definition of which are sufficiently guaranteed by the maker's name. Each did his best; each was far in advance of the other observers of the season; and yet at first sight there is more apparent difference in their results than might have been expected. It is not surprising that in the case of minute details each should have caught something peculiarly his own; but there is a general want of resemblance not easily explained till, on careful comparison, we find that much may be due to the different mode of viewing the same objects, to the different training of the observers, and to the different principles on which the delineation was undertaken. Green, an accomplished master of form and color, has given a portraiture the resemblance of which as a whole commends itself to every eye familiar with the original. The Italian professor, on the other hand, inconvenienced by color blindness, but of micrometric vision, commenced by actual measurement of sixty-two fundamental points, and carrying on his work with most commendable pertinacity, has plotted a sharply outlined chart, which, whatever may be its fidelity, no one would at first imagine to be intended as a representation of Mars. His style is as unpleasantly conventional as that of Green indicates the pencil of an artist; the one has produced a picture, the other a plan. The discordance arising from such opposite modes of treatment would naturally be less real than apparent; still, a good deal remains that it is not easy to harmonize. Let us hope that during the present favorable opportunity much may be effected toward clearing up the obscurities that still rest upon the study of Mars. Every contribution may prove of use, provided it is the result of that conscientious spirit that will show only what it sees, and take care to show it well.

A suggestion may be permitted that observations in the twilight might obviate the unpleasant glare arising from the vivid light of the disk, or that a screen-glass might be advantageously employed for the same purpose at a later hour.

Meanwhile the nomenclature of the spots—a point of increasing importance for identification—is in a state of pitiable confusion. This ought to be remedied at once; and its revision could be more suitably intrusted to no one than to Dr. Terby, who so thoroughly knows its difficulties, and is so competent to decide upon some system that may be adopted with the general concurrence of observers.

With regard to the satellites, we have entered into so much detail about the primary that little space remains for them. Yet we must express our hope that, once discovered, they may be more easily caught in our larger instruments, and that the magnificent reflector of Mr. Common may, as is very possible, increase their recognized number. Those already discovered are certainly among the most wonderful objects in the whole solar system. So disproportionately minute, according to our limited ideas of proportion, so speedy in their revolution that the innermost rises in the west and sets in the east, and compasses the whole heavens more than three times in a Martian day, so close that the same attendant ranges at less than 4,000 miles from the surface of his primary: so much of their time invisible in total eclipse, so powerless to influence any fluid mass beneath them, one might call them exceptions while yet they are among the strongest illustrations of the great principle of identity of character combined with the extremest variety in detail, in the inscrutable work of the Creator.—T. W. Webb, in *Nature*.

THE EARTH FIVE HUNDRED MILLION YEARS OLD.

In one of his recent lectures, Professor Proctor showed the immensity of time, past and future, as revealed by astronomy. The first general topic considered was the age of the earth. From the different geological features of the earth's surface, it has been calculated that 100,000,000 years have been consumed in the formation of its crust. Such is the estimate formed by Crowe and accepted by Sir Charles Lyell. Taking up the investigations of physicists on this subject, and from experiments by Bischoff, it is found that the time during which the earth was cooling from a temperature of 2,000° to 200°, some 350,000,000 years must have elapsed. And then prior to this again, there was a long period of time when the earth was in a nebulous condition; so that a fair estimate of the world's age may be placed at 500,000,000 years. This is considered as erring rather to the side of deficiency than to that of excess. Notwithstanding this enormous lapse of time, the speaker spoke of the earth as being one of the most short-lived of the planets. Comparing it with Jupiter, on the principle that the larger a body is, so its period of cooling will be prolonged, it is calculated that it will be 3,500,000,000 years before the larger planet reaches the stage at which our earth is. Ten times as long must pass before the sun reaches a similar condition. As for the moon, it is but 420,000,000 years since she was in this relative period of her existence. The earth will, in 1,000,000,000 years, reach the same stage of planetary decrepitude as is at present manifested by the moon.

The nebular hypothesis of Laplace was then explained. Originally all the system was star-drift, and then a dense gaseous mass, which, assuming the shape of a huge disk, began to whirl about its center. As the motion increased and the mass concentrated, a ring of matter was thrown off at the outer edge. This ring in course of time broke up into fragments. After a while these fragments aggregated into one body, and thus the outermost planet was formed. In the same way the inner planets took their shape; ultimately the great mass in the center formed the sun, around which the entire system revolved.

