the Gaikwar of Baroda, India. (Plate XVII.)

One of the finest brilliants known is the "White Saxon Brilliant." It weighs forty-eight and three-fourths carats, and was bought by Augustus the Strong for one million thalers.

The "Dresden Green Diamond" is of fine quality and flawless. The color is a bright apple-green. It has been in the possession of the Saxon crown since 1753, and is now in the Grüne Gewölbe, or "Green Vaults," of Dresden. Augustus the Strong paid sixty thousand thalers for it. The weight is variously given as thirty-one and one-fourth and forty-eight carats. Dr. Max Bauer states that the correct weight is forty carats. (Plate XVI.)

The "Polar Star," a stone of great purity and brilliancy, was purchased for a large sum by the Emperor Paul, of

Russia. It belongs now to the Princess Yassopouff. Its weight is forty carats. (Plate XVII.)

The "Pasha of Egypt," a fine octagonal brilliant of forty carats, was bought by Ibraham, Viceroy of Egypt, for £28,000. (Plate XIX.)

The "Cumberland" was bought by the city of London for £10,000, and presented to the Duke of Cumberland after the battle of Culloden. The House of Hanover claimed it, and about thirty years ago Queen Victoria restored it to them. Its weight is thirty-two carats. (Plate XVI.)

The "Star of the South" was found July, 1853, in the western part of Minas Geraes, Brazil. It weighed in the rough two hundred and fifty-four and one-half carats, and after being cut in Amsterdam to a brilliant of one hundred and twenty-five and one-half carats was sold to the Gaikwar of Baroda for £80,000. (Plate XVI.)

The "Star of South Africa" was the first large stone found in the Cape (1869). It weighed in the rough eighty-three and one-half carats, and was cut to a drop-shaped brilliant weighing forty-six and one-half carats. It is a river stone, and equal in quality to the diamonds of India and Brazil. It was sold for a large sum to the Countess of Dudley, and is known to many as the "Dudley diamond." (Plate XIX.)

The "Stewart" (Plate XIX.) was found in 1872, in the river diggings on the Vaal. In the rough it weighed two hundred and eighty-eight and one-half carats. It is of a yellowish tint.

A very imperfect stone of six hundred and fifty-five carats was found in the Jagersfontein, and another fine stone of two hundred and nine and one-fourth carats came from the same mine. It is said an illicit diamond buyer bought this of a Kaffir for £15.

By whom and where the "Victoria" was found is unknown. It came from the Cape to Europe in 1884, and weighed in the rough four hundred and fifty-seven and one-half carats. (Plate XVIII.) Cutting reduced the weight to one hundred and eighty carats, and gave a very fine colorless brilliant. (Plate XVII.)

A crystal weighing four hundred and twenty-eight and one-half carats was found March 28, 1880, in the De Beers mine, and cut to two hundred and eighty-eight and one-half carats. (Max Bauer.) Streeter calls this the "Victoria," and gives the weight as two hundred and twenty-eight and one-half carats. It is a yellowish stone, and when found was an octahedral crystal.

The largest diamond known is the "Jagersfontein Excelsior," found by a Kaffir on June 30, 1893. It is a beautiful blue-white crystal, the value of which cannot well be estimated. Its weight is nine hundred and seventy-one and three-fourths carats. (Plate XVIII.)

The "Porter Rhodes," found in Kimberly February 12, 1880, is probably one of the finest cape stones. It is a very fine blue-white diamond, variously reported to weigh from one hundred and fifty to one hundred and sixty carats. (Streeter says one hundred and fifty carats.)

One of the largest and finest orange-colored diamonds known, and the largest of any kind in America, is the "Tiffany" diamond, of one hundred and twenty-five and one-half carats. (Plate XIX.) It is a cape stone and was imported by Tiffany and Co., of New York.

The largest alexandrite known weighs sixty-three and three-eighths carats. It was found in Ceylon. By day it is a slightly yellowish grass-green, and by artificial light a pale red.

A smaller but finer stone, weighing twenty-eight and twenty-three thirty-seconds carats, was also found in Ceylon. The color by day is a beautiful soft green, and by gas-light a fine columbine red.

There is a cat's-eye in the Hope collection, South Kensington Musuem, London, of dark color, but not absolutely true line of light, thirty-five and one-half millimetres long and thirty-five millimetres thick.

A golden-brown cat's-eye was sold in the United States, weighing eighty and three-fourths carats. The light-line is very distinct and even for so large a stone.

A few cat's-eyes have been found in Ceylon which exhibit the dichroism of the alexandrite.

There are few world-renowned rubies, owing to the fact that most of the large stones found are claimed and held jealously by the rulers of the countries where they occur.

Tavernier speaks of two owned by the King of Visapur, India, one of which weighed fifty and three-fourths carats, valued at six hundred thousand francs, and the other seventeen and one-half carats, estimated at seventy-four thousand five hundred and fifty francs.

The King of Ava is said to have one the size of a small hen's-egg.

Gustavus III., of Sweden, is said to have presented a fine ruby the size of a pigeon's-egg to Catherine II., of Russia, when he visited St. Petersburg in 1777. Mr. Edwin W. Streeter says it was cut *en cabochon,* and had "Thelk Lephy" engraved on one end of it.

The German emperor, Rudolph II., had one the size of a hen's-egg, which Boetius von Boot valued at sixty thousand ducats.

In the list of French crown jewels published in 1791 the largest fine ruby was one of seven carats, valued at eight thousand francs. A larger one, but of light color, weighing twenty-five and eleven-sixteenths carats, was valued at twenty-five thousand francs.

Mention has been made of a large ruby from Thibet, weighing two thousand carats, but it was not fully transparent. Edwin W. Streeter also speaks of a similar stone from Burmah, of eleven hundred and eighty-four carats.

One found at Bawbadan weighed in the rough forty-four carats. It was cut to twenty carats, and given by the finder to King Tharawadis. It was named the "Gnaga Boh," or "Dragon Lord."

Another weighing one hundred carats, was found on Pingudoung Hill soon after Theebaw ascended the throne. It was given to him by Oo-dwa-gee, Woon of the ruby mining district.

The two best known rubies in Europe, brought over in 1875, were of magnificent quality and color. One was cushion-shaped, and weighed thirty-seven carats. The other, a blunt drop-shape, weighed forty-seven carats. They were recut by Mr. J. N. Forster, of London, to thirty-two and five-sixteenths and thirty-eight and nine-sixteenths carats, respectively, and sold abroad for £10,000 and £20,000. The necessities of the Burmese government, only, gave Europe the opportunity to acquire these royal gems.

A ruby of very fine quality, weighing eighteen and seven-sixteenths carats, was found January, 1895, at the Tagoungnaindaing mine, and in the summer of that year a large one of nine hundred and seventy-three carats was found in the Ingonk Valley, near Mogok. In common with all large rubies, parts of it were thick and cloudy.

The "Black Prince Ruby," in the Imperial crown, Tower of London, is a spinel. It is cut *en cabochon,* and has a hole drilled through it, though this has been plugged with a similar stone. It was presented to the Black Prince by Don Pedro, King of Castile, and was worn in his helmet by King Henry V., of England, at the battle of Agincourt.

Two very fine spinels were brought to England from India in 1861. One of them weighed one hundred and ninety-seven carats. It was cut *en cabochon,* octagon-shape, and was of perfect color and flawless. It was recut to eighty-one carats. The other was of perfect color and octagonal also, very spread and free from flaws. It weighed one hundred and two and one-fourth carats, and was recut to seventy-two and one-half carats. Both were exhibited in the exposition of 1862.

Among the exhibits of 1862, and later at the Paris Exposition of 1867, were two fine large sapphires. One, oval, dark, and of slightly inky color, but free from flaws, weighed two hundred and fifty-two carats. It was cut from the rough by Mr. Loop in 1840. The other, smaller but of richer color, was brought as an India-cut stone from India in 1856. It weighed two hundred and twenty-five carats, but the shape was bad, and it had a large yellow flaw in the back, which gave a greenish cast to the color. Mr. J. N. Forster, successor to Mr. Loop, recut it to a fine gem of one hundred and sixty-five carats. It was sold in Paris, and was estimated to be worth from £7000 to £8000.

There is a sapphire of fine color and flawless in the Jardin des Plantes, Paris, which was found by a poor man in Bengal. It came into possession of the house of Raspoli, of Rome, and left by them to a German prince, who later sold it to the French dealer in jewels, Perret, for £6800. It weighed rough one hundred and thirty-two and one-sixteenth carats.

The Duke of Devonshire, in England, has a fine sapphire of over one hundred carats, brilliant-cut above and step-cut below.

One of the largest sapphires known was reported by an English embassy as among the treasures of the King of Ava in 1827. It came from Burma, weighed nine hundred and fifty-one carats, but was not perfect.

There was a large sapphire of fine color in the Hope collection which appeared to equal advantage by artificial light.

A number of fine sapphires, beautifully engraved, exist in European collections.

One of the largest and finest emeralds of which there is any record is owned by the Duke of Devonshire, in England.

It is a thick six-sided prism, weighing thirteen hundred and fifty carats, of fine color, very clean and transparent.

The largest opal known is in the Imperial cabinet, Vienna. It is uncut, but free of matrix, and weighs about three thousand carats. It was found at Czerwenitza in 1770, and shows a beautiful color play. A smaller piece, about the size of a hen's-egg, and thought to have been at one time a part of the larger one, is in the treasure-house of Vienna. It is of marvellous beauty.

There are many fine pearls among the treasures of the Hindoo princes. It is impossible, however, to obtain definite knowledge of them. Tavernier, during his travels in the East, saw many of them, and makes mention in his writings of several. Many of these were pear-shape. One, in the midst of a chain of emeralds and rubies worn occasionally by the Mogul of his time, was egg-shaped. He sold one from the West Indian fisheries, weighing fifty-five carats, to Shah Est Khan, uncle of the Mogul. The Mogul had in his possession the largest round pearl Tavernier saw in his travels. He also mentions that Imenheet, Prince of Mascaté, owned one weighing twelve and one-sixteenth carats, the skin of which was the finest he ever saw. The King of Persia offered two thousand tomans for it. The Mogul sent an envoy offering forty thousand crowns, but the Arab would not sell it. The King of Persia bought a flawless, perfect pear-shaped pearl, in 1633, of an Arab, for thirty-two thousand tomans. One in the Beresford Hope collection in South Kensington Museum, London, weighs four hundred and fifty-five carats. Another in the Austrian crown, of medium quality, weighs three hundred carats. Probably the finest large pearl known is that in the Zosima Museum, in Moscow. It is white, round, and of fine lustre. It weighs twenty-eight carats, and is called "La Pellegrina."

III

SUPERSTITIONS ABOUT PRECIOUS STONES

In the days when there was less definite knowledge of gems, and people generally were not so familiar with them as now, they were invested by imagination with many wonderful properties, and superstition ascribed to them magic powers. In these matter-of-fact days it is difficult to understand how not only the ignorant, but men of learning and persons accounted great, could believe the things said of them. Our own latent superstitions, and books containing the quaint absurdities of our forefathers, are evidence, however, of the romances successfully foisted upon the public, by guileful dealers, probably.

One old writer claimed that the King of Pegu, in India, had a ruby which could illuminate a dark room as brilliantly as could the sun. Another says that if danger approaches the wearer of a ruby, it will turn black, and resume its natural color when the danger is past. A story is told of a man wearing a ruby in a ring, who observed, as he travelled with his wife, that the glory of it was obscured. His prognostication of evil was justified by the death of his wife, after which the stone recovered its splendor.

A writer gravely asserts that he cured a gentleman of an obstinate fever with a simple powder of topaz diffused in wine, and another of melancholy by a like dose. Another claimed that it would quench thirst if held under the tongue, and that the powder of it was good for asthma.

The emerald was often used medicinally. Some claimed that it was a specific against poisons. A German physician used it in all diseases of the heart, and one states that if a beryl be placed in water, the water will appear to be moved. Many believed it to be beneficial to the eyes. Wise men asserted that the emerald had such an influence upon the passions as to keep the wearer chaste, or, failing, that it would break.

The name amethyst was given to the purple crystal from an impression that wine taken from a cup made of it could not intoxicate. It was said to sharpen the wits, resist the effects of poison, destroy sleep, and, if worn upon the stomach, by drawing the vapors to itself, hinder eructation.

Carnelian was credited with making one strong of heart and free from fear, and of being a good protection against witchcraft, fascinations, and putrefaction of humors.

Onyx made into an amulet and worn about the neck was a preventive against epileptic fits. It would also excite the passions and stir up strife. Some said it was an antidote for melancholy, drove away evil spirits, and insured victory to the wearer.

A bloodstone placed in water beneath the sun's rays would make it boil, and the steam from it obscure the light of the sun like an eclipse. The magicians claimed that, if it was first anointed with the juice of the marigold, one carrying it could walk invisible.

An authority on gems said that the hyacinth, worn in a ring as an amulet, would give riches, honor, and wisdom, drive away plagues, cheer the heart, bring sleep, and, if need be, procure thunder.

The belief of the Indians that one wearing a cat's-eye would not want for riches was adopted by many of their more enlightened white brethren of the West.

The Greeks had faith in the power of the opal to secure for its wearer universal good-will, and thieves wore it because those who stood by the wearer could not see or did not mind what was being done.

Eugénie, of France, would not wear an opal, for fear of ill luck, but Queen Victoria gave to each of her daughters on their marriage opals and diamonds.

Tradition gave the chrysolite wonderful powers. It would fade and dull if brought near poison, recovering at once on the removal of the poison. If cast into boiling water, it so immediately assuaged the heat that one might safely put one's hand in also. It was a remedy for cholera and distemper of the brain, and drove away nocturnal fears.

Pearls worn upon the person were believed to be good for the sight.

A turquoise received as a gift, and worn in a ring of gold, preserved men from falls; it also took all enmity from between man and wife. One writer stated that he saw a turquoise which upon the death of its master not only lost all beauty, but contracted a cleft. The beauty returned and the cleft disappeared when a new master bought it for an under price. That same veracious author asserted that the turquoise pales if its master grows infirm and weak, but at once recovers its natural color and beauty if the health of the wearer returns.

The diamond was considered a safeguard against mania, an antidote for poison, and a preservative of virtue. In ancient times it was used to detect infidelities, for, if placed upon the head of one sleeping, it compelled the disclosure of the secrets of the bosom. Writers stated that it was so hard that, if one were placed on an anvil and struck a prodigious blow, it would break both the anvil and hammer. Authorities of the day said it would resist fire and could not be burnt. This superiority to steel and fire could be overcome, however, by soaking the stone in fresh, warm goat's blood. Then, by a blow sufficiently strong, the diamond would be broken and fall into pieces so small as to be almost imperceptible, but the anvil would be broken also.

A priest taught that whoso carried a transparent crystal of quartz in his hand when he entered the temple might be sure of having his prayer granted. He also said that if one were laid on dry wood, so that the sun's rays might fall upon it, there would be seen, first, smoke, then fire, and then a bright flame, and this was holy fire, and rendered the sacrifice most acceptable to the gods.

IV

DESIRABLE QUALITIES IN PRECIOUS STONES

A DIAMOND is a gem; a gem diamond is an extraordinarily fine one. It is in that sense the word will be used in this chapter.

In describing here the most desirable qualities to be sought, and the defects to be avoided in the various stones, it is not to be supposed that absolute perfection can be found. The information is given in order that the dealer may properly gauge values and secure for his trade the best that can be had for his limitations.

Nature has made precious stones, like other things, on the pyramidal plan, in which, tier by tier, they decrease in quantity as they improve in quality. There are but few at the apex. Gems are rare. The ideal stone is seldom if ever found.

Although there are not many who realize how small the proportion of gem-stones is to that of ordinary quality, or how few even these are to the mass of useless material found, there are, nevertheless, several reasons why gem-stones are safe stock. The public is constantly and rapidly climbing to a knowledge of the finer qualities of precious stones. The result is, it takes finer goods always to satisfy it. A comparison of what was "fine" twenty-five years ago with that considered so now will show how much more critical the public is now than it was then. With every year, people demand greater excellencies in quality and cutting, and the number of those increases who will have better goods even at greater cost. Yet there is so much ignorance of the great difference in quality and quantity between very fine stones and the mass of ordinary material, that gem-stones do not yet bring a price over poorer grades in proportion to their rarity and true relative value. All things considered, the highest-priced stones in the market are the cheapest.

But whatever the judgment of a dealer may be in this matter, or the limitations which his trade puts upon him, it is necessary, above all things, that a stone, of whatever kind, should have some positive merit. There are stones, like men, whose qualities are all negative; they have no striking flaws, even; they do not impress one. Avoid them. Others are faulty, but somehow one likes them. They have character; some distinguishing trait which makes them desirable, notwithstanding the faults. Such stones sell. A crystallized dew-drop that holds the play of the sun will have more lovers, though there is a black spot in the heart of it, than a dead stone which barely winks at the light of high noon, even if it is "perfect."

The chief quality of the diamond as a jewel is its brilliancy. That is the first consideration. Given fifty rings of equal size in a tray, the most brilliant, regardless of price, will sell first. They will attract the eye and interest of the buyer. Unless the lifeless stones are forced upon his attention, the chances are he will not even ask the price of them.

Sometimes want of brilliancy arises from impurity of color, imperfections, or poor cutting; sometimes from a lack of the native power to refract, reflect, and disperse light. Whatever the cause, a greasy, glassy stone, notwithstanding any negative quality it may possess, is undesirable. The eye cannot at all times distinguish fine shades of color, nor can ordinary flaws be seen, but if a stone has fire and life, it will please and fascinate, though otherwise faulty.

After brilliancy comes color. Judging by the commercial index of price, the finest is a bluish white. Of this there are two kinds,—a fine clean tint, and one that is dark. Because the latter is more easily discerned, many choose it as the more valuable. They err. A decided tint is desirable, but it should be free from the blackish admixture, which is often mistaken for depth of blue. The finest color is not always immediately recognized except by experts. Even they only grade it exactly by careful comparison with other stones. It should be remembered here that in these infrequent productions of nature every shade of betterment counts far beyond all reason, seemingly, to those who do not know their rarity.

This quality of color was long termed "Old Mine," from Brazil goods so called. Since the opening of the African mines, a new name has been given to material of this character. As a mine called the Jagersfontein yielded many of these bluish-tinted diamonds, it soon became customary in trade circles to call everything of that grade "Jagers" (pronounced Yahgers). This is now the trade term for blue goods, the name "Old Mine" being confined to the old cut stones of that quality which occasionally drift back into the market from private hands.

Rated next to blue goods, and preferred by many, are the purest white or "River" goods. Although rated here among dealers below Jagers, this material in the rough at the mines has brought a much higher average price than the Jagers. The name "River" is given to them because they are from the river diggings, being found along the Vaal River. These goods are notable for purity of color and the limpid appearance associated with it. They much resemble the fine stones of India in character. It is worthy of note that, for some unknown reason, the stones of wet diggings are superior in quality, as a rule, to those of the dry diggings.

After these come crystals, which are subdivided into "crystals" and "top crystals." This is the standard grade of many jewellers, who pride themselves on carrying nothing poorer in stock. Some, whose trade will not pay the price which clean goods of this grade command, use the imperfects, but adhere to the quality.

Below the "crystal" assortment, by almost imperceptible degrees, the color loses its purity by deepening shades of yellow, brown, and occasionally a greenish hue. Some of the lighter shades of brown can scarcely be distinguished except by careful comparison, and are much in demand for trade which object to yellow but will not pay the price of white goods.

White stones with a slight cast of yellow are termed "Silver Capes." As the tint deepens, they are called "Capes," and "By-Waters" when they are decidedly yellow.

There are stones, comparatively rare and unclassified, of uncertain or "false" color. These have two or more differently tinted strata, and vary in apparent color according to the position or light in which they are viewed. It may be a combination of white and yellow, or blue and yellow or brown, etc. Some face up blue, and side yellow, or the reverse. Some show still another color from the back. Others will face differently, according to the light under which they are seen. One notably fine stone bought by a speculator in Philadelphia, some years ago, was a beautiful blue under the sky, but appeared to be off-color in-doors. A diamond importer of New York had another, which had a blue, brown, or yellow cast, according to the angle at which it was held. Another, owned by a jeweller of Cleveland, Ohio, was a beautiful even orange on the face. Viewed from the back, it was white with a yellow star in the centre; the color was all in and around the culet.

Due consideration should be given to the face color, for these stones suffer in value as the poorer tints predominate when faced up, and appreciate as the poor color can be seen only from the edge and back.

Yellowish-white diamonds are apt to be brilliant night stones, and do not, as a rule, show their color so plainly by artificial light, though electric light sometimes intensifies it. Brownish-white, on the contrary, though good day stones, become dark under any but sunlight.

As these various shades deepen, they pass from the realm of "off-color" to "fancy" stones. Color then becomes desirable, and grows in value as it is intensified. These fancy colors cannot be definitely placed in the order of value. Red, emerald-green, and sapphire-blue are extremely rare, and the few stones found bring fancy prices. The "Halphen Red Diamond" was sold by Mr. Edwin W. Streeter, of London, for £800. It weighs one carat. The same gentleman sold a green diamond for £300. After passing through several hands, it was sold in New York for about seven thousand dollars. A pale-green diamond in the Grüne Gewölbe, or "Green Vaults," of Dresden, weighing forty carats, is valued at £30,000. This stone, however, is very light, much like a full-colored aquamarine. Mr. Streeter also paid £300 for a one-carat blue diamond which he believes to be part of the original blue diamond owned by Louis XIV., and now known as the "Hope" diamond. This celebrated stone was lately bought and imported to this country by the Messrs. Frankel, of New York.

Pink and violet diamonds are next in rarity. Fine orange or canary diamonds are scarce, and there is a growing demand for them. The color should be a deep, clean yellow, free from greenish or blackish tints. Fine browns are rapidly coming into favor here, and, as comparatively few really fine stones are found, they will undoubtedly command much higher prices in the near future. A rich coffee-color, seal-brown, and the red and golden-bronze browns are best.

Besides brilliancy and color, there are two other things to consider in the choice of a diamond,—*i.e.*, cutting and perfection. If due regard has been given to the quality of brilliancy, these two items are comparatively unimportant. A stone which is properly brilliant cannot be very badly cut or very imperfect. However, if a brilliant stone be imperfect, it would be still better without the imperfections; and though it must be fine material to be brilliant in spite of poor cutting, yet recutting would improve it. Care should be exercised about the recutting of old stones, as many lose color by the operation. Two things the old cutters knew,—to cut for weight, and for color. In recutting their work, there is always considerable loss in weight, often of color. It is best, therefore, to consult a cutter experienced in handling such stones before ordering them to be made over.

There are certain angles and arrangement of the facets, suited to its refraction, which hold and embody the light falling upon it, and best assist the natural power of the stone also to reflect and disperse rays of light. The nearer it is cut to that ideal the better; but to cut to exact proportions, the cutter must be expert, and prodigal of his time and material. It costs much more to cut a stone to ideal proportions than to cut the proportions to the stone. A stone cut for weight may yield fifty to sixty per cent.; for perfection, thirty-eight or forty per cent. A cut diamond should show, when faced up, an even distribution of light. If too shallow or too deep, the centre will be black and vacant. The reason for this, proportions, facets, etc., are described in the chapter on cutting.

Flaws which do not hurt the brilliancy of a stone are immaterial, though they materially affect the price, because any one, however inexpert, can discover by inspection, and recognize them as faults. Carbon spots offend, as they can be seen with the naked eye. Large cracks in the grain of the stone, imperfect crystallization giving an ice-like appearance, and holes in the surface are all serious objections and reduce the value considerably; but slight grain marks, needle-point bubbles, or specks, should not weigh in the slightest degree against the more important items, brilliancy and color.

For various reasons, variation in light, conditions of the atmosphere and surroundings, vagaries of the eye, etc., buyers will find it wise to correct off-hand judgment by comparison with stones of which they have tried and definite knowledge.

In colored or " fancy" stones—and this term includes all kinds of precious stones except diamonds—color is a prime requisite. The question is often asked, " What is the gem color of this or that stone?" and many efforts have been made to describe them. It is difficult to do so. Nor can colors be printed sufficiently reliable to be authoritative. There is no standard of color by which that of stones can be definitely gauged and placed in the order of their merit. Stones are not manufactured after a sample, but happen. Nevertheless, there is a consensus of opinion among experts and lovers of precious stones about color. Gem color is at once recognized by those who have seen it before, and usually the uninformed also will prefer it before all others, simply on its merits. The true shade in all gems is that degree of the natural color most pleasing to the eye. It should affect the sense of sight as silk velvet feels to the touch,—rich and soft. No gem color is harsh or thin, or watery. It bears the same relation to an ordinary one that an oil does to a water-color. Purity is the key-note of gem color. A tainted, undecided, weak, or characterless color is not " gem." An Oriental or Burmah ruby should be pigeon-blood red, full, rich, and clean. It is rarely found without some admixture of black or purple, and is valued as it is free from those prevailing faults. Many rose-colored and pink rubies are very beautiful, but they do not rank with the blood-reds. It is a common error among partially informed jewellers to classify all the lighter shades of red as " pink," and many really fine stones are refused consideration because they have not the depth of color necessary for a gem, while others of thinner and poorer, though darker, color are chosen. A clean red is good in any degree. Pink is a thinner color, like a watered rose-color. Rubies are seen at their best by morning light.

The color of a Siam ruby is dark and tainted, and the value increases as it approaches the Oriental. The stone is the same in everything save color.

Red, with a slight tint of orange, is the general color of the spinel. The nearer it comes to ruby-red, and the less it has of the orange tint, the better.

A deep corn-flower blue is the gem color of the sapphire. Like the ruby, it is generally marred by more or less purple or black.

Emerald should be a deep grass-green. At its best it is free from a slight touch of yellow or blue, which appears in many by comparison with one of the true color.

The gem alexandrite is a fine tourmaline-green by day and ruby-red by artificial light. The combination is rare, one or the other color being, as a rule, weak. The night color is rarely stronger than a purplish pink to columbine-red, and the day color is often too light. This is generally so if the stone be cut thin. The double colors show best when it is cut thick.

The stone known commercially as olivine should be a bright yellowish green. The light, watery, or muddy green is to be avoided. This stone loses the yellow cast by artificial light, and is often called for that reason the "night emerald."

The blue-tinted aquamarine is preferred to those of a greenish cast.

A deep royal purple distinguishes the finest amethysts.

The yellow of the topaz has such a wide range, from clean canary to amber and the deepest orange, that no one of the many beautiful shades can be designated as superior to the others. Some prefer the rich wine-reds of the Madeira variety.

Of the tourmalines, a medium bright green is better than the lighter, or the darker, which has a blackish appearance. The pink should be a deep, clean color, similar to a pink ruby, and the brown should be a rich amber-brown.

The best diopsides are very similar to the fine green tourmaline.

Fine moonstones show a blue chatoyant light on a gray background.

The desirable color in turquoise varies with fashion. At present it is the tint known as robin's-egg blue. It should always be free from a chalky appearance, white specks, or other evidence of matrix, and from the greenish cast of color which is its most common fault. The color should be even, and the surface show a high polish.

Probably honey-color is favored by the greatest number of the admirers of the Oriental cat's-eye, though apple-green, and a rich brown showing an inner light of golden yellow, are preferred by many. The line of light, in any case, must be sharply defined, passing straight over the centre of the dome when presented squarely to the eye, and spreading as it is turned.

Star rubies and sapphires are seldom of good color. Their beauty and value depend mainly on the clearness and even distribution of the rays from the centre of the dome.

Of the many stones of varied hues for which there is no standard, it can be said only that individual taste must decide between them, remembering always that a clean, rich, decided color, of whatever kind, is preferable. This includes the fancy colored sapphires and spinels, zircon, garnets, beryls, etc.

Fancy stones, especially of the more precious crystalline varieties, are seldom perfect, but if the flaws or imperfections do not destroy the brilliancy and distribution of color, they are not accounted of as much importance as in the diamond. Rubies generally contain clusters of light or dark-colored spots. Ragged cavities in the surface of the stone are common. They are frequently muddy, especially those of the finer shades of color. White, glistening streaks in the grain of the stone, called silk, are of frequent occurrence. As a rule, these can be seen at one angle only; sometimes from the back alone. If silk shows plainly when the stone is faced up, it is one of the most serious defects.

Sapphires are subject to the same peculiarities. Irregular coloring is even more common. Many fine stones depend on a small section around the culet for their exquisite color. For this reason it is dangerous to recut an irregularly India-cut stone. It will generally be found, if the culet is off from the centre, that it was cut there to catch a fine piece of color. Close examination will show that many sapphires are made up of sections of white and blue, and in some cases a streak of red will be found.

Emeralds are invariably imperfect. The worst imperfections are those which give the stone a muddy appearance, and others which break the color by reflecting light, glistening spots and streaks in the body of the stone. Ordinary grain-marks, red spots, etc., which do not appear to the naked eye, must be expected.

An even distribution of color is very desirable, and is best obtained in step-cut stones by cutting them rather thick. Thin stones do not centre well for color or brilliancy, the table showing up flat and dark, with the color confined to the edge facets.

The fire and glitter of the diamond cannot be expected in colored stones, but a great degree of brilliancy is often found in those which are now being cut diamond fashion, as the zircon, white and colored topaz, amethyst, beryl, etc., as well as the more precious corundums and emerald.

To summarize, the qualifications to be desired in this class of jewels, are color, brilliancy, even distribution of color, perfection, and cut. All these are rarely found combined, and the dealer must be prepared to sacrifice desire in one or more particulars to bring the possibilities of the market and his customers in accord.

Chief among the opaque, and by many esteemed above all precious stones, is the pearl.

A lustrous skin free from blisters and blemishes, white and round, constitutes a gem pearl. The faults to be avoided, as far as possible, are a lack of sheen, blisters and indentations, dark and yellowish tints, and irregularities of shape. There is also a dead, bony white which is undesirable. This, however, is more liable to occur in fresh-water pearls. A pear-shaped pearl should be rather long, of even shape, and well pointed at the smaller end. An egg-shaped pearl must be full and round at the larger end and well rounded also at the other. Both ends should face up like a round pearl. Button pearls are less expensive, and in many cases better than round for centres in clusters. In all cases the sheen of the skin is of the first importance. The rule heretofore laid down regarding colors applies also to fancy colored pearls. A nondescript tint is a decided disadvantage, but a clean, rich color enhances the value. Fresh-water pearls lack the soft, mellow appearance of the Orientals, and it is said that both their lustre and color are apt to fade after piercing.

The body of the best opals is somewhat dense and milky, yet so constituted that fiery lights of red, green, and blue flash through it with distinct brilliancy. These colors should appear to best advantage when the stone faces the eye, as the front appearance of the stone is of the greatest importance. Red lights are more uncommon than orange or yellow, and produce a much finer effect. The opal should not be shown in a cross-light, but with the light coming over the shoulder of the looker. A cross-light destroys the play of color. It should be full-domed rather than flat, and the colors intermixed. Large, splashy rays of color, if well diversified, are better than the small speckled lights, but, to be gem, the whole surface must show diverse colors at the same time, producing sharp flash-lights as it is moved.

Since the chief supply of diamonds in South Africa has come into the hands of a syndicate, they have been carefully graded and a definite price made for the various grades. In consequence, the price of cut stones in any country is now very even. And as there is an abundance of material, but little variation occurs at any time from a short supply. Pearls also are very constant, though they have advanced steadily of late as a result of the increasing demand for pearl necklaces. But the supply of fancy stones is so irregular and uncertain, and the qualities which count for value so varied, that definite grades and prices are impossible. Value is a question for individual decision. After an observation which extends over some years, it is the opinion of the writer that too much is seldom paid for really fine stones. When a find of some precious stone is made, the man who pays a liberal advance for the best specimens, will inevitably find that he has the most value for his money. Buyers very rarely pay the real value of a pick of any lot. Occasionally a pocket of fine tourmalines is discovered in Maine, aquamarine and golden beryls in North Carolina, Montana rubies out West, etc. When first found they are sold at very low prices; then, as the pockets are exhausted, and the transient supply absorbed, the demand naturally forces up the price of the few stones floating about in the market.

As a business speculation it pays to buy a gem stone whenever it is offered at a reasonable figure, for the proportion found is always small, and the number of those who appreciate them constantly increasing.

V

PRICES OF PRECIOUS STONES

The combinations of qualities affecting the value of precious stones are so many that it is impossible to quote grades and prices exactly. Cut diamonds are graded as Rivers, Jagers, Wesseltons, Crystals (top crystals and crystals), silver Capes (top silver capes and silver capes), Capes (fine capes and capes), By-Waters, and Browns. But in all these grades there are variations of color, quality, cut, and perfection, and the combinations are so many that one might think there could be no definite market value or price to any. Nevertheless, those familiar with the trade know that men who are constantly handling diamonds by the parcel will not differ much in their valuation of any one given lot.

Diamonds as they are first put upon the market in the rough are divided into various grades and sizes as closely as experts can assort them, and sold to the cutters at an upshot price from which there can be no deviation. It is true that some cutters are more expert than others in handling the rough and getting from it better results in finished material, but the average is close. After cutting, the goods are sold to dealers with the cost of cutting and a small profit added. They are then carried to various markets and sold again in unbroken parcels or "original lots," or in divisions assorted to suit the various buyers, at another small advance, and in the United States with a duty of ten per cent. in addition.

The sorting is done for this reason. Some dealers will only buy perfect goods of fine color and cut; some are not so particular about color as perfection; others insist on good color, but will use imperfects; and so on. Many require the sizes to be assorted, buying their various sized melees, one-, two-, three-, and four-grainers, etc., separately; others prefer melange lots. It is at this stage where the greatest variations in price occur. Few importers and dealers assort their goods exactly alike, and after the assortment is made, the ratings of the various lots by different dealers seldom agree. Take, for instance, an original lot of one hundred carats, of which seventy-five are clean. Of the twenty-five imperfect, probably one-fifth would be badly so; these are the rejections. Then the parcel may contain, for example, twenty-five per cent. averaging two-grainers, thirty per cent. three-grainers, twenty-five per cent. four-grainers, and twenty per cent. five- to eight-grainers. This gives an assortment as follows:

18¾ carats, clean	2-grainers.
22½ carats, clean	3-grainers.
18¾ carats, clean	4-grainers.
15 carats, clean	5- to 8-grainers.
5 carats, imperfect	2-grainers.
6 carats, imperfect	3-grainers.
5 carats, imperfect	4-grainers.
4 carats, imperfect	5- to 8-grainers.
5 carats, rejection, melange.	

Suppose the lot cost one hundred dollars per carat, the problem is to place a valuation on these different lots so as to come out even on the cost of the parcel, with none of them too high to meet competition, or so low, if sold first, as to leave the others unsafe at their respective ratings. A fair rating of these various lots as the demand is to-day would be as follows:

Cost of lot, one hundred carats, at $100 per carat		$10,000.00
18¾ carats, clean, two-grainers, at $88	$1,650.00	
22½ carats, clean, three-grainers, at $100	2,250.00	
18¾ carats, clean, four-grainers, at $115	2,156.25	
15 carats, clean, five- to eight-grainers, at $125	1,875.00	
5 carats, imperfect, two-grainers, at $78	390.00	
6 carats, imperfect, three-grainers, at $88	528.00	
5 carats, imperfect, four-grainers, at $100	500.00	
4 carats, imperfect, five- to eight-grainers, at $105	420.00	
5 carats, rejection, melange, at $65	325.00	
		$10,094.25

This would leave a margin to cover a possible close deal against competition where some one or more of similar lots in other hands may have been rated lower.

These ratings are also constantly influenced by the demands of the market. If two-grainers were in good demand and three- and four-grainers sluggish, the rating of the former would be higher and the latter correspondingly lower, and so on. Large stones are comparatively scarce, and therefore naturally worth more with an ordinary market than small stones, yet for two years past five- to twelve-grainers have been rated as low or even lower than four-grainers, because there was no demand for them. As they are being again called for, they are now rapidly advancing to a price in accord with their natural relative value.

Few men agree in the matter of rating. For this reason buyers think one importer cheaper than another, though both buy equally well and sell on the same margin. The probability is that one rates the goods which the buyer uses at a lower figure than the other, in which case he must have rated some of the other lots correspondingly high.

