ARTIFICIAL PRECIOUS STONES.

BY W. G. HOWGRAVE.

Since Sir Humphry Davy first discovered the diamond to be pure carbon, unmixed with any other substance, various attempts have been made by chemists to produce it, and other precious stones, by artificial means; and it may not be uninteresting to glance at some of these essays, and to see how far they have been attended with success.

But little progress has as yet been made toward the discovery of the means of imitating the natural diamond, men of science have hitherto been baffled in all their efforts to find a substance capable of dissolving carbon, the chief constituent of that crystal; and indeed, until Despretz succeeded, by the agency of electricity, in actually producing minute diamonds, the manufacture of this precious stone seemed as chimerical as that of the philosopher's stone, so perseveringly sought after by the ancient alchemists. Despretz found, that by passing a powerful galvanic current through a point of charcoal over which a platinum wire was suspended, the charcoal was volatilized and deposited on the wire in the form of minute crystals, which, on examination under the microscope, proved to be true diamonds. Since the discovery, no further advance has been made toward the solution of this interesting problem.

The search after the diamond having proved so unsatisfactory in its results, attention was directed to a class of stones almost as simple in their composition, going under the generic name of *corundum*. In order to understand the experiments that were made, and the difficulties attending them, it is necessary that a clear idea should be obtained of the compositions and distinctive characteristics of the stones belonging to this class. I will, therefore, in as few words as possible, give a description of their nature and properties.

The ruby, sapphire, oriental topaz, and several other precious stones, are all merely colored varieties of a mineral called corundum, or white sapphire, the composition of which was stated by Chenevix to be alumina, mixed with a small proportion of silica and oxide of iron. Dr. Thomas Muir and others proved, however, that it was pure alumina, the silica found by Chenevix being abraded from the substance in which the stones were imbedded. All the varieties of corundum crystallize in six-sided prisms, and have the curious property of double refraction; that is, causing everything that is looked at through them to appear double. Alumina, the oxide of the metal aluminium, now coming into such frequent use in the manufacture of articles of jewelry, &c., was, until the invention of the oxyhydrogen blowpipe, supposed to be, like carbon, infusible by any degree of heat. In 1837, however, M. Gaudin, who had given much attention to the effects produced by this then newly-invented means of generating heat on various metallic oxides formerly thought unsusceptible of fusion, attempted with some success to convert, by its aid, the apparently infusible alumina into crystals similar to the ruby and the other oriental stones. He proceeded by submitting to the action of the blowpipe a mixture of alum (sulphate of alumina and of potash) and chromate of potash, which he placed in a cavity of animal charcoal. In this manner he obtained small portions of melted alumina, having the color and hardness of the ruby, but which could be easily distinguished from it by their imperfect transparence, and by their not possessing the property of double refraction. All subsequent attempts to obtain crystals of alumina, colored like the precious oriental stones, have failed in a similar manner; and this has been accounted for by the discovery only lately that the color of these stones is not due to a metallic oxide, as had been always supposed, but to the presence of some organic coloring matter. The application of this discovery may bring us nearer than we have ever yet been to the invention of a mode of producing artificially these rare gems.

The next step in this direction was made by the manager of a manufactory of Sevres porcelain, named Ebelmen, who, ten years after M. Gaudin's experiments, found out a way of obtaining crystals of corundum, but of such minute proportions as to be of no practical use. He first discovered that boracic acid, which had been hitherto supposed to be absolutely fixed, could be evaporated by the intense heat of the porcelain ovens; upon this it occurred to him that by dissolving alumina in boracic acid, which could be done by heat, and then evaporating the liquid, it would be possible to obtain crystals resembling the oriental stones; and it was found, in fact, that by exposing a platinum capsule containing such a mixture to the heat of the porcelain oven for a considerable time, the boracic acid was evaporated, and a number of little shining crystals of alumina, having the properties and appearance of small precious stones, were left adhering to the capsule, but adhering so tightly that it was found impossible to detach them entire.

One other experiment is worthy of notice before proceeding to the only one which had any practical result; it is that of M. de Senarmont, who obtained similar microscopic crystals by exposing hydrate of alumina, or alumina combined with water, to a great heat, which caused the water to evaporate, and left the crystals at the bottom of the glass tubes in which the experiment was conducted.