Similarly, in the revolutions of the as yet nebulous planets, their satellites were thrown off. The asteroids may be considered as fragments which, for some cause or other, never aggregated together; perhaps they were thrown off and too widely separated to come together again. Laplace, however, seems to have overlooked one agency in the formation of the world, and that is the meteoric showers. Some 400,000,000 of these fall during each year, and about 10,000 tons of this material are annually accumulated by the earth; but, in comparison to its bulk, this is but a trifling addition. In the past it is probable that the meteoric showers were both greater and of more frequent occurrence. By the combination of the nebular hypothesis and the theory of meteoric aggregation, Professor Proctor thought that the earth's formation was accounted for. Thus, in the countless ages of time past, we and our surroundings are but particles of the same matter that then drifted through the enormous distances of the infinite space.

The ages of the planets was next taken up. Jupiter, Saturn, Uranus, and Neptune represent a later formation than do those planets nearer the sun. The two former planets, so similar in many respects, are hundreds of millions of years younger than the earth. The rings of Saturn, it is presumed, will, in time, break and become condensed into

satellites. Jupiter is surrounded by great masses of clouds of a very light density, far within which the real planet is supposed to exist. Coming to the planets nearer by, the moon, with its deep chasms and its great mountains, was described. The dark plains, once supposed to be seas, are in reality the beds of former oceans now absorbed by the lunar crust. The intense blackness of the shadows cast by the moon are indicative of the absence of any atmosphere that it might possess.

If any planet is of the same, or nearly the same, age as the earth, it is Venus. Mars is older. Mercury is a great deal older still, and the oldest of all her companion planets, the moon. He said that Venus has an atmosphere about as dense as the atmosphere of the earth, and must have a large water service. Mars has about an equal area of land and water, and must have an atmosphere. The moon represents what the earth will be in the future. It has neither water, clouds, nor atmosphere. But, as the earth is eighty-one times larger than the moon, while it has thirteen times as much surface, it will require about 2,500,000,000 years for the earth to arrive at the present condition of the moon. Following out this theory, we greatly reduce the number of planets on which it is possible for life to exist. In our solar system we have only the earth, possibly Venus, and, it may be, some of the satellites.

THE DIAMOND—ITS ORIGIN, ARTIFICIAL PRODUCTION, AND USES.*

By HENRY A. MOTT, JR., Ph.D., etc.

It will be necessary, for the proper consideration of this subject, to study the matrix in which the diamond occurs, when we will be better able to arrive at a theory as to its origin, and methods for its artificial production. The usual matrix of the diamond is an alluvial material, consisting chiefly of sandstone and rolled quartz pebbles, from which the diamond is extracted by careful sifting and washing. Itacolumite sandstone (a secondary red sandstone) is a solid matrix of the diamond in Brazil; this was pointed out first by M. Claussen. Prof. Leonhard† has shown that zanthophyllite shares with itacolumite in being the solid matrix of the diamond. This mineral is found in the Ural mountains. A microscopic examination of the laminae of this mineral reveals (when obtained from certain localities) a large number of minute crystals of the diamond. These crystals have been demonstrated to be diamonds by G. Rose;‡ they appear in hexakistehedrons, parallel to the cleavage of the zanthophyllite. Von Helmersen§ separates the diamonds from this mineral by treating the same with acids.

The mineral zanthophyllite is a micaceous substance occurring with magnetic iron in talcose slates. Mr. John Paterson says the marl soil (as he calls it) is the true matrix soil of the diamond in South Africa. This marl soil he considers to be the metamorphosed carboniferous shales of the country, and the changes which have worked upon these shales, by which they have been transformed from the black carboniferous shale to the whitish ashy marl in which the diamonds are found, he attributes to intrusion of queenstone trap, which traverses the country from N.E. to S.W., in continually reoccurring dikes. The African fields seem to date from the Triassic epoch. In the strata are found the remains of crocodiles, dinosaurs, labyrinthodonts, and other monsters, as also numerous fossil plants and much fossil wood, which have been pointed out by Prof. Morris.¶ A French writer¶ takes the ground that the diamonds of the Cape of Good Hope were originally components of aerolites which fell there and were scattered over a great distance in certain definite directions. This view is largely based upon the asserted fact that these objects occur on the summits of the highest mountains and in the plains, but very rarely, if ever, at great depths.