For this reason importers prefer to sell unbroken lots, and will do so at a very small margin of profit rather than assort them and take the chances of holding some of the lots until either cost of carrying eats up the profits or they are obliged to sell at a price below the rating to get rid of them and close up the parcel.

Present prices in this market, as near as can be stated, are as follows:

Finely Cut, Clean.	Jagers.	Crystals.
Very small melees	$90 to $120	$80 to $100
$\frac{1}{32}$ to $\frac{1}{64}$ carat	90 to 100	75 to 90
$\frac{1}{4}$ to $\frac{1}{16}$ carat	80 to 95	75 to 85
$\frac{3}{8}$ carat	90 to 110	75 to 90
$\frac{1}{2}$ carat	110 to 135	90 to 100
$\frac{3}{4}$ carat	140 to 160	110 to 130
1 carat	160 to 200	135 to 140

From one carat up the price of Jagers advances rapidly according to size as the bluish tint becomes more decided. Slight imperfections do not materially affect the prices of the small melees, but reduce one-fourth to one-sixteenth carats probably five to ten per cent. Light imperfect three-eighths to one-half carats are worth ten to fifteen per cent. less than the foregoing prices, and three- to four-grainers fifteen to twenty per cent. less, or even twenty-five per cent. in the finer grades of Jagers. Perfect Jagers of two carats and over are difficult to find under three hundred dollars per carat. If the color and quality are very fine, the question of value becomes a matter of adjustment between buyer and seller. Pieces of fine color are scarce and rapidly advancing. The price of crystals is steadier than that of any other grade, and it did not increase during the rapid advances made by the syndicate as much in proportion as that of the cheaper grades.

Well-made clean capes and silver capes bring about as follows:

	Silver Capes.	Capes.
Very small melee	$80 to $90	$70 to $80
$\frac{1}{32}$ to $\frac{1}{64}$ carat	70 to 80	60 to 70
$\frac{1}{4}$ to $\frac{1}{16}$ carat	65 to 75	60 to 65
$\frac{3}{8}$ carat	70 to 75	60 to 70
$\frac{1}{2}$ carat	78 to 85	70 to 75
$\frac{3}{4}$ carat	90 to 100	75 to 85
1 carat	100 to 110	85 to 95
5 grains and over	100 to 120	90 to 100

It is extremely probable that sizes of five grains and over will be rated higher in the near future.

Light browns cost about the same as capes, rather more if very good, in the larger sizes. By-waters about twenty per cent. less. Light imperfections from three-eighths carat up reduce the value about ten per cent. Good crystal melee melange, taken as it runs, ranges from sixty-five to seventy-five dollars; capes and silver capes, fifty to sixty-five dollars; light browns, fifty to sixty dollars; Bahias, forty-eight to fifty-two dollars. These lots are mixed, and as they can be assorted for color, cut, and perfection, as well as for sizes, they carry a wide range of value. These lots run from small melee to light two-grainers and average about six to the carat.

The demand for fancies is principally in the larger sizes at present. They are scarce. Fine canaries and browns from one to two carats range from one hundred and fifty to two hundred and fifty dollars per carat; two to three carats, about three hundred dollars per carat. Some very fine fancies of rare color, from three-fourths carat up, have brought one thousand dollars per carat and over, lately.

Rubies are abundant in small sizes and very scarce in large sizes, especially two carats and over. Good light reds and brilliant rose-color of one-half carat, fairly clean, sell for from fifty to sixty dollars per carat. The same in three-fourths carat are worth from seventy-five to ninety dollars, and in four to six grains, from one hundred to one hundred and fifty dollars per carat. Fair stones of good color from one to two carats range from two hundred to five hundred dollars per carat. Gems run up to one thousand dollars per carat and over.

Light Cashmere sapphires, India cut, running from one to four or five carats, cost from ten to twenty-five dollars per carat. This same clean blue in a deep gem color, well cut and free from noticeable flaws or white streaks, is worth in those sizes from sixty to one hundred and twenty-five dollars per carat; in good fair color, twenty-five to fifty dollars; in black, flawy or muddy, five to fifteen dollars. Good color and fairly clean, from three-eighths to three-fourths carat, cost from fifteen to twenty-five dollars per carat. Good yellow sapphires, from one carat up, range from fifteen to twenty dollars per carat. Ordinary fancies, from five to ten dollars.

Emeralds are high. Gem colors, bright, and without noticeable flaws, from one to two carats, bring from two hundred and fifty to five hundred dollars per carat; one-half and three-fourths carat, of the same quality, from one hundred and fifty to two hundred and fifty dollars; one-fourth and three-eighths carat, from one hundred to one hundred and twenty-five dollars. Good colors, but very flawy, from one-fourth carat to three carats, range from thirty-five to one hundred dollars. Very light colors sell at from fifteen to thirty dollars.

Aquamarines of the light-bluish tint cost from three to seven dollars per carat. Fine golden beryls, when they are to be had, bring from fifteen to twenty-five or thirty dollars.

Round Oriental pearls of good color and skin, from three to ten grains, cost from two dollars and fifty cents to four dollars base; smaller, about ten per cent. less; larger and especially fine gems, down to five grains, five to eight dollars. Fresh-waters are uncertain, though very fine ones command good prices. Baroques range from a few cents to five dollars per grain. Good wing pearls, from five to ten cents per grain.

Fine small olivines, from one-thirty-second carat down, are worth from twenty-five to fifty dollars per carat. Melange averaging about three-eighths carat, about thirty to thirty-five dollars. Good stones of over one carat seldom come into the market, and sell readily for from sixty to seventy-five dollars. The poorer grades of this stone find slow sale at any price in the market.

Fair Australian opals sell at from three to ten dollars per carat; very good at from ten to fifteen dollars. Gem pieces are very scarce, and find ready buyers at as high as fifty to sixty dollars per carat. Fine matrix sells at from one dollar and fifty cents to three dollars per carat.

Fine American turquoise is graded according to color and size, from three to twelve dollars per carat. Large flawless pieces sell as high as twenty dollars per carat.

Zircon and jargoon of good color range from five to ten dollars per carat. Ordinary material of foreign cut sells at from one dollar to five dollars. Fine yellow and other fancy colors bring fifteen dollars and upward.

Ordinary cat's-eyes of about one carat cost from ten to fifteen dollars per carat; fine, from thirty-five to fifty dollars. Large fine pieces are rare, and cost from fifty to seventy-five dollars per carat.

Good alexandrites bring from seventy-five to one hundred and fifty dollars per carat. If the day and night color are both gem, the price depends on the buyer and seller. Such stones are seldom found.

Chrysoberyl is rarely quoted, as this stone in its various colors is usually included in mixed lots of fancy stones under the general term "fancy sapphires."

Ordinary chrysolite or peridot may be had for from two dollars to five dollars per carat.

Gem amethyst, American cut, costs from one dollar to three dollars per carat.

Spinels vary considerably. Some are dear at five dollars per carat. There are others which would be cheap at seventy-five dollars per carat.

Fine green and pink tourmalines sell readily at fifteen to twenty dollars per carat. Ordinary material costs about half, and some grades are sold for from two to three dollars per carat.

Andalusite is so rarely seen that it is difficult to quote a price. Good specimens would probably bring from twenty to thirty-five dollars per carat.

Fine specimens of diopside can be had occasionally for from ten to fifteen dollars per carat. The poorer qualities are not marketable here.

Ordinary garnets are sold by the piece or hundred, but choice specimens of American cut American garnets are sold at from four to six dollars per carat. Large sizes of two carats and over command as high as twenty dollars per carat.

Good azurite and malachite cut *en cabochon* are worth from thirty-five to seventy-five cents per carat. Large, finely marked pieces bring more.

Only very fine specimens of moonstones command carat prices; such stones are worth from seventy-five cents to one dollar per carat.

There is no definite price for obsidian. Probably fifty cents to five dollars per carat is a fair valuation for the transparent variety in good colors.

The chalcedonic and jaspery varieties of quartz are not sold by the carat. Of the vitreous, amethyst, cairngorm, citrine, and rose quartz, there are grades which bring from seventy-five cents to two dollars per carat.

The sphene is rare, and the occasional specimens which come into the market are generally held for a fancy price. They have been sold as high as fifty dollars per carat.

Some fine specimens of topaz are sold up to two dollars per carat.

For stones seldom used as "jewels" no definite price can be given, as it depends entirely upon an uncertain demand and the supply at the moment.

The price of diamonds given here may seem to many too high. This will arise from the practice, which has grown quite common of late, of quoting goods as a grade higher than they really are. Capes are frequently offered as silver capes, silver capes as crystals, etc. Firms of high standing often pay as much for crystals as smaller concerns in the same city sell so-called crystals for. It should be remembered also that these prices are for well-cut goods. If by thick, irregular, or poor cutting of any kind the cutter succeeds in getting ten per cent. more cut material out of his rough, such goods can be sold at much less per carat and yet be dearer than well-made goods. For example, take two stones of the same grade of which the finely cut stone weighs one carat. The other, cut thick either by making it too deep, or too thick through the centre at the girdle, will weigh, if of the same spread, an eighth to three-sixteenths more, and will not be as brilliant as the spread stone. This would be the comparative cost of the two stones of the same size and material if the thick stone were sold for five per cent. less:

One brilliant, one carat, at $100 per carat..$100.00 for the stone.
One brilliant, one and one-eighth carat,
at $95 per carat........................ 106.88 for the stone.

In other words, the dealer pays six dollars and eighty-eight cents more for a poorer stone of the same size as the higher price goods, because it weighs more.

On the other hand, there are stones of all kinds worth much more than any prices quoted here. Gems of rare and exceptional qualities cannot be rated.

VI

CUTTING

Precious stones are cut and polished to develop the beauties which are latent in them.

Uncut, the diamond is not beautiful. In the rough, at its best as an octahedral crystal, it does not equal in appearance a piece of cut glass; generally it is an irregular, rough, luminous gray pebble. But it has inherent qualities which can be made beautiful. It will take a high polish; it has the power to reflect and disperse light falling upon it to an extraordinary degree, and to strongly refract and reflect the rays which enter its transparent body.

By cutting and polishing, the natural adamantine lustre, or surface power of reflection, is utilized to throw back as much as possible upon the eye the light-rays as they impinge upon the facets arranged to intercept and disperse them.

But as all the light cannot be held by the surface, advantage is taken of its reflective and refractive powers to hold and concentrate by the angles and arrangement of the back facets the light which enters the body of the stone. Knowing the exact angle to which rays of light are bent on entering, and the angle at which light endeavoring to pass from a denser medium into the air, as from a diamond, is totally reflected, it has been found possible to so form it and arrange its back facets as to catch the fugitive rays in their effort to pass through, and, by driving them back and forth among the adamantine walls, round them up within the interior and finally return them in brilliant flash-lights through the face of the stone, to the delighted eye of the beholder.

The primitive method of cutting diamonds was simply "bruting," or by rubbing one crystal against another, to grind away the skin of the natural facets and make a polished surface, or, if found as pebbles, to produce a few irregular facets upon which to catch an occasional flash-light. If the crystal was found as an octahedron or natural brilliant, as it was called, the eight faces were simply polished. In all cases, little of the original weight of the crystal was sacrificed.

A further improvement was made by increasing the number of facets to eighteen; eight in regular order extending from the table to the girdle, and eight to match them between the girdle and the culet. (Fig. 2, Plate XIV.) Double rows of star and corner facets, as in 1, 2, 3, and 4, 5, 6, in Plate XII., in all thirty, and thirty-four followed. Some of the old square brilliants were cut to fifty facets,—a double row of main and corner facets top and bottom, as in 3, Plate XIV. Then came the English round cut brilliant, as in 7, 8, and 9, Plate XII., having a triple row of star, main, and corner facets on top, and a double row of corner and main facets on the bottom, thirty-two and the table above the girdle, and twenty-four and the culet below; in all, fifty-eight facets. This arrangement remains in the perfect modern cut.

During all these years and stages of improvement, the early disinclination to lose weight in the process of cutting remained paramount, and some deplored the tendency of cutters even then to sacrifice magnificence to a mere sparkling effect. A comparison of one of the "lumpy" stones cut then with one of our modern cut brilliants will convince, however, that the royal magnificence of the diamond can be fully attained only by fitting its proportions to the natural qualities of the stone.

It remained for an American cutter, Mr. Henry D. Morse, of Boston, the first cutter of diamonds in the United States, to make the daring sacrifice of weight to proportion necessary to attain the perfection of the modern brilliant. Disregarding the European method of cutting less for beauty than weight, he did not hesitate to sacrifice material in order to make the finished stone as perfect and beautiful as possible. Machinery to increase the accuracy of the facets was perfected in his shop, and he taught and insisted on mathematical exactitude. His work was appreciated. The public, seeing its superiority, began to insist upon having stones cut and proportioned after his method, and European cutters were gradually obliged to conform more and more to it. The result is that the proportions of the American brilliant have been generally adopted, though the finest and most exact cutting is still done in the United States.

The "brilliant"-cut diamond resembles two cones united at their bases, the upper one truncated or cut off a short distance from the base, and the lower one having the apex only cut off. The flat top is called the "table." The rim where the cones unite is the "girdle." "Culet" is the name given to the small flat facet at the bottom, "pavilion" or "collet-side" to the entire lower portion from the girdle to the culet, and "bizel" to the space between the table and the girdle. It will be seen by referring to the drawings on Plate XII. that the proportions have been changed somewhat in the last few years. One-third of the depth of the stone above the girdle was considered best. It is less now, and the change gives a sharper brilliancy to the stone and less weight.

The brilliant-cut has thirty-two facets above the girdle and twenty-four below; in all, fifty-six, exclusive of the table and culet. To these are sometimes added eight extra facets around the culet. The top facets consist of eight triangular "star" facets, called top corner facets, which abut on the table, eight main facets, whose points reach from girdle to table, and sixteen split triangular facets, or "lower corner facets," lying between the points of the main facets, with their bases forming the edge of the girdle. Below the girdle are sixteen split triangular or "upper corner on bottom" facets, to match those on top, with eight main facets reaching below to the culet.

Though a buyer of diamonds cannot always tell by measurement whether or not a stone is cut to its best proportions, he can decide the question by its appearance. A stone properly proportioned shows an equal distribution of light and brilliancy. The centre under the table is as full of light, reflected by the back facets, as the edge of the stone from the table to the girdle, where it is cut up to receive light and reflect it from the surface. If the stone be too shallow or too deep, the light entering the stone is not thrown sufficiently into its body, but passes out around the culet, leaving a dead centre. In stones cut too deep this results in a black "well" through the centre of the stone; if too shallow, there is a different but similar effect of weakness which produces a glassy appearance. Such stones are termed "fish-eyes."

Since the trade have found how important it is to have a proper "spread" to the stone, and that one of the same diameter weighing less may be more brilliant than another which is heavier, there has been a tendency to demand stones too shallow for the best results. It is important that there shall be sufficient depth from the girdle to the culet; nor does this sufficiency, coming on the under side, as it does, almost to a point, add much to the weight. Thickness should be avoided at and above the girdle. If a diamond shows a full volume of brilliancy both when held near by and at arm's length from the eye, its proportions cannot be far wrong. If it shows weakness or a dead centre, it is not a good stone to buy or sell, though there is a demand for them, generally from people who have a mistaken notion that thin stones give them more show for their money. The actual size of a "fishy" stone never impresses the eye so much as the brilliancy of a smaller well-cut stone. Dealers should remember that while in "lumpy" stones they pay for weight of material which is detrimental, a sufficient depth is necessary to secure that brilliancy which is the chief beauty of the diamond. Figures on Plate XIX. illustrate the manner in which a ray of light traverses the body of the stone on entering a diamond, and the angle at which a light-ray is totally reflected.

In the American-cut brilliant, the rays perpendicular to the face of the stone when faced up, passing into it, meet the back facets at angles which successively reflect them totally until they are returned to the face again, and pass into the atmosphere. If the perpendicular light-rays fall upon the top side facets, they are refracted on entering the body of the stone, and also strike the under facets at angles which produce like results. If, however, the stone be cut too lumpy, the sides of the upper cone, being too straight, receive the light-rays at an angle which throws them too much to one side. On the other hand, if the stone be cut too shallow below, the under facets receive many of the light-rays at an angle which allows them to pass through into the atmosphere, leaving the centre of the stone without any play of light and dead. In either of the two latter cases, the full reflective power of the back facets has been lost.

The "twentieth century" is a new form of cutting lately introduced. The number of facets is greater than in the brilliant-cut and they are differently shaped and arranged. The first cuts of it printed showed eighty-eight facets and proportions similar to the American brilliant, but with an increased height from the girdle to the centre of the top, caused by the facets replacing the table being carried to a low pyramidal point in the centre. The stone as now cut is thinner, has but eighty facets, and the central top facets are almost flat. A print of the cutting is shown in Plate XV., Figs. 1, 2, and 3. It is still a question if it will become popular. The public have not yet given it general approval, and dealers are handling it with extreme caution, partially on account of its greater cost. Opinions vary about it. Many think it unsuitable for small stones, and though it increases the surface reflection and dispersion of light-rays, some claim that the central facets hinder the flash-light magnificence of the inner reflections of the table-cut stones. It is the opinion of the writer that the centre facets are helpful to shallow stones, and serve to hide defects and color by distracting the vision and confusing the eye in its efforts to locate flaws and measure the quantity of color. In effect this cut is an improvement on the double rose, Fig. 8, Plate XIII., or cutting such as shown in the "Florentine" brilliant, Fig. 3, Plate XVIII.

The diamond, being the hardest of all known bodies, can be cut only by means of powdered diamond. This powder is prepared from bort, which is diamond too faulty for use as jewels, or the refuse of cleaving and cutting. These pieces are pounded in a mortar of hardened steel, and the powder is used to charge the wheels upon which the diamonds are ground.

The first process is to examine the crystal and decide which way it shall be cut to get the best results. Flaws and imperfections in the finished stone must be avoided as far as possible, proportion preserved, and none of the precious material wasted which is not absolutely necessary in order to secure the most value in the finished product. The cutter having decided, he takes two diamonds, and, affixing them on the ends of two box-wood sticks made for the purpose, begins the actual work of cutting by "bruting," or rubbing them against each other. Having prepared it to his satisfaction, the stone is given to the setter, who sets it in a mixture of lead and tin melted in a metal cup resembling somewhat an old-fashioned egg-cup. A small part of the diamond is left exposed, a mark indicating the grain of the stone is made upon the solder, and, when it is set, it is handed to the polisher, who proceeds to grind it upon the mill first to produce the "table." This done, it is reset for the first or flat corner, and so on successively until all the facets are cut. During the entire process the direction of the grain is noted, and a mark indicating it is made on the solder by the setter for the guidance of the polisher. Each facet has a name, by which the grain and how to polish that particular facet is known. The work is done on flat, horizontal wheels which make about two thousand revolutions a minute.

During the polishing or grinding the diamond is kept moist with a mixture of olive oil and diamond-dust.

Ideal cutting not only requires exact proportions, but the placing of the facets mathematically true. The culet should be opposite the centre of the table, and their eight sides parallel to each other; the edges of the top and bottom corner facets should correspond, and the dimensions of their bases be alike. The edge of the stone should be cut evenly. Some prefer the finished appearance of a polished knife edge, though there are those who think it better to leave a very thin line of the skin of the stone around the edge, as it is less liable to chip and split. The skin being harder, it protects the natural cleavage along the grain of the stone. Nor is this detrimental to the brilliancy if the proportions are right. If, on looking into a stone, reflections of the edge appear in the body, its proportions are not exact.

It is impossible, however, at the general market price of the various qualities, to supply stones of absolutely perfect cut. The waste and care necessary to produce them add materially to the cost; nevertheless the public are rapidly learning the value of this kind of work, and as they become convinced that the increase of cost is returned to them in a full increase of value, they willingly pay the difference. It takes time to fully appreciate a perfectly cut stone, but acquaintanceship adds to the pleasure of its possessor and to his confidence in the dealer who sold it to him.

Another form of cutting diamonds, confined usually to small stones, and by which pieces too small for brilliants are utilized, is the "rose." It is circular, quite flat below, and rises to a low pyramid, which is covered with facets. Figs. 4 and 5, Plate XIV., give a side and front view of the "Dutch" rose of twenty-four facets. Fig. 6 is the "Brabant" rose of twenty-four facets. This is cut also with twelve or less. The "rose recoupé" of thirty-six facets is shown in Fig. 7. Fig. 4, Plate XIII., is the "marquise" rose, and Fig. 5 the "pendeloque" rose, both having twenty-four facets. Fig. 8, Plate XIII., is the "double" rose of forty-eight facets.

"Briolettes" are pear-shaped or oval stones faceted all over with triangular facets, as in Figs. 1, 3, and 6, Plate XIII.

The "pendeloque" is a brilliant-cut pear-shaped stone, as in Figs. 8 and 9, Plate XIV.

The "rondelle" is a flat, circular stone with faceted edges, as in Fig. 7, Plate XIII.

"Indian-cut" is a clumsy form of the single brilliant-cut, adopted by East Indian cutters for the purpose of getting as much weight after cutting as possible. It does not meet European, still less American, requirements, and must generally be recut for those markets.

"Point"-cut is seldom found except in antique jewels. It is produced by polishing the faces of a regular octahedron to a double, pointed, four-sided pyramid.

The natural shape of many crystals is such that much time, labor, and material are saved by first cleaving them into a shape more proportionate to the cut stone. By this process it is possible also to bring to the surface serious flaws in the interior of the crystal, and eliminate them in the polishing. The cleaver splits off badly flawed and imperfect pieces, leaving the clear, sound parts for cutting, and in various ways, by taking advantage of its cleavage, manipulates the crystal so as to get the maximum of value at a minimum cost of labor and waste material.

Although about twenty-five per cent. only of the diamonds found require cleaving, much of the success of a cutting establishment depends upon the judgment and skill of the man who does this work.

To cleave, the crystal is fastened to the end of a stick and a V-shaped incision made in the grain with a sharp piece of diamond, called a "sharp." Into this incision the edge of a knife is placed, a smart tap on the back is given, and the crystal parts along the line of the grain. As an error is irremediable and costly, good judgment and certainty are very necessary in this branch of the work.

Amsterdam is the head-quarters of the diamond-cutting industry, though many are also cut in Antwerp and other European cities. There are several large cutting establishments in the United States, notably that of Messrs. Kryn & Wauters, in Brooklyn, and an increasing number of smaller shops. The industry has grown here very rapidly in the last ten years. Some cheap work is also done in Switzerland, but it is not generally satisfactory, and Swiss-cut goods find little favor in this country.

In "fancy" or colored stones of the transparent varieties, although transparency and freedom from flaws are prime factors in their value, color is the first consideration. The aim of the cutter, avoiding defects in the rough as much as possible, is to develop the best color contained in the crystal, as it is seldom equally distributed. Color often lies in strata, blotches, or sections of the rough stone. Sometimes various shades of color appear in the same stone. The tourmaline frequently has different colors in the same crystal. The sapphire has occasionally a streak of ruby-red in it. Both the ruby and the sapphire, especially the latter, often have colorless sections running through them with the grain. Were the culet cut in such a streak, the color would be weakened. On the other hand, if the culet be cut in a small section of extraordinarily fine color, though the stone be otherwise well-nigh colorless, the color of the culet would appear solid of that tint throughout the cut stone when faced up. The finest amethysts are cut from crystals almost colorless, except for blotches of a deep, rich purple, of which the cutter takes advantage, and to which the colorless portions add a brilliancy not found in those of more even color. By skilful manipulation bad shades of color are neutralized or modified. The darkness of some green tourmaline crystals can be relieved by judicious cutting, and from the double-colored crystals stones of different colors are produced as they are cut with or across the grain, or they can be cut to dichroic stones resembling the andalusite.

Although stones of naturally dark color are necessarily cut thin to lighten them, whenever the color is sufficiently fine to stand it a thick-cut stone is better than a shallow one. A thin-cut colored stone is inevitably weak or black-centred. Color can only be distributed evenly by cutting thick, and a good night color can only be secured in the alexandrite by cutting the stone full and deep.

As a rule, the "step"-cut, in one of its many forms (see Plate XV.), is most suitable. This has been improved somewhat of late by cutting the upper portion with "brilliant" facets. Some object to the innovation, but they certainly help the natural lustre of the stone and increase its brilliancy.

Mr. E. Passmore, of Boston, has succeeded in preserving the color and enhancing the brilliancy of many fancy stones by cutting them entirely "brilliant." In the course of his experiments he has perfected and patented some very ingenious devices for securing, mechanically, right proportions and exact facetings. This gentleman has done for colored stones what Mr. Henry D. Morse did for diamonds,—viz., raised them in the scale of beauty by improved methods of manipulation and cutting, and he has shown that some of the finer specimens of the cheaper varieties of stones may be made to rival in beauty others far more costly.

The step-cut is a system of straight facets which decrease in length as they recede from the girdle.

Cabochon-cut is flat with a polished convex top. It is the usual cut of opal, cat's-eye, and turquoise. Rubies, sapphires, and emeralds are sometimes so cut, and the carbuncle is simply a garnet cut *en cabochon*.

A row of small facets is sometimes cut around the basal edge of cabochon-cut stones, as in Fig. 11, Plate XV. Some stones, notably moonstones, are frequently cut double convex, as in Fig. 12, Plate XV.

Although precious stones were cut after a fashion in the countries where they were found many centuries ago, the art of cutting as we know it is of late development, and originated in Europe. Diamond-cutting was done by one Hermann in 1407, and in 1434 Guttenberg learned gem-cutting and polishing of Andreas Drytzehen, of Strasbourg. In 1456 Louis de Bequem discovered a mode of cutting diamonds in regular facets, in Bruges.

Claudius de la Croix, a Frenchman, went to Nuremberg in 1590, and carried on the business of cutting rose garnets.

In 1475 Louis de Bequem made his first effort to obtain what was then called the "perfect cut" on three large diamonds sent him by Charles the Bold, Duke of Burgundy, receiving for his work three thousand ducats. The "Sancy" (Plate XVI.) was one of these.

His pupils went, some to Antwerp, some to Amsterdam, and some to Paris. Cardinal Mazarin gave much encouragement to these latter, and ordered twelve of the thickest diamonds of the French crown to be recut after the new "brilliant" fashion, which was first cut about 1520. These were called the twelve Mazarins. Their fate is unknown, though one appeared in the 1774 inventory of French jewels under the name of the tenth Mazarin. It was a fine four-cornered brilliant weighing sixteen carats and valued at £2000.

Diamond-cutting was brought to a high state of perfection in Lisbon by the Jews, but religious persecution drove them, in the latter part of the sixteenth century, to Amsterdam, where they have flourished ever since.

In 1700 there were seventy-five cutters in Paris. The political troubles which followed drove the industry to Antwerp. By 1775 there were but seven masters left there, and they earned but a scanty living.

India cutting has always been poor, as the natives value size and weight more than fine cutting.

Colored stones of inferior value are cut in Kandy, Galle, and Matura, but the better workmen who cut rubies, sapphires, and cat's-eyes are found in Colombo and Kalutara. Not until these are cut also with the prodigal determination of American workmen to develop the best in a stone and bring it to the highest state of perfection regardless of cost shall we know the full beauty of the harder and most precious varieties of colored stones.

Amsterdam and Antwerp are the great diamond-cutting centres at present, but the industry is rapidly growing here. With the genius of this country for improvement, and the wealth able to foster it, a prophecy that the time will come when this will be the centre of the whole cutting industry does not appear rash.

VII

WEIGHTS

THE standard of weight for diamonds is the "karat," or "carat." It is said to have been derived from a bean, the fruit of an African tree called by the natives "kuara" (sun), because both the fruit and the blossom are of a golden color. This bean being always, when dried, of about the same weight, it was used in Shangallas, the chief market of Africa, as a standard of weight for gold. By commerce with the merchants of India it came into use there, and, being found convenient, was adopted for the weighing of diamonds. The name comes from a word (keration) taken from the Greek by the Romans, which they described as the name of a very small weight or measure. An old book treating of it says, "Monardus writeth that he saw diamonds in Bisnager (Visnapour) that weighed one hundred and forty ceratia, and every ceratium weighed four grains."

The weight of the carat varies in different countries. The international carat is 205.5 milligrammes, which equals within a small fraction 3.17 grains troy, and the probability is that this will be universally adopted. Mr. Edwin W. Streeter gives the weight of the carat in various countries as follows:

	Milligrammes.
England and her colonies	205.409
France	205.5
Vienna	206.13
Berlin	205.44
Frankfort-on-Main	205.77
Leipsic and Amsterdam	205.0
Lisbon	205.75
Leghorn	215.99
Florence	195.2
Spain	105.393
Borneo	105.0
Madras	207.3533

The ounce troy (151.42 carats) is used for weighing Baroque pearls, coral, and semi-precious stones.

The Indian (Hindoo) weight rati (or ruttee) equals 0.89062 carat, and one thola is about fifty-seven carats.

The mangelin of Golconda and Visapur was equivalent to one and three-eighths carats.

In the weighing of diamonds, fractional parts of the carat are divided by two down to sixty-fourths. Beyond that no division is reckoned.

Pearls are sold by the grain, although it is not the standard grain weight, but one-fourth of a carat, which is a fraction less that 0.8 of a grain troy. This carat grain has led to the use of the word in connection with diamonds. One-half carat stones are called two-grainers; three-fourths carat stones, three-grainers; those weighing one carat, four-grainers, and so on.

The price of pearls is quoted by the grain and reckoned by the square, according to the size from the base price of a one-grain pearl, as follows: Given the price at three dollars base, the cost of different-sized pearls would be:

A one-half grain pearl at three dollars base would be one dollar and fifty cents per grain "flat," half of which would be seventy-five cents, the price of the pearl.

A one-grain pearl at three dollars base would be three dollars per grain "flat," and three dollars for the pearl.

A two-grain pearl at three dollars base would be twice three dollars, or six dollars per grain "flat," and two grains at six dollars would be twelve dollars, the cost of the pearl.

A four-grain pearl at three dollars base would be four times three dollars, or twelve dollars per grain "flat," and four times twelve dollars would be forty-eight dollars, the price of the pearl, and so on.

VIII

ARTIFICIAL COLORING OF STONES

It is possible, by various processes, to improve the natural color of some stones by artificial means. One of the simplest methods is by fire. Experience and care are necessary, however, as the stone is liable to damage. White spots are removed from rubies by burning. The color can be more or less burned from the jargoon. Smoky rock crystal is clarified by carefully heating in a crucible with lime, sand, or charcoal. The usual method of burning is to heat the stone in a crucible with unslaked lime, or iron filings, or sand and iron filings. The pink tint of Brazilian topaz is the result of burning. The tint of Oriental carnelian is also produced by exposure to heat. The red color of carnelian is produced by steeping in a solution of copperas or ferrous sulphate and then subjecting the stone to heat.

Onyx is dyed by soaking it, after being thoroughly washed and dried, for a period of two to three weeks in a mixture of honey and water, or sugar and water, or in oil. It absorbs this to a certain extent, some more, some less, according to the porosity of the layers in the stone. It is then taken out, washed, and placed in another dish with sulphuric acid. This is covered and placed in hot ashes, with burning charcoal over the cover. The acid carbonizes the saccharine matter in the pores of the stone, and the carbon gives to it a black or dark-brown color. It is then washed again, dried in an oven, and laid for a day in oil to increase the brilliancy. The results of this process are not uniform, some stones being very slightly affected only.

Agate is colored blue by first soaking it in a solution of yellow prussiate of potash and then in one of a ferric salt, by which a precipitate of Prussian blue is formed in the pores. Another method is to use a solution of blue vitriol and ammonia. Green is obtained by impregnating the agate with salts of nickel or chromium; yellow, by the use of warm muriatic acid. There are many processes by which almost any tint may be obtained, but the exact methods are known to few. Most of this work is done in Oberstein and Idar, on the river Nahe.

IX

DIAMOND

Of all precious stones, the diamond is supreme, not alone for its inherent qualities, but for the fascination it has for all people.

The shifting steps in the path of the sun across the sea to a far-off horizon; the limpid light of dew-drops among the grasses of the valley; the dance of moonbeams over crusted snows, or the shimmer of frosted trees under a cloudless sky, are all caught and fixed, for our enjoyment at will, in the diamond. No flight of imagination dreaming could gather material for a fairy-tale equal to that which science has constructed in its patient researches into the nature and antecedents of this gem. With every breath a man exhales there passes into the atmosphere the only thing a diamond yields when it disappears under the fierce heat of the laboratory,—dioxide of carbon, or carbonic acid. How nature transformed this colorless gas into the hard and beautiful stone has long puzzled investigators. Scientists have experimented for years to find out how the metamorphosis was accomplished.

Although many things connected with the process are still matters of conjecture, it has been established beyond doubt that the diamond is composed of pure carbon. When burned with a free supply of oxygen, it is completely converted into carbon dioxide. It is worthy of note that the two most precious stones are composed of the most common elements, and are the least complex of all. The diamond is pure carbon; the ruby is pure alumina.

If a diamond is subjected to intense heat in a vessel from which the air has been exhausted, although it cannot be consumed while the air is excluded, it becomes coated with graphitic carbon. Strongly heated and thrown suddenly into liquid oxygen, the diamond burns brilliantly and yields, by its oxidation, carbonic acid.

In oxygen, under a powerful lens, the diamond becomes clear red. Soon after, it is apparently enlarged in bulk, being surrounded by a faint white light, the result of combustion. Black spots appear on the surface, especially if the heat is diminished. If the heat be continued, it will be entirely consumed, but if the heat be withdrawn, it will immediately cease to burn.

A diamond placed in a muffle previously heated red-hot soon acquired the same color, and a few seconds later became conspicuous by a bright glow. On being then removed, it had a slight milky appearance.

There has been much speculation and many theories about the processes by which carbon was gathered and crystallized, but authorities concur in the opinion that the result was attained by an exceedingly slow process and under tremendous pressure. It has been demonstrated, also, that the physical condition of carbon depends somewhat on the pressure to which it is subjected at the time of consolidation.

Carbon in the adamantoid form has been obtained by saturating iron with pure carbon and subjecting the molten mass by various processes to great pressure, but the results have not been sufficient to demonstrate with certainty how nature secured the material of which the diamond is composed, or the exact methods used in the transformation.

Diamantoid carbon has been discovered in meteoric iron. Carbonado was found in a meteorite which fell in Russia in 1886; and in 1890 particles were found in meteoric iron in Arizona, which were, after careful examination, pronounced to be diamonds.

Some have adopted the theory that pure carbon was separated by electricity from carbonic acid, and after absorption by some mineral for which it had an affinity, became, by natural processes of heat, pressure, and cooling, solidified and crystallized.

Whatever the processes of nature were, the attempts to make them artificially have shown that the forces and time necessary are beyond our compass. Science and present means at its disposal have succeeded only in making a few very minute and imperfectly crystallized particles, sufficient to illustrate vaguely the larger method of nature.

The qualities which make the diamond valuable are its extreme hardness, great lustre, and the reflective, refractive, and dispersive powers which it possesses.

It is the hardest substance known, and for purposes of comparison is rated 10 in a scale running from 10 to 1. On account of this excessive hardness, the ancients could only partially polish it, and did so by rubbing one rough diamond against another,—"bruting," as it was termed. This knowledge of its extraordinary hardness gave rise to an error which exists to some extent even now. It was said that it was so hard, one could be laid upon an anvil and struck with a hammer without danger to the stone. Many beautiful gems have been destroyed by this test, for though they are so hard that they will wear a way through any other substance, they are also brittle, easily fractured, and, by pounding in a steel mortar, may be reduced to powder. They may be also worn away by constant rubbing against softer material. As rocks are worn away by the constant washing of water, so would friction with other substances, if persisted in, eventually wear even upon a diamond. In fact, Mawe says, "I am in possession of a globular diamond, upon the surface of which neither the naked eye nor the microscope is able to discover the smallest appearance of facets." He mentions this to refute the statement that diamonds were never found as rolled pieces.

The degree of hardness varies in different crystals, and sometimes in the same stone. Diamond-cutters find knots in the grain of some stones, which are as troublesome in the cutting as are knots in wood to the sawyer. It is also said that the diamonds of Australia are harder than others, as those of Africa are softer than those of India and Brazil. Black diamonds are occasionally found in Borneo, however, so hard that ordinary diamond-dust makes no impression on them; they can only be ground by using their own dust.