The perseverance of M. Gaudin, who appears never to have abandoned the idea of manufacturing precious stones, enabled him, in 1857, to present to the Academy of Sciences several white sapphires produced by a very simple process, and of sufficient size to be used as jewels in watches.

The following is the mode of procedure by which M. Gaudin succeeded in producing these crystals:—

In a crucible lined with animal charcoal are placed equal parts of alum and sulphate of potash, previously calcined to expel the water. With this mixture the crucible is half filled; it is then filled up to the top with animal charcoal, the lid is put on and cemented in its place with clay, and it is then exposed in a furnace, and kept at a white heat for a quarter of an hour. The heat and the reducing power of the charcoal cause the formation of sulphuret of potassium, which fuses and dissolves the alumina; the continued action of the heat partly evaporates this sulphuret of potassium, and the alumina separates in the form of little crystals. On opening the crucible, a black mass, sparkling with brilliant points, is found in it, which consists of sulphuret of potassium mixed with crystals of alumina. This mass is afterward placed in diluted nitro-hydrocloric acid, which dissolves the sulphuret, and lets fall the crystals of alumina to the bottom of the vessel, where they appear as a coarse powder, and seen through a microscope, have an exact resemblance in form to the natural precious stones. By using a larger crucible, and exposing it to the action of the fire for a longer period, M. Gaudin produced crystals of much greater dimensions, which, upon examination, proved to be true white sapphires, and were even superior in hardness to the rubies ordinarily used for the jeweling of watches. He endeavored to produce colored crystals by the addition of metallic oxides, but found that these were invariably reduced into metals by the action of the charcoal. The successful result of this experiment encourages us to hope that at a future period M. Gaudin, or some one else possessed of his indomitable perseverance, may discover some substance capable of dissolving carbon in a similar manner to that in which sulphuret of potassium has been found to dissolve alumina, by which the problem of the artificial production of that beautiful and valuable stone, the diamond. will at length be solved.

Although not belonging strictly to the subject of the artificial production of precious stones, it will not, perhaps, be thought inappropriate to notice some experiments undertaken by Messrs. Deville and Wohler, which resulted in the discovery of a crystal strongly resembling the diamond in its hardness and properties, although of a different composition. This crystal is that of a substance called boron, which attracted the attention of Messrs. Deville and Wohler on account of its resemblance to carbon. It occurred to these gentlemen that a substance having such a great similarity to the element of which the diamond is composed would, in all probability, if crystallized, have some characteristics in common with that gem. They, therefore, set to work to find some process which would enable them to reduce it to the crystalline form.

Boron is only found in nature in combination with oxygen, as boracic acid, and in union with soda as borax; and it had, up to this time, been obtained from these combinations only in the form of a brownish green powder, insoluble in water, possessing many of the properties of carbon. It was reserved for the two chemists whose names are given above to produce it in a form hitherto unknown, by the following process:—

In a crucible lined with animal charcoal are placed eighty grains of aluminium and one hundred grains of boracic acid; this crucible is then exposed for five hours to an intense heat, which causes a portion of the boracic acid to part with its oxygen to the aluminium. After it has been taken from the furnace and allowed to cool, it is found to contain a sort of glass composed of the remainder of the boracic acid and of the alumina formed during the process of heating, and underneath this a gray metallic mass sparkling with crystals. This mass consists merely of boron imbedded in aluminium. To separate the boron, the mass is plunged into boiling caustic soda, which dissolves the aluminium, and is afterward treated with hydrochloric acid, to remove all traces of iron, and with a mixture of nitrate and hydrofluoric acids, to get rid of any silicon that may have been left by the soda. After all these processes have been gone through, the boron remains alone.