This is perfectly erroneous; as, at the Colesberg diamond mines, the mining has been carried to the depth of 200 ft. without any appreciable decrease in yield. More of these diamonds check, flaw, and explode, than of those obtained at the surface, and, it is supposed, on drifts. The law of natural selection has already acted on the sensitive ones, allowing only those to remain that could withstand light and atmospheric conditions. According to M. Denis there are thirty-four minerals found with the diamond, consisting chiefly of sulphurets, carbonates, oxides, silicates, and native metals.

THE ORIGINAL FORMATION OF THE DIAMOND.

To establish a theory as to the formation of the diamond, it becomes necessary to find out its composition. It is amusing to note, even as late as the middle of the eighteenth century, the definition of its composition given in a standard work on physics, which was "the purest and finest earth, the most ethereal fire, and the most limpid water." The first important fact relative to the nature of the diamond was established by Boyle, about the middle of the seventeenth century. He showed that, under the influence of a great heat, the diamond disappeared. A little later (1694), the Florentine academicians burned a diamond before Cosmo III., Grand Duke of Tuscany, by the intense heat of the sun's rays, concentrated by a large burning-glass or lens. Humphry Davy in England, and Lavoisier in France, first solved the problem as to its composition, which was afterward made complete by the investigations of M.M. Dumas and Stass. They showed the diamond to be composed of carbon in a crystalline condition, and nothing else. This is true of exceptional crystals, but most crystals, especially if colored, leave an ash when the diamond is burned. The ash is yellow, and contains silica and oxide of iron; it is generally in the form of a cellular network, which fact may some time help to determine its origin. The crystalline colorless diamonds give about 0.01 per cent. of ash. In the colored varieties the proportion is larger, the black diamond giving 2 to 3 per cent. the ash of black diamonds resembling that of vegetable fuels. Diamonds sometimes inclose other crystals. Hartwig has noticed iron pyrites in it. Dr. Nello Franco mentions a diamond inclosing a gold leaf, and he says, "the gold leaf is seen as if not embedded in the diamond at all." The diamond incloses cavities, some of which contain gas, and others liquid carbonic acid. This last fact was arrived at by Prof. Simmler,** of Switzerland. Brewster found the liquid in some cases to have a refractive power less, but its expansive power greater, than water.

In comparing the results made by Brewster with those calculated for other liquids, Simmler found the numbers

for the expansive and refractive power of the liquid to coincide with those for liquefied carbonic acid. Other observers have concluded that some of the cavities contain another liquid—one behaving toward heat and light like water, and the other like liquid carbonic acid; but this is evidently erroneous.

Besides the diamond containing other minerals at times, it also contains sometimes germs of plants and fragments of vegetation. Prof. Goppert* states, in 1868, that he had a diamond which contained *dendrites*, such as occur on minerals of aqueous origin; that there are at Berlin one which contains bodies resembling *Protococcus phylloides*, and another green corpuscles linked together, closely resembling *Palmogloia macrococca*. To these supposed algae the names have been given *P. adamantinus* and *Palmogloia adamantinus*. As illustrating the view he takes of these diamonds, he says: "The metamorphic rocks in which they occur also contain evidences of fossils (vegetable) such as *Rhynchonella canadense*," and that even in some topazes there are traces of organic substance.

Prof. Goppert† further remarks, with respect to these foreign bodies inclosed in the diamond, while they cannot be said to be evidently and undoubtedly vegetable in their origin, it would, on the other hand, be difficult to deny their vegetable nature altogether.

The black specks in diamonds, Messrs. Sorby and Baker (such, e. g., as those seen in their Cudgong minerals) are crystals which are sometimes surrounded by contraction cracks, a black cross appearing under polarized light.

In the face of all these facts, what is the most reasonable theory as to the origin of the diamond? The Indians believe diamonds are continually regenerating and growing to this date, and the inhabitants of Pharah in Hindostan affirm that the quantity of diamonds by no means decreases, but, on the contrary, the soil will yield a new supply fifteen or twenty years from the time it is exhausted. Mr. Norman Taylor‡ and many others also think the diamond is a product of chemical forces now in operation; and therefore it is strictly a local and limited product, not necessarily connected with any carboniferous beds of comparatively high antiquity.