Some of the diamonds found in South Africa reach the usual hardness only by degrees after exposure to the air.

It has been found, in cutting, that diamond-powder from the surface of the crystals has a greater cutting power than that obtained by the pulverization of larger pieces, showing that the outside of the diamond is harder than the inside.

The surface differs also, for a crystal often cuts easier in one direction than another, and some facets cut easier than others.

The supreme test of a diamond is its hardness. If a stone resists the ruby or sapphire, it must be a diamond.

"Adamantine" is the term given to the character of lustre possessed by the diamond. It is indescribable, but has a peculiar, fascinating glitter which is immediately recognized by any eye which has once looked upon its intense brilliancy.

The refractive power of the diamond is very great. When a ray of light enters a diamond, it is turned from its path to a greater degree than by other transparent mediums, and its magnifying power is much greater than that of glass. It also possesses in an extraordinary degree the power to reflect and disperse the rays of light, producing thereby that play of colors which comes from breaking up the ray of white light into prismatic tints. This is one of its most admirable features, and is evidence of good quality and skilful cutting.

Diamonds are found as crystals more or less perfect, belonging to the group known as the cubic or isometric system. The regular octahedron and the rhombic dodecahedron (see

Figs. 1 and 2, Plate I.) are the most common forms, though not unfrequently it takes the form of a six-faced octahedron (Fig. 3, Plate I.); and as the faces of all the crystals are often more or less curved, or convex, these latter are almost spherical. Some are "twinned" or "macled." (Fig. 7, Plate I.) Occasionally one distinct crystal is enclosed within another.

Although the surface is generally smooth, they are sometimes indented; some have a rough surface, and others have a thin gray coating like a skin.

Two forms not considered here are carbonado, a brownish-black variety very indistinctly crystalline, and bort, an imperfectly crystallized form which is used for mechanical purposes. Neither of these varieties can be used as jewels, one being without brilliancy, and the other non-transparent.

The diamond has a perfect cleavage, parallel to the faces of the octahedron. This natural structure enables the diamond-cutter to save much material which would otherwise go to waste, and time also. It is not necessary to split all stones preparatory to cutting. Some are cut from the stone as found. Beyond the small pieces resulting from cleavages, other fragments are saved which cannot be cut to jewels. Some of these are called "splints," and are used for mechanical purposes or ground to powder. Still smaller pieces can be used only for grinding.

Neither acids nor alkalies act upon the diamond. It is infusible, but combustible,—the only gem that is, in fact,—yielding to fire at a very high degree of temperature, and disappearing entirely.

It is a non-conductor of electricity, but acquires positive electricity when rubbed, and retains it for some little time. Unlike other gems, it is electric in the rough also. Some become phosphorescent by exposure to the sun's rays, or to the blue rays of the spectrum alone when concentrated upon it; others do not, though it has been claimed such stones may be made susceptible by previously immersing them for some time in melted borax.

Mr. Edwin W. Streeter exposed a fine orange-colored diamond to the prolonged action of a powerful lime-light, and then removed it to a dark room, when the phosphorescence was sufficient to light up the apartment. He also says, in his "Precious Stones and Gems," "All diamonds do not phosphoresce after exposure to light, but diamonds of yellow color seem peculiarly susceptible to luminous influence."

M. Chaumet reports that violet light develops fluorescence in diamonds in proportion to their fineness—more as they are finer.

The diamond is transparent to the X-rays, whereas the glass used in the manufacture of imitation diamonds is always opaque to them.

Frequently there are minute air-bubbles, cavities, and flaws in diamonds, which contain vapor or gas held there under great pressure. Stones have been known to explode, after being released from the matrix and brought to the surface from the mine, probably from the expansion of the imprisoned gas produced by the warming of the stone.

The diamond, when ideally pure, is colorless. But a small proportion, however, are of this character. A large percentage of the so-called white stones have a tint of yellow, green, or brown. A few are of a bluish tint, and these are highly esteemed. Besides these, the diamond is found at times in almost every color. Red, sapphire-blue, and emerald-green are very rare and are highly valued. Orange-color, violet, canary, and rich browns also bring a good price and are growing in favor.

As "off-colored" stones do not bring as much in the market as those which are colorless, many attempts to eliminate the color by the use of acids and heat have been made, but, so far as known, without success. Unprincipled dealers have also resorted to various devices for neutralizing the natural yellow of off-color stones. The usual method is to paint the under side, around the culet, with violet ink or an aniline dye. This is then carefully rubbed down until the dye cannot be distinguished, but leaving enough of the coloring matter to very much improve the apparent color of the stone when faced up. The effect, of course, is only temporary, and can easily be detected by cleaning the stone with alcohol. Many of these painted stones have undoubtedly been sold by irregular dealers, who by this means induce the unwary to buy stones at what appears to be much less than market value.

The cutting of diamonds is treated at length in another chapter devoted to that subject.

As diamonds differ in hardness, so also do they vary in their power of refraction and dispersion. In these qualities the Indian excel all others, and the Brazilian come next, though the river stones of South Africa resemble them very closely, and in some cases equal them.

In this connection it may be of value to note that although any one can, with the aid of a glass, discover the most minute flaws, and many have an educated eye for color and have learned to appreciate the value of good cutting, but few recognize the differences which exist among diamonds in native "quality." This term is used by the writer to designate that combination of qualities which give to some diamonds an extraordinary fire and brilliancy. It arises from the superior powers of reflection and dispersion possessed by some to an eminent degree, and which, as has been stated, characterize the diamonds of India, Brazil, and the river stones of the Cape. Not many realize that there is a grading of "quality" quite distinct from, and independent of, color and cut. Some off-color stones have a finer "quality" than whiter goods, and some crystals cannot be cut to the brilliancy and beauty of others which are similar, because they lack quality.

Some Cape and Bahia diamonds do not show as good color play by artificial light as by daylight, though generally it is the reverse.

Usually, artificial light destroys the yellow color in a stone, and electric light intensifies it. Canaries lose their distinctive color by artificial light; they should be shown in a strong natural light, as they do not appear to advantage in a dull or even in a waning light.

Blue in a stone is sometimes intensified by sunlight. In other cases the arc electric light will give to some diamonds a deep violet hue.

Cape stones run to yellow, but the tendency of the Brazilian is towards green.

Although in ancient times some diamonds, as well as emeralds and other gems, may have been found in Africa, the oldest known diamond-fields which have been continuously worked are the Indian. In common with all other diamond-mines except those of South Africa, the Indian diamonds are found scattered among the sands and gravels, long since released by the processes of time from their matrix, carried by waters and deposited in the beds and along the course of streams and rivers in the superficial strata of the earth in the valleys. They are found, as a rule, at a depth varying from two or three feet to fifteen or twenty feet, occasionally fifty feet. In the South they occur on the banks of the Panar and between that river and the Kistnah. At the western end of this diamond-bearing territory is the celebrated Wajrah Karrur district. To the east, towards the mouth of the Kistnah, and on its southern banks, are the Kollur mines, called by Tavernier "Gani Coulour," sometimes spoken of as "Gani" only. Still farther east, and on the northern side of the Kistnah, are the Partial mines. This district lies almost due east of Golconda, a name often used to distinguish the diamonds of this region, and sometimes as a designation of all Indian diamonds.

Along the Godavery, from near the mouth to the central provinces of India, are other groups.

Northeast, from the Mahanady north almost to Benares on the Ganges, are the most ancient workings in India.

The Panna group lies southwest of Allahabad and the Ganges, along the banks of two of the tributaries of that river.

The mining in India is mostly in the hands of natives, and, compared with the certain results afforded by mining in Africa, very speculative and unremunerative.

The story of the finding of diamonds in Brazil is, that the natives engaged in washing the river sands for gold found, occasionally, small, hard stones of an odd shape, which they used as counters in playing cards, or threw away when they had no present use for them. An inhabitant of Serra do Frio, in the Minas Geraes gold district, accidentally discovered that they were diamonds. This was in 1727. He had seen rough diamonds in India, and, noticing their similarity, took some to Portugal for sale.

European merchants, fearing that the discovery would lessen the price of diamonds, endeavored to discredit them, and spread the report that these Brazilian stones were Indian refuse sold by way of Brazil. The Portuguese very shrewdly took advantage of this statement by sending the Brazilian stones to Goa, and thence to Bengal, where they were sold as Indian stones at Indian prices.

The Portuguese government districted the country about Serra do Frio, and placed it and the search for diamonds under sharp military supervision.

The province of Minas Geraes, where diamonds were originally found in Brazil, is situated due north of Rio de Janeiro. Diamantina (formerly Tejuco), the former centre, is situated on the crest of the mountain-range, on either side of which, upon the plateaus, in the valleys, and about the rivers and streams, the diamonds are found. It is rough, wild, mountain land, averaging about four thousand feet above sea level. Diamonds found here are contained in a clayey substance traversing the rocks in veins. Twelve miles west of Diamantina, at São João da Chapada, they are also found in clay, or "barro." In the valley of the river Tibagy, in Southern Brazil, the stones are found in pot-holes in the sand of the river and also in old beds of gravel situated at some distance above the level of the river.

On the Corrego dos Bois, near Grao Mogul, they are found in a conglomerate rock called by the miners "pigeons' eggs." This is about one hundred miles north of Diamantina.

Included in the Minas Geraes district is that of Bogagem, to the west, separated from Diamantina by the Rio das Velhas and its tributaries. It was here the "Star of the South" was found in 1853.

Northeast from Grao Mogul there are diamond-fields between the rivers Pardo and Belmonte, and inland, a little west of north of these, are the fields of Bahia. The yield of these new fields is greater than that of those in Minas Geraes, but the quality is inferior. The proportion of off-colored stones is greater and the average size smaller. Carbonado is found in this district.

During the dry season, from April to October, when the Paraguay River is low, the water is drawn off into a canal, and the mud, to a depth of six feet and over, is carried to a dry place to be washed for gold and diamonds during the wet season.

Large stones are seldom found in Brazil.

According to law now all diamond- and carbon-bearing lands belong to the State, but persons of any nation can take out a claim by complying with the regulations. An application with general description in writing of portion desired must be filed at the office of the director of diamond-mines. The claim must not be more than five hundred and seventy-three thousand eight hundred and sixty-four square yards nor less than thirty-four thousand seven hundred and thirty-two square yards. If the portion has never been leased, notice of the sale of the parcel selected is published, and thirty days after is sold at auction to the highest bidder. Only ten days' notice is required if the claim has been leased previously. A claim can be leased from one to ten years and renewed *ad libitum* on payment in advance of fifty per cent. of the auction price for subsequent periods of renewal. Usually there is no competition.

To work without a lease, a license is issued which grants the privilege for one year. It costs one dollar and fifty cents, including stamps. In addition, each village imposes a miners' tax of ten milreis (two dollars and forty cents).

Mining without lease or license subjects tools and stones to confiscation.

Besides the leases, concessions have been granted, all to Brazilians, except one to a French company at Cannavieriras. Most concessioners allow miners to mine from one-fifth to one-fourth the value of the stuff found.

In olden times there were many laws governing the search for diamonds. Dishonesty was severely punished. The finders of large stones were rewarded. Nevertheless, it was estimated that about one-third of the entire find was disposed of surreptitiously.

The entire Brazilian yield up to 1850 is estimated at something over ten million carats. Since then it has fallen off, the introduction of African diamonds having rendered the search for them in Brazil unremunerative. The rise in the price of diamonds during the past three years has, however, given an impetus to the industry, and Brazilian stones are again finding their way in larger quantities into the world's markets.

Borneo has produced more fancy colored diamonds than other countries, and a smaller proportion of "off-colored" stones. Nevertheless, the average quality is not good, and they run flawy.

The mines have never been scientifically worked, and with the advent of African diamonds the industry has been much neglected. The crystals are found in the river sands, or in beds of clay, sand, and gravel, sometimes at a considerable depth. They are usually in the form of octahedrons or dodecahedrons. Twinned crystals are common also.

Landak, in Western Borneo, is most famous, though many are found in Kusan on the eastern side of the island, and near Martapura in the gold-bearing district of Tanahlant in the southwest. They are found also in the Sikajam and Meran Rivers. Some very rare colors have been found in the Sarawak River.

The crystals are generally small; ninety-five per cent. are under one carat, and the few large stones found come into the possession of the rulers. The Prince of Landak has several large diamonds, and the Rajah of Mattam has a very fine one, the "Segima," weighing seventy carats, and another of fifty-four carats. When the crystal is found in the form of an octahedron, the natives call it a "perfect stone," and polish the faces simply.

It is not possible to know what the production of Borneo has been, as the princes of the country assert the right to all stones they may desire over five carats found in their several provinces, at a fixed price. The consequence is that either they obtain all the important pieces, or they are sold at home as contraband.

Diamonds were found in New South Wales as far back as 1851, but not until July, 1869, were the diggings systematically worked. Operations were then commenced by the Australian Diamond Mines Company of Melbourne. A London company was formed in 1897, "The Inverell Diamond Fields, Limited," for the purpose of mining diamonds in Australia.

Two fields are worked west and northwest of Sydney, one on the Lachlan River and the other along the banks of the Macquarie and its tributaries. Diamonds are also found about Bingara on the Gwydir River and near the coast to the east. Also on the coast to the north, and south of Brisbane. Also near the coast south of Sydney. A few have been found in Victoria, and West and Northwestern Australia. They usually occur in the neighborhood of the gold-fields and tin-drifts, although the yield has been less in Victoria, the "Golden Colony," than in New South Wales.

The crystals are small, very hard, and cut to exceptionally brilliant stones. They are found in old river-gravels.

Occasionally diamonds are found while washing gold in the placer diggings of British Guiana. Prospecting parties went from Georgetown up the Magaruni River in 1891, and obtained a few crystals, but no further organized effort to find more was made in that country until lately clearings were made along the Mazarine River. During the six months after the work was commenced eight thousand two hundred and twenty-seven small diamonds, weighing seven hundred and sixty-seven carats, were found. They were valued at two thousand pounds.

July 5, 1829, the first European diamond was found in the district of the Hütte Bissersk, in the Urals, Russia. But few, probably one hundred and fifty to one hundred and sixty, have since been found, the largest of which did not weigh quite three carats.

A few diamonds have been found in the United States,—in Georgia, North Carolina, South Carolina, Southern Virginia, California, Oregon, Idaho, Montana, and, it is claimed, also in Kentucky and Indiana. Except the "Dewey" or "Morrisey" diamond, which weighed in the rough twenty-three and three-fourths carats, and eleven and eleven-sixteenths after cutting, they are all small and of little value. There have been no discoveries to warrant a systematic search for more. The "Dewey" was found at Manchester, Virginia, in 1855, by a laborer at work on one of the streets.

Diamonds were discovered in Africa in 1867. Later developments showed that they had long been seen and handled by many without being recognized. Children had played with them, and they were in the mud plaster of farm-house walls. The discovery came about in this way. The son of a Boer woman, Mrs. Jacobs, often amused himself by gathering and playing with the curious and pretty stones on and in the neighborhood of his mother's farm near Hopetown, on the Orange River. One of these with which her son was playing attracted Mrs. Jacob's eye, and some days later, in talking with a neighbor, Schalk van Niekirk, she spoke of it. He was interested, and asked to see it. Although cast aside, the boy succeeded in finding it, and Van Niekirk offered to buy it. Mrs. Jacobs, laughing at the idea of taking money for a stone, gave it to him. He showed it later to a friend named O'Reilly, who, on going to Grahamstown, submitted it to Dr. Guibon Atherstone. He pronounced it a diamond. The crystal weighed twenty-one and three-sixteenths carats, was exhibited at the Paris Exposition, and afterwards sold to Sir Philip Woodhouse, governor of Cape Colony, for £500.

The fact that a diamond had been found becoming noised abroad, search began along the Orange River, and also on the Vaal. By 1869 about one thousand persons were seeking diamonds.

In December, 1870, diamonds were found south of Barkly West, on the Vaal, towards the Modder River, on the Vooruitzigt farm. The children had a lot of small stones gathered without knowing what they were. Farmer Van Wyk, living on the Du Toits Pan farm, found a number of them in the walls of his house, which he had plastered with mud from a neighboring pond. This led to the discovery of the Du Toits Pan, the first of the four celebrated mines. Thousands followed the find, and the rush made the Boer farmers glad to sell the land to rid themselves of the trouble it caused them. This they did to an English company, for one hundred and twenty-five thousand marks. The Bultfontein was then discovered south and a little west of the Du Toits Pan. Then the "Old De Beers," on the Vooruitzigt farm, owned by a Boer named De Beers; and on July 21, 1871, the Old De Beers "new rush" on Colesburgh Kopje was discovered. This, known later as the Kimberley, proved to be the richest of all. These four mines produce about ninety per cent. of all the diamonds found in South Africa. The Wesselton mine was discovered on the Benaudfontein farm, in the Kimberley district, in 1891. It was owned by Mr. J. J. Wessels, Sr., and named after him.

The town of Kimberley, lying between the Kimberley and the De Beers mines, now has a population of thirty thousand. Beaconsfield, a town two miles southwest, has ten to twelve thousand inhabitants.

Soon after the Kimberley was opened up, the Jagersfontein, near Fauresmith, and the Koffyfontein, on the Riet River, between Jacobsdal and Fauresmith, in the Orange Free State, were discovered. The Jagersfontein is about eighty miles to the south and a little east of Kimberley. These two mines produce, when worked, about six to seven per cent. of the total African output, and have been lately acquired by the syndicate.

When the mines of the Kimberley district were discovered, a question arose as to the domain. The Orange Free State claimed that the land was in its territory, and England maintained that it was part of Griqualand West, over which she held some sort of protectorate. Finally, England annexed the fields and paid the Orange Free State £90,000 in settlement of its claims.

At first, the people sought for the diamonds in and along the edges of the river; then they found that the sand lying away from the banks was equally rich, and this led them finally to the kopjes and dry diggings, resulting in the discovery of the immense chimneys of diamond-bearing clay which have yielded such enormous quantities of the precious material.

The tops of these chimneys were filled with a yellow clay called "yellow ground" to a depth of fifty to sixty feet. Beneath this lay a quantity of "rusty ground" sixteen to twenty feet thick, which, as it became distinct from the "yellow ground," yielded no diamonds, and it was feared that the end of the diamond-bearing clay had been reached. However, on going through this, another clay of a greenish-blue color, fully as rich, if not richer, than the yellow ground, was discovered, and this has been continuously worked since. This is called the "blue stuff."

In the Du Toits Pan the clay is in the form of a horseshoe about two thousand two hundred and forty-seven feet long by six hundred and seven feet broad; in the Bultfontein it is circular and has a diameter of one thousand and eighty feet. The De Beers is elliptical, nine hundred and fifty-eight feet east and west by six hundred and thirty feet north and south, and the Kimberley is an oval eight hundred and eighty-six feet long by six hundred and fifty-six feet broad, with an eastern spur extending one hundred and eleven feet farther. The Kimberley narrows as it goes down.

These chimneys of diamond-bearing clay appear to have been forced upward through intervening strata from nature's retort deep in the earth. Some of the crystals bear evidence of having been shattered in the grinding process of volcanic upheaval. Splinters and microscopic crystals are abundant in the "blue earth." The upper portion of each of these pipes consisted of the sandy soil peculiar to the country, under which was a light deposit of tufaceous rock, to which occasional diamond crystals were found adhering. Lower down, volcanic rock, often broken up and oxidized. This, from its color, was known as "yellow earth," or "yellow ground," as heretofore described. The crystals are distributed very irregularly, though the form of them varies so distinctly with the different claims, that men acquainted with the mines can generally tell, by the appearance of the crystal, from which mine it was taken.

The opinion of Sir William Crookes as to the origin of the mines appears, from all the known facts, to be reasonable. He assumes that deep-seated masses of molten iron, holding carbon in solution, were confined at a very high temperature under enormous pressure. By these forces, and a process of cooling continued during ages, the carbon was crystallized and finally, by volcanic energy, forced through intervening strata to the surface of the earth.

In the early days these mines were worked as open quarries. Now shafts are sunk near the pipes, tunnels and galleries are driven in the diamond-bearing clay, and the material is run in trucks to the shaft and hoisted to the surface. It is then lifted to a high platform and allowed to fall to the ground. By this means the earth is broken until it is the size of nut coal when it is searched for the larger diamonds. Later, the stuff is passed over a separator, which is a machine of six plates. These plates are covered with fat, to which the diamonds adhere. Mr. Edwin W. Streeter says of this, "We have, on the authority of Mr. E. D. Rudd, who has just returned from South Africa, the remarkable statement that ninety per cent. of the diamonds contained in the blue earth are found on the first plate, and he has never known of one being found below the second plate."

The yield averages about three-fourths carat to the load of sixteen hundred pounds of clay.

The relative value of the rough from the various mines, according to the prices paid for it during a period of years, and taking the price of Rivers at 100 as a standard, is as follows:

River	100.00
Jagersfontein	69.25
Du Toits Pan	43.00
Wesselton	38.46
Kimberley and De Beers	33.85
Bultfontein	28.05

Dr. Max Bauer gives the assortment of rough as follows:

Crystals or glassies: octahedron, white or nearly white.

Round stones: crystals with arched facets; cape white firsts, seconds, and by-water.

Yellow stones: light yellow, yellow, and dark yellow.

Melee: round or glassies, white to by-water and brown.

Cleavage: spotted and twinned crystals that must be cleaved.

Black cleavage: very imperfect; speculative stones.

Mr. Edwin W. Streeter's classification is as below:

White clear crystals.
Bright black cleavage.
Cape white.
Light by-water.
Large white cleavage.
Picked melee.
Common and ordinary melee.
Bultfontein melee.
Large white chips.
Small white chips.
Bright brown.
Deep brown.
Bort.
Yellow.
Large yellows and large by-waters.
Fine quality river stones.
Jagersfontein stones.
Splints.
Emden.
Fine fancy stones.
Mackel or macle (flat for roses).

The African mines are now practically all under the control of the company known as the "De Beers Consolidated Mines, Limited," of which the Hon. Cecil Rhodes was chairman. The capital was £3,950,000 (since increased).

Of the diamonds found in the Cape, according to Streeter, about twenty per cent. are of the first quality, fifteen per cent. of the second, and twenty per cent. of the third. The remainder is "bort." Kunz grades the output differently, and accords more with the American idea of quality, probably. He gives it as: First quality, eight per cent.; second quality, twenty-five per cent.; third quality, twenty per cent.; and the balance "bort."

Great precautions are taken to prevent theft and illicit trading in diamonds in Africa. The native kaffirs or "boys" employed in the Kimberley mines are kept in a "compound" and closely watched. A law is in force—the "Diamond Trade Act," or the "I. D. B. Act," as it is commonly called—to prevent illicit buying. Notwithstanding the severe punishment accorded by the Special Court to offenders, a considerable quantity of diamonds are smuggled out.

The Jagersfontein and the Koffyfontein mines in the Orange Free State produce a finer grade of diamonds than either of the others; small quantities only are found in the Koffyfontein.

The diamonds found in the Leicester mine are hard, white, and cross-grained, and have a peculiar frosted appearance.

Fine white or bluish-white stones are seldom found larger than ten carats, and will not exceed two per cent. of the total output.

The Kimberley stones are usually of poor quality or fragmentary, and if of good color, are generally specked. Ninety per cent. of the African bort comes from this mine.

All sorts and colors are found in the De Beers. They do not average as good in color as the Kimberleys, but run larger.

The average of the Bultfontein is the poorest of the four Kimberley mines. The crystals run small and imperfect.

Du Toits Pan crystals are well formed, and the yellow octahedrons are often large. The stones from this mine average better than the others in the Kimberley district, though the yield in weight is less than that of the Kimberley and De Beers. Streeter gives the yield per load of sixteen hundred pounds of clay as follows: Kimberley, one and one-fourth to one and one-half carats; De Beers, one and one-fifth to one and one-third carats; Du Toits Pan, one-sixth to one-fifth carat; Bultfontein, one-fifth to one-third carat.

Diamonds from the river diggings, Jagersfontein and Du Toits Pan are said to be harder than those from the Kimberley, De Beers, and Bultfontein.

In olden times the price of diamonds and other precious stones, compared with the value of money, was high. Comparatively few were found, and though the number of those able to buy and own them was much smaller than now, they were of a class who gratified desire without regard to price, and set great store on gems as evidences of power and affluence. The rulers of Oriental lands valued the jewels found in their countries so highly, that fine gems cost more in Colombo than in London. This condition prevails to-day, but it arises to some extent from the fact that the rough and native cut stones are regularly collected by Western buyers and shipped to London, whereas the stock in the hands of natives is uncertain and variable. Prices depend on the conditions of the moment, and are influenced by the rank and wealth of the buyers.

Years ago the payment of interest on the Brazilian state debt in diamonds by Dom Pedro so glutted the market in London that the price fell nearly one-half. In 1838 the price rose, but the French Revolution in 1848 broke it again. From that year until the discovery of diamonds in Africa the price rose steadily. The immense amount of new money thrown upon the world by the Civil War in America resulted in a further rise of about twenty-five per cent. The Franco-German War sent it up another ten per cent., and the effect of all this newly acquired money in the world produced a further rise, during the two years succeeding, of probably fifteen to twenty per cent. more. The panic of 1873 in America, and a growing knowledge of the tremendous quantities being found in Africa, then began to influence the market, and prices again fell steadily until after the formation of the London syndicate controlling the African market. This company has probably engineered its enormous interests with a shrewdness and understanding of the world's conditions seldom equalled. For several years it held the market steady by a firm maintenance of the price of rough, stiffening it gradually by a closer assortment. Then as the effect of the enormous gold output of the world began to give impetus to trade, it kept in touch with it by rapid advances of five and ten per cent. until it became evident that the market would bear no more. In this way without checking the sale of diamonds, the syndicate has in three years advanced the price fully fifty per cent.

This syndicate, which is intimately associated with the "De Beers Consolidated Mines, Limited," takes the output of the diamond-mines for periods, according to contract, at a stipulated price, and markets it.

The variations of quality, color, and cut are so many, and the relative value of the sizes changes so frequently to accord with the demands of the market, that an exact table of prices is impossible. In a general way the prices of cut goods in this market to-day may be stated roughly as follows: Melees, from brown imperfect to very small white, range from thirty to one hundred and twenty dollars per carat. Two-grainers, from brown to Jagers, thirty-five to one hundred and thirty dollars per carat. Three-grainers, brown to Jagers, fifty to one hundred and sixty dollars per carat. Four-grainers, brown to Jagers, sixty to two hundred dollars per carat. Five- to eight-grainers, unless specially fine, are bringing little more than four-grainers at the present. Fine blue Jagers and fancy colors are rapidly advancing.

X

RUBY AND SAPPHIRE

THESE stones theoretically are composed of pure alumina, or aluminum, 53.2, and oxygen, 46.8. This oxide of aluminum, or alumina, is known in its natural state as corundum, a name derived from the Hindoo word "kurand," and the two stones ruby and sapphire are frequently spoken of as the "corundums." It is called ruby when it is red, and sapphire in any other color.

Comparatively little is found in the perfectly crystallized transparent condition necessary for gem purposes. Quantities of this mineral are unfit for jewels. This common corundum lacks transparency and color. The colorless transparent, called white sapphire, is the purest. The colored transparent varieties contain between one and two per cent. each of silica and oxide of iron, and it is supposed that the fine color of the Burmah rubies is due to the presence of a very small quantity of oxide of chromium. The common corundum contains a much greater proportion of impurities with the alumina. On account of its hardness it is useful for mechanical purposes. The best of it is used for bearings in fine machinery. Jewels for watches have long been made from it, and it is now used also in the manufacture of electrical supplies.

Various names are given to the mineral according to the color. The blood-red is invariably called ruby; blue to colorless is always known as sapphire; and all the other colors are usually termed fancy sapphires, but separate names are often attached to them, as follows: Violet, Oriental amethyst; green, Oriental emerald; yellow, Oriental topaz; yellowish red, Oriental hyacinth; light bluish green, Oriental aquamarine.

Although the crystallization of the different corundums is the same,—hexagonal,—the red variety, or ruby, when not found as a rolled piece, usually is in the form of a prism, whereas the blue or sapphire occurs as a double pyramid. The blue is also a little harder and heavier than the red.

The ruby was known to the ancients under various names, and was undoubtedly confused with others widely different. Before mineralogy became a science, and chemistry could determine the character of minerals by their composition, stones were named very generally according to their color. "Carbunculus," a "fiery red stone," included spinels and garnets with the harder and more finely colored ruby. Only by the gradual acquisition of knowledge, extending over many years, were the various stones, as we know them, separated as their different qualities became known. Some kinds of carbunculus were esteemed more highly than others, especially one termed lynchnis, because it had a lustre like that of a lamp. The Greeks wrote of a red stone called anthrax, which was probably the mineral we know as the ruby. It is doubtful, however, if any of the ancients recognized the intrinsic superiority of the ruby. To them the brightest and reddest stone was the best. In Tavernier's time all colored stones were called rubies in Pegu, and were distinguished by a prefix of color. There, a sapphire was known as a "blue ruby." Some think that the "adamas" of early Greek writers was a corundum and not a diamond. The probability is that the name was applied to both when they presented a similar appearance. A lustrous stone, if colorless or nearly so, would be "adamas," whether diamond or white sapphire, and a fiery red stone was termed carbunculus, lychnis, or anthrax, though in either case it may have been ruby, spinel, or garnet.

The corundums crystallize in the hexagonal system, the ruby generally taking the form of a hexagonal prism or six-sided crystal; the sapphire that of a double six-sided pyramid; but the system of crystallization is rarely discernible in the rough as it is found. The crystals are usually rough, worn, irregular, or fractured pieces free of matrix. They are found in a brownish-yellow clay called "byon," widely distributed over the valleys among the hills, or under the lower slopes of the mountains, where they were doubtless carried by torrents from the disintegrated matrix.

The ruby matrix is a species of limestone associated with basic rock, and is supposed to have been produced by the alteration of lime-bearing feldspars from which carbonate of lime was eventually formed, while the aluminum silicates by decomposition produced alumina. This later, under heat and pressure, crystallized as corundum and became ruby or sapphire according to the conditions during crystallization.

The color of rubies is supposed to be due to the presence of a small quantity of oxide of chromium, though experiments made in the efforts to produce them artificially show that, although oxide of chromium usually gives the crystal a red color, under some conditions it produces blue, and under others both red and blue, in the same crystal.

Although more even than that of the sapphire, the color of the ruby is rarely distributed quite evenly through the stone. Thin white streaks often lie within the body of the red; sometimes these disappear by the application of heat. It can be subjected to a high temperature if the heat is applied gradually. In cooling it becomes first white, then greenish, and finally red again. Heat does not destroy or permanently change the color.

It has been found by experiments of M. Chaumet that Burmah rubies are extremely sensitive to violet light, which excites on them intense fluorescence, whereas it produces but feeble fluorescence on Siam rubies.

The best color of a ruby is developed by cutting the table of the stone parallel to the end facets of the crystal, and the weakest by cutting it parallel to the prism facets.

One of the most valuable characteristics of the ruby is that the color is equally beautiful by day or artificial light.

As flawless, transparent, pigeon-blood red crystals of corundum are rare, and extremely so in large pieces, rubies of that character have always been very costly stones, and command a higher price than any other. They are much more valuable in large sizes than the finest grades of diamonds.

Many rubies contain clouded strata in the crystal, which, when the stone is cut *en cabochon,* exhibit under strong light six divergent rays. As this peculiarity occurs in a more marked degree in the sapphire, these star stones, as they are called, will be described more fully with the sapphire.

Rubies are found in Burmah, Siam, Ceylon, Afghanistan, Thibet, Australia, and North Carolina, United States. The finest are those of Burmah.

The ruby-mines of Upper Burmah have been worked since the fifteenth century. They border on the eastern bank of the Irrawaddy. The mines under English control are situated in a section known as the Stone-tract. It is a mountainous district of about four hundred square miles, thirty miles east of the Irrawaddy, beyond a low-lying jungle country. Mogok, one hundred miles north of Mandalay and sixty from the Irrawaddy, is the trade centre, and the district includes the townships of Kathe and Kyat-pyin. Formerly the ruby-mines were worked under the permission of the Burman government, which required the product to be brought first to Mandalay for inspection and that tribute might be laid on it. Under Oriental rulership the result may be imagined. Few large stones left the country except they were smuggled out. Although the diggers were closely watched and dishonesty was severely punished, it is estimated that a third of the findings were smuggled into India without having paid the tax. Since the English took possession this is changed, and the tribute paid in rents to the East Indian government is much less than was formerly paid to the native government.

The mines are worked by the "Burmah Ruby Mines Limited" Company, under a lease from the British government signed February 22, 1889, to whom the company has paid, according to Mr. E. W. Streeter, a rental which in 1897-98 amounted to £20,815. The company also permits the natives to dig under royalty, and has established very satisfactory relations with them. The year ending February, 1900, was remunerative, the company paying a dividend of twelve and one-half per cent. The succeeding year, ending February 23, 1901, showed still better results. Seventeen and one-half per cent. was paid, and £10,123 17*s*. carried over. Nine hundred and forty-seven thousand four hundred and forty-four loads of byon were mined, at a cost of 10.29*d*. per load.

The ruby-bearing clay, or byon, is about three to five feet thick, and is usually found at from fifteen to twenty feet from the surface. In the valley bottoms this clay is brought by very primitive methods to the surface during dry weather to be worked when convenient.

In the wet season the hill-sides are worked. The stratum of clay is thicker than in the valley bottoms,—thick enough to be tunnelled. This is extracted and washed as it is mined. Many kinds of minerals are found with the rubies, including sapphires, spinels, tourmalines, and others of less value.

Although many rubies are found, few are of good color, and the majority do not weigh over one-eighth carat. Larger stones are generally full of flaws.

Limestone caves abound among the hills. The byon on the floors of these caves is more sandy, and, though the rubies are not as plentiful, they are usually of a better quality.

Rubies are also mined near Mogoung, in the north of Burmah, and at Sagyin, fifteen miles north of Mandalay.

The principal ruby-mines of Siam are in the provinces of Krat and Chantaboon. Occasionally a few are found in the sapphire-mines of Battambong, southeast of Bangkok. As in Burmah, the stones are found in detrital matter seldom over twenty feet from the surface. The ruby-bearing gravel, less than a foot thick, lies between a coarse sand which forms the surface of the country and the clay bed on which it rests. The mines are worked by an English company which obtained a concession. The search for them formerly was very irregular, owing to the claims and exactions of the rulers.

Rubies are found in similar deposits in the valleys and sands of rivers in the island of Ceylon, principally in the neighborhood of Ratnapura and Rakwena.

The Ameer of Afghanistan obtains rubies east of Kabul, and mines are worked at Gandamak.

Thibet yields some large specimens of ruby, but they are usually opaque and silky, cutting to star stones.

A few rubies have been found in Australia, but they are small and of little value.

Corundum is found in North Carolina, and occasionally a ruby crystal of fine color and quality is discovered. A gentleman connected with the American Gem Company reported having met with some of exceptional quality during a visit there in 1901.

The color of the Burmah rubies excels all others, though some of a like color are found in Siam. The rubies of Siam are usually dark, the red being of a blackish shade. Those of Ceylon are a light rose-color or pink. The red has a purplish tint, and as it degenerates is classed as pink sapphire.

Barklyite is a magenta-colored corundum found in Victoria, Australia. It is almost opaque.

Whatever has been said of the nature and genesis of the ruby applies also to the sapphire.

The sapphire is ordinarily blue of some shade to colorless. Usually it is not a good night stone, the color becoming inconspicuous or black by artificial light. Some sapphires appear reddish or purple and occasionally violet by artificial light. The latter are rare and valuable.

The color is supposed to be due to a small quantity of iron found in its composition, and is often very irregular.

White and yellowish-white streaks are mixed with the blue. A majority of colorless stones contain numerous blue spots. Some are in thick blotches, others scattered throughout. Only when the stone can be cut to show an even color is it of value as a jewel. Great heat is liable to destroy the color entirely. It does not leave the stone equal to one naturally colorless, but grayish. Sometimes one end of the crystal is blue and the other colorless; occasionally both ends are blue and the middle colorless. The dark sapphires of Siam often contain several shades of blue in the same crystal, a clean blue and a greenish blue, etc. Some are blue at one end, red at the other; others blue at the end and yellow in the middle. Max Bauer, in his "Edelstein Kunde," speaks of a figure of Confucius in the museum in Gotha cut from a sapphire, of which the head is white, the body blue, and the legs yellow. The dark-blue sapphires are most highly esteemed; the blue must be clean and free from the indigo or inky taint, which destroys alike the beauty and transparency of the color. The gem color is a deep shade of corn-flower blue.