An examination of the boron obtained in this way shows that a great analogy exists between it and carbon, which, as every one knows, is found in three forms: uncrystallized in charcoal; semi-crystallized in plumbago; and crystallized in the diamond. Similarly the boron resulting from the above experiment is found to exist in three forms, namely, in black flakes almost as hard as the diamond; in brilliant prismatic crystals less hard than the former variety; and in small, beautifully-formed reddish crystals, having a great resemblance to the diamond. These crystals are as hard as the diamond itself, and may, in the course of time, should their manufacture be brought to perfection, supersede that stone in many of its uses, such as cutting and polishing precious stones, forming jewels in watches, &c.; and thus, although from their being unknown in nature they can not be considered precious stones, the discovery of these boron diamonds may prove of more practical value than all the attempts at the artificial production of the real diamond.

Another Good Word.

THE SCIENTIFIC AMERICAN.—The next number of this valuable journal will commence a semi-annual volume, and it is therefore a most excellent opportunity to subscribe for it. The writer of this watched its course since its first publication in 1845, seventeen years since, and its uniform intelligence, candor and general reliability upon all subjects falling within its range, has challenged our admiration and respect. It has attained a larger circulation than any other paper of its class in the world, and is the lowest in price, the leading English scientific papers being treble its price per annum. The SCIENTIFIC AMERICAN is devoted to the interests of popular science, the mechanic arts, manufactures, inventions, agriculture, commerce and the industrial pursuits generally, and is valuable and instructive not only in the workshop and manufactory, but also in the household, the library and the reading room. We shall continue, as heretofore, to make liberal use of the AMERICAN in enriching the columns of the *Express.—Rochester Express.*

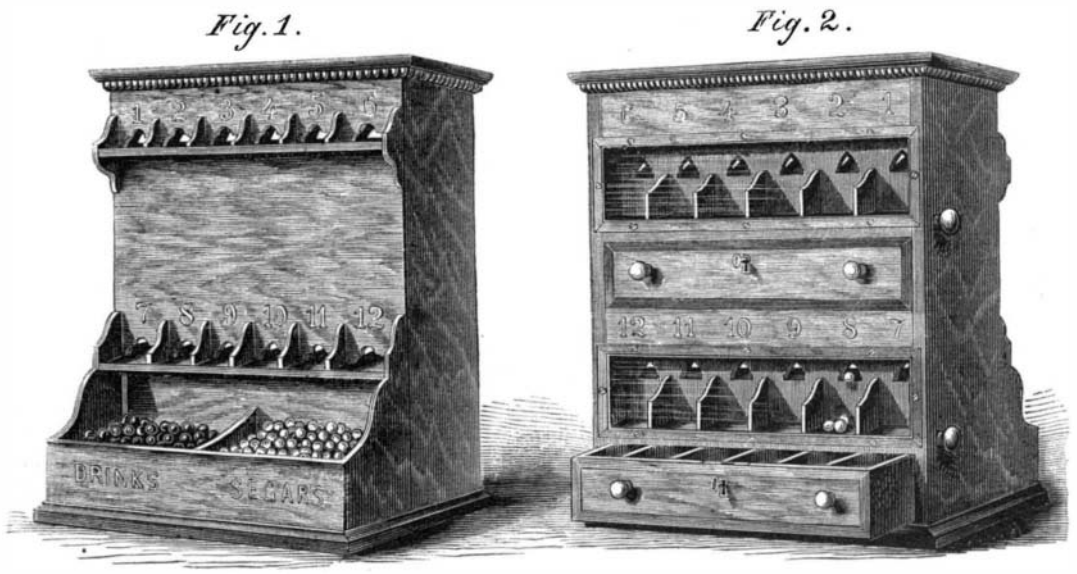
What is Heat Lightning?

The flashes of lightning, often observed on a summer evening, unaccompanied by thunder, and popularly known as "heat lightning," are merely the light from discharges of electricity from an ordinary thunder cloud beneath the horizon of the observer, reflected from clouds, or perhaps from the air itself, as in the case of twilight. Professor Henry says that Mr. Brooks, one of the directors of the telegraph line between Pittsburgh and Philadelphia, on on eoccasion, to satisfy himsely on this point, asked for information from a distant operator during the appearance of flashes of this kind in the distant horizon, and learned that they proceeded from a thunder storm then raging two hundred and fifty miles eastward of his place of observation.

THE Schenectady N. Y. Locomotive Works are constructing some engines for canal boats, which are much on the locomotive principle.

