THE CHEMISTRY OF METEORITES.

M. Daubrée, already so distinguished for his researches on metamorphism, has recently published the results of his Synthetical Experiments on Meteorites, and has thus brought before us, from an entirely different point of view, an inquiry into the nature and origin of the silicated magnesian rocks and minerals.

M. Daubrée first describes his experiments on *the imitation of the meteoric irons.* The most characteristic feature of these masses is the crystalline pattern, which is brought to view on a polished surface by the action of an acid. Simple fusion of the meteorite of Caille (Var) in a *brasque* of alumina (to avoid the contact of carbon, which would have combined with the iron), was insufficient to reproduce the appearance, although the resulting substance was certainly crystalline. Further experiments, in which soft iron was associated with some of the other substances that commonly accompany meteoric iron, such as nickel and protosulphide of iron and silicon, yielded a highly crystalline result, but not yet of the true character. If, however, to the soft iron was added phosphide of iron, in the proportion of from two to five or ten per cent, and, still better, if there was introduced at the same time nickel, and if a mass of as much as two kilogrammes in weight was operated on, there appeared, when the cooled lump was polished and etched, in the midst of dendritic patterns of great regularity, lines of a brilliant material dispersed in a reticulated form.

A third mode of attempting the imitation was that of melting down certain terrestrial rock substances, as peridote, lherzolite, hypersthene, basalts, and melaphyres. By this means specimens of iron were obtained which, both in composition and structure, bore strong resemblance to many of the siderolites. Especially was this notable in the metal obtained from the lherzolite of Prades (Eastern Pyrenes). These artificial irons were then found, like the natural meteoric ones, to contain nickel, chromium, and phosphide of iron, the latter in long needles recalling the appearance of the natural patterns.

Imitation of the Meteoric Stones.—Contrary to what might have been expected from the appearance of the black vitrified crust on the surface, the substance produced by the melting down of meteorites obtained from above thirty different falls, was in every case highly crystalline. Those of the common type present a group of metallic granules, disseminated in a stony mixture of peridote and enstatite, the former generally on the surface as a thin crystalline pellicle, the latter in the interior as long acicular crystals. A notable contrast was yielded by the aluminous meteorites, such as those of Juvinas, Jonzac, and Stannern, which produced, instead of crystalline, a vitreous mass.

But perhaps the more remarkable results were those obtained synthetically by melting down pieces of rocks characterized by the minerals peridote and enstatite. For this purpose peridote (olivine), from the basalt of Langeac (Haute Loire), and lherzolite, from Vicdessos and Prades, were fused in earthern crucibles. They melted easily and yielded crystalline substances, the latter especially closely resembling the original rock. The proportion of enstatite (the bisilicate of magnesia) was found to be increased by the addition of silica.

When similar mineral substances were melted in presence of a reducing agent, the iron (which in the other case remained combined in the silicate) segregated itself in grains of various sizes, separable by the magnet. Thus a perfect analogy was established between the above rocks and the meteorites, as well in the stony minerals as in the iron, which always contained nickel.

Furthermore, some remarkable characters in the structure of the stony meteorites were found to have been imitated, especially the delicate parallel lines attributed to cleavage, which are visible when a thin slice is examined under the microscope, and the globular structure where the little spherules are sometimes smooth at the surface, at others drusy, or roughened with the points of minute projecting crystals, like the meteorite of Sigena, November 17, 1773.

When hydrogen was employed as the reducing agent, the results were very similar, and the reduction would take place at a temperature not exceeding red heat.

Again, another method of imitation, the reverse of the foregoing, was by oxidation. From silicide of iron, heated in a *brasque* of magnesia by the gas blowpipe, a substance was obtained extremely similar to the common type of meteorite. The iron was separated partly as native iron, partly as a silicate, forming peridote, some of it in the crystallized state. Further details of resemblance were attained by heating a mixture of silica, magnesia, and nickeliferous iron, phosphide and sulphide of iron. The stony gangue of the melted product was found to be free from the latter three substances; and instead of the simple phosphide introduced in the experiment, there was observable the triple phosphide of iron, nickel, and magnesium, first noticed by Berzelius in meteoric irons.