Sapphires are found in Siam, Burmah, Cashmere, Ceylon, Australia, and the United States. The stones of each section differ in general characteristics. The sapphires of Siam are the finest. The color of the Burmahs is generally too dark, that of the Ceylon stones too light. Cashmere yields some of the finest, but they are generally too thin in color. The Australians are too dark and dense, and have little value. Montanas are light and uneven, and the color inclines almost invariably to indigo, though the writer has seen some which would compare favorably with the finest Orientals.

The sapphires of Siam are found principally in the province of Battambong, in a district (Pailin) about two by six miles, situated about fifty miles from Battambong. There are a number of villages in the district, of which Bo Din Nia and Bo Yaka are the most important. They are also found with rubies in the provinces of Chantaboon and Krat. The mines have been worked systematically only of late years. Those of Chantaboon are older than the Battambong mines. The crystals run larger than the rubies, and, unlike the latter, are finer in the carat and larger sizes than in the smaller.

Burmese sapphires are found associated with rubies. The crystals are generally larger, some weighing several hundred carats. The color is usually too dark.

The sapphires of Cashmere come principally from the Chinab valley of the Himalayas, near the line of perpetual snow. They are found loose in veins of disintegrated granite, together with tourmaline. They are also found by the Lacha Pass. As far as known, they were first discovered about 1880.

The color of the Cashmere sapphires is a very clean blue, but it is usually too light and often milky. Even in the finer stones thin white streaks frequently traverse the stone with the grain, giving an appearance of alternate shafts of light and blue shadows. When the stone is free from these common defects, and the color is deep, it is the finest of all sapphires.

In Ceylon the sapphires are found under much the same conditions as rubies. Much of the corundum is too poor for use as jewels, being coarse and impure. The transparent stones are usually pale, some being colorless. Many are particolored, others yellow. With them are found rolled pieces of spinel, chrysoberyl, zircon, tourmaline, and quartz. The best are found in the old river gravels.

Sapphires are found in many parts of Australia, but they are of more interest to the mineralogist than to the jeweller, as they cut too dense and black to be desirable as jewels. Occasionally a piece of fine color can be obtained from the edge of a crystal. A bronze-colored variety is notable for its high specific gravity, some being, according to Mr. Streeter, as high as 4.4. They are found in the tin-drifts and goldfields.

It was reported that a sapphire had been found in 1890 in Tasmania.

Corundum is found in Ontario, Canada, but it rarely approaches the quality of a gem.

Sapphires were discovered in Montana in 1865. They are found near the bed-rock in the old river gravels. They are unusually tough and hard, and occur in many delicate shades of blue, pink, green, etc., but rarely in the deep, clean blue of the fine Orientals. Late reports show very satisfactory results from the working of the mines, large quantities being sent to Europe, where they are cut to stones weighing from one-eighth to one-half carat. Much of it is returned after cutting to this country and used for mounting in moderate-priced gold jewelry. Although the color is usually weak, the stones are very brilliant and effective, especially when combined with pearls. The crystals differ somewhat from the Oriental, taking a form nearer to that of the hexagonal tabular ruby crystal. They are always more or less rolled. They are found near Helena and in several localities near Utica, Montana.

Star stones were known to the ancients as asterias. Other names were given them, as the "lightning-stone," the "king," etc. These crystals contain three sets of structural planes made up of fine striations, which intersect. When the crystal is cut *en cabochon,* with the summit at the central point of intersection, these lines produce under a strong light six rays, which spread at equal angles from the centre of the dome and form a six-pointed star. This optical phenomenon is not confined to the corundums, though it is rarely seen except in the sapphire and in a lesser degree in the ruby. They are designated "star sapphires" and "star rubies." Ordinary stones of this description sell at from two to five dollars per carat. Good, from five to twenty-five dollars per carat. A combination of fine color and chatoyancy is rare, and such stones bring high prices.

XI

EMERALD

The emerald is a green beryl. Color excepted, it is the same as aquamarine, golden, and other beryls. In common with the best of everything in nature, it is the rarest variety of the beryls, and a flawless emerald is more rare than any other precious stone.

Its beautiful color has been attributed by chemists and scientists to various causes. Some have thought it due to the presence of a small quantity of organic matter, but the preponderance of opinion is that the coloring-matter is an oxide of chromium.

Clear and very transparent aquamarine is abundant, but emerald is peculiarly subject to structural defects, flaws, muddiness, and variations of color, and the better the color the more faulty it usually is. A flawless emerald of fine color is almost unknown.

It is a silicate. Over two-thirds of its composition is silica, an oxide of silicon. The remainder is composed of nearly equal parts of alumina and glucina. It crystallizes in the hexagonal system, and takes the form of a six- or twelve-sided prism. It differs from the beryl in that the prisms are usually without striations.

It was known and esteemed by the ancients, though undoubtedly included by them with other green stones under the term "smaragdus." There is evidence, also, that green glass often passed among them for emerald.

At one time very rare in Europe, it became comparatively common after the discovery of Peru. The Spanish marauders robbed that country of great quantities of the precious mineral. One writer says that the ship on which he returned to Spain from America, in 1587, carried two chests, each of which contained one hundred weight of emeralds.

The temples of Peru held many beautiful stones, the natives believing, probably through the teaching of their priests, that they were peculiarly acceptable to the gods. These fell into the hands of the Spanish conquerors, who destroyed many by their ignorant tests.

Probably until the seventeenth century emeralds were mined in Africa somewhere on the borders of Egypt. Many evidences of ancient workings remain about Sikait.

The Aztecs cut them into fantastic forms, shaping them after the fashion of flowers, insects, fishes, etc.

The best emeralds of modern times have been taken from mines in the republic of Colombia. They are situated in a wild mountainous country among the passes of the Andes. Those of Mugo, on the banks of the Minero, about eighty miles north-northwest of Santa Fé de Bogota, were discovered in 1555 and worked by the Spaniards in 1558. These mines were worked under a government concession to a French syndicate for some years, but, owing to a disagreement over the rental, have been practically idle for some time. The emeralds are found in veins of white calcite and iron pyrites, embedded, or loose in cavities.

Emeralds, associated with chrysoberyl, phenacite, etc., are found on the right bank of the Tokowoia, east of Ekaterinburg, on the Asiatic side of the Ural Mountains. They were first discovered there by a charcoal-burner in 1830. Some large crystals have been taken from the mines there, but they are generally badly flawed and of a very pale color. The yield of late years has been small. They occur in a matrix of mica-schist.

Small emeralds are also found in a dark mica-schist in the Heubachthal of the Salzburg Alps, Austria. Some also, valueless as gems, are found near Snarum in Norway.

Some pale emeralds, associated with topaz, fluorspar, and quartz, were discovered in 1890 in New South Wales near the Queensland border. Mines were opened and worked for some time, but proved unremunerative.

Emeralds of good color exist in North Carolina. Much money has been expended on a mine where the crystals are fairly abundant, but, as none of them are transparent, work has been discontinued. The crystals have the appearance of being in process of alteration.

Aquamarine, like the emerald, is a beryl. The composition, crystallization, hardness, and specific gravity are the same. Unlike the emerald, however, the crystals run large and remarkably free from flaws. Cut pieces without noticeable imperfections, of ten to twenty carats and over, are not uncommon. It is almost colorless, the usual tint being green. Of late, considerable quantities have been mined in North Carolina having a bluish tint, and these are esteemed more than the green. Cutters find the crystal very deceptive in the matter of color. Specimens showing good color in the rough often appear almost colorless after cutting. This is most frequently the case with those found in Connecticut. The color of the aquamarine comes probably from the inclusion of a very small quantity of oxide of iron. It is a beautiful night stone, being very brilliant under artificial light.

Golden beryl is a yellow variety of the same stone. The crystals are not usually as large as the aquamarine, but it is also very free from imperfections. Some of a very beautiful rich color are found occasionally in North Carolina, but the supply is uncertain and irregular.

XII

CHRYSOBERYL

The chemical constitution of the chrysoberyl was long in doubt. Its composition was differently described by analysts, some of whom undoubtedly confounded it with varieties of the chrysolite. With the errors made, however, the presence of one constituent after another was demonstrated, until the various elements and their proportions became definitely known. It is composed of nearly eight-tenths alumina, a little less than two-tenths glucina, and a small proportion of ferrous oxide, which differs with the varieties.

In hardness it is inferior only to the corundums, but it seldom approaches the precious or many of the semi-precious stones in beauty of coloring. The common variety is usually pale yellow, greenish-yellow, or yellowish-green. In the latter shade it resembles the chrysolite, and is often so called. Sometimes it is golden yellow and golden brown, occasionally a columbine red or pale olive-green, similar to the ordinary day and night colors of the alexandrite variety. Heat does not change the color.

The lustre is vitreous, but somewhat oily, and some show an internal bluish opalescence.

It is found usually as rolled pieces in river gravels, with the diamond in Brazil, with tourmaline, sapphire, and spinel, in Ceylon, and among the pebbles of Burmah and Borneo. It is often associated with topaz and the corundums, and with emeralds in the Tokowoia mines east of the Urals. Well-formed crystals have been found with aquamarine and garnet in Connecticut granite. A few very beautiful specimens of the alexandrite variety from the latter State were reported some years ago by Mr. E. Passmore, of Boston. It also occurs with garnet, apatite, and tourmaline, in New York State, at Saratoga and elsewhere.

The variety known as alexandrite ranks among the "precious" stones. It is light to dark olive-green by day and purplish or reddish, rarely ruby-red, by artificial light. It was named after Alexander II., Czar of Russia, as it carries the Russian military colors, red and green, and was discovered on his birthday in his dominion in 1830 in the emerald-mine at Tokowoia. This variety is often nearly opaque, and when transparent is usually so flawy that it cannot be cut to gems. Ceylon furnishes most of the alexandrite marketed at present, as the material from that country is structurally more perfect and easier of manipulation by the cutter.

Mr. Edwin W. Streeter mentions in his book on precious stones that in the course of his experience he had seen several specimens which, cut *en cabochon,* showed a perfect cat's-eye line.

The cat's-eye is another variety of chrysoberyl. This singular stone contains fine striations caused by regular layers of infinitesimal cavities, which produce, when properly cut *en cabochon,* if the structural arrangement is perfect, a narrow and distinct line of light over the dome from one edge of the stone to the other. It is regarded by the natives of the East Indies, the Cingalese especially, with superstitious veneration, and they will seldom part with one that has come into their possession. It is rarely found outside of Ceylon, though occasional specimens are found in China.

The common color is gray, but it ranges through all shades of honey-brown to one that is almost black, and from the palest apple-green to a deep olive. The light-line, when the stone is held squarely before the eye, should cross the centre of the dome and be narrow and well defined. In the finest the edges of the ray appear more brilliant than the centre. The chatoyant line is usually white; rarely, bright yellow.

XIII

TOURMALINE

SINCE tourmaline was discovered in Maine and brought into notice by Dr. Augustus C. Hamlin, of Bangor, it has grown rapidly in favor. It was discovered in 1820 by Elijah L. Hamlin and Ezekiel Holmes, on Mount Mica, at Paris, Maine. Since then many very beautiful crystals have been found in that State.

Tourmaline is remarkable for the number and variety of the elements of which it is composed, and also for the variations in their proportions in different specimens. In his book on "Gems and Precious Stones of North America," Mr. George F. Kunz gives a table of the analysis of twenty-seven specimens, of which not only are no two alike in composition, but only a few contain the same proportion of any one of the thirteen constituents.

It is one of the most dichroic stones known, and in the crystal frequently appears of a different color as it is viewed from the end or side faces. It also produces a different colored gem as it is cut with or across the prism. Crystals have been found light blue at one end shading to deep blue and blue-black at the other; green outside and pink within; green and pink at opposite ends; brown and yellow, etc. The colors are seldom vivid, though some Siberians are a bright rich red, and many of those from Maine are a brilliant green.

It is found in Maine, Massachusetts, and New York States, Brazil, Burmah, Ceylon, Siberia, the Urals, and the Isle of Elba.

Brazil and Ceylon tourmalines are usually yellowish green, and are found in the river-beds. The Siberian are of various shades of red, running to violet-blue. In the Isle of Elba colorless specimens, with short black terminations and the reverse, occur.

The crystal is hemihedral, the two extremities terminating differently, and, in common with others showing that peculiarity, becomes electric by heating, exhibiting positive electricity at one end and negative at the other. Mr. Streeter mentions an interesting experiment by Professor Miers: If a mixture of red lead and flowers of sulphur be sprinkled through a sieve on a tourmaline which is slowly cooling after being heated, the powder separates, the red lead, positively electrified by friction through the sieve, is drawn to the negative end of the tourmaline, and the sulphur, negatively electrified, seeks the positive end.

XIV

OPAL

For variety and beauty of color the "precious" opal is without a peer. These colors do not come from any chemical constituent, but are produced by structural peculiarities which, in varying degrees, diffract the light rays entering it and give a prismatic play of colors. It is composed of silica with six to twelve per cent. water, and occurs in thin, irregular veins within a matrix. Although always a soft stone, its hardness is increased by exposure to the air. It is infusible before the blow-pipe, but heat drives off the water and renders it opaque.

The combinations of color are infinite. The most beautiful opals are called "harlequin." These are distinguished by small, angular patches of brilliant and variegated colors, which change their positions and character as the stone is moved. Others show large blotches of color which change as the stone is turned, but seldom show more than two colors at the same time, one being much more pronounced than the other. Usually the colors of the opal are broken up into small speckled lights, which play as it is moved. The rarest form is the cat's-eye opal, which exhibits a chatoyant line over the centre of the dome similar to the cat's-eye and usually of a bright-green color.

Formerly this stone was obtained almost exclusively from Hungary, the principal mines being in the Libanka Mountain, west of Dubnik, and not far from Czerwenitza. It is found there in the clefts and cavities of an old lava, generally brown in color, known as andesite. It is supposed that alkaline waters decomposed this rock and, setting free the silica, deposited it in a gelatinous condition, which afterwards solidified as opal.

Hungarian opal does not average as good as others, but occasional specimens are found superior to any. The body is usually opaque and milky, but if the lights are fine this condition intensifies them and renders them more striking by contrast.

The principal supply comes from Australia. It is found in Queensland in brown ironstone nodules, and in New South Wales in a matrix of kaolin. In another locality it is found in a matrix similar to the Hungarian.

Black opals are occasionally found in Australia, but they are rarely seen in this country.

Mexican and Honduras "fire" opals have little sale in the United States. They are more transparent than the precious opal, of brownish-red color, in which various indistinct colored lights float. The colors are less fiery, and they fade.

They are found at Esperanza, in the state of Queretaro, Mexico, in the department of Gracias in Honduras, and in Guatemala.

Agates and fossilized wood and bone are found opalized, and are called "agate opal," "wood opal," etc. The *Jewellers' Circular,* of New York, in a late issue reports the importation of a piece of opalized bone weighing eleven hundred and fifty carats, of rich color and fire.

XV

TURQUOISE

THIS mineral is known to scientists as "callaite." Although not transparent, its beautiful color, and the fact that it is considered peculiarly suited to blond complexions, make it a favorite jewel with many. The color, equally good by artificial light, is due to phosphate of copper, of which it contains, according to different analyses, two to eight per cent. It is found only in compact form in irregular veins within a matrix. It has no cleavage, and the fracture is conchoidal. Heat sweats the water out of the stone and crackles it.

The most celebrated mines are the Persian, and the turquoises taken from them are renowned for their beauty and credited with holding the color better than others, though the stones of different localities vary in this respect, some fading badly soon after being released from the matrix. The mines are situated in the northeastern part of Persia, in a district of the Nishâpûr province, and the turquoise is taken from a stratum of eruptive and altered rock at a height of nearly seven thousand feet. An old mine called the Abdurrezzâgî produces the finest. Many of the Persian turquoises lose color as they dry; others change to a greenish tint. This is the prevailing fault of turquoises, and though many are treated to preserve the color, and are guaranteed, they are liable, under certain conditions, to turn more or less green. And this is true of all turquoises, wherever they are mined. The mines are worked in a careless and irregular way by the natives. There is an abundance of good material, but the shafts and cuttings are so choked with débris and in such a dangerous condition that no European cares to make the outlay necessary to put them in proper working condition.

Centuries ago turquoise was mined by Egyptians in the Wady Maghara, in the desert of Sinai. They prized this Arabian turquoise, but specimens obtained from the red sandstone quarries of Arabia about fifty years ago proved very poor, fading soon after exposure to the light.

Turquoise was also mined in ancient times in the land of Midian, and in Mexico before the discovery of America.

It is found also in Victoria and New South Wales, but the most plentiful supply to-day comes from New Mexico, Arizona, Nevada, and California. The American product is rapidly growing in favor, large quantities being cut here and also shipped to Europe, where it finds ready sale among the cutters.

XVI

CHRYSOLITE

This stone is generally known as olivine and peridot. Mineralogists include all the varieties under the one species olivine, and dealers probably sell more green garnets than chrysolites under the name olivine.

The distinction between the varieties is practically one of color only. For many years lapidaries were in the habit of calling the chrysoberyl "Oriental chrysolite," and in consequence the two stones have been confused, though the chrysolite is much the softer stone and usually shows marked differences in color and lustre.

At present it is customary to call those which incline most to yellow "chrysolite;" the yellowish green, resembling a light tourmaline with a dash of yellow, is known by the name "peridot," given to it by the French jewellers; and "olivine" is the name associated with the brighter yellowish emerald-green variety, although originally the yellow to olive-green stones were known by that name.

It is an ancient stone and in olden times was highly prized, but it has fallen in public estimation because of its softness. It is not as hard as quartz.

Some very beautiful specimens of peridot have come into the market lately and it is growing in favor, especially in the larger pieces, as they are more free from flaws and defects than other green transparent stones. The deeper shades of green are considered best.

It takes a fine polish, especially if treated with sulphuric acid, but is easily scratched.

The green color is due to the iron oxide included in the composition and is deeper as the proportion of iron is greater. Almost colorless specimens contain much less iron and are lighter.

Few olivines are sold as such. The beautiful bright yellowish-green stones known here as olivines are generally demantoids, Russian green garnets of about the same hardness. These are rarely found large enough to cut to gems of over one-half to three-quarters of a carat.

Olivine is found in many countries and also in meteorites.

XVII

MATRIX

Opal and turquoise, where they occur in small and irregular veins, are often cut together with the matrix for jewels, and are then known in the trade as opal matrix and turquoise matrix. With the opal the matrix often takes as fine a polish as the gem it encloses, and the combination is pleasing. If the small bits of the precious stone are full of color and fire, as they frequently are, the effect is not unlike the flash of an imprisoned spirit from the dark cell in which nature confined it. The play of light and color is intensified by the opaque darkness of the matrix, with which it is intermingled, and is both beautiful and fascinating. As little good rough comes into the market, there has not been sufficient of late for the demand. Poor grades are to be had, but they are not satisfactory, only pieces containing strong lights of good color finding favor.

Turquoise matrix has also been used of late in large quantities. That with a dark-brown matrix is most favored, as the mottling of brown in the blue produces a much richer effect than the lighter or chalky matrix. The turquoise of some American mines occurs in a flinty matrix. Both the gem and the matrix of this character are unusually hard, and both, cut separately or together, take a high polish, but it is found that the flint often penetrates the turquoise and renders it, cut either way, liable to break after being polished.

Matrix is cut *en cabochon,* and is used principally for brooch, pendant, and chain settings.

Some emerald matrix from the North Carolina emerald-mine has been cut. It met with a ready sale at first, but the matrix proved to be friable, so that after cutting, parts of the beryl frequently fell out. This entailed so much loss on the cutters that they discontinued cutting it.

A few semitransparent rubies found in this country have also been cut in the matrix, but the finds have been so small and infrequent that it could not become a fashion.

XVIII

TRADE TERMS AND THEIR MEANING

BAHIAS	Brazil diamonds from the Bahia district.
BIZEL	The upper portion of a brilliant-cut diamond above the girdle.
BLUE GROUND	Diamond-bearing clay of the lower levels in African mines.
BORT	Imperfectly crystallized diamonds.
BRUTING	Polishing diamonds by rubbing one against another.
BUBBLES	Small hollow specks in the body of a stone.
BY-WATERS	Diamonds having a yellowish tint.
CAPES	Diamonds having a yellowish tinge.
CARBON SPOTS	Opaque black spots in the body of a diamond.
CHIPS	Cleavage under three-fourths carat.
CLATERSAL	Small diamond splints, from which diamond powder is produced by crushing.
CLEAN	As applied to precious stones, freedom from interior flaws.
CLEAVAGE	Diamond crystals which require cleaving; pieces cleaved from the crystal.
CLEAVING	Splitting a crystal along the grain.
CLOUDS	Flat, subtransparent blotches along the grain of a stone.
COLOR-PLAY	Prismatic colors produced by dispersion.
CORUNDUM	Crystallized alumina, as in rubies and sapphires.

CRYSTALS .... Colorless diamonds.
FALSE COLOR.......... A variable color in a diamond arising from strata of different tints.
FEATHERS .... White, subtransparent lines in the body of a stone.
FIRST WATER......... Limpid and colorless diamonds scarcely to be distinguished from water when immersed in it.
FISH-EYE .... A diamond cut too thin for proper brilliancy.
FLAT ENDS........... Thin cleavages from the faces of a diamond crystal.
FLATS .... Thin, flat pieces of diamond crystal.
GEM COLOR .... The most desirable color for a stone.
GLASSIES .... Octahedral diamond crystals (transparent).
GLASSY .... Applied to diamonds which lack brilliancy.
GOLCONDAS .... Indian diamonds.
GRAIN MARKS......... Lines on the facet surfaces, the result of imperfect polishing.
JAGERS .... Bluish-white diamonds of modern cut; originally, diamonds from the Jagersfontein mine.
KNIFE-EDGE .... The girdle of a brilliant cut to a sharp edge and polished.
LUMPY .... Stones cut thick.
MELANGE .... Diamonds of mixed sizes.
MELEE .... Small diamonds.
MUDDY .... Imperfect crystallization which obstructs the passage of light as mud stirred in water does.
NAATS .... Thin, flat crystals, much used for roses and splitting into thin, flat pieces for draw-plates.

Off-Color	Not quite colorless; having a tint of undesirable color.
Old Mine............	Specifically, Brazil diamonds from the old diggings; as generally used, old cut diamonds of good color.
Pigeon-Blood	A deep, clean red; the gem-color of the ruby.
Rivers	Diamonds found in the beds of rivers.
Rough	Uncut crystals.
Round-Stones	Diamond crystals with arched facets.
Sharps	Thin, knife-edge pieces of diamond.
Siams	Dark, garnet-colored rubies usually found in Siam.
Silk	White, glistening streaks in the grain of rubies.
Silver Capes	Diamonds having a very slight tint of yellow.
Specific Gravity.....	The relative weight of bulk as compared with distilled water at 60° F.
Splints	Thin, pointed pieces of diamonds.
Spread	Surface in proportion to the depth of a cut stone.
Tallow-Topped	A stone cut with a flattish convex surface.
Torn End............	A three-cornered pyramid from the point of a wassie.
Twinned	Two or more distinct crystals which have been formed in conjunction.
Wassie	A large cleavage of a crystal split for cutting, as an octahedron divided in two pieces.
Well	Name given the dark centre of a diamond cut too thick.
Yellow Ground......	The upper diamond-bearing clay of African mines.

XIX

DESCRIPTIVE TERMS EXPLAINED

In the following condensed descriptions of the various stones, if they are found in many localities in a country, only the country is given.

Where different tests for hardness and specific gravity have given different results, the extremes of those recorded are given.

The chemical composition, as stated here, is the average of analyses by authorities.

"Lustre" refers to the power of the surface of stones to reflect light.

"Adamantine" is the strongest, as for instance that of the diamond.

"Vitreous" is the lustre of broken glass. Example: the ruby, emerald, etc.

"Resinous" is the lustre of yellow resins. Example: the common forms of garnet.

"Pearly" resembles the sheen of the pearl.

"Metallic" is the usual lustre of metals. Example: hematite.

"Silky," like silk. Example: crocidolite.

"Glassy." When this term is used, it refers to an imperfect vitreous or subvitreous power.

Diaphaneity is the property of transmitting light. The degree in which it is possessed by the various stones is expressed as follows:

"Transparent," when the outlines of objects can be seen through it distinctly.

"Semitransparent," when the objects can be seen, but the outlines are indistinct.

"Translucent," when objects cannot be seen, though light is transmitted.

"Subtranslucent," when the edges only transmit light faintly.

"Opaque," when no light is transmitted.

It should be noted, however, that objects cannot be seen through transparent stones when cut *en cabochon*. That is not owing to lack of diaphaneity, but to optical phenomena due to the convex shape.

"Cleavage" refers to the property of separating or splitting on certain lines into natural layers. When "perfect," the split is clear and even, leaving planes of equal lustre. If "imperfect," the cleavage planes are irregular.

"Fracture" means the breaking of a stone other than on the lines of cleavage. "Conchoidal" means that it breaks with a curved or concave and convex surface, "even" when the surface of the break is flat or nearly so, "uneven" when the surface is irregular.

When a stone is said to be "brittle," it means that parts of it separate in powder on attempting to cut it.

"Under the blow-pipe" means, unless otherwise specified, without the assistance of a flux.

"Amorphous," from the Greek, meaning "without shape," refers to a condition of minerals having no regular structure or form.

"Reniform," kidney-shaped.

"Botryoidal," a surface consisting of a group of rounded prominences.

"Streak" is the color of the surface of a stone where it has been rubbed or scratched. The powder abraded is the "streak-powder."

"Play of colors" is the prismatic effect produced by dispersion of the rays of light, as by the diamond and precious opal.

"Change of colors" occurs in stones like the labradorite, where the colors change as the stone is turned.

"Opalescence" is a milky or pearly reflection from the interior of a stone.

"Iridescence" describes the prismatic colors seen within a crystal.

"Dichroism," from the Greek *dis,* twice, and *chroa,* color, implies different colors in two directions. It is a property of all doubly refractive stones, of which the two images shown by the dichroiscope appear in different colors. The "twin-colors" are these two colors. "Pleochroism," from the Greek *pleos,* full, and *chroa,* color, applies to minerals in which a different shade of color is seen in more than two directions.

"The index of refraction" is the angle to which the ray of light is bent upon entering the stone. In water it is 1.335; in quartz, 1.548; in zircon, 1.961; in diamond, 2.439. The index for both rays in doubly refractive stones is given in all cases where a record of measurement could be found.

Digests

XX

ALEXANDRITE

So named after Alexander II. of Russia, being discovered in his dominions on the day he attained his majority (1830), its dichroism exhibits the Russian colors.

It is a variety of chrysoberyl, of which the Oriental cat's-eye is one, and is found in Russia, Ceylon, Brazil, and occasionally in the United States. Some have been found in Ceylon which exhibit a cat's-eye chatoyancy.

Crystallization trimetric. Crystals, modified rectangular prisms, usually double six-sided, sometimes thick, often tabular.

Hardness, 8.5. Specific gravity, 3.5 to 3.8.

Lustre vitreous; transparent to translucent.

Cleavage imperfect; fracture conchoidal.

Doubly refractive (index, 1.756 and 1.747); strongly dichroic, sometimes trichroic; twin colors, green and yellow or green and red; positively electric.

It is composed of alumina, 79; glucina, 18; iron and chromic oxide, etc., 3.

Melts with borax, but is infusible and unaltered before the blow-pipe, and is unaffected by acids.

By day the color is a light to dark bottle-green, but by artificial light it becomes purplish pink to columbine-red, rarely ruby-red. The streak is uncolored.

The rough is generally so full of structural defects, crevices, etc., as to make it unfit for use as a gem.

The ideal gem, a bright tourmaline-green by day, and ruby-red at night, is very rare, one or the other color, often both, being weak. Usually step-cut.

Symbolizes undying devotion.

AMBER

Is a fossilized vegetable resin, called, in mineralogy, succinite. Ancient name, "elektron."

It is found on the Baltic, Adriatic, and Sicilian coasts; in France, China, India, and the United States; also associated with lignite or brown-coal. It also exists in Alaska.

It is amorphous, occurring as nodules, non-crystalline, brittle.

Lustre resinous; transparent to translucent.

Electric by friction. The Greeks first observed electrical phenomena in connection with this substance.

It is composed of carbon, 79; hydrogen, 10.5; oxygen 10.5.

Hardness, 2 to 2.5; specific gravity, 1.05 to 1.10, or about the same as sea-water or a trifle heavier.

It burns with a yellow flame and aromatic odor. It also gives off this odor after strong friction without becoming sticky like other resins.

Color, yellow in all shades, tending to white and red, or brown and black; green and blue rarely.

Sicilian amber is opalescent, the tints differing as it is seen by transmitted or reflected light.

It is of value to scientists, as it often carries within it perfectly preserved fossils of the oligocene age of the Tertiary period, moss, seeds, stones, leaves, insects, etc.

Amber was highly esteemed by the ancients. The Turks believe their amber mouth-pieces prevent inhalation of pestilence. Many persons in Europe and the United States ascribe to it medical properties beneficial especially to the throat.

AMETHYST

So called on account of its supposed preservative powers against intoxication.

It is crystallized quartz, or a colored rock crystal, found in Siberia, India, Brazil, Uruguay, and the United States.

Crystallization hexagonal, occurring in six-sided prisms more or less modified and terminating in pyramids.

Hardness, 7; specific gravity, 2.6 to 2.7.

Lustre vitreous; transparent to translucent.

Cleavage none or very indistinct; it may sometimes be discovered by heating the crystal and plunging it in cold water. Fracture conchoidal, glassy.

Doubly refractive (index, 1.55 and 1.54); twin colors, reddish and bluish purple.

Sections at right angles to optic axis show circular polarization.

It is composed of silica, colored probably by oxide of manganese.

Heat changes color to a more or less yellowish tinge, turning to greenish at high temperature, and colorless at 250° F., and sometimes makes it opalescent. It is infusible before the blow-pipe, but dissolves if heated with carbonate of soda. It is not attacked in any way by the three acids.

Color, pale to deep violet and purple, some shades of the latter being especially rich and beautiful. The color is often distributed very unevenly through the stone. Sometimes another color—yellow or green—is found in connection with the natural purple in the crystal.

Usually cut step; often cut brilliant in the finer qualities.

The name is used in heraldry to designate the purple color on escutcheons of noblemen.

Symbolizes deep and pure love, February, Matthew the Apostle.

ANDALUSITE

Was named from the district in Spain where it was first discovered.

Chiastolite and macle are varieties of this mineral. It is found in Spain, Brazil, and Ceylon.

Crystallization trimetric, in right rhombic prisms.

Hardness, 7 to 7.5; specific gravity, 3.1 to 3.32.

Lustre, when clear enough to cut for jewels, vitreous; translucent to opaque; tough.

Cleavage lateral, distinct.

Dichroic, sometimes trichroic; twin colors, Green: green, red, yellow; brown: reddish brown and greenish yellow. The colors are similar but not as strong as in the alexandrite.

Composition: silica, 36.9; alumina, 63.1.

Infusible before blow-pipe, but with borax melts with extreme difficulty.

Gems show mixed colors of green, brown, and yellow; opaque variety is gray to flesh-red.

But little is found sufficiently transparent to cut for gems. Many stones sold as andalusite are brown tourmalines cut from twin-colored crystals. They are much more magnetic by friction than the andalusite, readily lifting small pieces of tissue paper, cotton, and the like, after being rubbed on a woollen sleeve.

Usually cut step.

AQUAMARINE

So called from its resemblance to sea-water.

It is a beryl, of which the emerald is the most valuable variety. Found in South America, Indies, Russia, and United States.

Crystallization hexagonal, occurring in six- or twelve-sided prisms, usually long and stout, without regular terminations and sometimes deeply striated.

Hardness, 7.5 to 8. Siberian aquamarine is said to be slightly harder than the emerald. Specific gravity, 2.65 to 2.75.

Lustre vitreous; very brilliant by artificial light; transparent to subtranslucent.

Cleavage in four directions; perfect only parallel to basal planes and indistinct. Fracture conchoidal, uneven.

Double refraction (index, 1.582 and 1.576); dichroic; twin colors, light straw and azure-blue, varying, with the depth and character of color, to yellowish green and light bright blue; electric by friction, positive.

Composition varies: silica, 68; alumina, 15 to 20; glucina, 11 to 14.

Becomes clouded before blow-pipe and fuses on edges with difficulty; melts with borax to clear glass; soluble in salts of phosphorus, but is not attacked by acids.

Gem color is a deep water-blue; general color, various shades of sea-green to colorless.

The finer qualities are now brilliant-cut in the United States.

Symbolizes happiness, everlasting youth; in Polish and Jewish lists, October.

Golden beryl is the same stone, in various shades of golden yellow.

CAT'S-EYE

Is named from its resemblance to a cat's-eye.

It is a variety of chrysoberyl found in Ceylon, China, and Brazil.

Crystallization trimetric, occurring in composite crystals containing minute internal striations.

Hardness, 8.5; specific gravity, 3.5 to 3.8.

Lustre brilliant, with iridescent ray; translucent.

Cleavage imperfect; fracture conchoidal.

Doubly refractive; dichroic.

Composed of alumina, 78 to 79; glucina, 18 to 20; a trace of lime and oxide of iron.

Infusible alone, but melts with borax or salts of phosphorus; unaffected by acids.

Colors are gray, brown, black, modified by yellowish or greenish tints.

It is cut *en cabochon.*

Symbol: warns of danger and trouble.

A similar stone, the quartz cat's-eye, lacks the brilliancy and soft coloring of the true cat's-eye. It is found in various shades of greenish and yellowish gray, and brown. Hardness, 6 to 7; specific gravity, 2.6. Melts with soda to a clear glass; soluble in hydrofluoric acid, and is never dichroic. It is composed of silicon, 48; oxygen, 51; oxide of iron, etc., 1. When cut convex, a band of light appears across the parallel fibres of asbestos which are included in this variety of quartz, as it does in the Oriental cat's-eye.

CHRYSOBERYL

The name is derived from the Greek *chrysos,* golden, and *beryllos,* beryl.

Alexandrite and Oriental cat's-eye are varieties of this stone. It is found in Ceylon, Borneo, Brazil, Europe, and the United States.

Crystallization trimetric. It occurs in double six-sided pyramids; often found as rolled pieces.

Hardness, 8.5; specific gravity, 3.5 to 3.8.

Lustre vitreous to resinous; transparent to translucent.

Cleavage imperfect; fracture conchoidal.

Doubly refractive (index, 1.756 and 1.747); dichroic; twin colors of yellow, golden brown and greenish yellow; positively electric by friction, lasting several hours.

It is composed of alumina, 78 to 79; glucina, 18 to 20; and a small percentage of oxide of iron. In the alexandrite less iron and a very small quantity of chrome.

Infusible and unaltered before the blow-pipe; it is not subject to acids, but melts with borax or salts of phosphorus.

Color, light golden yellow to brown and green; sage and leaf-green; very similar in some colors to the chrysolite.

The light golden yellow was valued nearly as high as the diamond in the time of Louis XIV.

Cut step and brilliant.

The cymophane (from *kyma,* wave, and *phaino,* to appear) is a somewhat milky variety of the chrysoberyl, which shows a floating spot of light as it is moved. It is cut *en cabochon,* like the cat's-eye.

CHRYSOLITE

The straw-yellow to greenish-yellow variety only is known commercially as chrysolite. In olive-green it is called peridot. The yellowish green variety, which is the mineralogist's olivine, is also known commercially as peridot. It is found in Egypt, Brazil, Mexico, Germany, Ceylon, South Africa, the United States, and in meteorites.

Crystallization trimetric; form, rhombic prism; usually found as water-worn pebbles.

Hardness, 6.5 to 7; specific gravity, 3.3 to 3.5; heavy according to the proportion of iron and consequent dark color.

