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ARTIFICIAL DIAMONDS.

THE world of science and the world of fashion are so far removed from each other that they are seldom stirred by the same event, but the production of artificial diamonds has lately startled both these distant realms.

Mr. Hannay, of Glasgow, has recently exhibited before the Royal Society certain crystals which are no accidental productions, but direct results of a process conceived for a definite end. These have been examined by analysts like Professors Maskelyne, Roscoe, and Dewar, and declared to exhibit all the physical and chemical properties of true diamonds.

Mr. Hannay's gems are very small; but whether he will hereafter succeed in producing large stones, and what effect success of this kind would have on the value of the diamond, we do not propose to inquire. This is a question which concerns the world of fashion alone; the world of science is interested in asking by what means the crystallization of carbon has at length been accomplished.

Every one is acquainted with the various forms of the substance called carbon. It constitutes a large proportion of all animal and vegetable structures, and we know it best in an impure condition as coke or charcoal; but it occurs crystallized, and in a state of purity, in two very different forms, viz., diamond and plumbago, or black-lead.

Those bodies which resist all attempts of the chemist to resolve them into simpler forms of matter are called elements, and among the vast number of substances composing our earth some sixty-four, which are for the most part metals, are simple bodies; of these carbon is one.

Almost every substance which is capable of existing in the solid state assumes, under favorable conditions, a distinct geometrical figure. This power which bodies possess of taking on definite forms is called crystallization, and its most beautiful examples are found among natural minerals, the results of exceedingly slow changes occurring in the substance within the earth. Artificial crystals may be obtained from solutions, by fusion, and in the passage of bodies from the gaseous to the solid condition. Thus crystals of common salt are formed by the evaporation of brine; many metals, as iron and bismuth, crystallize on cooling after being melted; and the vapors of some substances, like iodine, for example, deposit crystals in the act of condensation.

Every body possesses its own distinct crystalline form; every crystal is a geometrical figure, usually bounded by plane surfaces having angles of constant value, and the science of crystallography teaches us to distinguish substances by the measurement of these angles. It is invariably found that artificial crystals which have been deposited slowly and quietly surpass in size, regularity, and beauty those of more rapid formation; hence it is conjectured that natural minerals owe their great perfection to very gradual deposition in the rocks within which they are found.

Under different conditions the same substance sometimes assumes two crystalline forms, of which somewhat uncommon phenomenon carbon furnishes an example by crystallizing now into diamond, and now into graphite, or plumbago.

Although found in every quarter of the globe, the diamond is the rarest as it is the hardest known mineral. It occurs exclusively among gold-bearing rocks, or sands derived from gold-bearing rocks, and among strata which, though originally soft, shaly deposits of sand or mud, have been "metamorphosed," as it is called, into hard crystalline schists. It was once supposed by geologists that the metamorphic rocks were deposited in their existing crystalline form from a boiling ocean enveloping the still heated globe; but it is now known that these formations were originally deposited as mud or sand, and have been transmuted into schists by the influence of subterranean heat acting under great pressure, through lengthened periods of time, and aided by thermal water or steam permeating the porous rocks and giving rise to various chemical decompositions and new combinations within them. The diamond probably originates, like coal or mineral oil, from the gradual decomposition of vegetable or animal matter; we may therefore regard the brilliants which we prize in the drawing room as having been slowly elaborated from carbonaceous matter furnished by some dead fish, or rotting plant, originally buried in the mud of an inconceivably ancient palæozoic shore.

It will now be seen that, in order to produce the diamond artificially, some means must first be devised whereby the element carbon, which will dissolve in no liquid and vaporize in no flame, can be rendered soluble or gaseous, from either of which conditions it might then probably be recovered in a crystalline form, as happens in the case of other bodies.

Mr. Hannay's attempts to crystallize carbon originated from a research of a very different character. Water, as we all know, vaporizes at a heat of 212° Fahr., and in the same way every liquid has its "boiling-point," or temperature at which it ceases to be a fluid and becomes a gas. Little is known about the condition of matter immediately beyond the "critical point," as the moment of passage from the liquid to the gaseous state is called; and while investigating this subject it occurred to Mr. Hannay that some insight might be gained into a state of things then so obscure as to be thought hopeless, by dissolving in the liquid under examination some solid substance which fused at a temperature much above the critical point of the fluid.