As magnesite exists in the vicinity, and that is certainly a recent product, arising from the decomposition of the exposed igneous rocks; so, infiltration, decomposition, and reconstruction of carbonaceous materials of whatever age, under the influence of chemical transformation, may be producing diamonds at this moment, wherever the needful conditions exist. The question is whether the diamond had an igneous origin or not. Clark§ says: "I was struck, when examining the sand in which the Cudgong diamonds are found, with the amount of minute gems, such as zircon, topaz, sapphire, corundum, spinel, pleonate, etc., which composed the finest sifted materials, in which gold is also found; and Mr. Taylor not only dwells upon the circumstance that the diamond is not only associated with gold (as in most other foreign localities), but with those gems which are held to have had an igneous origin, occurring as they do in rocks which are so denominated, and in some cases (I may add) in true lava of modern volcanoes." M. Favre shows that, of the thirty-four minerals found with the diamond, thirty have been artificially formed; and of the thirty, twenty-nine were produced by the aid of volatile chlorides. "If this be the case," says Clark, "though one of the conditions is heat, the argument as to an igneous origin for the diamond, because it is associated with materials of igneous origin, must be abandoned or modified." Dr. Percy§§ says there is nothing to show that an igneous origin can be attributed to the diamond, corundum, spinel, or other gem stones. Sir John Herschel infers,|| from the diamond containing well-formed filaments of iron pyrites sometimes, and from the combination of iron and carbon at high temperatures, the possibility of an igneous origin of the diamond. Sorby and Baker conclude that the diamond does not afford positive evidence of a high temperature, though not opposed to it.

Mr. Morren has proved that the diamond burns in layers; for if the combustion is arrested at any period, the special system of crystallization is still regularly displayed. This is a very important point, as Dieulafoy¶ points out, since it excludes all idea of fusion for the diamond. No heat hitherto applied suffices for the fusion or volatilization of the diamond, or indeed carbon in any of its forms; though in the intense heat of the voltaic arc, it appears to be transported mechanically from one electrode to another.

From a careful examination of the subject, I am convinced, for several reasons, that the origin of the diamond cannot be attributed to plutonic action. Newton, Brewster, and Liebig all agreed that, even with respect to the matrix of the diamond, the gneiss, itacolumite, zanthophyllite, and the metamorphic rocks in which it is found, could not have a plutonic origin.

The fact that most of the associating minerals found with diamond have been artificially produced by the aid of volatile chlorides—the fact that the diamond burns in layers and, if arrested, the special system of crystallization is still displayed—the fact that the diamond countries contain within it bodies which are apparently vegetable in their origin—the fact that these black spots disappear when the diamond is heated to redness, seems to prove, as Prof. Egleston suggests, that the temperature at which the diamond was formed was below red heat—and, lastly, the fact that the diamonds often contain cavities filled with a liquid, are quite sufficient to disprove an igneous origin to this gem. Newton conjectured that the diamond was an "unctuous substance coagulated." Jameson thought it might be a secretion from some ancient tree, like amber; and Brewster also traced it to a vegetable origin. Liebig and others have explained its origin by a slow process of decomposition in a fluid rich in carbon and hydrogen. Dana** states that the diamond has probably proceeded, like mineral coal and oil, from the slow decomposition of vegetable material, or even from animal matters, either source affording the requisite carbon; but it has been under those conditions as to heat that has produced the metamorphism of argillaceous and arenaceous schists and their auriferous quartz veins, since it is found exclusively in gold regions or in the sands derived from gold-bearing rocks. The schists that were altered at the time may have been previously shales, impregnated with petroleum or other carbonaceous substances (hydrocarburates) of organic origin.

* Read before the New York Academy of Sciences, January 19, 1880.

† Das Ausland, Augsburg, June 26, 1870, p. 621.

‡ Am. Chem., vol. 2, p. 429.

§ The Academy, Jan. 1, 1872, p. 15.

¶ Communication to the Geol. Soc. of London. The Academy, Dec. 1870, p. 70.

¶ Les Mondes, Paris, Dec. 14, 1871, p. 601.

** Sch. Am., Oct. 7, 1868.

* "On the Organic Nature of the Diamond."