Lustre vitreous to greasy; transparent to translucent; electric by friction.

Cleavage perfect, parallel to the smaller lateral plane; fracture conchoidal. It looks like glass except in the direction of the cleavage.

Doubly refractive (index, 1.70 and 1.66); dichroic; twin colors of olive, brown-yellow and sea-green.

Composition varies: silica, 40; magnesia, 50; ferrous oxide, 9; nickel oxide, etc., 1.

Excepting those containing much iron, it darkens but does not fuse under the blow-pipe, but fuses with borax to green glass and is attacked by sulphuric acid.

Color, yellow and various shades of olive-green.

Cut step and brilliant; does not hold sharp, fine edges to the facets.

Symbolizes gladsome heart; September, on the Jewish list of month stones.

CROCIDOLITE, or TIGER-EYE

Is a variety of hornblende found in gem form in South Africa; otherwise in the United States.

It consists of thin, silky fibres compacted together, and is probably converted from some original fibrous stone to a variety of quartz, but retaining the fibrous form.

Hardness, 4 to 7; specific gravity, 3 to 3.3.

Lustre silky; chatoyant.

When cut *en cabochon* it exhibits more or less chatoyancy similar to the cat's-eye.

The composition is very varied, and consists of silica, oxide of iron, soda, magnesia, and water in varying proportions.

Colors, light brown, brownish yellow, dark green, and greenish blue. The blue variety is sometimes called "hawk's-eye."

It is usually cut for cameos, paper-weights, umbrella-handles, etc. Since the discovery of large quantities at the Orange River, Griqualand-West, in South Africa, it is not much used for jewelry.

Tiger-eye is frequently sold as petrified wood, and is artificially colored to imitate some of the finest shades of Oriental cat's-eye.

DIAMOND

Is the pure crystalline form of carbon, of which bort is the imperfect, and carbonado the crypto-crystalline. It is found principally in South Africa; also in Brazil, India, Sumatra, Borneo, Australia, Russia, China, and very rarely in the United States. Bort comes principally from South Africa, and carbonado from Brazil only.

Crystallization isometric. It is found as octahedron, rhombic dodecahedron, hexakis octahedron, and otherwise modified crystals.

Hardness, 10; specific gravity, 3.48 to 3.52 (carbonado, 3.14 to 3.41).

Lustre adamantine; transparent; phosphorescent by heat or solar light. Though a non-conductor, it becomes positively electric by friction; it is also electric in the rough.

Cleavage perfect, parallel to the faces of the octahedron; fracture conchoidal or curved.

It is singly refractive (index, 2.439), reflective, and dispersive.

Composed of pure carbon.

Infusible, not acted upon by acids or alkalies, but burns in oxygen under intense heat to dioxide of carbon, without residue.

Usual colors in order of rarity: bluish white, white, yellowish and brownish white. Rare colors: red, green, blue, pink, violet, orange, canary, and brown.

Common imperfections, carbon spots, fractures, feathers, bubbles, white specks; streak, gray to black. The finer the material the darker the powder.

Cut brilliant, rose, briollette, pear, heart, marquise, and square.

Symbolizes purity, preserves peace, prevents storms; the month of April.

DIOPSIDE

A VARIETY of pyroxene; is found in the mountains of Europe, and the United States.

Crystallization monoclinic; in modified oblique rhombic prisms, usually thick, of six or eight sides, and terminating in two faces meeting at an edge.

Hardness, 5 to 6; brittle; specific gravity, 3.1 to 3.3, higher as the proportion of iron is greater.

Lustre vitreous to greasy; transparent to translucent.

Cleavage perfect, parallel to the sides of the prism; distinct, parallel with the diagonals.

It is composed of silica, 55.3; lime, 27; magnesia, 17; ferrous oxide, and slight proportions of alumina, soda, and water.

Doubly refractive; dichroism in the finest color, very weak.

It cannot be dissolved by acids, but melts under the blowpipe to a colorless glass; with soda or borax, to a transparent glass.

Colors, gray, greenish gray, bottle-green to blue. The finest resemble, when cut, a fine green tourmaline, and are very lustrous. Neither of the colors shows any trace of yellow.

Sahlite, named after Sahla, where it is found, is a coarser form of diopside, with less lustre and a more dingy color.

Alalite is a diopside from Piedmont.

Fassaite is a variety of rich green color, with a smooth, bright exterior.

Coccolite is the name given to granular varieties of the same general character.

Very fine diopside is now being found in New York State. They are cut brilliant, and rival in appearance the best green tourmaline.

EMERALD

EMERALD is the grass-green variety of the beryl, of which the aquamarine, aquamarine chrysolite (a greenish-yellow variety), and golden beryl are the others.

The finest are found in the Republic of Colombia. It occurs also in Egypt, Russia, Austria, Australia, and the United States.

The crystallization is hexagonal; form, stout hexagonal and dihexagonal prisms, variously modified and without regular terminations.

Hardness, 7.5 to 7.8; specific gravity, 2.65 to 2.75. It is generally somewhat lighter than the aquamarine, about 2.67.

Lustre vitreous; transparent to translucent.

Cleavage in four directions, but perfect only parallel to terminal plane; fracture conchoidal and uneven.

It is doubly refractive to a slight degree (index, 1.582 and 1.576); dichroic; twin colors, yellowish, and bluish green; positively electric by friction.

Composition: silica, 68; alumina, 15 to 20; glucina, etc., 11 to 14. The coloring matter is probably an oxide of chromium.

Before the blow-pipe it becomes clouded, and fuses on the edges with difficulty. It melts with borax, and is soluble in salts of phosphorus, but is not attacked by acids.

It occurs in all shades of green, some showing a very slight tint of yellow or blue. The gem color is a clean, dark, velvety green; streak uncolored.

It is usually cut step, occasionally brilliant on upper half, and *en cabochon.*

Symbolizes immortality, incorruptibility, May, John.

GARNET

HAS many varieties and as many names.

The crystallization is isometric, and it occurs in rhombic dodecahedrons and trapezohedrons, sometimes variously modified. It is found nearly all over the world.

Hardness varies from 6, that of demantoid, the softest variety, to 7.5 to 8, that of uwarowite (or ouvarovite), the hardest; the red varieties range from 7 to 8; specific gravity, 3.4 to 4.3; brittle.

Lustre vitreous; transparent to opaque.

Cleavage parallel to faces of dodecahedron, rather indistinct; fracture uneven.

Refraction single (index, 1.74 to 1.815); pyrope, highest; essonite, lowest; electric by heat and friction.

The composition is very varied, but is a compound of three or four silicates in different proportions, the various combinations giving rise to the many shades of color in which it occurs. The green demantoid contains a large proportion of iron.

Most varieties fuse to a brown or black glass. Uwarowite fuses with borax to a green glass. Demantoid under blow-pipes fuses to a black bead.

Color, red in all shades, green, orange, yellow, etc. The reds tend to brownish, yellowish, and purple tints.

Large stones are usually cut brilliant and *en cabochon;* small, rose-cut.

Symbolizes power, grace, victory, January.

Names by which the Garnet Varieties are known

ALMANDINE ....Wine-red; hardness, 7¼; specific gravity, 4.1 to 4.3.

CAPE RUBY	Deep-red African stone; found with the diamond in South Africa.
DEMANTOID	Or green garnet, a pale to deep and slightly yellowish green. The finer qualities are known commercially as olivine. Hardness, 6 to 6.5; specific gravity, 3.83 to 3.85.
ESSONITE	In pale cinnamon color this is cinnamon stone. In orange it is called jacinth; in a mixed red, orange, and brown, hyacinth. (The true jacinth and hyacinth are zircons of those colors.) Hardness, 7¼; specific gravity, 3.6 to 3.7.
GROSSULARITE	Or gooseberry stone, is a pale or yellowish-green variety.
MONTANA RUBY......	Is a fine, rich red variety found in Montana and Arizona.
PYROPE	Is the blood-red Bohemian garnet. Hardness, 7¼; specific gravity, 3.7 to 3.8.
RHODOLITE	Is the pink garnet of North Carolina.
SPESSARTITE	Yellow.
UWAROWITE	Is an emerald-green variety found in Russia. It contains about twenty-two per cent. of oxide of chromium. The crystals are seldom sufficiently large or transparent to cut.
CARBUNCLE	Is the name given to any of the red varieties when cut *en cabochon.* It is the name by which most red stones were known to the ancients.

HIDDENITE

Or lithia emerald, was named after Mr. Hidden. It is found only in North Carolina. It is said to have been first discovered in 1879, by Mr. Hidden, though J. A. D. Stevenson, of Statesville, North Carolina, had specimens at that time in his cabinet which he claimed to have had for some years.

It is a variety of spodumene or triphane.

Crystallization monoclinic. When in rock, it is found as unchanged crystals. The ends of the crystal generally vary in color, yellow and green.

Hardness, 6.5 on the prism faces; across them, nearly that of the emerald; specific gravity, 3.17 to 3.19.

Lustre vitreous; transparent.

Very perfect prismatic cleavage; fracture uneven.

Double refraction (index, 1.67); dichroic; electric in polished state.

Composition: silica 64.34; alumina, 27.61; lithia, 8.05, with traces of iron and soda.

Melts to clear glass under the blow-pipe, and is attacked by salts of phosphorus.

Color, light yellow to yellowish green and deep yellow; rarely colorless.

It is cut step and brilliant.

Spodumene

Is sometimes cut as a gem. It is found in greenish white, grayish green, yellow, and very light red, as pitted and altered fragments. It is difficult to cut on account of its very easy cleavage, and because it is harder in one direction than the other. A few of amethystine color have been found in the United States, but the transparent variety is almost confined to Brazil.

LABRADORITE

Is so named because it was originally from Labrador.

It is a feldspar, and is found on the coast of Labrador, Finland, Russia, and the United States.

Crystallization triclinic; usually in cleavable masses.

Hardness, 6; specific gravity, 2.7.

Lustre vitreous to pearly; translucent to opaque; some specimens show an iridescent chatoyancy and play of blue, green, golden-yellow, and red.

Cleavage, one direction perfect; one imperfect.

Composition: silica, 53; alumina, 29; lime, soda, etc., 18.

Fuses with difficulty before the blow-pipe, and is decomposed with muriatic acid.

Body color, gray, brown, or greenish brown, in which prismatic hues appear if the stone is polished flat and parallel to the reflecting surfaces. This is due to minute particles of oxide of iron distributed throughout the body of the stone. These are not always present.

Other forms of feldspar not used as jewels are lennilite, elæolite, albite, perthite, peristerite, leopardite, and pitchstone.

Albite and peristerite often show considerable chatoyancy, and are called "moonstones" in the localities where they are found.

MALACHITE

(Green Carbonate of Copper)

Is a hydrated carbonate of copper, found in the upper parts of copper-ore deposits in the Urals, South Australia, and the United States.

Crystallization monoclinic; usually botryoidal or stalagmitic; structure finely and firmly fibrous.

Hardness, 3.5 to 4; specific gravity, 3.7 to 4.

Lustre adamantine to vitreous; crystals translucent.

Composition: copper oxide, 71.9; carbon dioxide, 19.9; water, 8.2.

It dissolves with effervescence in nitric acid, blackens under the blow-pipe, fusing with borax to a deep green globule, and ultimately affords a bead of copper.

Color, a bright green with lines of a darker shade, showing, by its concentric structure, evidence of deposition from a solution in water, of successive layers.

When used for jewelry it is usually cut flat or *en cabochon,* or pear shape for pendants. It is seldom used for gem purposes in the United States, except in connection with azurite, with which it is sometimes found in combination. Cut *en cabochon* across these alternate layers, a beautiful mottled effect is produced. But little of this combined form of the mineral is to be had now, as most of it was melted for copper before it came into vogue for jewelry.

MOONSTONE

(Adularia)

An opalescent variety of feldspar, so named from a supposed chatoyant similarity to the moon. It is found in Ceylon, Mount Adula, and occasionally in Northern Europe and the United States.

Crystallization monoclinic; usually in thick, rectangular prisms or crystalline fragments. Also massive and granular.

Hardness, 6 to 6.5; specific gravity, 2.4 to 2.6.

Lustre pearly and chatoyant; transparent to subtranslucent. If cut with a high dome, an effect is sometimes produced resembling the cat's-eye.

Cleavage perfect parallel to the shorter diagonal; fracture conchoidal or uneven.

Doubly refractive (index, 1.55); dichroic; electric when polished.

It consists of silica, 64.7; alumina, 18.4; potash, 16.9.

It is not attacked by acids; fuses only on the edges, but with borax melts slowly to transparent glass.

Color, light tints of pearly gray, blue, green, and flesh-red. Sometimes the play of light shows one of these tints floating on a gray background.

It is cut *en cabochon* or rounded on either side.

Adularia is the same stone when white or colorless subtransparent.

Selenite, one of the finer varieties of gypsum, is found in some of the central counties of England. Its name signifies "moonstone," but it is not the mineral known to jewellers as moonstone. It is soft, has a moonshine lustre, and is used for beads, etc.

OBSIDIAN

Is a volcanic glass found in all volcanic regions.

It is amorphous.

Hardness, 5 to 5.5, and brittle; specific gravity, 2.3 to 2.6.

Lustre vitreous to metallic; takes a high polish; translucent to opaque, sometimes transparent.

It is not easily attacked by acids, but melts under the blowpipe.

Color, bottle- and peridot-green, yellow, blue, white, velvet-black to gray and brown. A streaked brown American variety is called mahogany obsidian. Many specimens have black or yellow spots or veins.

Globular masses of pearl-gray translucent obsidian, known as "obsidian bombs," or "marekanite," after a locality in Siberia, are found occasionally in Siberia and Western Australia. These sometimes explode when struck; hence the name.

Obsidian was used by primitive people for arrow-heads, knives, and other cutting implements.

Although some specimens show very beautiful color and polish, it does not find favor as a jewel, for the reason that it is practically the same as the manufactured imitations of more precious stones.

OPAL

PRECIOUS or noble opal is compact and amorphous, occurring as thin strata within a matrix. It was known and highly esteemed by the ancients, who called it "paideros," or "child beautiful as love." It is found in Hungary and Australia. The common varieties occur in Mexico, Honduras, and the United States.

It consists of a soluble silica and about ten per cent. water.

Hardness, 5.5 to 6.5; specific gravity, 2 to 2.2.

Lustre subvitreous; translucent in various degrees.

Single refraction (index, 1.48).

It is traversed by microscopic fissures, which decompose the rays of light and produce beautiful prismatic colors.

It is infusible before the blow-pipe, but heat cracks it, and, driving out the water, renders it opaque. Sulphuric acid turns it black. It is almost entirely soluble in a cold solution of caustic potash.

Color, white, yellow, and brownish yellow body, in which the prismatic colors by an optical phenomenon appear in various degrees. Color is temporarily improved by the warmth of the hand or mouth. Occasionally one is found which, when cut, has a chatoyant colored light similar to the cat's-eye.

It is usually cut *en cabochon,* and is also carved to represent flowers, insects, etc.

Symbolizes hope, innocence, purity, October.

Varieties of Opal

Besides the noble opal there are several other varieties.

Fire opal, or girasol, is more transparent than the precious opal, softer, and the prismatic colors are less distinct. The body color is yellow to a bright brownish red, in which the prismatic colors float. It is found in Mexico and the Färöe Islands.

Common opal, or semi-opal, is very similar to the noble opal, except that the play of prismatic colors is very indistinct and the milky body lacks brilliancy.

Hydrophane is an opal which has lost brilliancy by the evaporation of its water. It becomes temporarily translucent by soaking in water or alcohol. If boiled in oil, it will retain its brilliancy for some time.

Cacholong is milky white and nearly opaque. It is similar to and often confounded with chalcedony.

Hyalite, a glassy variety, is valueless as a gem. It is found in the United States.

Menilite is a brown, opaque, and slaty variety.

Wood opal is wood petrified with a hydrated silica. The color is gray, brown, or black.

Other forms are simply silicas having some opalescent features insufficient to warrant attention as gems.

PEARL

Is not a mineral, but the production of a shell-fish. It ranks, however, among the most valuable of the precious stones.

It is formed by the secretions of a mollusk or shell-fish which forms lustrous concretions of carbonate of lime, interstratified with animal membrane. Latest research shows that a parasite or foreign substance within the shell becomes surrounded by a soft, jelly-like material enclosed in a sack. This gradually hardens, and is later covered by concentric layers of nacre. Dr. H. Lyster Jameson reports to the Zoological Society, London, that he found the pearl nucleus to be dead larva of a distoma or fluke. These spend their early life in the bodies of fresh-water shell-fish.

Pearl oysters have shells with a nacreous lining, varying in size from two to eight inches. The marine or meleagrina shell is square, with rounded corners and very thick sides. From these are taken the Oriental pearls. The fresh-water, or unio, is an even, egg-shaped mussel.

The meleagrina are found in the Indian and Pacific Oceans, and off Lower California and parts of the coast of Australia, on hard rocks or sandstone, to which they cling by a fibrous beard. The unio is found in the brooks and streams of Europe, China, and the United States.

It consists of carbonate of lime and a small proportion of organic matter.

Specific gravity, 2.5 to 2.7; hardness, about 4.

Color, white with various tints, yellow predominating; pink, yellow, grays, bronzes, black, etc.

Symbolizes purity, innocence, June.

Varieties of Pearl

The Oriental pearl is distinguished by its mellow skin and the soft tones which appear, whatever the color.

The fresh-water pearl, even at its best, is characterized by a slightly chalky appearance, and harshness as compared with the Oriental.

Pink or conch pearls, pink to pale yellow and white, having a peculiar wavy sheen, are distinguished by a hard china-like lustre. They are found in the Gulf of California, and off the coasts of Mexico and West India Islands.

Round, pear, and egg-shape pearls are formed within the oyster, and are not attached to the shell, the nucleus of their successive skins of nacre being within themselves.

Button pearls are those having a flat underside.

Baroques are irregular and odd-shaped pearls.

Wing pearls are long and slim, resembling the closed wing of a bird, and are attached at some point to the shell during formation.

Blister pearls are excrescences raised on the inner side of the shell by the oyster in its effort to exclude a parasite which has intruded or bored its way through the shell.

In all cases, pearls are successive layers of nacre deposited by the oyster over a nucleus of foreign substance.

QUARTZ

Is a mineral which takes on more forms and colors than any other.

The crystallization is rhombohedral, and it occurs usually in six-sided prisms, more or less modified, terminated with six-sided pyramids; also granular and compact.

Hardness, 7; specific gravity, 2.6 to 2.7.

Lustre waxy to vitreous; transparent to opaque.

Seldom has even a trace of cleavage.

It consists of pure silica. Some other mineral is often disseminated through the opaque varieties: oxide of iron, chlorite, clay, etc.

The varieties result from different modes of crystallization or impurities, and are divided into three groups:

I. The vitreous, having a glassy fracture.

II. The chalcedonic, of subvitreous or a waxy lustre, and generally translucent.

III. The jaspery, opaque and with very slight lustre.

Quartz is infusible before the blow-pipe alone, but melts readily with soda, and effervesces. It is not attacked in any way by the three acids.

The vitreous are known as amethyst, aventurine quartz, cairngorm, citrine, prase, rock crystal, rose quartz, siderite, and sagenite.

The chalcedonic are chalcedony, chrysoprase, cat's-eye, carnelian, plasma, sard, onyx, and agate.

The jaspery comprise basanite, bloodstone, jasper, and others.

Massive Varieties of Quartz

Agate .... Ribbon agate has strata of different colors playing into each other.

Circular agate has stripes of different colors arranged around the centre.

Eye agate has points of other colors within the centre.

Fortification agate has angular colored bands suggesting a plan of fortress.

Moss agate contains green or brown mineral matter (oxide of iron) having an appearance of vegetable growth. The colors may be darkened by boiling the stone in oil and then dropping it in sulphuric acid.

Asteriated Star ...... Is a quartz containing substances between layers of crystal, which, cut *en cabochon* across prisms, exhibits asterism.

Aventurine Quartz .. Is gray, brown, or reddish brown, translucent, and contains iridescent spangles of mica or other mineral.

Basanite .... A velvet-black, flinty jasper used for trying metals; called also Lydian stone and touchstone.

Beckite .... Silicified corals, shells, or limestone, resembling chalcedony.

Bloodstone .... Heliotrope. Deep green chalcedony, colored with red spots (oxide of iron).

CARNELIAN ....Translucent; yellow, brown, or red; color is deepened by several weeks' exposure to the sun's rays.

CAT'S-EYE ....Gray and greenish gray; translucent; chatoyant when cut *en cabochon,* due to fibres of asbestos or actinolite.

CHALCEDONY ....Clouded or translucent white, yellow, pale brown, or blue, with a glistening or waxy lustre.

CHRYSOPRASE ....Translucent, pale bluish or yellowish green variety of chalcedony; color is due to oxide of nickel.

HELIOTROPE ....Bloodstone.

JASPER ....Impure opaque, colored quartz; red, yellow, brown, gray, sometimes blue. Called ribbon jasper when striped. Egyptian jasper is of a dead yellow running to brown.

ONYX ....Is like agate with colors arranged in parallel strata.

PLASMA ....Faintly translucent; various greens, sprinkled with yellow and whitish dots.

PRASE ....Translucent; deep green (supposed to be colored by a trace of iron).

ROSE QUARTZ.........Pink, sometimes opalescent. Fades on exposure to light, but may sometimes be restored by leaving it in a moist place.

SAPPHIRINE ....Or siderite. Translucent; grayish blue, indigo, and Berlin blue.

SARD ....Light to dark brown-red.

SARDONYX ....Sard with underlying parallel strata of color.

SYMBOLS ....*Bloodstone:* Courage, wisdom, March.
Chalcedony: Disperses melancholy, James.
Chrysoprase: Thaddeus.
Jasper: Courage, wisdom, Peter.
Onyx: Conjugal felicity.
Sardonyx: Conjugal happiness, August, Philip.

ROCK CRYSTAL

The name is derived from the Greek *krystallos,* like ice.

It is crystallized quartz, and is found in Brazil, Europe, and the United States.

Crystallization rhombohedral; usually in six-sided prisms variously modified, with pyramidal terminations.

Hardness, 7; specific gravity, 2.65.

Lustre vitreous; transparent to translucent.

Cleavage indistinct; sometimes discovered by heating the crystal and then plunging it into cold water.

Doubly refractive (index, 1.55 and 1.54); positively electric by friction; shows phosphorescence in the dark.

It is composed of oxygen, 53; silica, 47.

It can be melted with the oxyhydrogen blow-pipe. Melts with soda to a clear glass, and is soluble in fluohydric acid, but is infusible before the blow-pipe alone.

Colorless.

For gems it is cut brilliant. Largely cut for optical purposes to lenses called "pebbles." Cut in spheres for divination; also to imitate diamonds.

When yellow, it is called citrine or false topaz.

The brown variety is named cairngorm or smoky topaz.

The black is known as morion, and sagenite or Venus's hair stone is a variety containing needles of rutile, a brownish-red mineral, which traverse the stone in the same general direction, but at confused angles.

RUBY

Is a corundum, of which the red are called rubies, and blue and other colors, sapphires. The deep, clear red is known commercially as Burmah or Oriental ruby; the pink, as Ceylon ruby; and the dark garnet-red, as Siam; the colors being usually found in the localities with which they are coupled.

Crystallization hexagonal, occurring in six-sided prisms, and usually found as rolled fragments.

Hardness, 8.8 to 9; very tough when compact; specific gravity, 3.97 to 4.05.

Lustre vitreous; sometimes pearly on the basal planes; transparent to translucent; phosphoresces with brilliant red glow when exposed to electric discharge in high vacuo; electric by friction, retaining it for several hours.

Cleavage perfect, parallel to basal plane; fracture conchoidal and uneven; brittle.

Doubly refractive (index, 1.77 and 1.76); dichroic, twin colors of Burmah, crimson and aurora-red; of Siam, crimson and brownish red.

Composition: pure alumina.

In combination with borax it melts with difficulty into a clear glass. Is unaffected by chemicals.

Color, various shades of red; gem color, blood-red; streak, white.

Cut step and *en cabochon.*

Symbolizes charity, dignity, divine power, July.

Star ruby is a variety having fine striations on the basal plane. When cut *en cabochon,* with the top of the convex surface at the intersection of these lines, a chatoyant star appears.

SAPPHIRE

From the Greek *sappheiros,* name of a blue gem. It is the name given to all but the red corundums, being, color excepted, identical with the ruby. It is found in Siam, Burmah, Ceylon, Cashmere, United States, and Australia.

Crystallization hexagonal, occurring in double six-sided pyramids, found usually as rolled pieces detached and separated from the original matrix.

Hardness, 9; specific gravity, 4, or nearly so.

Lustre vitreous; transparent to translucent.

Cleavage basal, breaking across the prism.

Double refraction (index, 1.77 and 1.76); dichroic; twin colors of blue sapphire, light greenish yellow and blue. Natural stones are often dichroitic, blue one way, red the other.

Composition: pure alumina.

Infusible alone, but with borax melts to clear glass; unaffected by chemicals.

Color: gem color, corn-flower blue; occurs in all shades of blue, yellow, pink, green, etc.

It is cut step and *en cabochon.* Many small stones, especially Montanas, are now being cut brilliant.

The imperfections of cut stones consist of muddiness, clouds, spots, fissures, and white streaks.

Symbolizes constancy, truth, virtue, September, Andrew.

In star sapphire, or asteria, the summits of the primitive rhomboid are replaced by secondary planes. Cut *en cabochon,* with the summit over the point corresponding with the summit of the rhomboid, a star of six rays is produced, as in star ruby.

SPHENE

The name is from the Greek *sphēn,* a wedge, the shape of the crystals. The dark varieties of this stone were formerly called titanite, and the lighter only, sphene. It is found in Switzerland, Norway, the Urals, Finland, Wales, Ireland, Germany, Tyrol, and North America.

Crystallization monoclinic, occurring in wedge-shaped crystals; occasionally massive.

Hardness, 5 to 5.5; specific gravity, 3.25 to 3.5.

Lustre adamantine to resinous; transparent to opaque.

Cleavage in one direction, parallel to faces of the prism, sometimes perfect: fracture conchoidal, imperfect.

Doubly refractive (index, 1.88); dichroic; brilliant dispersive powers when transparent; electric in the polished state.

Composition: titanic oxide, 41; silica, 31; lime, 27; iron oxide, 1.

Before the blow-pipe the yellow varieties do not alter in color, but others become yellow; on charcoal they fuse on the edges to dark glass.

Color, pale yellow to green and brown, showing mixed colors; streak uncolored.

Cut step and brilliant.

Some varieties of this stone are opaque; others exhibit various degrees of transparency; few are sufficiently clear to be used as gem stones, and its softness prevents these from being generally used as jewels.

SPINEL

At one time thought to be a ruby. It is found in India, Burmah, Ceylon, Afghanistan, Tartary, North America, Sweden, Bohemia, and Australia.

Crystallization isometric; generally octahedron; often found as rolled crystals.

Hardness, 7.5 to 8; specific gravity, 3.5 to 3.7.

Lustre vitreous; transparent.

Cleavage parallel to faces of octahedron, but difficult; fracture conchoidal or uneven.

Single refraction (index, 1.72); slightly electric by friction, but not by heat.

Composition: alumina, 72; magnesia, 28; and variable quantities of metallic oxides.

Under the blow-pipe the color changes, but the original color returns as it cools; melts with borax or salts of phosphorus with difficulty, into a glass; is not attacked by acids.

Color, red, pale and dark violet, indigo blue, purple, light to blackish green; light reflected from the spinel of any color is pale yellow.

Cut step.

The spinel is designated according to color as follows: scarlet, spinel ruby; rose-red, balas ruby; orange-red, rubicella; violet, almandine ruby; green, chlorospinel; black, pleonaste.

The balas ruby shows in the rough a tinge of blue at the angles of the octahedron. It is found chiefly at Badakshan in Tartary.

Pleonaste is black and opaque, unfit for gems.

Hercynite is a black iron-spinel found as rolled pieces with the sapphires of Siam, and known by the diggers as "nin."

TOPAZ

Was found in old times on a foggy island in the Red Sea, difficult to find, and the stone was named from the word *topazo,* to seek. It is found now in Brazil, Russia, Saxony, Bohemia, Great Britain, Egypt, New South Wales, Madeira, and the United States.

Crystallization trimetric, in right rhombic prisms with dissimilar pyramidal ends. Found often as rolled pieces.

Hardness, 8; specific gravity, 3.5 to 3.56; slightly higher in the colorless than in the colored.

Lustre vitreous; transparent to subtranslucent.

Cleavage perfect basal; fracture subconchoidal, uneven.

Double refraction (index, 1.63 and 1.62); dichroic; twin colors of yellow, yellow and rose-pink; electric by friction or heat (pyro-electric), retaining electricity for many hours.

Composition varies: alumina, 57.5; silica, 34.2; fluorine, 15.

Infusible before blow-pipe alone; melts with borax to white bead; dissolves in salts of phosphorus, and is attacked by sulphuric acid; it changes color under heat, and is liable to crack and flow by the action of fire.

Color, white, light green and blue, pink, straw, yellow, orange approaching to red; some are changed by heat to a wine-yellow or pink; streak white.

Cut step; in the United States, generally brilliant.

Symbolizes friendship, happiness, November, James the Younger.

TOURMALINE

This is said to be a corruption of the name by which the stone was known in Ceylon, when it was first brought to Europe. It is found in the United States, Ceylon, Brazil, Moravia, Sweden, Burmah, and elsewhere.

Crystallization rhombohedral, in three-, six-, nine-, and twelve-sided prisms differently terminated at the opposite ends; generally striated and channelled vertically; often different colors within and externally, or one color at one end, another at the other end.

Hardness, 7 to 7.8; brittle; specific gravity, 3 to 3.15.

Lustre vitreous; transparent and translucent to opaque.

Cleavage perfect on the basal plane; fracture uneven.

Double refraction (index, 1.64 and 1.62) in a high degree; cut in slices it is used in the polariscope; dichroic; twin colors of red, salmon- and rose-pink; of green, pistachio, and bluish green; of blue, greenish gray and indigo-blue; electric by friction; some crystals, by heating (pyro-electric), become positively electric at one end and negative at the other.

Fusible under the blow-pipe with difficulty to a spongy enamel; melts with borax to transparent glass. Rubellite turns white; indicolite and green turn black under the blow-pipe.

Color, red (rubellite), blue (indicolite), green (Brazilian emerald), colorless (achroite), black (schorl); also gray, yellow, and brown; streak uncolored.

Cut step and brilliant.

TURQUOISE

Is found in opaque masses in a matrix, in Persia, Mexico, the United States, Australia, and New South Wales.

It is amorphous, without cleavage, and conchoidal fracture.

Hardness, 6 (varies); specific gravity, 2.6 to 2.8.

Lustre waxy; opaque to slightly translucent.

Composition varies: phosphorus pentoxide, 33; alumina, 40; water, 19; copper, iron, and manganese oxides, 8.

It is affected by acids; becomes brown under the blowpipe; melts to clear glass with borax and salts of phosphorus; soluble in hydrochloric acid.

Color, all shades of azure and greenish blue; color is due to phosphate of copper.

Varieties: "old rock," said to retain its color perpetually; "new rock," which fades or changes to a greenish tint. Odontolite, or fossil turquoise, is not a true turquoise or mineral, but fossilized tooth, bone, or ivory of the mammoth, colored by phosphate of iron, with which it is permeated. Callainite is a mineral of lighter color and less translucency.

Cut *en cabochon.*

Symbolizes prosperity, soul-cheer, December.

The color of all turquoise, whether treated for the preservation of color or not, is liable under certain conditions, when worn, to assume a greenish tint.

ZIRCON

A COLORLESS variety of this stone, with a smoky tinge, is called jargoon, and that name has of late been given also to the deeper shades of brown. The true hyacinth is the zircon of a decided red color, and the jacinth is another shade. These names have been used commercially of late, to designate certain colors of the essonite tribe of garnets, which are now known commonly as hyacinths and jacinths. It is found in Ceylon, Germany, France, Bohemia, America, India, Arabia, and Australia.

Crystallization dimetric; in quadrilateral prisms, terminating in a pyramid at both ends.

Hardness, 7.5; specific gravity, 4.1 to 4.9.

Lustre vitreous to adamantine; transparent to opaque.

Cleavage imperfect; fracture conchoidal, brilliant.

Double refraction (index, 1.97 and 1.92) to a high degree; dichroism very weak, weaker than any other; positively electric when polished; phosphorescent when heated.

Composition: Zirconia, 66 to 76; silica and oxide of iron, 24 to 34.

Melts with borax to glass; sulphuric acid affects it at length after maceration; infusible before the blow-pipe, but loses color.

Color, brown of all shades, red, violet, yellow, and green; streak uncolored.

Cut brilliant and step, mostly brilliant in this country.

Under the microscope the zircon has a watery appearance, which is called in Europe "ratiné." It approaches the diamond in appearance more closely than any other stone.

XXI

STONES SELDOM USED AS JEWELS

THERE are minerals unfit, as generally found, for use as gems, which occasionally occur with the necessary qualifications. These suggest the possibility of finding perfect specimens in greater quantities. Others, though interesting, beautiful, and rare, are not as beautiful as similar stones found in abundance. Many minerals which cut to opaque stones are useful only for ornamentation, being abundant and not sufficiently prized to use as jewels. Some of these come into vogue occasionally and are sought for their adaptability to a prevailing style, as, for instance, chrysocolla, thulite, azurite, and malachite, which are now being used for pendants and brooch settings. Many of exceeding beauty do not come into general knowledge and appreciation because the supply is fitful and uncertain; for instance, the fine tourmalines of Maine, the blue variety of aquamarine, the deep golden beryls of North Carolina, and the beautiful green diopsides of New York State.

For these reasons and because public interest in unique and hitherto unknown varieties is awakening, the following list of minerals, having some if not all the qualifications of precious stones, is appended.

Allanite is an opaque, bright, black mineral, brittle, very similar to epidote, and with a greenish streak. Hardness, 5.5 to 6; specific gravity, 3.3 to 4.2. It is of little value as a gem.

Amazon-stone is a beautiful green stone first discovered on the banks of the Amazon River, later in Siberia. It is now found also in Scotland and Colorado. It is usually dis-colored in places or speckled with small white spots. Hardness, 6; specific gravity, 2.4 to 2.6. Acids do not affect it, nor does it yield readily to the blow-pipe. It consists of silica, alumina, lime, and soda. It is cut *en cabochon* and drop shape for brooches and pendants. Subtranslucent.

Apatite is named from the Greek *apataō,* to deceive, from an early misunderstanding of its nature. It occurs in Europe and the United States, and is found as hexagonal prisms, also massive and of compact fibrous structure. Transparent crystals of green, pink, and violet, resembling tourmaline, have been found in Maine. Hardness, 4.5 to 5; specific gravity, 3 to 3.2. Lustre resinous, but somewhat greasy; transparent to opaque. It is composed principally of subsesquiphosphate of lime. Dissolves slowly in nitric acid, but is infusible under the blow-pipe. Some small crystals are transparent and colorless, but it is usually green. It is probably derived from animal fossils, as its constituents are contained in animal bones and ligaments. It is too soft to cut successfully. Some phosphoresce when heated, and become electric by friction.

Aragonite is named after Aragon in Spain, where it was originally found. It is the "satin spar" sold to tourists at Niagara Falls, and is imported from Wales. An amber and brown variety is called "California onyx." Crystallization trimetric in rhombic prisms. Hardness, 3.5 to 4; specific gravity, 2.9 to 2.10. Lustre vitreous; transparent to translucent. Cleavage parallel to faces of rhombohedron. Same composition as calcareous spar: lime, 56; carbonic acid, 44. Falls to powder before the blow-pipe; effervesces with acids; phosphoresces when heated. Color, white with tinges of gray, green, yellow, and violet.

Axinite, called also thummerstein and thumite from Thum in Saxony, is found in Europe and the United States. Crystallization triclinic, in acute oblique rhomboidal prisms. It is remarkable for the sharp, thin edges of its crystals. Hardness, 6.5 to 7, and brittle; specific gravity, 3.27. Lustre vitreous; transparent to subtranslucent. Cleavage indistinct. It is trichroic and pyro-electric. Composition: silica, 43.68; boron trioxide, 5.61; alumina, 15.63; iron sesquioxide, 5.45; manganese sesquioxide, 3.05; lime, 20.92; magnesia, 1.70; potash, 0.64. It is not attacked by acids, but fuses easily under the blow-pipe to green glass. Color, clove-brown, blue, and gray.