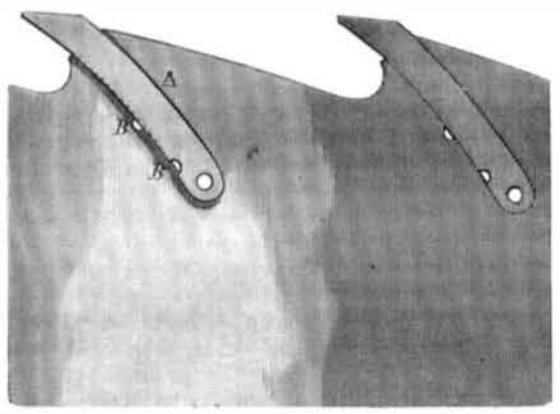
The preceding experiments suggest some important deductions on the condition of the planetary matter from which the meteorites have been diverted to our own globe. M. Daubrée makes no attempt to enter the lists with Von Haidinger, Baron Reichenbach, Prof. Lawrence Smith, and others, on the questions attending the entry of these bodies into our atmosphere, and the circumstances of their fall; but, considering that their surface alone is modified by these conditions, he infers that their interior mass remains the same as when it was wandering in space, and may to a great extent be taken as a sample of the material of the planetary bodies of which they are the fragments.

Seeing how nearly the composition and structure of the meteorites are reproduced by the two methods of experiment, M. Daubrée refers by their aid to the original mode of formation of the bodies from which these meteorites come.

If they were produced from silicated minerals by reduction, in which carbon was the reducing agent, it may be objected that the iron could scarcely have remained in the metallic state; and if hydrogen be supposed to have been the reducing agent, water ought to have been formed at the surface, whence it appears more simple and reasonable to recur to the idea of an oxidizing process. Allow that silicon and the metals existed at one time in the meteorites, not combined with oxygen as they now mostly are, and this by reason either of too high a temperature to allow them to remain in combination, or of too great a separation of their particles, then, as soon as, by their cooling down or by their condensation, the oxygen was able to act upon the other elements, it would at once combine freely with those for which it had most affinity, and if not sufficient in quantity to oxidize the whole, or not enabled to act long enough, would leave a metallic residue. In fact; there would be produced the silicate of magnesia and iron, peridote or olivine, and granular portions of nickeliferous iron and of sulphides and phosphides of iron. These views, while applicable to a large proportion of the meteoric bodies, would require modifications for those rarer varieties which consist essentially of pyroxene and anorthite. While the magnesian silicates crystallize so readily after simple fusion, these latter substances would only melt to vitreous and amorphous masses, and in order to become crystalline would have needed the presence of water.—*Address to the Geological Society*, 1867.

CLEMSON'S ADJUSTABLE SPRING-HELD SAW TEETH.

The engraving shows a saw tooth differing not only in form but in manner of being retained in place, from others. Its simplicity of shape and consequent ease of manufacture and management is one of its advantages, while the form of the slot as compared with that of the tooth is another. The tooth is dovetailed, or rather its edges conform to the slot, which



is of a V-shape. The tooth is curved the lower end, being struck on a circle. It is retained in place by a spring pressure as the curve of the slot in the plate differs slightly from that of the tooth, as seen at A. When partially worn the teeth may be moved outward from the center of the plate although still held by the spring of the tooth. When, however, worn quite short, the two halves of the holes, B, in the plate and tooth may be brought together and a pin or screw inserted. This is only necessary when the tooth is removed so far from the slot as not to be affected by the spring of the tooth against the plate. These half holes may be several in number, if required, but it is found in practice that one on the plate and one on the tooth is sufficient. The dissimilarity of the curvature in the tooth and the slot in the plate amounts to about one-sixteenth of an inch.

The patent of Aug. 14, 1866 claims holding the teeth by elastic pressure, which is the peculiarity of the device, and others are being secured by a pending application through this office. Address for further information William Clemson Middletown, N. Y.

COATING IRON WITH COPPER.

The *Mechanics' Magazine* furnishes the following account of a simplified process of copper plating employed in the extensive electro-metallurgical establishment of M. Oudry, located in the village of Auteuil, three miles out from Paris. Such complete success has attended the introduction of this new method of depositing copper upon wrought or cast iron, that the inventor and founder of this establishment, relinquishing to his compeers the ordinary applications of copper plating which are limited to articles intended principally for purposes of interior decoration, produces chiefly such articles connected with the external decoration of stately and superb edifices, which are, therefore, exposed to all the destructive effects of air and water, to the deteriorating alterations of heat and humidity, and to the corroding action of gas and frost. To M. Oudry was entrusted the plating in copper of all the cast iron monuments of the city of Paris, including the fountains of Venus and Diana in the Champs Elysees, that of Visconti in the Louvais square, that of the four seasons, and the monumental designs which embellish the Place de la Concorde. Among other works deserving notice is the reproduction in galvanoplastic of the bas-reliefs composing the Trajan column, exhibited at the Louvre, and the surface of which cannot be less than 700 square yards in extent.