Improved Bar Register.

The pretty little piece of cabinet work, two pictures of which are embraced in the annexed engraving, is intended for the convenience of barkeepers—a class far too numerous in this country. The inventor says, and it is presumed that he knows, that there are frequently loafing about bar rooms persons so mean that when they see a company drinking they will step up and take a glass without any invitation, and hence, in settling, disputes are liable to occur between the barkeeper and the person giving the treat. To effectually prevent these disputes, and also to provide a check on the money receipts of the barkeeper, is the object of the invention here illustrated.



M'NAMEE'S BAR REGISTER.

A number of red balls are placed in the apartment marked DRINKS, and a number of white balls in that marked SEGARS. If a person wants one drink he calls for it, and at the same time drops a red ball in the pigeon hole marked 1. The ball rolls through the cabinet to the back side where it drops into a box with a glass front in plain sight of the barkeeper. The barkeeper allows it to rest till he is ready to make change, the ball thus forming a record of the number of drinks ordered. When the drink is paid for the barkeeper turns the bottom of the box in which the ball rests, by means of a knob at the side of the cabinet, when the ball falls into a locked drawer below, preserving the record of the number of drinks sold. If a customer order two drinks, he drops a ball into the pigeon hole No. 2, when it falls into a compartment in the drawer of a corresponding number; and it will be seen that provision is made for any number of drinks from one to twelve. Beyond this it is not supposed that any treater will go, except politicians in election time, for whom no adequate provision can be made.

The apartment marked SEGARS contains a number of white balls, and when a customer orders a cigar, he will drop one of these balls into a pigeon hole numbered to correspond with the price of his cigar; if a six-cent cigar he drops a white ball into No. 6, and so on.

The drawers are locked with keys of peculiar construction, difficult if not impossible to duplicate, and the keys are carried by the proprietor, who, by opening the drawers every night and counting the balls in each compartment, can ascertain exactly how much money his barkeeper has received.

It is said to be a matter of common observation that barkeepers generally buy out their employers in about three years, but it is supposed that by means of this register the relations of employer and employed may be somewhat longer preserved.

The patent for this invention was granted, through the Scientific American Patent Agency, June 10, 1862, and further information in relation to it may be obtained by addressing the inventor, James McNamee, at Easton, Pa. [See advertisement on another page.]

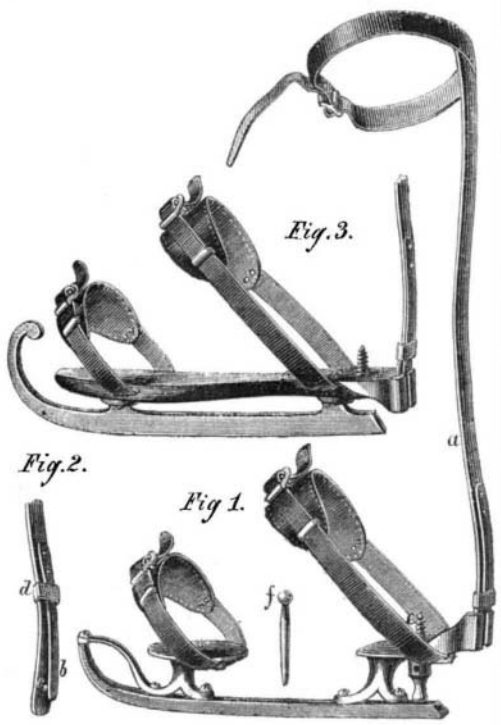
Business in Lynn.

The Lynn, Mass., *Reporter* states that a great deal has been done in that place during the present season in the erection of buildings as compared with previous years. It also says:—"Carpenters and masons as well as shoemakers and other mechanics, have been and still are full of business and good prices. We can scarcely pass through a street in the city without seeing some evidence of thrift and a desire for improvement, either in the way of building, repairing or painting buildings, replacing fences, trimming up gardens and the like. This is the natural result of an improved state of trade, and a more free circulation of the "needful," without which almost everbody feels too poor to "improve" on anything. We should lack space to enumerate one half of the improvements that have met our eye in our walks about town."