Azurite is a deep blue form of copper ore, found in the upper part of ore-beds. Crystallization monoclinic, in short, stout, modified rhombic prisms massed together. Hardness, 3.5 to 4.5; specific gravity, 3.5 to 3.8. Lustre vitreous; transparent to nearly opaque. Consists of copper oxide, 69.2; carbonic acid, 25.6; water, 5.2. When found in connection with malachite, the two minerals are cut together *en cabochon* across the bandings, producing a beautiful and striking contrast.

Beryllonite was thought, from its transparency, brilliancy, and form of crystallization, to be topaz. It is found only in Maine. Hardness, 5.6 to 6; specific gravity, 2.8. It contains cavities filled with water or carbon dioxide.

Bowenite is a white, and light to dark-green variety of serpentine.

Brookite is similar to rutile. Flat, ruby-red, and honey-yellow crystals, at times transparent. They have been found in the United States, but they cannot be easily polished. Hardness, 5.5 to 6; specific gravity, 3.8 to 3.9. Anatase and arkansite are practically the same mineral. The crystals are usually thin, hair-brown, and nearly transparent.

Calcomalachite is a slightly harder variety of malachite, consisting of equal parts carbonate of lime and carbonate of copper. It takes a high polish.

Cancrinite is found in Maine. There are three varieties, —orange-yellow, cleavable and transparent in thin fragments; pale yellow, not cleavable; and the common form, bright yellow and granular.

Cassiterite is composed of stannic acid, 95; ferric acid, 3.4, etc.; specific gravity, 6.5. Only a few small transparent gems have been cut. It is found east and west in the United States. Color, brownish white to reddish brown.

Cave-pearls are calcareous concretions, formed probably from water-worn pieces of stalagmite, or pieces upon which water has deposited successive layers of carbonate of lime. They are found in the caves of America.

Chiastolite is a variety of andalusite found in California and Massachusetts. First found in Andalusia, Spain. It is a curious opaque stone showing cross-like markings formed by the dissemination of impurities in a regular manner along the sides, edges, and diagonals of the crystals. Hardness, 3 and over. Color, black or blackish gray and white.

Chlorastrolite is found in rolled pebbles, on the beach of Isle Royale, Lake Superior, where it is cast as it is weathered out of the native underlying rock. It is opaque, green, mottled, and stellated. It admits of a high polish, and, when the stellations radiate from the centre, shows a chatoyancy similar to the cat's-eye. It is composed of silica, alumina, lime, ferric oxide, soda, and water. Hardness, 5.5 to 6; specific gravity, 3.2.

Chrysocolla is a silicate of copper, occurring usually as incrustations, botryoidal and massive, having no appearance of crystallization or fibrous structure. It consists of oxide of copper, silica, and water in varying proportions, sometimes including carbonic acid and oxide of iron. Hardness, 2 to 3; specific gravity, 2 to 2.3. Translucent to opaque. Color, bluish green to blue, mottled with darker shades and black. Mixed or coated with quartz or chalcedony, it is used occasionally. With the demand for odd stones it is being cut for charms and pendants. Found in the Lake Superior region and Arizona.

Cobaltite is sometimes cut for gem purposes in Europe, and has the appearance of a flesh-colored pyrite. It is a sulphide of cobalt. Crystallization cubic. Hardness, 5.5; specific gravity, 6.3 to 6.4.

Compact titanic iron takes a high polish, and is sometimes cut for ornaments. It is found in Rhode Island and Arkansas.

Coral is the product of a family of zoöphytes. These polyps make this substance in the cavities of rocks, several hundred feet under the surface of the sea. It is found in branches of irregular shapes, varying from twelve inches to several feet long, and an inch or less in diameter at the thickest part. It is found off the coasts of Africa and Corsica. Red is the usual color, though it is occasionally found in white and black. A wild-rose pink is the color most desired.

Cyanite, or kyanite, is named from the Greek *kyanos,* sky-blue. It is also called sappar, a corruption of sapphire; also disthene. It is found in Europe, the East Indies, and North America. Crystallization triclinic, in thin bladed crystals massed together. Lustre vitreous to pearly; transparent. Hardness, 5 to 7; specific gravity, 3.4 to 3.7. Composition: silica, 37; alumina, 63; with a small percentage of ferric oxide. Lateral cleavage distinct. It is infusible before the blow-pipe; melts with borax, but is not attacked by acids.

Danburite is seldom found clear enough to cut into gems. The finest, which are colorless, come from Switzerland. It is found also in Connecticut and New York State. It is a silicate of lime and boracic acid. Hardness, 7 to 7.2; specific gravity, 2.96. Color, wine, honey, or yellowish brown.

Datolite, or datholite, is a borosilicate of lime found in the Lake Superior copper region, Connecticut, and New Jersey. Crystallization trimetric, in hemihedral prisms. Crystals are small and glassy, and without distinct cleavage; also botryoidal. Composition: silica, 37.4; lime, 35.7; boracic acid, 21.3; water, 5.7. Translucent to opaque. Hardness, 5 to 5.5; specific gravity, 2.9 to 3. Color, white, creamy, and flesh-colored.

Dioptase is a brilliant green silicate of copper found as rhombohedral crystals and hexagonal prisms in the cavities of mahogany ore. Lustre vitreous; transparent to nearly opaque. Hardness, 4.5; specific gravity, 3.28. It is too soft for use as a gem.

Elæolite is named from *elaion,* oil, and is a variety of nepheline. It is found in Norway, Siberia, Arkansas, and Maine, in dingy, subtranslucent, cleavable masses. Lustre vitreous to greasy. Hardness, 5.5 to 6; specific gravity, 2.4 to 2.65. Composition: silica, 43.4; alumina, 33.5, with soda, potash, peroxide of iron, lime, and water. Color, bluish.

Enstatite and bronzite are found in Pennsylvania and Maryland. If cut across the fibre, they show a cat's-eye effect, but none have been found sufficiently fine to cut for gems. Color, dark green or greenish brown, with a lustre like bronze.

Epidote, of which zoisite and thulite are varieties, is a translucent to opaque stone, transparent only in very small crystals. Crystallization monoclinic, in right rhomboidal prisms, often with six or more sides. Hardness, 6 to 7; specific gravity, 3.3 to 3.4. Lustre vitreous to pearly. Cleavage parallel to side planes. Refraction double. Composition varies considerably in proportions of silica, alumina, lime, and ferric oxide, mainly. It is attacked by acids, and slightly affected by the blow-pipe. The usual color is pistachio-green; it also ocurs in gray to grayish green, and blue with brownish and reddish modifications. It is found in Europe, Brazil, and the United States. Magnesian epidote contains fourteen per cent. of oxide of manganese.

Euclase is a rare mineral, which has, however, been cut and polished. Crystallization trimetric, in prismatic crystals of perfect cleavage. Hardness, 7.5, and very brittle; specific gravity, 3. Lustre vitreous; transparent. Very lustrous, trichroic, and pyro-electric. Composition: silica, 41; alumina, 35; glucina, 18; water, 6. Before the blow-pipe, with strong heat, it swells and finally melts to a white enamel. Color, pale straw to green and blue. It is found in Peru, with topaz in Brazil, and with beryl in the Urals. Chemically it is closely related to the beryls, but is distinguished from them by its perfect cleavage, and from the topaz by its very oblique crystals.

Fluorite, or fluorspar, is a soft mineral found in various parts of Europe and the United States. Crystallization monometric. Hardness, 4; specific gravity, 3.1 to 3.2. Cleavage perfect parallel to face of octahedron. Lustre vitreous; occasionally transparent, when it is termed false ruby, emerald, sapphire, amethyst, topaz, etc. Some varieties are extremely phosphorescent at a low temperature, and give out various-colored lights at different temperatures. It is composed of nearly equal parts calcium and fluorine,—calcium, 51.3; fluorine, 48.7. It melts under the blow-pipe and is attacked by acids. Pulverized and moistened with sulphuric acid, the gas given off corrodes glass. Some shade of yellow is the most common color; also red, green, purple, colorless, etc. Rarely rose-red and sky-blue. Fluoric acid is obtained from it.

Fossil corals consist of carbonate of lime, and are found at Little Traverse Bay and in Iowa. They take a high polish, and are set in studs, sleeve-buttons, etc.

Gadolinite is found in Norway, Sweden, and Greenland, in oblique rhombic prisms. It is very compact. Lustre resinous. Cleavage indistinct. Color, deep velvet-black, green, greenish-gray streak. Hardness, 6.5 to 7; specific gravity, 4.1 to 4.4. Consists mainly of silica, yttria, glucina, protoxide of iron, and oxide of lanthanum.

Hematite is a peroxide of iron, consisting of iron, 70; oxygen, 30. Its crystallization is rhombohedral; form generally reniform and massive, whence it is often called kidney-ore. Though dark steel-gray when polished, it has a reddish-brown or cherry-red streak, from which its name hematite, or "blood-stone," is derived. The lustre is highly metallic. Hardness, 5.5 to 6.5; specific gravity, 4.5 to 5.3. It is found in Europe, South America, and the United States.

Hypersthene, or Labrador hornblende, resembles horneblende, but differs in cleavage and the angles of its crystals. It is found in crystalline masses in Labrador and in various localities of northern and central Europe, the Isle of Skye, and the United States. Composition varies: silica, 54; magnesia, 24; protoxides of iron and manganese, 22. Specific gravity, 3.39. Lustre pearly to metallic; translucent to opaque. Brittle. Some varieties fuse under the blow-pipe; others fuse with difficulty to a grayish green semi-opaque glass. Color, grayish, greenish, and jet black, green, and dark brown.

Iolite, dichroite, or cordierite, is named from the Greek *iodēs,* violet. Crystallization trimetric. In rhombic and hexagonal prisms, and as pebbles. Hardness, 7 to 7.5; brittle; specific gravity, 2.6 to 2.7. Cleavage indistinct; crystals often separable into layers parallel to the base. Lustre vitreous to greasy; transparent to translucent. Very flawy. Its pleochroism is remarkable and it sometimes shows, when properly cut, a chatoyancy similar to the corundum star-stones. Composition: silica, 48.3; alumina, 32.5; magnesia, 10; and ferrous oxide in slightly varying proportions. It melts with difficulty on the edges under the blow-pipe, and is partially decomposed by acids. It undergoes a gradual alteration if exposed to air and moisture, absorbing water and assuming a foliated micaceous structure. The blue variety is known as water-sapphire. It is also found colorless; in blue, and yellowish shades of white, gray, and brown; and in indigo and violet. It is obtained in Ceylon, Greenland, various parts of Europe, and the United States.

Isopyre is a glassy, amorphous silicate of iron found in New Jersey. Hardness, 6 to 6.5; specific gravity, 2.9 to 3. It consists of silica, 47.1; alumina, 13.9; peroxide of iron, 20.1; lime, 15.4; oxide of copper, 1.9, etc. Color like that of blood-stone (without the red spots).

Jade, or nephrite, or kidney-stone, is named from the Greek *nephros*, kidney. It is a very tough, compact variety of hornblende, found in upper Burmah, New Zealand, Siberia, Turkestan, and Alaska. Hardness, 6.5 to 7.5; specific gravity, 2.9 to 3.18. It has no cleavage, and the fracture is uneven. Lustre vitreous; translucent to subtranslucent, and takes a high polish. Composition: silica, 57.7; magnesia, 19.9; lime, 14.9; oxide of iron, alumina, etc., 7.5. It is infusible alone before the blow-pipe. Much of the mineral from China called jade is prehnite. The Chinese esteem it highly. It is supposed to be a cure for diseases of the kidney and is much worn as a charm on that account. The six private seals of the emperor and empress of China, looted during the late war, were of jade. Color, greenish or bluish to white. A distinction is now made between nephrite and jade, owing to a difference in the proportions of some of the constituent elements, especially of magnesia and lime. In all other respects they are practically the same.

Jet was known to the ancients as gagates, from the river Gagas, in Syria, at the mouth of which it was found. It is a black mineral much used some years ago; found in Colorado and at Whitby, in England. It has been superseded by so-called black onyx, a chalcedony chemically treated.

Lapis lazuli is a blue stone containing yellow spangles of iron pyrites. It is the sapphire of the ancients. Crystallization monometric, in dodecahedrons. Generally found in massive form. Hardness, 5.5; specific gravity, 2.3 to 2.5; brittle. Cleavage imperfect. Translucent only at the corners of thin edges. It has but little lustre. Composition: silica, 45.5; alumina, 31.8; soda, 9.1; sulphuric acid, 5.9; lime, 3.5; etc. Fuses to a white glass. The principal color is azure-blue; this is often modified by green and yellow tints, and it is sometimes red. Found in Persia, China, Siberia, Bucharia, and South America.

Lazulite, supposed at first to be lapis lazuli, is found at Salzburg, in Styria, in North Carolina, and Georgia. It occurs in dark-blue crystals and crystalline masses; rarely in oblique crystals. Hardness, 5 to 6, brittle; specific gravity, 3.1. Lustre vitreous; opaque. Composition: phosphoric acid, 41.8; alumina, 35.7; magnesia, 9.3; water, and ferrous oxide. It swells under the blow-pipe, but does not fuse. Color, fine azure-blue.

Lepidolite occurs in the Urals, Moravia, and in Connecticut, Massachusetts, and Maine, United States, in purplish crystals and massive. It is a lithia mica, containing about three per cent. lithia. Color, lavender to heliotrope.

Lintonite is a variety of prehnite.

Lodestone is the iron oxide possessing magnetic qualities. This ore was called magnes, from Magnesia, a province of ancient Lydia, where it was found. Our words *magnet* and *magnetism* were derived from this source.

Microlite is found in Virginia. Hardness, 6; specific gravity, nearly 6. Transparent to opaque. Consists of tantalum oxide, 86; lime, 12; and other oxides, etc. Color, hyacinth-red to yellow.

Moroxite is a bluish-green variety of apatite.

Natrolite is named from *natron,* soda. It is a limpid white mineral, the crystals of which are too small to cut for gems. Crystallization trimetric, in right rhombic prisms terminated by a short pyramid. Hardness, 4.5 to 5.5, and brittle; specific gravity, 2.14 to 2.23. Cleavage perfect parallel with lateral planes. Lustre vitreous; transparent to translucent. Consists of silica, 47.4; alumina, 26.9; soda, 16.2; water, 9.5. It becomes opaque and fuses to a glass bead before the blow-pipe, and forms a thick jelly with acids before or after heating. It is found in Nova Scotia, New Jersey, and the Lake Superior copper region. Used occasionally for the letter "N" in initial jewelry.

Octahedrite is a variety of rutile, probably the same, except for color, as that called anatase. It occurs in flat glassy crystals of yellow and blue, small but brilliant, in the United States and Brazil.

Pectolite is a mineral of crypto-crystalline structure, having very fine inseparable fibres, curved, radial, and interwoven. Hardness, 7, and very tough; specific gravity, 2.8 to 3, the dark varieties being heavier. It has no cleavage, and the fracture is uneven. Lustre, silky. Composition varies, but averages, silica, 55; lime, 30 to 34; soda, 7 to 9; water, 3 to 5. Fuses to a white transparent glass. Exposed to the weather, its china-like transparency changes to an earthy appearance, which shows its fibrous structure plainly. Color, from white to pale and dark green. Found in Alaska and California. A silicate of alumina found in the Tyrols and Lake Superior region, is rated for hardness 4 to 5.

Phenacite is found in Russia, Alsace, and Mexico. Its crystals and cleavage are rhombohedral. Hardness, 7.5 to 8; specific gravity, 2.97 to 3. Lustre vitreous; transparent to semitranslucent. Doubly refractive. Composition: silica, 54; glucina, 46. It is unaltered before the blow-pipe. Color, reddish yellow, brown, and colorless. When colorless it is very brilliant under artificial light.

Prehnite is an oily-green mineral resembling chrysoprase in lustre and color. It occurs in right rhombic prisms, usually barrel-shaped and six-sided; often reniform and botryoidal. Hardness, 6 to 6.5. Specific gravity 2.8 to 2.96. Lustre vitreous. Subtransparent to translucent. Composition: silica, 43; alumina, 23.25; protoxide of iron and manganese, 2.25; lime, 26; water, 4. Melts to a light green slag under the blow-pipe, and dissolves slowly in muriatic acid. It is found in the Eastern States and Lake Superior region.

Pyrite is sulphide of iron. A variety which is found in crusts of small, brilliant crystals, is trimmed and cut into various shapes for jewelry. These and some larger single crystals are found in Pennsylvania. Crystals sufficiently compact to be faceted have been found in Colorado and sold in Europe under the name of marcasite.

Rhodonite is a manganese spar used largely in Russia as an ornamental stone. Crystallization monoclinic, in oblique rhombic prisms. Hardness, 5.5 to 6.5; specific gravity, 3.6 to 3.7. Cleavage indistinct. Lustre vitreous; transparent to opaque. Very tough. Composition: silica, 39.6; manganous oxide, 52.6; ferrous oxide, etc., 7.8. It blackens with exposure, turns brown when heated, and fuses to a hyacinth bead in the outer flame. Color, flesh to light red. Found in Sweden, Russia, and the United States.

Rutile is pure titanium oxide. Crystallization dimetric, in prisms of eight, twelve, or more sides, with pyramidal terminations, and often bent. Hardness, 6 to 6.5; specific gravity, 4.15 to 4.25. Cleavage lateral. Lustre submetallic; transparent to opaque. Some transparent stones have been cut. Composition: titanium, 61; oxygen, 39. Infusible before the blow-pipe alone, but melts to a red bead with borax. Color, black and red. The crystals are often found embedded in a compact red oxide of iron. Long, slender crystals occur in the body of rock crystal, in which case it is called "Venus's hair stone," and "love's arrows." It is found in Europe, Georgia, North Carolina, Connecticut, and Colorado. Cut black rutile strongly resembles the black diamond.

Scapolite is found in Norway, Sweden, Finland, at Vesuvius, and in the Eastern United States. Crystallization dimetric, in modified square prisms, often terminating in pyramids. Hardness, 5 to 6; specific gravity, 2.6 to 2.75. Lustre pearly; transparent to opaque. Cleavage indistinct parallel to lateral planes. Composition: silica, 48.4; alumina, 28.5; lime, soda, etc., 23.1. Fuses slowly before the blow-pipe, and with borax melts with effervescence to a transparent glass. Color, white, pale blue, green, or red; purple, pink, and lavender are found in Massachusetts. Streak uncolored.

Serpentine is a deep green stone, very soft, and useless as a gem.

Smaragdite, a variety of hornblende, is of emerald-green, gray, and greenish-gray color. It is also found with pink and ruby corundum disseminated through it. Consists of silica, alumina, magnesia, lime, soda, ferrous, and other oxides. Hardness, 5.5; specific gravity, 3.12.

Sodalite is found in dodecahedrons, like lapis lazuli. Hardness, 6; specific gravity, 2.25 to 2.3. Composition: silica, 37.2; alumina, 31.7; soda, 19.1; sodium, 4.7; chlorine, 7.3. Color, gray, brown, violet to deep azure-blue. Found in Greenland, Vesuvius, and in the State of Maine.

Spodumene, or triphane, takes a high polish, but is difficult to work, being harder in one direction than another, and of very easy cleavage. Crystallization monoclinic, in modified oblique rhombic prisms. Hardness, 6.5 to 7; specific gravity, 3.1 to 3.19. Surface of cleavage pearly. The fragments in which it is usually found show two parallel cleavage planes. Translucent to subtranslucent. Composition: silica, alumina, lithia, and a small proportion of iron oxide and soda. Acids do not attack it, but it fuses before the blow-pipe to a transparent glass. Color, gray to greenish yellow. It is found in many localities in Europe and the United States, but transparent only in Brazil. Hiddenite is a variety of spodumene, containing about two per cent. more lithia.

Staurolites, or staurotide, from the Greek *stauros*, a cross. Crystallization trimetric, in right rhombic and six-sided prisms. Some of the crystals are cruciform, having twinnings, or two prisms crossing one another in the form of a cross. Hardness, 7 to 7.5; specific gravity, 3.65 to 3.73. Cleavage imperfect. Lustre vitreous to resinous; transparent to opaque. Color, reddish brown to black. Transparent stones cut like poor garnets. Composition: silica, 29.3; alumina, 53.5; peroxide of iron, 17.2. It darkens but does not fuse before the blow-pipe. It is found in Europe and the Eastern States. Staurolites are used abroad as charms, and there is a legend in Brittany, France, that those found there were cast from heaven.

Sunstone, or aventurine feldspar, is like moonstone, a variety of orthoclase, and is very similar, except that it is reddish gray or reddish gold to gray, and shows internal prismatic reflections arising from minute crystals of oxide of iron or mica scattered throughout the stone. It is found in various parts of Europe, Ceylon, and the United States, but is seldom used, as an imitation called "goldstone" has been preferred.

Thomsonite was named after Dr. Thomas Thomson, of Glasgow. Crystallization trimetric, in right rectangular prisms; usually in masses, and found as rolled pebbles in size from a pin-head to an inch in diameter. Hardness, 5 to 6, brittle; specific gravity, 2.3 to 2.4. Lustre vitreous to pearly; translucent. Composition: silica, 37.4; alumina, 31.8; lime, 13; soda, 4.8; water, 13. Edges round merely at a great heat. The pebbles found on the beach at Lake Superior show a series of concentric layers of color in shades of flesh-red, creamy white, yellow, and green, similar when polished to an eye-agate. They are cut by simply rounding off and polishing to show the markings.

Thulite is a red variety of epidote, containing fourteen per cent. of oxide of manganese. It is pink in color, whereas the manganesian epidote is of the darker shades of red. Lustre vitreous; translucent to opaque. Thulite is being cut for brooches and as drops for pendants. It appears, when cut, an opaque, mottled pink stone. It fuses to a black glass.

Vesuvianite, known also as idocrase and xanthite, is named after Vesuvius, in the lava of which it was first found, Idocrase is derived from the Greek *eidō,* to see, and *krasis,* mixture: an allusion to the resemblance of its crystalline forms to those of other species. The crystallization is dimetric, in modified square prisms. Hardness, 6.5; specific gravity, 3.3 to 3.5. Cleavage indistinct parallel to sides. Subtransparent to opaque. It has been found sufficiently transparent to cut for initial jewels. Doubly refractive to a high degree. Composition: silica, lime, alumina, and ferrous oxide mainly. Fuses under the blow-pipe with effervescence to a yellow bead, and is attacked by acids. Color, yellowish brown to brown, and red; sometimes green; in some varieties it is oil-green in the direction of the axis, and yellowish green at right angles with it. Streak uncolored. It is obtained in various parts of Europe and the United States. A brown variety from Bohemia has been called "egeran." Blue crystals, supposed to be colored by copper, have been named "cyprine."

Willemite, formerly called "troöstite," is an anhydrous silicate of zinc found in Belgium and New Jersey. It occurs in large hexagonal prisms with rhombohedral terminations. Hardness, 5 to 5.5; specific gravity, 4 to 4.1. It does not take a high polish, but it is hoped that it may be found sufficiently transparent for gem use. Lustre vitreous; opaque to transparent. Color, gray, honey-yellow to apple-green, and a rich brown. It consists of silica, 27.15; oxide of zinc, 72.85.

Williamsite is a rich green variety of serpentine, used for decorative purposes. It is translucent and frequently mottled. Hardness, 4; specific gravity, 2.6.

Wollastonite is a tabular spar found in Canada, New York State, Pennsylvania, and Lake Superior. Crystallization monoclinic, in distinct oblique flattened prisms, to a fibrous structure; usually massive. Hardness, 4 to 5, brittle, and nearly as tough as jade. Specific gravity, 2.75 to 2.9. Lustre vitreous, inclining to pearly; translucent. Cleavage easy in one direction, showing a lined surface. Composition: silica, 52; lime, 48. Fuses with difficulty to colorless glass; with borax, to transparent glass. Color, white to yellowish pink or brown.

Zoisite is a variety of epidote, with two to nine per cent. of oxide of iron. The prisms are often striated longitudinally. The name was given originally to the epidote of grayish or hair brown, but yellowish-brown and greenish-gray crystals have been found in Tennessee, and rose-red in Pennsylvania. The finest come from Norway. It fuses on the edges and swells up before the blow-pipe, but does not liquefy. Hardness, 6 to 7; specific gravity, 3.25 to 3.46; brittle. Lustre vitreous; translucent to opaque.

Zonochlorite is a banded green stone, from which appearance its name was taken. It is found in the Lake Superior region.

XXII

HARDNESS

The scale of hardness does not represent exact and absolute degrees of that quality, but is simply an arrangement of minerals of different degrees from the softest to the hardest known, numbered, for convenient reference, from 1 to 10. Many suppose the numbers represent exact quantities in the progressive scale, as the numbers of inches on a foot-rule express an exact quantity of extension. It is not so. Minerals, constant in the quality of hardness, of various degrees, were selected, and numbers attached to them as they increased in hardness, from talc, the softest, to diamond, the hardest; but the difference between the minerals does not necessarily correspond with the ratio of the numbers. The difference between the diamond (10) and sapphire (9) is much greater than between sapphire (9) and topaz (8). In fact, the diamond is said to be as much harder than the sapphire as the sapphire is harder than talc. The scale is arranged simply as a means for the comparison of the relative hardness of minerals, and not for the purpose of expressing in terms a definite degree of the quality. In saying that emerald is 7.5 to 7.8, it is meant that its hardness lies about half-way between that of quartz (7) and topaz (8), and that its variations incline towards the harder mineral. The Moh scale is as follows:

1. Talc, common foliated variety.
2. Gypsum, or rock salt.
3. Calcite, transparent variety.
4. Fluorspar, crystallized variety.
5. Apatite, transparent crystal.
6. Feldspar, cleavable variety.
7. Quartz, transparent variety.
8. Topaz, transparent crystal.
9. Sapphire, cleavable variety.
10. Diamond.

XXIII

HOW TO FIND THE SPECIFIC GRAVITY AND HARDNESS OF STONES

To obtain the specific gravity of a stone, first thoroughly cleanse it, removing all grease and air-bubbles. As the Kohlbusch pocket-scale is in most general use among jewellers, it is presumed that it will be used in the experiment. Weigh the stone, noting the exact weight to the smallest fraction. Then loop one of the cords by which one of the pans is suspended through the ring from which it hangs, so that it will hang sideways without interfering with the balance of the scales. Take a thin silken thread, double it, make a double loop at one end that will hold the stone and suspend it from the ring to which the pan is attached; or, better still, take a fine aluminum wire, bend it at one end to an open stud spiral, to a hook at the other; put the stone to be weighed in the spiral and hook the wire to the ring from which the pan is suspended. Place under it a wide-mouthed vial of convenient size (about two and a half inches high, with a half-inch opening) containing distilled water at 60° F., and, hanging the stone immersed in this, weigh it again. Deduct the weight of the wire. Then divide the first weight (in air) by the difference between the first and second weights (second in water), and the result will be the specific gravity. Be sure that the stone hangs free and is completely immersed when it is weighed.

To find the hardness of a stone use a finely tempered steel point upon an under facet near the girdle. This will bite with growing difficulty until quartz is reached. The higher the tone which comes from the scratching, the harder the stone.

For tests of stones harder than quartz, take stones of known hardness, as diamond, ruby, sapphire, and topaz, find a smooth polished place on the edges of both stones used, and draw them across each other; that which scratches the other is, of course, the hardest. If the stone being tested is the softer one, try it with other known stones of less hardness than the first used, until its place in the scale is found. If it is harder, reverse the process.

Observation of the facet edges of a stone under the loop will give an idea of its hardness, as the edges of a soft stone are more or less rounded; they cannot be cut to the sharp edge of the harder gems.

In making a test of hardness, judgment must be used to avoid damage to valuable stones.

XXIV

SIMILAR STONES AND HOW TO DISTINGUISH THEM

1. Cat's-Eye; Quartz Cat's-Eye; Crocidolite Cat's-Eye

The Oriental cat's-eye, a variety of chrysoberyl, and third in the scale of hardness, being 8.5, has a natural imitation in the quartz cat's-eye. The latter is softer (7), and lacks both the lustre and mellow coloring of the Oriental. The specific gravity is also 2.65 as against the 3.65 to 3.75 of the chrysoberyl.

Crocidolite, or tiger-eye, is also cut and artificially colored to imitate cat's-eye. It is much softer, has a silky lustre, and the chatoyant light is neither sharp nor concentrated.

2. Chrysoberyl; Chrysolite

In the yellow and greenish-yellow colors of these stones there is little difference for the eye to distinguish. Except in unusually fine specimens, the latter has a somewhat greasy lustre, compared with the former, which looks sharper and harder, though many are not perfectly transparent, inclining somewhat to a cats'-eye chatoyancy. As the dichroism is not very decided in either, the only sure test in case of doubt is by hardness and specific gravity.

	Hardness.	Specific Gravity.
Chrysoberyl	8.5	3.65 to 3.75
Chrysolite	6.5 to 7	3.34 to 3.37

3. Ruby and Spinel

These stones sometimes approach each other very closely in general appearance, although the red of the ruby, when it is not clean, shows a black or purple tendency, whereas the spinel inclines to a suspicion of yellow. When the color of the latter is most free from the yellow taint, it still lacks the lustre of the ruby. The dichroiscope will establish their identity, as the ruby is doubly refractive and the spinel single.

	Hardness.	Specific Gravity.	
Ruby	9	3.9 to 4.1	Refraction double.
Spinel	8	3.60 to 3.63	Refraction single.

4. Ruby and Garnet

Some of the finer red garnets have a very clear and beautiful red color, and when finely cut might deceive some. They all lack the hard lustre and transparent color of the ruby, and are singly refractive. The difference can be found in the hardness. Specific gravity is not as sure a test, as some garnets are nearly as heavy as the ruby.

	Hardness.	Specific Gravity.	
Ruby	9	3.9 to 4.1	Refraction double.
Garnet	7.25	3.65 to 3.86	Refraction single.

5. Spinel and Garnet

There is a greater resemblance betwen these two than any other red stones, especially when cut alike. Some of the garnets are very nearly spinel color, and, as they are both single refraction stones, and their specific gravity and hardness are very nearly the same, it is difficult to decide between them, except by very careful tests. There is, however, usually a clearer, finer appearance to the body of the spinel, and a difference in the hardness can be detected. The spinel and some of the essonite variety are most alike.

	Hardness.	Specific Gravity.
Spinel	8	3.60 to 3.63
Essonite	7.25	3.65

6. Ruby and Tourmaline (Red)

The red tourmaline is occasionally so nearly ruby-red in color as to necessitate care. The dichroism of the tourmaline is very similar to that of the ruby, but stronger. The color is not so deep nor the lustre so great, but it is often more transparent than the ruby. The test of hardness is sufficient, also specific gravity.

	Hardness.	Specific Gravity.
Ruby	9	3.9 to 4.1
Tourmaline	7.25	3.08

7. Spinel and Tourmaline (Red)

The dichroiscope will decide between these, as the spinel is singly refractive, the tourmaline strongly doubly refractive, and the latter lacks any yellow tint.

8. Tourmaline (Red) and Topaz (Red)

If the eye fails to distinguish between the rose-pink red of the tourmaline and the denser yellowish to brownish red of the topaz, hardness, specific gravity, or the dichroiscope will do so. One of the twin colors of the topaz is yellow.

	Hardness.	Specific Gravity.	Dichroism.
Topaz	8	3.50 to 3.56	Red and yellow.
Tourmaline	7.25	3.08	Rose and dark red.

9. Sapphire (Blue) and Tourmaline (Blue)

These may be distinguished by the quality of color. Whatever the shade of color in the sapphire, from corn-flower to indigo, it is always clearly blue. The tourmaline blue inclines to green. Under the dichroiscope this is reversed, the twin colors of the sapphire being dark blue and a light greenish blue, those of the tourmaline light and dark blue.

Either of the other tests is sufficient to establish identity.

	Hardness.	Specific Gravity.
Sapphire	9	3.9 to 4.1
Tourmaline	7.25	3.1

10. Cyanite, Fluorite, and Iolite

These stones, when blue, may be known by the several tests, and by certain peculiarities which characterize them. The lustre of the cyanite usually inclines to pearly; that of the iolite is somewhat greasy. The fluorite is generally phosphorescent at low temperatures.

	Hardness.	Specific Gravity.	
Cyanite	5 to 7	3.60	Dichroism perceptible.
Fluorite	4	3.1 to 3.2	Single refraction.
Iolite	7.25	2.60 to 2.66	Dichroism, blue and yellowish gray.

11. Sapphire, Topaz, Aquamarine, and Tourmaline, in Light Blue

The identity of these stones is easily determined. They are all doubly refractive, but the twin colors of the topaz only are distinct. They are colorless and bluish. Sapphire has a harder lustre; tourmaline a more inky color; aquamarine is a water blue; and topaz may be known by the hardness and specific gravity.

	Hardness.	Specific Gravity.
Sapphire	9	3.9 to 4.1
Topaz	8	3.50 to 3.56
Aquamarine	7.75	2.68 to 2.75
Tourmaline	7.25	3.1

12. Sea-Green Sapphire, Topaz, Aquamarine, and Euclase

These are all doubly refractive, but as the euclase is very rare, and the sapphire in this color is not often seen or desired, question is most likely to arise between the topaz and the aquamarine. In appearance they are very much alike. The dichroisms are distinct, however, the twin colors of the topaz being colorless and greenish blue, those of the aquamarine bluish and yellowish, and of the sapphire and euclase indistinct.

	Hardness.	Specific Gravity.
Sapphire	9	3.9 to 4.1
Topaz	8	3.50 to 3.56
Euclase	7.5	3.05 to 3.1
Aquamarine	7.75	2.68 to 2.75

13. Fluorite and other Sea-Green Stones

Fluorite is so much softer than other stones of this color, that it is easily known (hardness, 4).

14. Siam Ruby and Almandine

The purplish red of these two stones is sometimes similar, but the harder lustre and sharper transparency of the ruby are generally unmistakable. If there is doubt, the double refraction of the ruby will distinguish it.

15. Purple Spinel and Sapphire

These are often so much alike that it becomes necessary to have recourse to the dichroiscope as the easiest method of deciding. The spinel is single refraction, the sapphire double.

16. Amethyst, Siam Ruby, Almandine, Spinel, and Sapphire

The amethyst is more decidedly purple than the Siam ruby or the almandine, which are red with purple tints, and is a redder purple than the purple spinel and sapphire, which are darker and more inky.

17. Axinite, Apatite, and Fluorite (Purple)

These are seldom seen. Axinite shows a decided leaning to brown, and is strongly dichroic (violet, brown, green); the twin colors of apatite are weak, and fluorite is singly refractive.

	Hardness.	Specific Gravity.
Axinite	6.75	3.29 to 3.3
Apatite	5	3.2
Fluorite	4	3.1 to 3.2

18. Zircon, Garnet, Staurolites, Tourmaline, and Topaz of the Brownish-Red Color

There should be no difficulty in distinguishing these. The lustre of the zircon is much greater. The topaz shows less brown, the tourmaline more. Staurolites are seldom met with, and they are very dark. Some of the almandine and essonite garnets are similar to the zircon, but the brown tint is not so decided, nor are they as transparent or lustrous, and they do not show the inclination to yellow, noticeable in the topaz. The brown or brownish-red tourmaline shows more or less of a double color, inclining to amber. The dichroiscope will decide in a case of uncertainty. Zircon, staurolites, topaz, and tourmaline are doubly refractive, the two former weak, the two latter strong. Topaz, yellow and red. Tourmaline, light and dark brown. The garnets are single refraction.

19. Epidote, Vesuvianite, Axinite, Andalusite, and Cairngorm (in Gray to Brown Shades)

Except the cairngorm, these seldom come into the market. The following table will give a clue to the differences existing between them. They are all doubly refractive, but the colors of the vesuvianite and cairngorm are indistinct.

	Hardness.	Specific Gravity.	Dichroism.
Epidote	6.25	3.47 to 3.50	Green, yellow, brown.
Vesuvianite	6.5	3.4	Indistinct green, yellow.
Axinite	6.75	3.29 to 3.30	Violet, brown, green.
Andalusite	7.5	3.17 to 3.19	Yellow, red.
Cairngorm	7	2.65	Weak.