† Seemann's Jour. of Botany, 1864.

‡ Article "On the Origin of the Diamond," by Rev. W. B. Clark, Chem. News, 607, 1871.

§ Lecture on Chem. Geol., Dec. 12, 1863.

|| Physical Geography.

¶ "Diamonds and Precious Stones," Louis Dieulafoy, 1876, p. 83.

** "Mineralogy," article "Diamond."

Chaucourtois suggests that, in the humid oxidation of a carburated hydrogen, the hydrogen would be oxidized; part of the carbon would be changed to carbonic acid, and the rest he supposes would remain as carbon, and might form crystallized diamonds. Prof. Simmler, a few years ago, offered a new theory to explain the origin of the diamond, and it is to me a very reasonable one, and one which a few experiments I hope soon to make will settle as to its worth. He supposes that carbon is soluble in liquid carbonic acid, which, on slow evaporation, would permit the dissolved carbon to separate out in crystals. In evaporating quickly, the black diamond would be formed. It is thought probable that liquid carbonic acid may form in the interior of the earth. In the gaseous form it is evolved from fissures, volcanoes, and mineral springs. When, now, this gas is produced in the cavity of a rock which is free from fissures, it will finally be compressed so highly that it will assume a liquid form. Certain rocks may be considered strong enough to resist the expansive force of this agent. Let, now, carbon be present. If the same is soluble, it will be taken up and deposited again, while the carbonic acid is escaping as gas through some newly formed cracks or fissures.* Another theory has been advanced: that perhaps the carbonic acid gas which forms in the earth by some peculiar process, becomes deprived of its oxygen, and leaves the carbon behind to crystallization.

In favor of this view I can state that, in all attempts to produce the electric light between two carbon points in a partial vacuum, the oxygen present is not only satisfied in forming carbonic acid gas once, but actually by some peculiar process deposits its carbon on the sides of the globe containing it, and goes back and oxidizes more carbon, and this process goes on indefinitely. Some such process might possibly be going on in nature, or have taken place, with the exception that the carbon separated out so slowly and continually that crystals formed.

Just the opposite to this took place in some experiments with the diamond conducted by E. H. Von Baumbauer. He heated a diamond to whiteness in an atmosphere of dry carbonic acid, when the diamond became dull on the surface and lost in weight, hence it must have decomposed the carbonic acid gas, and united with its oxygen. This is, of course, a very exceptional action for an element to make; and one writer has offered as a theory that the diamond might be an allotropic modification of carbon, like ozone is of oxygen. I think the first theory relating to liquid carbonic acid is the most probable, for it would not be difficult to understand how this liquid could take up vegetable matter—crystals and gold—and leave them in the diamonds formed, and an explanation of the liquid carbonic acid in the diamond is at once understood. Prof. Clark† says: "If the diamond were derived from carboniferous rocks, why are they not found in the river bed, except where the tailings of the miners have been washed in? From all the evidence arrived at, the newer drift is derived from the older, and with them is associated a cement of quartz and altered rock, held by a yellowish green silicate of iron and hydroxide of iron, from hand specimens of which I have myself taken gold. Mr. Taylor says it contains diamonds also."

THE ARTIFICIAL PRODUCTION OF DIAMONDS.

The first experiments on record to produce the diamond by artificial means were made by Cagniaud de Latour and J. N. Gaunal, in 1828. Cagniaud de Latour sent to the Academy of Sciences ten tubes containing brown crystals, some of which were of considerable dimensions. They were brilliant, transparent, and harder than quartz. They were carefully examined by M. M. Thenard and Dumas, who showed them to be merely silicates or artificial precious stones. The process adopted by Gaunal to produce his diamonds was as follows: he took equal weights of carbon sulphide and phosphorus, both as pure as possible, and put them in a flask, pouring on top a little water to prevent the sulphide from turning to vapor and from taking fire. The whole was placed in some situation where it would not be disturbed. The sulphur of the sulphide combined with the phosphorus and released carbon, which fell to the bottom and assumed a crystalline form.