JEBB AND CUTLER'S ANKLE-SUPPORTING SKATE.

Another improvement in skates! It would have been naturally supposed that an implement so simple as this certainly could not require a very large number of improvements, but since skating became so fashionable as to create an extraordinary demand for skates, devices for making them better or for rendering them more convenient of adjustment or in some way more nearly perfect, have come forth in astonishing variety, and we begin to think that even this little department of invention will never be exhausted.

The skate here illustrated was invented by Thomas Jebb and Abner Cutler, of Buffalo, N. Y., who have assigned the invention to George D. Teller, of the same place. Its principal feature is the ankle support. This is a thin strip of tempered steel, *a*, Fig. 1, which is inserted into a slot in the rear end of the



heel plate, and is secured at the upper end to the leg of the skater by a strap around the calf. The mode of securing this ankle support is shown in Fig. 2. A thin steel spring, *b*, is fastened to the back side of the support, and carries a pin, *c*, on its lower end, which projects forward, passing through a hole in the heel plate. It is held in place by slipping the loose band, *d*, down near the heel plate.

As the projection provided on the heel plate to receive the lower end of the ankle support would prevent the screw, *e*, from being turned into the boot heel, by turning the whole skate in the usual way, this screw is fitted to turn independently of the heel, and a small bar, *f*, is provided for turning it; the end of the bar fitting into holes in the shank of the screw.

For adapting this ankle support to skates with wooden stocks, a heel plate is made to be secured by wood screws upon the stock, and the projection to receive the support is turned downward in order that the screw may be turned into the heel in the usual manner; see Fig. 3.

The other peculiarities of this skate are manifest on an inspection of the cut.

It is well known that the principal fatigue in skating comes from the great strain on the ankles, and as this support is very thin in the longitudinal direction of the foot, while it is broad in the transverse direction, it supports the ankle firmly sideways, though yielding freely in the opposite direction. We are assured that new beginners and ladies find it a great assistance, and that old skaters are able with its use to continue the exercise for hours without any considerable fatigue.

The patent for this invention was granted July 2, 1861, and further information in relation to it may be obtained by addressing the assignee and manufacturer, George D. Teller, at 170 Main street, Buffalo, N. Y.

Penetrating Armor Plates and Punching Iron.

An intelligent writer in the *Mechanics' Magazine* in the course of a series of articles on "The Iron Walls of Old England," makes the following remarks:—

The term penetrating force, and penetrating effect, are used with great laxity. They have been so used in reports of experiments to such an extent that their true meaning has been lost sight of. By penetrating force or effect, as applied to an iron projectile striking an iron plate, I understand the power of the shot to pass through or bury itself in the material of the plate, supposing the plate to be held firmly in its place without motion or vibration, and without any yielding of the back support on which it bears. To exemplify my meaning I will refer to the familiar example of a punching machine punching rivet holes in a plate. The effect produced in that case is the penetrating effect of iron, or rather of steel on iron.

Now, in this operation there is a law known to every boiler maker. No force will drive a punch through a plate unless it be of greater diameter than the thickness of the plate. A one-inch steel punch will not go through a one-inch iron plate; it will go through a $\frac{3}{4}$ or perhaps a $\frac{7}{8}$-inch plate; but if the punch, instead of being of steel, were of iron, it probably could not be driven through a $\frac{1}{2}$-inch plate. Experiments have been made which invariably have resulted in the punch or the machinery being broken if the former has been less in diameter than the thickness of the plate. Here, then, we have a law which applies to projectiles in the shape of cannon shot, which are punches propelled with the explosive force of gunpowder. Pursuing the analogy of the punching process, if a plate were placed under a punching machine without a die or a solid support at the back of the place struck, the punch would not penetrate the plate. It might, if there were no support behind the plate, or if the plate were placed on a plank of wood, bulge and perhaps crack the plate, but it would not pass through it. I think, then, the nature and extent of the penetrating force of iron projectiles against iron plates is clearly defined by the punching process, and the truth of this definition is confirmed by numerous results of target experiments, showing that where the backing was hard, and rigid, and did not give way, the amount of penetration of the shot into the iron was extremely limited.