20. True Hyacinth (Zircon), Commercial Hyacinth (Essonite), Spinel, and Topaz in Reddish Yellow

The first of these may be known by its adamantine lustre and specific gravity (4.6 to 4.7); the topaz by its strong dichroism (red and yellow), and the other two by their single refraction. For difference between spinel and essonite, refer to No. 5.

21. Brownish-Yellow Varieties of Topaz, Citrine (same as Cairngorm only Yellow Tints), Epidote, Vesuvianite, Axinite, and Sphene

Remarks in No. 19 will apply to these. In addition, topaz is more deeply yellow in coloring, and harder than the others. Sphene is almost as soft as glass, does not give such decided colors under the dichroiscope, shows generally a greenish tendency, and is rarely quite transparent.

22. Hyacinth, Yellow Sapphire, Chrysoberyl, Chrysolite, Topaz, Golden Beryl, and Citrine (in Yellow)

Of these, the sapphire, topaz, beryl, and citrine are at times most nearly alike in general appearance.

The sapphire has a harder lustre and is generally like the light-yellow topaz. They are both more transparent than citrine, and usually lack the rich depth of the beryl's yellow. The hyacinth is distinguished by an inclination to red (it is never clean yellow) which does not appear in any of the others except topaz. Chrysoberyl and chrysolite have a similar tendency towards green. They are all double refraction stones, but the twin colors are decided only in the topaz (light and dark yellow). The variations of hardness and specific gravity between those most alike are sufficient to separate them with ease. The fluorite, a single refraction stone, softer than glass, is yellow also, but cannot be mistaken for either of the others.

	Hardness.	Specific Gravity.
Yellow sapphire	9	3.9 to 4.1
Chrysoberyl	8.5	3.68 to 3.78
Topaz	8	3.50 to 3.56
Hyacinth	7.5	4.6 to 4.7
Citrine	7	2.65
Chrysolite	6.5	3.33 to 3.37
Fluorite	4	3.1

23. Zircon, Sapphire, Chrysoberyl, Chrysolite, Hiddenite, and Tourmaline in Greenish Yellow

In these stones yellow is usually the stronger in the first four, and the green tint predominates in the latter. Individual characteristics are generally sufficient to distinguish them. The zircon has the greatest lustre, the sapphire is more transparent, chrysoberyl is usually somewhat milky, and chrysolite is not so lustrous or transparent as the zircon and sapphire.

	Hardness.	Specific Gravity.	Dichroism.
Sapphire	9	3.9 to 4.1	Decided.
Chrysoberyl	8.5	3.68 to 3.78	Weak yellow and green.
Tourmaline	7.25	3.1	Strong yellow and green.
Zircon	7.5	4.6 to 4.7	Very weak.
Hiddenite	6.75	3.17 to 3.20	Weak, light and dark green.
Chrysolite	6.75	3.33 to 3.37	Green and yellowish green.

24. Demantoid (Green Garnet), Epidote, Vesuvianite, Sphene, and Andalusite (in Yellowish Green)

The demantoid color is that of a fine emerald with a mixture of yellow. Epidote tends to brown. Vesuvianite is seldom very transparent. Sphene is rarely transparent. Andalusite inclines to reddish tint.

	Hardness.	Specific Gravity.	
Demantoid	6 to 6.5	3.83	Single refraction.
Andalusite	7.5	3.17 to 3.19	Dichroism, strong; yellow, green, red.
Epidote	6.5	3.47 to 3.5	Dichroism, strong; green, yellow, brown.
Vesuvianite	6.5	3.35 to 3.45	Dichroism, green and yellow.
Sphene	5.5	3.35 to 3.45	Dichroism, decided.

25. Green Zircon, Sapphire, Chrysoberyl, Diopside, and Tourmaline

The first two of these stones are very rarely seen. The specific gravity of the first and the hardness of the second distinguish them. The bottle-green chrysoberyl, or alexandrite, is known by its red color under artificial light. The diopside and tourmaline are more plentiful and very similar. As they are in this color sometimes almost identical in appearance, it is best when uncertain to put them to one of the usual tests.

	Hardness.	Specific Gravity.	Dichroism.
Sapphire	9	3.9 to 4.1	Decided; green and brown.
Chrysoberyl	8.5	3.68 to 3.78	Strong; green, yellow, red.
Zircon	7.5	4.6 to 4.7	Very weak, scarcely discernible.
Tourmaline	7.25	3.1	Strong; yellow and bluish green.
Diopside	6	3.2 to 3.3	Weak.

26. Epidote, Vesuvianite, Sphene, Apatite, Andalusite, Fluorite, and Dioptase (in Green)

Sphene in this color shows decided tints of yellow, green, and reddish brown under the dichroiscope. Dioptase is not quite clear, and is a very deep green. For the distinguishing marks of the others, refer to No. 24.

27. Emerald and Demantoid

These can scarcely be mistaken for each other, as the admixture of yellow in the green of demantoid (commercial olivine) is very marked. It is not, however, so discernible at night, when the color often appears to be the true emerald-green.

XXV

DISTINCTIVE CHARACTERISTICS OF VARIOUS STONES

THERE are some marked characteristics of certain stones which it is well to remember. Spinel and the garnets, like the diamond, are singly refractive.

Light reflected from the spinel is always yellow.

The lustre of the zircon, like that of the diamond, is adamantine.

Garnet, topaz, and tourmaline become electric by heating, as well as by friction.

Heat changes the color of topaz; it also changes the color of spinel and ruby, but the color returns as it cools.

Diamond, rock crystal, zircon, and fluorite are phosphorescent.

The green of the tourmaline tends towards blue; of the chrysolite and chrysoberyl, to yellow.

The red of the ruby inclines to blue or purple; of spinel, to yellow; of garnet, to both purple and yellow.

The blue of the sapphire has a purplish tendency; of the tourmaline, a greenish.

Mixed colors appear in the andalusite, sphene, and some brown tourmalines.

Imitations are warmer to the touch than stones, and a drop of water flattens and spreads over the surface as it does not on the genuine. An aluminum point will leave a mark upon the surface of an imitation when drawn over it. It will not do so on the precious stones.

Imitation amber made from gum copal can be detected by soaking in alcohol. The joining of pieces of amber glued or melted together can be discovered by the same method.

Imitation pearls, under the glass, as compared with the genuine, lack body, are iridescent, and show minute holes in the surface.

The eye cannot detect the yellow of off-color diamonds so clearly after looking at yellow stones.

White diamonds appear to have a brownish tint after one has looked at emeralds closely.

If one turns immediately from yellowish-green stones (chrysolite, etc.) to the examination of emeralds, the latter, even of the finest color, will seem to have a bluish tint.

In judging the color of stones, do not pass the eye directly from one color to another.

XXVI

TWIN COLORS OF DOUBLY REFRACTIVE STONES

Alexandrite	Green, yellow, red.
Amethyst	Weak.
Andalusite	(Yellowish green) yellow, green, red.
	(Green) yellow, green, red.
	(Gray and brown) yellow, red.
Apatite	Weak.
Aquamarine	(Sea-green) clear; bluish and yellowish.
	(Blue) weak.
Axinite	(Gray and brown) violet, brown, green.
Cairngorm	Weak.
Chrysoberyl	(Yellow) weak.
	(Yellowish green) yellowish and greenish.
Chrysolite	(Green) yellowish green and green.
	(Yellowish green) yellowish green and green.
	(Yellow) yellowish green and green.
Citrine	Weak.
Cyanite	(Blue) perceptible.
Dichroite	(Blue) light and dark blue and yellowish gray.
Diopside	Weak.

Dioptase	Weak.
Emerald	Green and blue-green or yellowish green.
Epidote	(Green) green, yellow, and brown.
	(Yellowish green) green, yellow, and brown.
	(Gray and brown) green, yellow, and brown.
Euclase	Perceptible.
Hiddenite	(Green) bright and dark green.
Olivine	See Chrysolite.
Peridot	See Chrysolite.
Phenacite	
Rose Quartz.........	Very weak.
Ruby	Bright and dark red.
Sapphire	(Blue) dark blue and greenish blue.
	(Light blue) colors not decided; weak.
	(Yellow) weak.
	(Yellowish green) distinct.
	(Green) green and brown.
Sphene	(Green) yellow, green, red-brown.
	(Yellowish green) distinct.
Staurolites	Weak.
Topaz	(Sea-green) colorless and greenish blue.
	(Light blue) colorless and bluish.
	(Pink) red and yellow.
	(Red) red and yellow.
	(Red-brown) red and yellow.
	(Yellowish red) red and yellow.
	(Yellowish brown) yellow and brownish red.
	(Yellow) light and dark yellow.
	(Yellowish green) distinct.

Tourmaline	(Green) yellow and greenish blue.
	(Yellowish green) yellow and green.
	(Reddish brown) light and dark brown.
	(Red) pink and dark red.
	(Blue) light and dark blue.
Vesuvianite	Distinct.
Zircon	Very weak in all colors.

XXVII

HARDNESS OF PRECIOUS STONES IN ORDER FROM THE HARDEST TO THE SOFTEST

Diamond	10
Sapphire	9
Ruby	8.8 to 9
Chrysoberyl	8.5
Cat's-eye	8.5
Alexandrite	8.5
Topaz	8
Spinel	7.5 to 8
Phenacite	7.5 to 8
Garnet	6 to 8
Emerald	7.5 to 7.8
Aquamarine	7.5 to 7.8
Tourmaline	7 to 7.8
Zircon	7.5
Euclase	7.5
Iolite	7 to 7.5
Staurolites	7 to 7.5
Andalusite	7 to 7.5
Jade	6.5 to 7.5
Danburite	7 to 7.2
Pectolite	7
Quartz	7
Amethyst	7
Cairngorm	7
Citrine	7
Rock crystal	7

Axinite	6.5	to	7
Gadolinite	6.5	to	7
Spodumene	6.5	to	7
Chrysolite	6.5	to	7
Epidote	6	to	7
Zoisite	6	to	7
Cyanite	5	to	7
Crocidolite	4	to	7
Vesuvianite	6.5		
Hiddenite	6.5		
Isopyre	6	to	6.5
Prehnite	6	to	6.5
Rutile	6	to	6.5
Moonstone	6	to	6.5
Hematite	5.5	to	6.5
Rhodonite	5.5	to	6.5
Opal	5.5	to	6.5
Turquoise	6		
Labradorite	6		
Sodalite	6		
Microlite	6		
Amazon stone	6		
Beryllonite	5.6	to	6
Allanite	5.5	to	6
Brookite	5.5	to	6
Chlorastrolite	5.5	to	6
Elæolite	5.5	to	6
Lazulite	5	to	6
Scapolite	5	to	6
Thomsonite	5	to	6
Diopside	5	to	6
Cobaltite	5.5		
Lapis lazuli	5.5		
Smaragdite	5.5		
Sphene	5	to	5.5

Datolite	5 to 5·5
Willemite	5 to 5·5
Obsidian	5 to 5·5
Glass	5
Natrolite	4·5 to 5·5
Apatite	4·5 to 5
Dioptase	4·5
Wollastonite	4·5
Azurite	3·5 to 4·5
Pearl	4
Fluorite	4
Williamsite	4
Aragonite	3·5 to 4
Malachite	3·5 to 4
Chiastolite	3 and over
Chrysocolla	2 to 3·5
Amber	2 to 2.5

XXVIII

SPECIFIC GRAVITY OF PRECIOUS STONES, SHOWING VARIATIONS AS RECORDED BY DIFFERENT MINERALOGISTS

Cassiterite	6.5		
Cobaltite	6.3	to	6.4
Microlite	6		
Hematite	4.5	to	5.3
Zircon, including hyacinth and jacinth	4.1	to	4.9
Gadolinite	4.1	to	4.4
Rutile	4.15	to	4.25
Almandine (wine-red garnet)	4.11	to	4.23
Allanite	3.3	to	4.2
Sapphire	3.94	to	4.16
Ruby	3.97	to	4.08
Willemite	4	to	4.1
Aragonite	3.5	to	4
Brookite	3.8	to	3.9
Cape ruby (garnet)	3.86		
Demantoid (green garnet)	3.83		
Azurite	3.5	to	3.8
Chrysoberyl	3.5	to	3.8
Pyrope (red garnet)	3.69	to	3.78
Staurolites	3.65	to	3.74
Rhodonite	3.6	to	3.7
Cyanite	3.4	to	3.7
Spinel	3.5	to	3.7
Topaz	3.5	to	3.56
Diamond	3.48	to	3.52

Epidote	3.3	to	3.5
Vesuvianite	3.3	to	3.5
Sphene	3.35	to	3.5
Chrysolite	3.33	to	3.5
Zoisite	3.25	to	3.46
Hypersthene	3.39		
Andalusite	3.1	to	3.32
Jade	2.95	to	3.3
Axinite	3.27	to	3.3
Diopside	3.10	to	3.3
Dioptase	3.28	to	3.29
Apatite	3.16	to	3.22
Hiddenite	3.18	to	3.20
Fluorite	3.1	to	3.2
Chlorastrolite	3.2		
Spodumene	3.1	to	3.19
Tourmaline (green and blue)	3	to	3.15
Smaragdite	3.12		
Lazulite	3.1		
Tourmaline (red)	3	to	3.08
Euclase	3	to	3.05
Tourmaline (pink and colorless)	3	to	3.02
Phenacite	2.95	to	3
Isopyre	2.9	to	3
Datolite	2.9	to	3
Pectolite	2.8	to	3
Prehnite	2.8	to	2.96
Danburite	2.96		
Wollastonite	2.75	to	2.9
Turquoise	2.6	to	2.8
Beryllonite	2.8		
Aquamarine	2.65	to	2.75
Beryl	2.65	to	2.75
Emerald	2.65	to	2.75
Scapolite	2.6	to	2.75

Cairngorm	2.65 to 2.7
Amethyst	2.65 to 2.7
Iolite	2.6 to 2.7
Pearl	2.5 to 2.7
Citrine	2.65
Jasper	2.65
Rock crystal	2.65
Chrysoprase	2.65
Chalcedony, agate, etc.	2.65
Elæolite	2.4 to 2.65
Obsidian	2.5 to 2.6
Moonstone	2.4 to 2.6
Williamsite	2.6
Lapis lazuli	2.3 to 2.5
Thomsonite	2.3 to 2.4
Sodalite	2.25 to 2.3
Chrysocolla	2 to 2.3
Natrolite	2.14 to 2.23
Opal	2 to 2.2
Amber	1.08

XXIX

STONES AND THE COLORS IN WHICH THEY OCCUR

Achroite	Colorless tourmaline.
Adularia	Moonstone.
Allanite	Bright black.
Alexandrite	Light to dark tourmaline green by day; purplish pink to red by artificial light.
Almandine	Wine-red garnet.
Amazon Stone	Light green.
Amber	Yellow in all shades, tending to white and red or brown and black.
Amethyst	Pale to deep violet and purple.
Andalusite	Mixed, green, brown, and yellow.
Apatite	Green, pink, and violet.
Aragonite	Gray, amber, and brown.
Aquamarine	Sea-green, water-blue, and almost colorless.
Axinite	Brown, blue, and gray.
Azurite	Deep blue.
Beryllonite	Yellow.
Bowenite	White, and light to dark green.
Brookite	Red and honey-yellow.
Calcomalachite	Green.
Cairngorm	Brownish yellow rock crystal.
Cancrinite	Pale to orange-yellow.
Cape Ruby	Deep-red garnet.
Carbuncle	Red garnet.

CAT'S-EYE	Gray, brown, and black, with yellowish or greenish tints.
CAVE PEARLS	Gray.
CHIASTOLITE	Black, blackish gray, and white.
CHLORASTROLITE	Green, mottled.
CHRYSOBERYL	Yellow to brown, and various shades of green.
CHRYSOLITE	Yellow, olive-green, bright green.
CYMOPHANE	Milky colors of the chrysoberyl.
CINNAMON-STONE	Brownish-red garnet.
CHRYSOCOLLA	Light to dark mottled greenish blue.
CITRINE	Yellow rock crystal.
COBALTITE	Flesh color.
COMPACT TITANIC IRON	Black.
CORAL	Red, pink.
CASSITERITE	Brownish white to reddish brown.
CROCIDOLITE	Light brown, brownish yellow, green, and greenish blue.
CYANITE	Bluish, yellowish, and reddish white, sapphire-blue, gray, and green.
DATOLITE	White, creamy, and flesh-colored.
DANBURITE	Wine, honey or yellowish brown.
DEMANTOID	Green garnet.
DIAMOND	Colorless, red, green, blue, pink, violet, yellow, brown, and black.
DICHROITE	See Iolite.
DIOPSIDE	Green, greenish gray and white, blue.
DIOPTASE	Brilliant green.
ELÆOLITE	Blue.
EMERALD	Green, pale to dark grass-green.
ENSTATITE	Rhodonite.
EPIDOTE	Gray to grayish green and blue with brown and red tints.
ESSONITE	Yellowish to brownish-red garnet.
EUCLASE	Straw to green and blue.

Fluorite	Colorless, purple, red, green, etc.
Fossil Corals	Red.
Gadolinite	Gray to grayish green and blue with brown and red tints.
Garnet	Red, pink, cinnamon, orange, yellow, pale green, bright green.
Grossularite	Pale-green garnet.
Hematite	Grayish black.
Hiddenite	Various and intermixed shades of yellow and green.
Hyacinth	Orange-red garnet.
Hypersthene	Grayish, greenish and jet blacks, green, and dark brown.
Indicolite	Blue tourmaline.
Iolite	Colorless, yellowish shades of white, gray, and brown, violet, indigo, and blue.
Isopyre	Dark green.
Idocrase	Vesuvianite.
Jacinth	Yellowish-red garnet.
Jade	Deep green.
Jargoon	Brown zircon.
Jet	Black.
Labradorite	Gray, brown, or greenish brown, containing prismatic hues.
Lapis Lazuli	Blue with yellow spangles.
Lazulite	Dark blue.
Lepidolite	Pink and lavender to heliotrope.
Lintonite	Nearly colorless.
Lodestone	Black.
Malachite	Bright green.
Microlite	Hyacinth-red to yellow.
Montana Ruby	Red garnet.
Moonstone	Gray, with blue, green, yellow, or red tints.

MORION	Black rock crystal.
MOROXITE	Bluish green.
NATROLITE	Limpid white.
OBSIDIAN	Green, yellow, blue, white, velvet-black to gray and brown, streaked brown, black, and yellow spotted.
OCTAHEDRITE	Yellow, blue.
OLIVINE	Yellow, olive-green, bright green.
OPAL	White, yellow, brown, and red body, containing prismatic colors.
ORTHOCLASE	Moonstone.
PEARL	White, pink, yellow, brown, bronze, blue, etc.
PECTOLITE	White, pale, and dark green.
PERIDOT	Light olive to yellow green.
PHENACITE	Reddish yellow, brown, colorless.
PREHNITE	Oily green.
PYRITE	Gray to yellowish black.
PYROPE	Deep-red garnet.
QUARTZ:	
AGATE	Nearly all colors.
ASTERIATED	Gray, etc.
AVENTURINE	Red and yellow, spangled.
BASANITE	Velvet-black.
BECKITE	Similar to chalcedony.
BLOODSTONE	Deep green with red spots.
CAT'S-EYE	Gray and greenish gray.
CHALCEDONY	Clouded white, yellow, brown, blue.
CHRYSOPRASE	Pale bluish or yellowish green.
CARNELIAN	Yellow, brown, red.
HELIOTROPE	See Bloodstone.
JASPER	Red, yellow, brown, gray, and sometimes blue.
ONYX	Various in strata.
PLASMA	Various greens.

PRASE	Deep green.
ROSE QUARTZ.....	Pink.
SARD	Brownish red.
SARDONYX	Brownish red with strata.
SIDERITE	Grayish, indigo and Berlin blue.
SAGENITE	Colorless, penetrated by crystals of other minerals.
ROCK CRYSTAL....	Colorless.
RHODOLITE	Pink garnet.
RHODONITE	Flesh to light red.
RUBY	Blood and wine-red; pink.
RUBELLITE	Red tourmaline.
RUTILE	Black and red.
SAPPHIRE	Blue, yellow, pink, green, purple, etc.
SCAPOLITE	Purple, pink, and lavender.
SCHORL	Black tourmaline.
SERPENTINE	Deep green.
SMARAGDITE	Green, greenish gray, gray.
SODALITE	Violet to deep azure-blue.
SPESSARTITE	Yellow garnet.
SPHENE	Yellow to green intermixed.
SPINEL	Yellowish red, violet and indigo-blue, light to blackish green.
SPODUMENE	Gray to greenish gray.
STAUROLITES	Reddish brown to black.
SUNSTONE	Gray, reddish gray, and gold with prismatic reflections.
THOMSONITE	Flesh with concentric markings of red, yellow, and green.
THULITE	Mottled pink.
TOPAZ	White, light green, and blue; pink; all shades of yellow to red.
TOURMALINE	Green, pink, red, blue, gray, brown, and colorless.
TURQUOISE	Azure-blue in various shades.

Uwarowite	Green garnet.
Vesuvianite	Yellowish brown to brown and red.
Willemite	Honey-yellow, apple-green, brown.
Wollastonite	White to yellowish pink.
Williamsite	Mottled green.
Xanthite	Vesuvianite.
Zircon	Brown, red, yellow, green.
Zoisite	Yellowish brown, greenish gray, rose-red.
Zonochlorite	Banded green.

XXX

COLORS AND THE STONES IN WHICH THEY OCCUR

COLORLESS ....Diamond, fluorite, hiddenite, iolite, natrolite, phenacite, rock crystal, sapphire, sagenite, topaz, tourmaline.

WHITE ....Bowenite, chalcedony, datolite, opal, pearl.

GRAY ....Axinite, cats-eye, cyanite, diopside, epidote, jasper, labradorite, moonstone, pearl, obsidian, smaragdite, sunstone, tourmaline.

BLACK ....Allanite, basanite, chiastolite, diamond, gadolinite, hematite, hypersthene, jet, obsidian, pearl, pyrite, spinel.

BROWN ....Amber, andalusite, axinite, carnelian, cat's-eye, chalcedony, crocidolite, danburite, diamond, hypersthene, jasper, labradorite, obsidian, pearl, phenacite, staurolites, tourmaline, vesuvianite, willemite, zircon or jargoon, zoisite.

YELLOW ....Amber, andalusite, aragonite, aventurine, brookite, carnelian, cancrinite, cat's-eye, chrysoberyl, chrysolite, diamond, fluorite, garnet, hiddenite, jasper, microlite, obsidian, octahedrite, opal, pearl, phenacite, sapphire, topaz, willemite, zircon.

BLUE .... Aquamarine, aragonite, axinite, azurite, brookite, chalcedony, cyanite, chrysocolla, diamond, diopside, epidote, euclase, elæolite, iolite, jasper, lapis lazuli, lazulite, obsidian, octahedrite, pearl, sapphire, siderite, sodalite, spinel, topaz, tourmaline, turquoise.

GREEN .... Alexandrite, amazon stone, apatite, aquamarine, bloodstone, bowenite, chalcedony, chlorastrolite, chrysoprase, chrysocolla, crocidolite, cyanite, diamond, diopside, dioptase, emerald, epidote, euclase, fluorite, garnet, hypersthene, isopyre, jade, moroxite, malachite, obsidian, olivine, pectolite, peridot, plasma, prase, prehnite, sapphire, smaragdite, spinel, serpentine, topaz, tourmaline, williamsite, willemite, zircon, zonochlorite.

RED .... Alexandrite, aventurine, carnelian, coral, diamond, fluorite, garnet, jasper, microlite, rhodonite, rutile, ruby, sard, sardonyx, spinel, sunstone, topaz, tourmaline, zircon, vesuvianite, zoisite.

PURPLE .... Amethyst, fluorite, pearl, sapphire, scapolite, spinel.

VIOLET .... Apatite, diamond, iolite, lepidolite, sapphire, spinel.

PINK	Apatite, cobaltite, coral, diamond, garnet, lepidolite, pearl, rhodolite, rose-quartz, ruby, sapphire, scapolite, thulite, tourmaline, topaz, wollastonite.
MIXED COLORS	Thomsonite, andalusite, sphene, tourmaline.

XXXI

THE ALPHABET OF PRECIOUS STONES

Letter.	Transparent Stones.	Opaque Stones.
A.	Amethyst.	Agate.
	Alexandrite.	Aventurine.
	Almandine.	
B.	Beryl.	Bloodstone.
C.	Chrysoberyl.	Cacholong.
	Carbuncle.	Carnelian.
	Cairngorm.	Chrysoprase.
	Cinnamon-stone.	Cat's-eye.
	Cymophane.	
D.	Diamond.	Datolite.
E.	Emerald.	Egyptian pebble.
F.	Feldspar.	Fluorite.
G.	Garnet.	Granite.
H	Hyacinth.	Heliotrope.
	Hiddenite.	Hematite.
I	Idocrase.	Ilvaite.
	Iolite.	Isopyre.
J	Jargoon.	Jasper.
K	Kyanite.	Krokidolite.
L.	Lynx sapphire.	Lapis lazuli.
M	Moonstone.	Malachite.
N.	Natrolite.	Nephrite.
O.	Opal.	Onyx.
P.	Pyrope.	Pyrite.
	Peridot.	Plasma.
Q.	Quartz.	Quartz agate.

Letter.	Transparent Stones.	Opaque Stones.
R	Ruby.	Rose quartz.
S	Sapphire.	Sard.
	Spinel.	Sardonyx.
	Sphene.	Staurolites.
T	Topaz.	Turquoise.
	Tourmaline.	Thomsonite.
U	Uranite.	Ultramarine.
		Uralian emerald.
V	Vesuvianite.	Verd antique.
W	Water sapphire.	Wood opal.
	Willemite.	Williamsite.
X	Xanthite.	Xylotile.
Z	Zircon.	Zonochlorite.

XXXII

STONES IN THE JEWISH HIGH PRIEST'S BREASTPLATE

Twelve precious stones were set in the breastplate of the Jewish High Priest, in four rows of three each, counting from left to right, each bearing the name of one of the children or tribes of Israel engraved upon it. (Exodus xxviii.)

Row.	Bible Name.	Translated by Later Biblical Writers.	Arranged by G. F. Kunz.	Remarks.
First	Sardius.	Carnelian.	Carnelian.	Name in the original means "red stone;" by some thought to be ruby; probably carnelian.
	Topaz.	Olivine.	Peridot.	Topaz of ancients was green color. The three Targums call this stone jarken or jarketha, which signifies green; olivine, probably.
	Carbuncle.	Ruby.	Emerald.	Septuagint and Braunius think emerald is meant. Danaeus says ruby. Carbuncle generally signified a fiery red stone.
Second	Emerald.	Emerald.	Ruby.	Rendered by the Targums of Onkelos and Jonathan, "emerald;" by the Septuagint, "carbuncle;" by Braunius, Aborbinel, and others thought to be ruby.
	Sapphire.	Lapis lazuli.	Lapis lazuli.	The sapphire of the ancients, sky-blue with golden spots, is lapis lazuli.
	Diamond.	Diamond.	Agate.	Dr. Gill says its name "jahalom," signifying "to break," accords with the character of the stone, and means, as it is translated, "diamond."
Third	Ligure.	Jacinth.	Sapphire.	Braunius and Ainsworth suppose it to be jacinth.
	Agate.	Agate.	Banded agate.	Undoubtedly agate as we know it.
	Amethyst.	Amethyst.	Amethyst.	The name "achlamah" is from a word signifying "to dream." This stone was supposed to cause people to dream.
Fourth	Beryl.	Chrysolite.	Topaz.	The name "tarshish" signifies the sea. Braunius and Ainsworth take it to mean the chrysolite, and it is so rendered by the Septuagint.
	Onyx.	Sardonyx.	Beryl.	Braunius, Josephus, and others say sardonyx is meant.
	Jasper.	Jasper.	Jasper.	Undoubtedly jasper.

XXXIII

SYMBOLS OF MONTHS

Month.	Polish.	Jewish.	Modern.
January	Garnet.	Garnet.	Garnet.
February	Amethyst.	Amethyst.	Amethyst.
March	Bloodstone.	Jasper.	Bloodstone.
April	Diamond.	Sapphire.	Diamond.
May	Emerald.	Agate.	Emerald.
June	Agate.	Emerald.	Pearl.
July	Ruby.	Onyx.	Ruby.
August	Sardonyx.	Carnelian.	Sardonyx.
September	Sardonyx.	Chrysolite.	Sapphire.
October	Beryl.	Beryl.	Opal.
November	Topaz.	Topaz.	Topaz.
December	Turquoise.	Ruby.	Turquoise.

XXXIV

APOSTLE STONES

1. Jasper .... Peter.
2. Sapphire .... Andrew.
3. Emerald .... John.
4. Chalcedony .... James.
5. Sardonyx .... Philip.
6. Carnelian .... Bartholomew.
7. Chrysolite .... Matthias.
8. Beryl .... Thomas.
9. Topaz .... James the younger.
10. Chrysoprase .... Thaddeus.
11. Amethyst .... Matthew the Apostle.
12. Hyacinth .... Simeon.

XXXV

THE SYMBOLIC SIGNIFICANCE OF PRECIOUS STONES

Agate	Health, longevity, wealth.
Alexandrite	Undying devotion.
Amethyst	Deep and pure love, prevents intoxication.
Beryl	Happiness, everlasting youth.
Bloodstone	Courage, wisdom.
Carnelian	Prevents misfortune.
Cat's-Eye	Warns of danger and trouble.
Chalcedony	Disperses melancholy.
Chrysolite	Gladdens the heart.
Diamond	Purity, preserves peace, prevents storms.
Emerald	Immortality, incorruptibility, conquers sin and trial.
Garnet	Insures power, grace, and victory.
Hyacinth	Gives second sight.
Jacinth	Modesty.
Jasper	Courage, wisdom.
Moonstone	Good luck.
Onyx	Conjugal felicity.
Opal	Hope, innocence, purity, ill-omen.
Pearl	Purity, innocence.
Ruby	Charity, dignity, divine power.
Sapphire	Constancy, truth, virtue.
Sardonyx	Conjugal happiness.
Topaz	Friendship, happiness.
Turquoise	Prosperity, soul-cheer.

XXXVI

IMPORTATIONS OF DIAMONDS INTO THE UNITED STATES FROM 1867 TO 1889

Year.	Rough.	Cut.
1867		$1,317,420
1868		1,060,544
1869		1,997,282
1870		1,768,324
1871		2,340,482
1872		2,939,155
1873	$176,426	2,917,216
1874	144,629	2,158,872
1875	211,920	3,234,319
1876	186,404	2,409,516
1877	78,033	2,110,215
1878	63,270	2,970,469
1879	104,158	3,841,335
1880	129,207	6,690,912
1881	253,596	8,320,315
1882	449,513	8,377,200
1883	443,996	7,598,176
1884	367,816	8,712,315
1885	371,679	5,628,916
1886	332,822	7,915,660
1887	262,357	10,526,998
1888	322,356	10,473,329
1889	195,341	11,466,708

XXXVII

IMPORTS OF PRECIOUS STONES FROM 1892 TO 1902

In the following table "uncut diamonds" include miners', glaziers', and engravers', not set, and watch jewels up to 1896, inclusive. From 1897 uncut diamonds only. "Cut diamonds" include other precious stones up to 1896, inclusive. Years end June 30.

Year.	Uncut Diamonds.	Cut Diamonds.	Other Cut Stones, including Pearls.
1892	$1,096,587	$12,354,420	....
1893	1,066,586	15,168,746	....
1894	566,267	4,844,809	....
1895	562,890	6,863,288	....
1896	113,888	6,598,527	....
1897	47,865	1,937,944	$686,789
1898	2,517,759	4,438,030	1,982,456
1899	3,678,266	8,497,284	2,141,106
1900	3,891,226	7,890,945	2,403,048
1901	6,574,630	11,680,823	2,134,980
1902	6,154,853	12,732,620	4,403,919

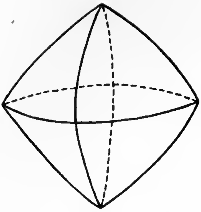
The above table marks very plainly the period during which the duty on cut diamonds was twenty-five per cent. While that law was in force most of the diamonds brought into this country were undoubtedly smuggled in; and as a duty of ten per cent. was put on the rough, that made cutting here in competition with smuggled goods unremunerative, and shows in the decrease of the importations of rough.

Although the importations of cut diamonds in 1902 is not as large in amount as in 1893, and still less in quantity owing to the higher price, it must be remembered that the figures of 1893 included all other cut stones and pearls, and the value of rough imported is now nearly six times greater. Say the rough is quadrupled in value by cutting, the present consumption of diamonds in the United States is double in value that of the high-water mark of 1893. The table also shows the rapidly increasing demand for precious stones other than diamonds.

Index

PLATE I.

DIAMOND.



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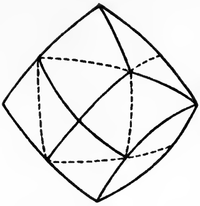

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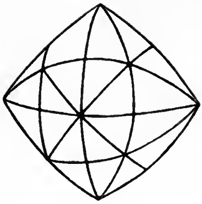

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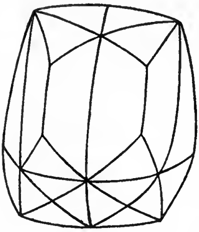

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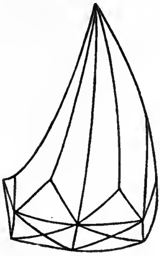

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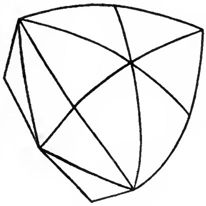

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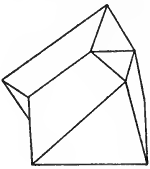

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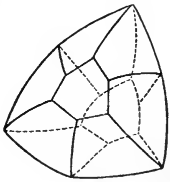
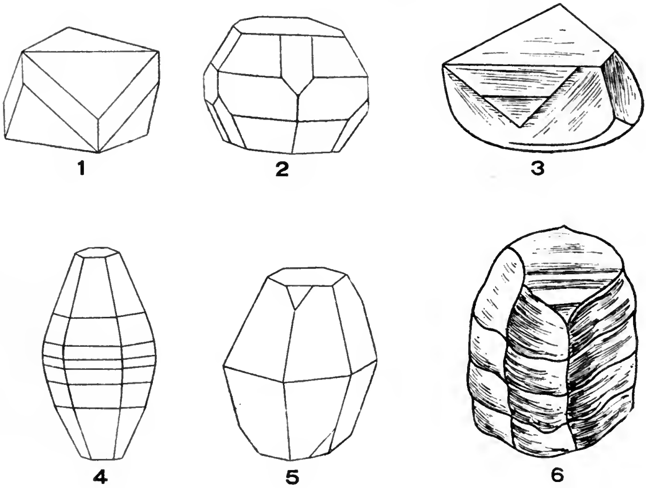


8

Monometric. In octahedrons, dodecahedrons, six-faced octahedrons, and other forms. 1, octahedron; 2, dodecahedron; 3, six-faced octahedron; 4, 5, 6, 8, modifications of No. 3; 7, twinned crystals (a common form in spinel).

PLATE II.

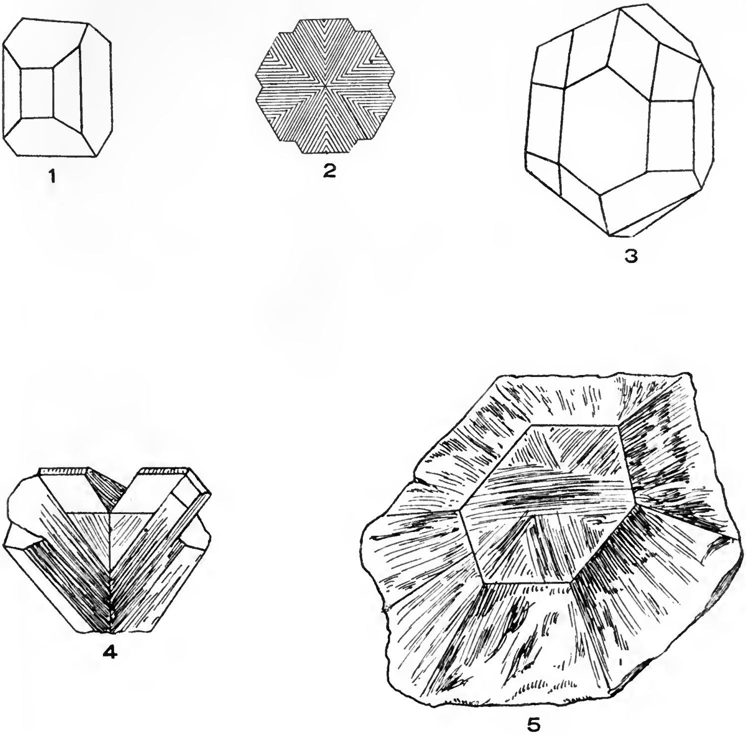
SAPPHIRE AND RUBY.