This result took place slowly and not until the loss of six months even diamonds were obtained the size of a grain of millet seed. The experiment was repeated many times by Gaunal with the same results. The carbon consisted of pure carbon in dodecahedral crystals, and they scratched steel like the natural diamond. M. Champigny examined these diamonds with care, and pronounced them to be such. Dieulafoy says the opinion expressed by Champigny was perfectly erroneous. Whether this is so or not it is difficult to answer. M. Despretz was the next experimenter: he endeavored to produce the diamond by igneous means. He secured and united all the Bunsen piles that he could procure in Paris, and so obtained a very powerful current, and he then submitted carbon to the action of the intense heat. The carbon was molecularly dissociated and deposited in the form of fine dust on the walls of the vessel, but no diamonds were produced by this method. Having failed by the use of intense heat, he changed his system. For the current of the pile, intense and incessant, he substituted currents of induction, intermittent and feeble; and in place of continuing their action for several hours, maintained them in activity during entire months.

He made use of a glass vessel, similar to and similarly fitted up as that known as the electric egg. To the lower rod he attached a cylinder of pure carbon, an inch or so in length and nearly one-half an inch in diameter. To the upper rod he affixed a bundle of fine platinum wires. At the completion of a month, a slight black layer of carbon had been deposited on the wires. This layer viewed through a magnifying glass presented nothing very distinct, but to the compound microscope with magnifying power of about thirty diameters it offered several interesting features. Upon the wires, and especially upon their extremities, certain separate points were discoverable, which appeared to belong to the octahedral system. An experienced crystallographer confirmed this view, and recognized octahedrons, both black and white, the black being truncated at their extremities. In another experiment M. Despretz fixed a cylinder of pure carbon to the positive pole of a weak Daniell pile, and a platinum wire to the other pole. The experiment lasted two months, when the negative wire or pole became covered with a black coating which M. Gaunal proved in the presence of M. Despretz, when mixed with oil, sufficed to polish several rubies. The black powder deposited in the water served to give a similar polish, but required a longer time. As it is known that the diamond is the only substance that polishes the ruby, both M. Gaunal and Despretz did not hesitate to consider both these substances as the powder of

the diamond. Despretz also claims to have produced diamonds by the action of an electric current on one of the chlorides of carbon (not particularly specified). The crystals obtained were warty bodies, exhibiting shining faces, and having nearly the hardness of the diamond produced in his second experiment.

The late Dr. Hare, of Philadelphia, succeeded in melting down mahogany charcoal so as to produce a metallic appearance by his deflagration. Prof. Silliman likewise made similar experiments with plumbago, which produced small globules, some of which were so transparent that they could not be distinguished from the genuine diamond. Prof. Vanuxem, who examined the globules obtained from charcoal, found them to contain iron and carbon, which led him to the conclusion that the charcoal had not undergone a real fusion. M. De Chaucourtois proposed to pass a very slow current of carburated hydrogen in a mass of sand containing putrescible matter, believing that, under the influence of the humid oxidation, all the oxygen would be transformed eventually into water; one part only of the carbon into carbonic acid; and he thought it possible that the remainder, being slowly deposited, might crystallize and form diamonds. A number of years have passed since the expression of this view, but with no positive results. Recently we heard from across the ocean that Mr. James MacTear, of the St. Rollox Chemical Works of Glasgow, had, after having thought carefully over the subject from time to time, and made many abortive experiments extending over a period which dates back to 1866, succeeded in obtaining crystalline forms of carbon. These were said to be perfectly pure and transparent and have all the refractive power of diamonds, have the crystalline form of diamonds, and would resist acids and alkalis. From experiments and examinations made by several observers, they were pronounced diamonds; but Prof. Maskelyne, of the British Museum, after a careful examination, pronounces them to be silicates, and not diamonds at all. Production of crystals of carbon, as has been already shown, has been accomplished by others; so unless Mr. MacTear has discovered a process to make them of considerable dimensions, there is really nothing new except, perhaps, the process he adopts, which he has not as yet published. M. Deville and Vöehler came to the conclusion from their experiments in producing crystallized boron that the carbon contained in the crystallized boron is present there in the state of the diamond.

Some of the crystals they obtained gave the following analysis:

Boron.....	89.1
Aluminum.....	6.7
Carbon.....	4.2
	100.0

It would be supposed that this proportion of carbon (4 to 100) would prevent the boron from being transparent, but such is not the case; and, what is still more surprising, the boron becomes more and more transparent as the proportion of carbon increases. It is for this reason that Deville has concluded that the carbon is in the condition of diamond in the crystals of boron. That the diamond will be produced in time, I think, there can be no doubt, for substances of much more complex composition and with far more complicated crystalline constitution have been artificially produced with ease.