Sulphur, for example, melts at 111° Fahr., and is soluble in carbon dioxide, a liquid whose boiling-point is 42°. When such a solution was vaporized it was found that the sulphur was not deposited, but remained diffused in the atmosphere of dioxide vapor; or, in other words, the sulphur was dissolved in the gas. If the side of a tube containing such a gaseous solution of sulphur is approached by a red-hot iron, the part next the source of heat becomes coated with a crystalline deposit, which redissolves into the gas on the removal of the heat. In the course of his experiments on the solubility of solids in gases Mr. Hannay further noticed that many bodies, such as alumina and silica, which, like carbon, are insoluble in water, dissolved to a considerable extent in "water-gas," or water at the critical point when it is neither a true liquid nor a true gas. This fact suggested to him that a solvent might even be found for the hitherto insoluble element, carbon; and, as gaseous solutions were found to yield crystalline solids in almost every case upon the withdrawal or dilution of the solvent gas, it was hoped that, from such a gaseous solution of carbon, crystals of diamond might be obtained.

After a large number of experiments, however, it was found that neither charcoal, lampblack, nor black-lead would dissolve in the most probable solvents when these were brought to their critical points, and a new road out of the difficulty had accordingly to be sought.

Chemists have long known that what is called the "nascent" state of matter is one very favorable to chemical combination. Thus nitrogen, for example, refuses to combine with hydrogen, but, if these two substances are simultaneously liberated from some previous combination, they unite at the moment of birth with the utmost ease. Bearing this in mind, it was ascertained that, when a gas containing both carbon and hydrogen is heated under pressure in presence of a metal, the hydrogen is attracted by the metal and the carbon left free.

Mr. Hannay attacked this nascent carbon with many gaseous solvents, and it is his triumph to have found what he sought. In doing so, he has removed a reproach of long standing from the science of chemistry; for, whereas the larger part of that science is occupied with the chemistry of carbon and its compounds, this element has never previously been either dissolved or vaporized by man.

What the solvent is, we are not at present definitely told; we only know that it is some nitrogen compound, probably a cyanide; but the process is quite intelligible in the absence of this information, while its products are open to the examination of experts.

A hydrocarbon vapor, such as petroleum, is decomposed at a high temperature and under great pressure. As the hydrogen and carbon part company, the former is absorbed, while the latter, being nascent, dissolves in a gaseous solvent, from which solution of carbon crystals are then obtained, just as table-salt is produced by the evaporation of brine, and these crystals are diamond.

The temperature at which the dissociation of the hydrocarbon is effected must be very high, and the pressure enormous, so that the great difficulty of the process lies in the construction of an inclosing vessel strong enough to withstand the combination of heat and disruptive force. Coiled tubes of wrought iron, of half an inch bore and four inches external diameter, have been torn open in nine cases out of ten.

The mineralogical tests which demonstrate the genuineness of diamond are as follows: It must scratch topaz and sapphire, its angles must be those of a regular octahedron, it must burn without leaving any residue, and it must exert little or no action on polarized light. Professor Maskelyne, of the British Museum, has already stated in the "Times" that Mr. Hannay's crystals satisfy all these tests. They score topaz and sapphire easily and deeply; the angle of their cleavage-faces, which could not be measured with great accuracy on account of the minuteness of the gems, is 70° 29', while that of the diamond is 70° 30'. Particles ignited on platinum glow and disappear exactly as the gem would do, and they are very nearly inert in polarized light.

It is not long since science rejected the claims of another Glasgow investigator to the artificial production of crystalline carbon, and it is somewhat singular that Mr. Hannay's successful solution of this great chemical problem should have followed so quickly upon Mr. McTear's failure.

That the diamonds in this case are real there is now no question; and it is quite possible that, just as experience has taught chemists how to produce large and perfect crystals from solutions which under ordinary treatment yield only small and imperfect specimens, so Mr. Hannay may by and by succeed in making diamonds as big as the Koh-i-noor or the Regent.

We learn, however, from the investigator's own statement, that up to the present time it has cost him five pounds to produce five shillings' worth of diamond; but, even if the world of fashion is destined to deplore the degradation of its cherished gem, we may be sure that, long after some new toy has satisfied society for its loss, the crystallization of carbon will possess for the greater world of science the same kind of interest as clings around the discovery of oxygen by Priestley, or the demonstration of magneto-electricity by Michael Faraday.—*Belgravia.*