Rhombohedral. Usually in six-sided prisms; surfaces generally uneven and form irregular. 1, common form of six-sided ruby prism; 2, double six-sided pyramid; 3, ruby crystal; 4, 5, forms of sapphire crystals; 6, sapphire crystal. Although sapphire and ruby are the same except in color, the natural ruby crystal is generally found as a prism, whereas the sapphire occurs as a pyramid.

PLATE III.

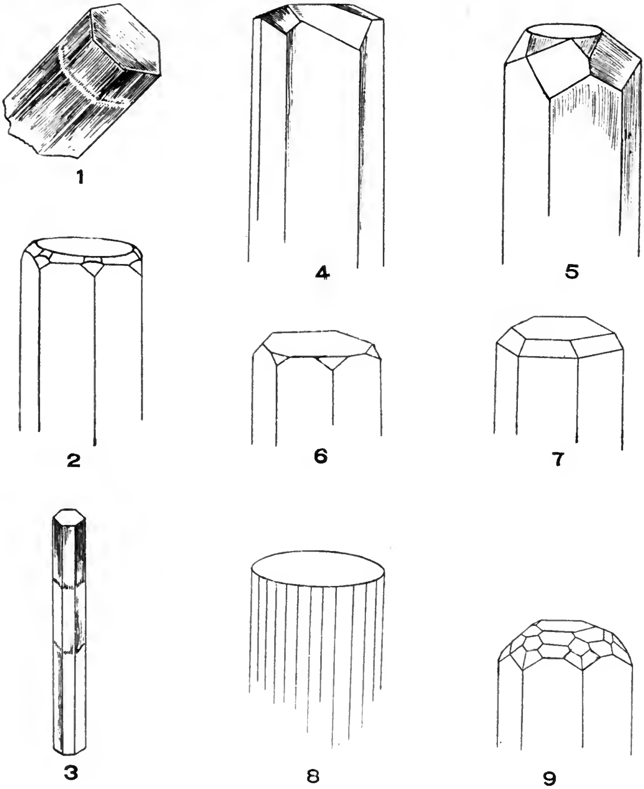
CHRYSOBERYL.



Cat's-eye. Alexandrite.—Trimetric. 1, 3, modified rectangular prisms; 2, compound crystal; 4, rough chrysoberyl crystal; 5, rough alexandrite crystal.

PLATE IV.

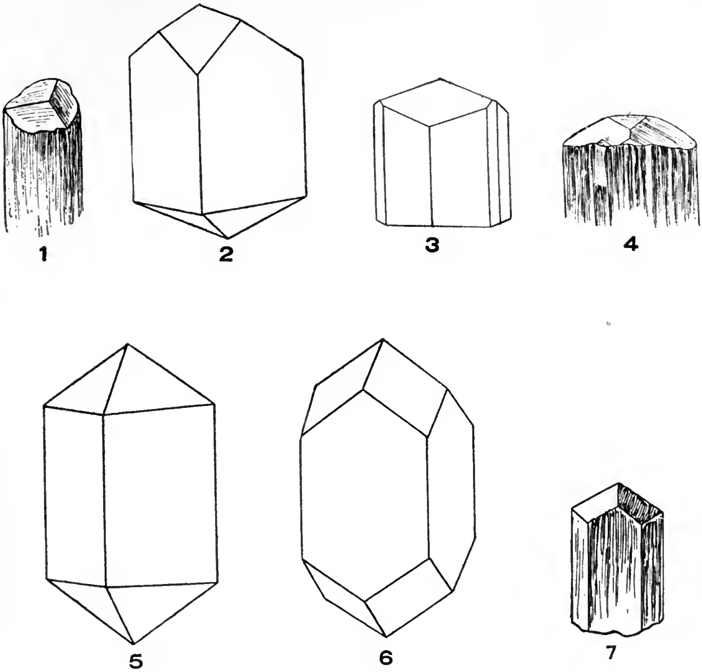
BERYL.



Emerald. Aquamarine. Golden beryl.— Hexagonal. In hexagonal prisms. 1, 2, 3, emerald crystals; 4, aquamarine crystal; 5, golden beryl crystal; 6, 7, 8, 9, beryl crystal terminations.

PLATE V.

TOURMALINE. ZIRCON.

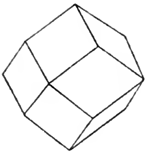


Tourmaline.—Rhombohedral. Usually in prisms terminating in a low pyramid at either end. The terminations of a crystal differ (hemihedral). 1, 4, tourmaline crystals; 2, 3, tourmaline terminations.

Zircon.—Dimetric. Square prisms. 5, square prism (zircon); 6, square prism with truncated edges (hyacinth); 7, hyacinth crystal.

PLATE VI.

GARNET. SPINEL.



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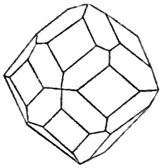

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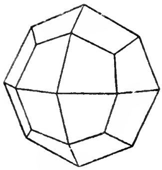

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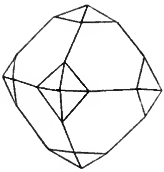

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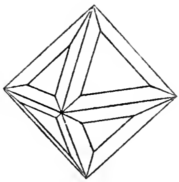

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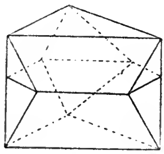

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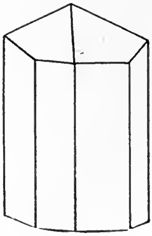
Garnet.—Monometric. Common in dodecahedrons and trapezohedrons variously modified. 1, dodecahedron; 2, truncated edge modification of No. 1; 3, trapezohedron.

Spinel.—Monometric. Octahedrons variously modified, and dodecahedrons. 4, octahedron with dodecahedron corners; 5, bevelled-edge octahedron; 6, twin crystal.

PLATE VII.

TOPAZ. SPHENE.



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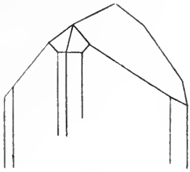

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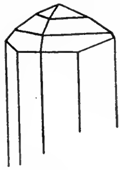

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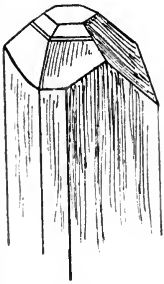

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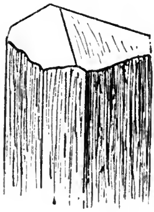

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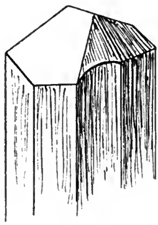

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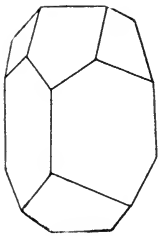


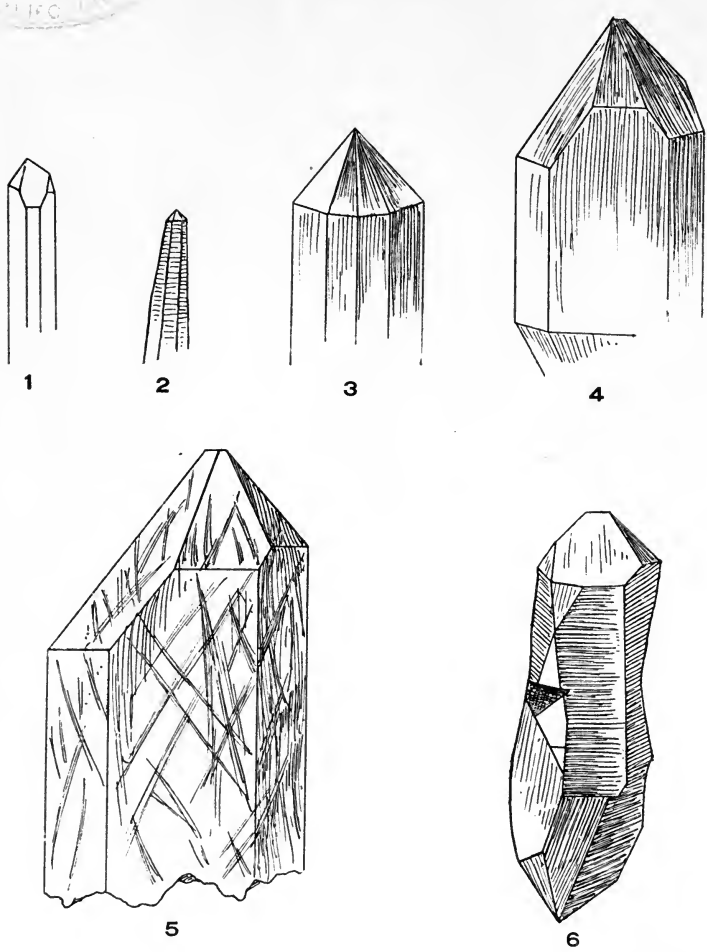
7

Topaz.—Trimetric. In right rhombic prisms, generally modified differently at the two extremities. 1, 2, 3, topaz terminations; 4, 5, 6, topaz crystals.

Sphene.—Monoclinic. Very oblique rhombic prisms (7).

PLATE VIII.

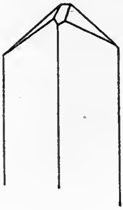
CRYSTALLIZED QUARTZ.



Amethyst. Rock crystal. Citrine. Cairngorm.—Rhombohedral. Usually in six-sided prisms, more or less modified, terminating in six-sided pyramids. 1, 2, quartz crystals; 3, 4, amethyst crystals; 5, rock crystal containing rutile; 6, cairngorm crystal from a cluster.

PLATE IX.

ANDALUSITE. CHIASTOLITE. CHRYSOLITE. OLIVINE. PERIDOT. AXINITE.



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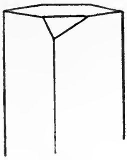

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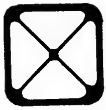

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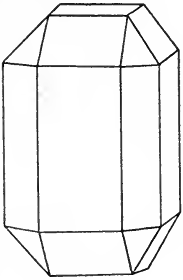

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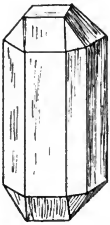

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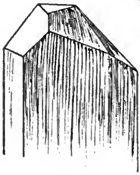

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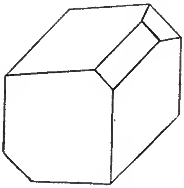

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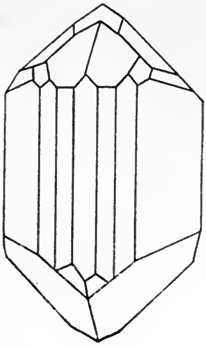
Andalusite. Chiastolite.—Trimetric. In right rhombic prisms. 1, 2, andalusite crystals; 3, chiastolite crystal.

Chrysolite. Olivine. Peridot.—Trimetric. In right rectangular prisms. 4, theoretical form of chrysolite crystal; 5, crystal of peridot; 6, crystal of chrysolite.

Axinite.—Triclinic. Acute-edged oblique rhomboidal prisms (7).

PLATE X.

EUCLASE. PHENACITE. VESUVIANITE.



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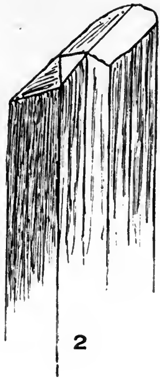

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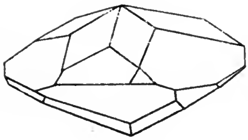

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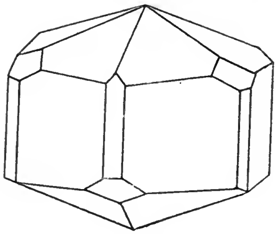

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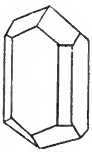

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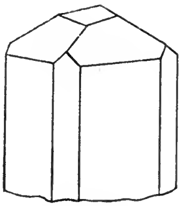

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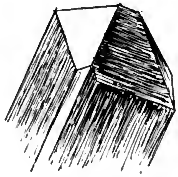

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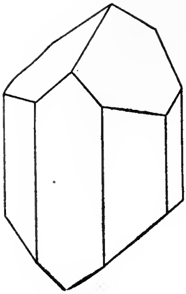
Euclase.—Monoclinic. In right rhombic prisms. 1, prism; 2, euclase crystal.

Phenacite.—Rhombohedral. 3, 4, phenacite prisms.

Vesuvianite.—Dimetric. Square prisms. 5, 6, vesuvianite or idocrase prisms; 7, vesuvianite crystal.

PLATE XI.

DIOPSIDE. ORTHOCLASE (FELDSPAR). MOONSTONE. SUNSTONE. AVENTURINE FELDSPAR. EPIDOTE.



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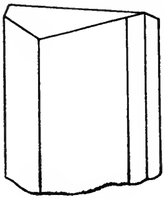

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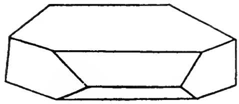

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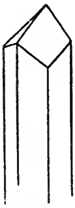

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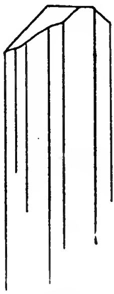

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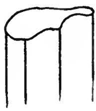

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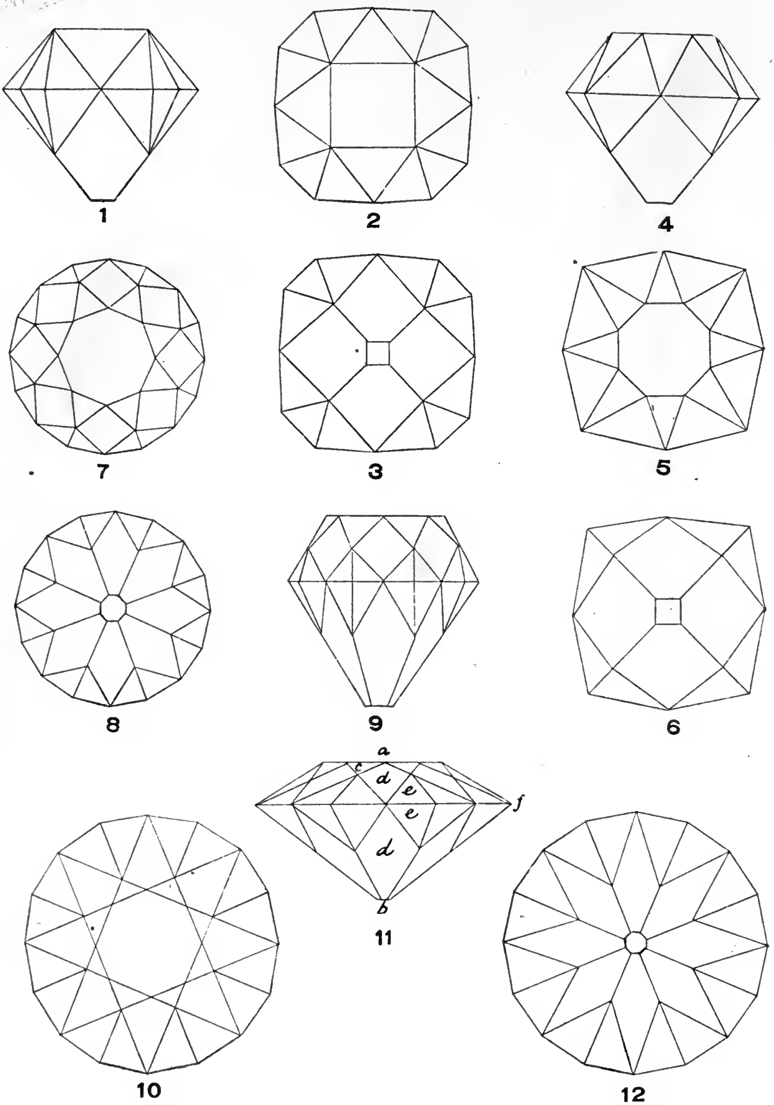
1, Diopside.—Monoclinic. Modified oblique rhombic prisms.

2, 3, Orthoclase (feldspar). Moonstone. Sunstone. Aventurine feldspar.—Monoclinic. Modified oblique rhombic prisms.

4, 5, 6, Epidote.—Monoclinic. Right rhomboidal prisms. 4, theoretical prism; 5, 6, epidote crystals.

PLATE XII.

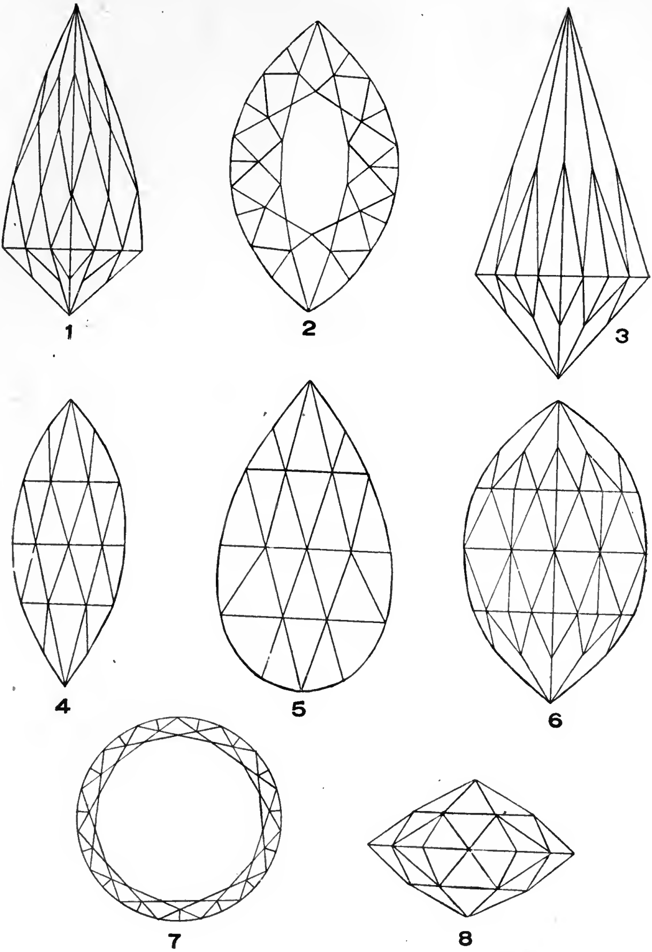
FORMS OF DIAMOND CUTTING.



1, 2, 3, side, top, and bottom of old square-cut brilliant; 4, 5, 6, side, top, and bottom of English square-cut brilliant; 7, 8, 9, top, bottom, and side of English round-cut brilliant; 10, 11, 12, top, side, and bottom of modern American-cut brilliant. 11*a*, table; 11*b*, culet; 11*c*, star facets; 11*d*, top and bottom main facets; 11*e*, top and bottom corner facets; 11*f*, girdle. All above the girdle is the "bizel"; below, the pavilion.

PLATE XIII.

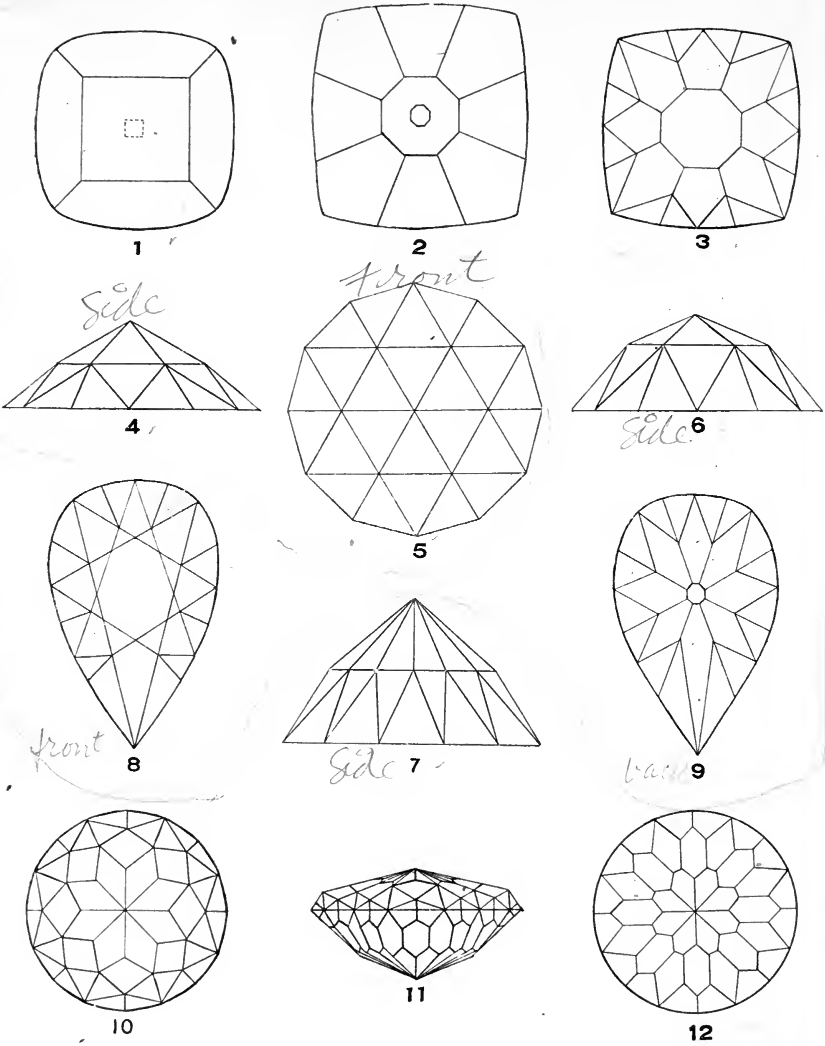
FORMS OF DIAMOND CUTTING.



1, briolette brilliant, 88 facets; 2, marquise brilliant, 72 facets; 3, briolette brilliant, 48 facets; 4, marquise rose, 24 facets; 5, pendeloque rose, 24 facets; 6, briolette brilliant, 88 facets; 7, rondelle, 128 facets; 8, double rose, 48 facets.

PLATE XIV.

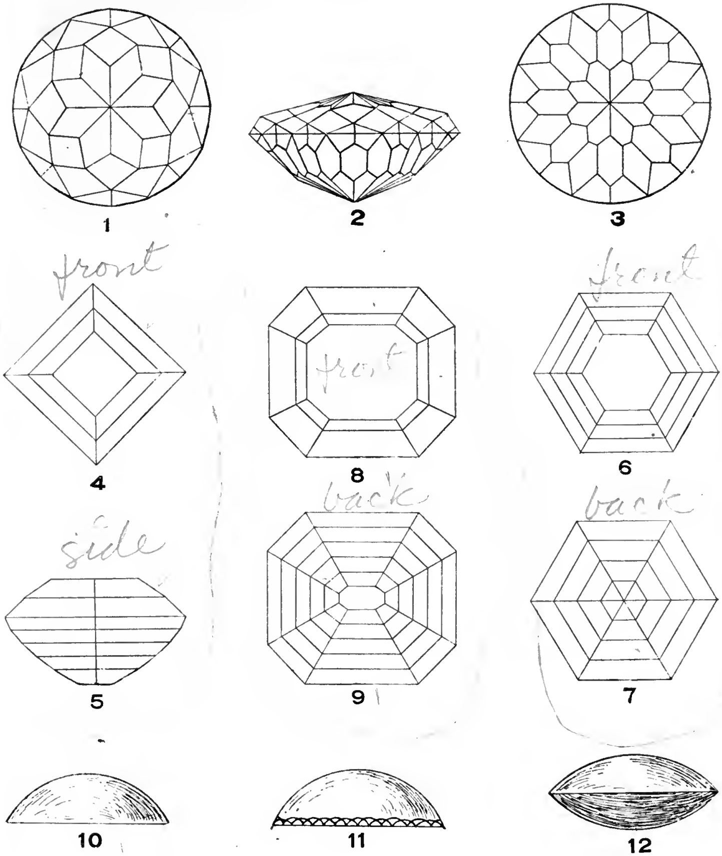
FORMS OF DIAMOND CUTTING.



1, 2, 3, old brilliant cuttings: (1) 10 facets, (2) 18 facets, (3) 50 facets; 4, 5, Holland rose, side and front, 24 facets; 6, Brabant rose, side, 24 facets; 7, rose récoupée, side, 36 facets; 8 (front), 9 (back), pendeloque, 58 facets; 10, 11, 12, twentieth-century brilliant, rose-cut top in place of table, 88 facets. (Now cut with 80 facets; see Plate XV.)

PLATE XV.

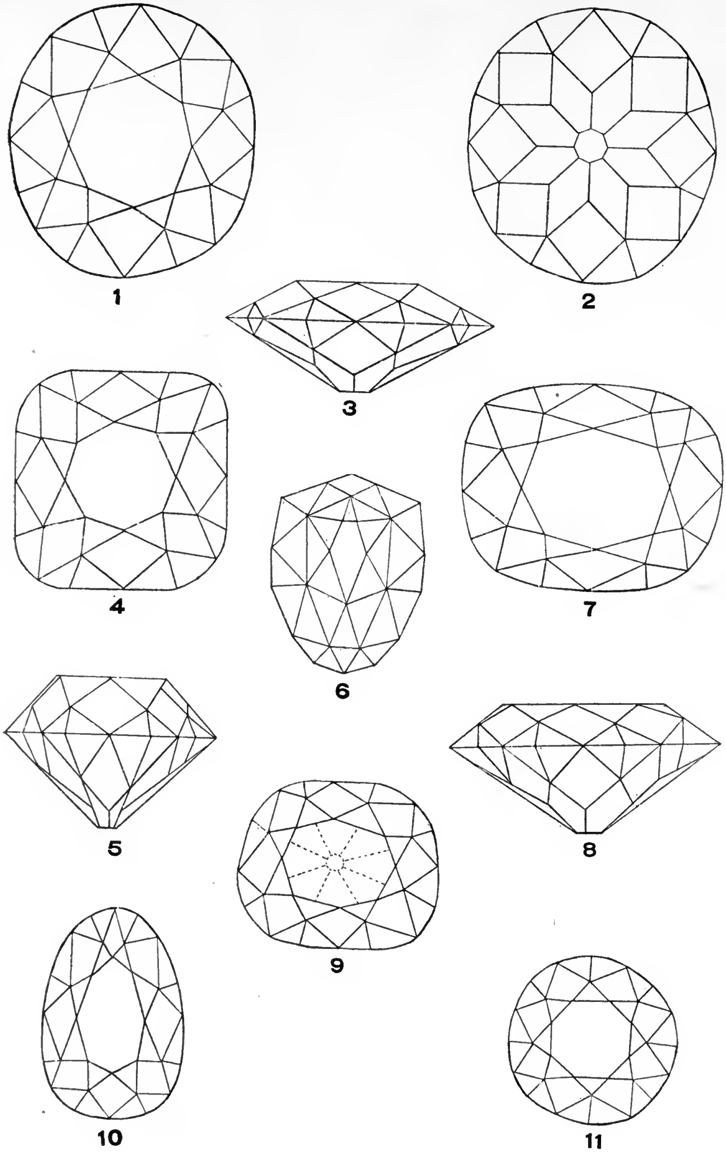
FORMS OF DIAMOND CUTTING.



1, 2, 3, front, side, and back of twentieth-century cut (80 facets); 4, 5, front and side of square step-cut; 6, 7, front and back of six-sided step-cut; 8, 9, front and back of octagon step-cut; 10, cabochon-cut; 11, cabochon-cut, with edge facets; 12, double convex.

PLATE XVI.

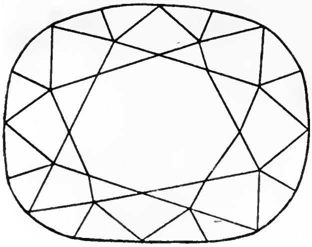
CELEBRATED DIAMONDS.



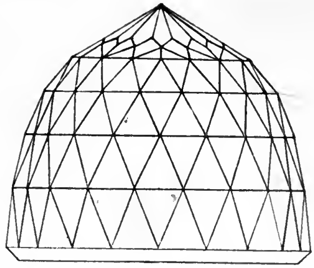
1 (front), 2 (back), 3 (side), Koh-i-noor, 106¼ carats; 4 (front), 5 (side), the Regent or Pitt, 136⅞ carats; 6, Sancy, 53¾ carats; 7 (front), 8 (side), Star of the South, 125½ carats; 9, the "Hope" Blue Diamond, 44⅜ carats; 10, Dresden Green Brilliant, 40 carats (some say 48½ carats, others 31¼); 11, the Cumberland, 32 carats.

PLATE XVII.

CELEBRATED DIAMONDS.



1



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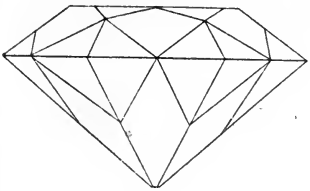

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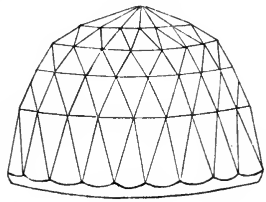

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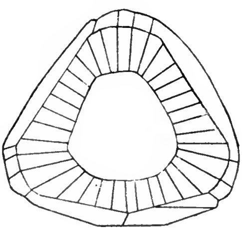

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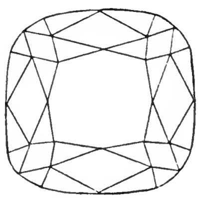

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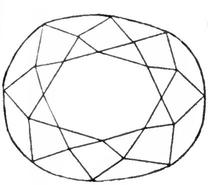

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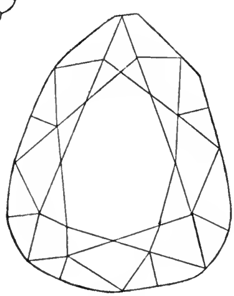

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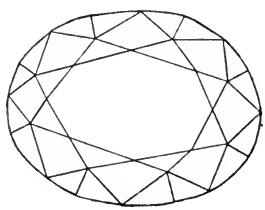
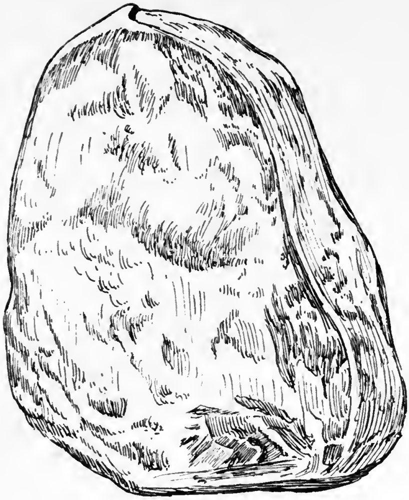


9

1, 2, the Imperial or Victoria, rough 457½ carats, cut 180 carats; 3, the Great Mogul, 188 carats (variously estimated, size and weight uncertain); 4, the Orloff, 194¾ carats; 5, the Nassac, 89½ carats; 6, the Polar Star, 40 carats; 7, the Eugénie, 51 carats; 8, Dresden Brilliant, 76½ carats; 9, the Piggott, weight uncertain, quoted as 82¼ and 81½, but according to Mawe 49 carats.

PLATE XVIII.

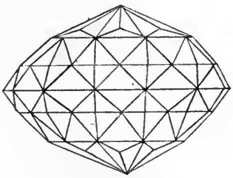
CELEBRATED DIAMONDS.



1

2

4



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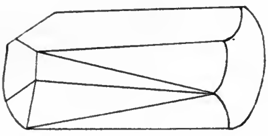

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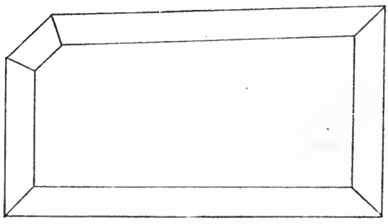
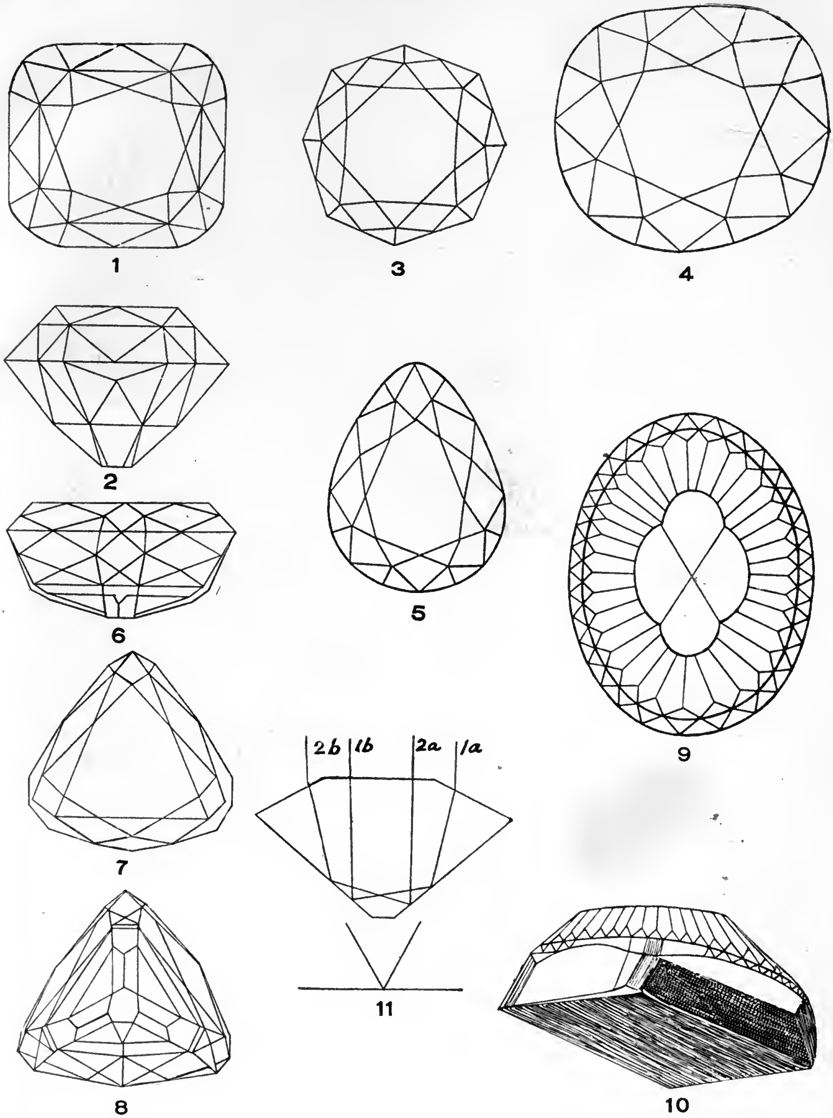


6

1, the Jagersfontein Excelsior (rough), 971¾ carats; 2, the Mattam, 367 carats; 3, Florentine, 133⅛ carats (Florentine weight, 139½ carats); 4, Victoria (rough), 457½ carats; 5, the Shah, 86 carats; 6, Great Diamond Table of Tavernier, 242$\frac{3}{16}$ carats.

PLATE XIX.

CELEBRATED DIAMONDS.



1, 2, Tiffany Brilliant, 125⅜ carats; 3, the Pacha of Egypt, 40 carats; 4, the Stewart, rough 288⅜ carats, cut 120 carats; 5, Star of South Africa, 46½ carats; 6, 7, 8, Nassac, recut 78⅝ carats; 9, 10, front and side of Koh-i-noor before recutting; 11, angle of total reflection: *1a* to *1b*, course of a refracted and reflected ray through an American-cut brilliant (*1a*, entrance; *1b*, exit); *2a* to *2b*, course of a perpendicular ray (*2a*, entrance; *2b*, exit).