THE USE OF THE DIAMOND.

Besides its use for personal adornment, its uses in the arts are numerous. For cutting glass* no other substance equals it. A natural edge or point is used for this purpose about $\frac{1}{16}$ of a carat. It is said,† when a diamond is used to cut hot glass, it will only last one day, assuming a milky appearance; if the glass is cold, one will last three months. Hot glass, however, is cut more readily than cold. Diamond points are used to engrave on carnelians, amethysts, and other brilliants, and for finer cutting on cameos and seals. Being very hard, the diamond is used for the steps of pivots in chronometers. Since it possesses high refractive with inferior dispersive power and little longitudinal aberration, it has been successfully employed for the small deep lenses of single microscopes. The magnifying power of the diamond in proportion to that of plate glass ground to similar form is as 8 is to 3. For drawing minute lines on hard steel and glass, to make micrometers, there is no substitute for the diamond point. Diamonds are also employed for drill points, to perforate rubies and drill holes in draw plates for fine wire, and to drill in hard steel. Large drills containing a number of diamonds are used to drill holes in rock for blasting, to bore artesian wells, etc. The diamonds used for most of the above purposes is a modification of the diamond called "bort." These consist of translucent, but not transparent, colorless, or grayish spheroids, from which small octahedra can be split out, which are much harder than the well-crystallized diamond, but inferior to the carbonado—another modification in this point. Small, irregular, and imperfect diamonds are crushed in steel mortars, and the splinters are made into drills in many cases. Diamond dust produced by the abrasion of diamonds against each other in the process of cutting and polishing them is very valuable for polishing gems and giving the finest edge to every kind of cutlery.

Diamond dust works quicker and gives a finer edge than emery, corundum, or ground glass. The discovery of the use of diamond dust, a few years since, led certain dishonest persons to extensively advertise spurious preparations, consisting chiefly of emery powder or powdered quartz, under the name of diamond dust. As a rule, such preparations destroy the edge of cutting instruments, converting razors into saws.

The uses of the carbonado or black diamond may be summarized as follows: It is used to point edges or face tools for drilling, reaming, sawing, planing, turning, shaping, carving, engraving, and dressing flint, grindstones, whetstones, emery, corundum or tripoli wheels, iridium, nickel, enamels, crystals, glass, porcelain, china, steel, hardened or otherwise, chilled iron, copper, and other metals.

AMMONIA FROM ATMOSPHERIC AIR.

A METHOD of obtaining ammonia from nitrogen derived from atmospheric air has been patented by Wm. Müller, of Antwerp, and Edmond Geisenberger, of Brussels, and has some features of interest, and possibly of commercial value.

In carrying out their invention the patentees subject to the action of electricity in the presence of hydrogen the products of combustion, which are almost exclusively composed of nitrogen, and which may be purified so as to eliminate any foreign bodies from them. The hydrogen is obtained

by any suitable means. It is well known that the action of electricity sometimes decomposes gases at rest. According to the invention the gases subjected to the action of electricity for the manufacture of ammonia are put in motion with or without pressure, and the ammonia produced therefrom, as soon as it is formed, is made to pass away from the decomposing action of electricity.

The apparatus consists of a suitable retort or vessel mounted in a furnace, and containing coke or other carbon, which is heated to a red heat. Vapor of water is conducted into the retort or vessel, and hydrogen gas is evolved. The hydrogen is taken from the retort by means of a pump or other suitable apparatus, and is conducted into a reservoir in which it may be cooled or purified previously to its being conducted to the combining apparatus. The products of combustion, which consist in reality of atmospheric air that has been employed in promoting combustion, with the addition of certain products of combustion, are taken by means of a pump or other suitable apparatus from the flues of the furnace, and are conducted to a vessel containing a body (such, for example, as lime) capable of absorbing gases other than nitrogen gas. From this vessel the nitrogen is conducted to the combining apparatus.