Were people in general to know the price paid for success in any department of scientific knowledge and application, it is very questionable whether they would not be more inclined to pity than to envy the representative. The present proprietor of the establishment at Auteuil has had his due share of labor and anxiety in bringing the art to so high a degree of perfection. For many years he was engaged in conducting experiments of a troublesome and complicated nature, in order to arrive at his end, which was copper plating of any required thickness upon cast and wrought iron by a direct operation. This was the only method, in his opinion, available for effectually resisting oxidation, when the specimens plated possessed a large area of surface, together with numerous details of tracery, graving, and ornament. Similarly, this was the only plan which promised success in plating bodies composed of several pieces and connected together by bolts or rivets, and which might be exposed to stain and friction, such as pistons, screws and armor plates. Under the same category may be included substances undergoing a heavy pressure, such as rollers. All these require not merely a plating of copper, as understood by the ordinary term, but absolutely a thick crust of copper upon them. To obtain this result it was necessary to immerse the objects in a bath of sulphate of copper, and to keep them there for several days in the presence of an electrical current. It was found that if the pieces were cleaned and plunged into a preliminary bath to obtain a superficial film, and then transferred to a bath of a stronger and more acid nature, the iron, owing to its impurities, having been but imperfectly cleaned, and consequently but very slightly coated, was at once attacked by the acid, and the result was the very reverse of what was desired. Instead of the object being plated, it was rapidly corroded and destroyed. After many attempts to succeed by the use of two successive baths of different strengths, M. Oudry was compelled to renounce the endeavor and to turn his attention to another plan of operation. The one he has finally adopted consists in discarding the preliminary bath and the cleaning, and replacing them by a fluid coating of an isolating and impermeable character. By this new process, the exact *modus operandi* of which is a secret, the monuments we have alluded to were plated, together with 20,000 gas lamps and fittings ordered from Auteuil for the city of Paris. These lamps are composed of a pedestal and shaft, the former of which is seldom retouched, but the shaft is generally adorned with garlands, and requires to be filed up. This having been done, the workmen cover the surface with a very thin film of benzine, and so soon as this coating is dry a second, and then a third, is applied, the whole three operations embracing a period of three days. Subsequently, the surface is rubbed over with charcoal powder, and then it is fit for the plating. Any part that is not required to be plated is covered with a paste of some conducting earthy substance. The objects having been duly prepared are transfeared to large wooden vats containing the baths, are tied together with copper wires, and surrounded with numerous earthern jars of a porous description, in which are placed plates of zinc furnished at the top with strips of copper, to which are attached the conducting wires encircling the objects to be plated. The contact of the copper and the zinc sets up the galvanic action which commences directly the earthern jars are filled with dilute sulphuric acid, and a saturated solution of sulphate of copper is introduced into the vats. The strength of the solution is maintained constant by supplying or feeding it with crystals of the sulphate of copper. Notwithstanding that the theory of the process depends upon these conditions being fulfilled, yet the beauty of the plating and the practical success is very much due to the thousand and one little devices and dexterous manipulations only to be acquired by long practice and experience. About three or four days suffice to render the operation complete, the thickness being the 1-25th part of an inch, and the objects are then taken out of the bath, washed in water slightly acidulated, brushed with a wire brush, and rubbed with green paper to relieve the dull tint the newly plated copper assumes. The finishing touches consist in brushing the objects with a brush steeped in a preparation of ammoniacal acetate of copper, which attacks the surface of the fresh coating, and imparts an agreeable greenish tint to it, and finally rubbing them with a hard brush well waxed.

Our readers will recognize in the battery adopted at the establishment of Auteuil, that of the well known Daniell's constant battery, the especial feature of which is to furnish regular currents of uniform intensity, by means of the partition separating the two liquids, and through the pores of which they come into contact. In all these substitutions for solid metal of the same nature as the superficial film, the question of cost enters largely, and a few remarks will be *apropos* to the subject. A gas lamp of the newest pattern, in Paris, weighs 4½ cwt., and costs, including casting, filing up, copper plating, and bronzing, exactly £8, being at the rate of a fraction under fourpence per pound. The same article cast in bronze will only weigh, in consequence of the reduced thickness, 2¾ cwt., but owing to the price of that metal the cost would amount to a trifle over £30. It has been estimated that the difference between these two specimens for the whole city, amounts to a saving of nearly half a million pounds sterling. The Emperor of the French has marked his approbation of the energy, enterprise, and skill of M. Oudry, by presenting him with the cross of the Legion of Honor; and all those who have witnessed the success which has attended his efforts at the Exposition, will concur in the opinion that the honor had been well earned and deservedly merited.

CASTINGS IN SOFT STEEL.—It is noted as a fact in casting steel to patterns, that Messrs. Vickers, Sons & Co., of Sheffield, Eng., have cast a hydraulic cylinder 8 inches in diameter and 2½ thick, perfectly sound and malleable. The Wm. Butcher Steel Works, Philadelphia, Pa,, have recently cast a hydraulic cylinder 12 inches in diameter and but 1¾ inches thick, perfectly sound and malleable, which is a much more difficult casting to make, on account of the thinness of the metal.