The yield of the pumps or exhausting apparatus is calculated so as to supply the gases to the combining apparatus in the proportions required for the formation of ammonia, that is to say, three parts of hydrogen to one of nitrogen. The combining apparatus consists of a glass or other tube fitted at its upper end to a tubular or other shaped box, connected by suitable pipes with the vessel containing the hydrogen and the vessel containing the nitrogen. In the combining apparatus is a helical wheel or fan, caused to revolve by the gases as they pass into the tube. To the lower end of the glass tube is attached a valve box, to which is connected a pipe for the exit of the ammonia as soon as it is formed. In the glass tube are electric wires or conductors connected to a suitable source of electricity. The hydrogen and the nitrogen entering the combining apparatus are mixed together by the action of the helical wheel or fan, and in the glass or other tube are acted upon by electricity in the form of electric sparks or otherwise, and under the influence of the electricity they unite and form ammonia, which as soon as it is formed passes out through the valve box, and may be utilized as required.

ON A NEW VIOLET COLORING MATTER.

By M. PRUD'HOMME.

THE coloring matter recently introduced into commerce by the firm of Baeyer, of Elberfeld, under the name of "solid violet" or "anthracene violet," presents at first sight such analogies with galleine that we are naturally led to make a comparative study of the principal properties of these two bodies.

Anthracene violet (we preserve this name until better informed) presents itself in the form of a violet-brown paste like galleine or anthracene blue. The solutions of the two coloring matters in alkalies or other solvents offer on comparison shades almost identical.

Reduction with soda and zinc powder gives in either case a yellow-brown solution. The decanted liquid, on treatment with an acid, followed by soda, takes the same brownish-red coloration.

Reduction in an acid liquid presents analogous phases of coloration.

Cloth mordanted with alumina and iron is dyed in shades which differ but little. The reds obtained with alumina have a more violet tone in the case of anthracene violet than in that of galleine. Under the influence of light this difference becomes less in consequence of a reversion, with loss of blueness, toward the red of galleine.

Soaping at a boil strips cloth mordanted with iron and alumina and dyed in galleine, whilst under the same treatment anthracene violet resists well and is brightened.

This property alone may serve to distinguish between the two bodies.

Mordanted goods dyed with either color are only affected in a transient manner when passed through dilute sulphuric or muriatic acids, and the colors may be restored by alkalies.

With nitric acid both are completely destroyed.

The degradation of the shades on treatment with a solution of bleaching lime occurs in the same manner in either case, and the shades finally disappear.

Boiling lime-water in both cases turns all the shades to a very blue violet. On studying the mordants best adapted for the fixation of anthracene violet by the steaming process, it is readily found that acetate of chrome gives the best results, especially in presence of the bisulphite of soda. M. H. Koehlin has already established the same facts for galleine and ceruleine.

Steam violets obtained either with galleine or anthracene violet stand soaping at a boil.

Under certain conditions anthracene violet, fixed with acetate of chrome, may give rise to a blue. It is merely requisite to print upon cloth prepared with oil as for turkey red a color containing, in addition to the acetate of chrome, chloride of calcium, as for instance:

Color.	
Thickening.....	2 lb. 3 oz.
Anthracene violet.....	7 oz.
Acetate of chrome, at 10° B.,	1-16th of 35 fluid oz.
Chloride of calcium, at 10° B.,	4½ fluid oz.
Bisulphite of soda, at 20° B.,	4½ fluid oz.

Thickening.	
Water.....	105 fluid oz.
White starch.....	8¾ oz.
Light calcined starch.....	1 lb. 1½ oz.
Olive oil.....	5 oz.

Steam for 90 minutes; wash and soap for 30 minutes at 122° to 140° F. Upon cloth not oiled this same receipt gives a fine violet.

A galleine color, applied under the same conditions, gives the same results. The blue shade is certainly less pure and more violet than that from anthracene violet.

M. C. Kopp, having undertaken to examine the two coloring matters with the spectroscope, concludes that the two spectra at unequal strengths are identical, the one being merely a dilution of the other. Both, then, must belong to the same family.

A consideration of another order is added to these proofs. Anthracene violet possesses a considerable tinctorial power; samples containing five per cent. of dry coloring matter give violet shades as intense as alizarines at ten per cent.

Galleine possesses the same property, which, up to a cer

* See *Sci. Am.*, Oct. 7, 1868.

† *Chem. News*, 607, 1871.

* *Sci. Am.*, vol. 2, new series, p. 84, 1860.

† *Pop. Sci. Rev.*, Oct. 1870, p. 440.