a pecuniary point of view. Having recently visited most of the places where the stone was produced, he would describe the plans adopted. The slag was allowed to run from the furnace in a fluid state into pits in the ground, eight or nine feet in diameter at the top, with sides sloping inwards to the bottom, the pits being three feet deep in the centre. The liquid hardened on the top, and the hardened mass rose as the pit filled. The furnaces were tapped every eight hours. The mass in the pits took nine or ten days to cool. It was quarried by means of large hammers and iron bars. The material thus obtained, except the crust on the top and a thin layer at the sides and bottom, was a hard, compact, crystalline stone, often resembling certain basalts. Of course, its quality depended on the nature and proportion of the materials with which the furnace was charged. That produced from cinder iron did not equal that produced in the manufacture of grey pig. The stone was found to have a high degree of resistance to crushing. It was largely used in France for paving, and was worked by masons into pieces of the form and size desired with facility, while the waste thus obtained was employed for macadamized roads. He had seen it where it had been laid down for three years. The French engineers spoke favorably of it, and the iron masters showed him proofs that, while this process got rid of a cumbersome material, it was itself a profitable branch of industry. The great consideration in England to such a manufacture would be the space it would require. With three tappings a day, each tapping filling one pit, and ten days for cooling, 30 pits would be needed, which would require a space of 2400 square feet. It was not often that so large a space could be made available at our iron works; but, on the other hand, it should be remembered that France was very deficient in stone suitable for paving.

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On the Hydraulic Properties of Magnesia. By M. H. STE. CLAIRE-DEVILLE.

From the Proceedings of the Academy of Sciences of Paris.

About seven years ago, M. Douy, an Engineer of the Salt-Spring Company of the North, sent me some magnesia obtained by calcining the chloride of magnesium. It was a product of the processes invented by M. Balard for the utilization of the mother-waters of the salt springs, put in practice in France and also at Strassfurt in Prussia, in mines from which there is at present extracted considerable quantities of the chlorides of magnesium and potassium, and of sulphate of soda.

This magnesia, which was anhydrous and in compact lumps, was left for several months in the running water under a hydrant in my chemical laboratory at the Normal School. It assumed a remarkable firmness, became hard enough to scratch marble, of which it had the density and tenacity, translucent in thin pieces like alabaster, and crystalline in geodes, which were formed in the interior of the mass. After six years of exposure to the air, this material is in no wise altered, and its analysis gave me the following results:

Water,	.	.	.	.	.	.	27.7
Carbonic acid,	.	.	.	.	.	.	8.3
Alumina and oxide of iron,	.	.	.	.	.	.	1.3
Magnesia,	.	.	.	.	.	.	57.1
Sand,	.	.	.	.	.	.	5.6
Total,	.	.	.	.	.	.	100.0

The small quantity of carbonic acid found in this material shows that it is essentially formed of a crystallized hydrate, and that this hydrate, like brucite, does not attract carbonic acid and form a carbonate.

To prove that this is the case, I prepared very pure magnesia by calcining the nitrate at a low red heat, and pulverized the mass finely enough to make with water a semi-plastic mass, which I allowed to remain for some weeks in boiled distilled water enclosed in a tube hermetically sealed.*

The magnesia gradually combined with the water and assumed a hardness and compactness comparable with those of my former specimens. It also became crystalline and translucent. After drying in air it had the following composition :

Water,	.	.	.	.	31.7	30.7
Magnesia,	.	.	.	.	68.3	69.3
Total,	.	.	.	.	100.0	100.0

It was, therefore, a simple hydrate of magnesia. I made with this substance, medals cast as with plaster, and they set under water, presenting the appearance of marble.†

The magnesia of M. Balard, when calcined at a bright red heat, has hydraulic properties, which show themselves with a wonderful rapidity and perfection. Calcined at a white heat for twelve hours, pulverized and made into a paste, it does not set unless it be left for several weeks in contact with the air, and even then it hardens slowly, so that its hydraulic properties appear to be almost lost.

A mixture of chalk, or of marble, and of magnesium pulverized, furnishes with water a slightly plastic paste, which moulds well and gives, after remaining some time in water, products of very great solidity. I intend to try this material for casting busts in artificial marble, the qualities of which may be very important if my expectations are fulfilled. All my experiments have been made heretofore with a mixture of equal parts of marble and magnesia.‡ Fontainebleau sandstone gives with

* If the pulverised magnesia be tightly packed at the bottom of the glass tube, and water poured on it, the tube will soon be broken by the formation of a compact hydrate of greater volume than that of the calcined magnesia.

† I speak here only of the magnesia obtained by calcining the chloride or the nitrate of magnesium. As to the light magnesia prepared by means of the hydrocarbonate, it gives on hydration a less tenacious talcose product, to which I shall refer again.

‡ M. Damour has published in the *Bulletin de la Société Géologique* (2d series, vol. iv., 1846) the analysis of a mineral, predazzite, composed like my artificial stones, of carbonate of lime and hydrate of magnesia. M. Damour considered this substance as formed by a mixture in which the carbonate of lime is cemented by the hydrate of magnesia. My experiments confirm manifestly this explanation. Predazzite is composed of carbonate of lime 63, hydrate of magnesia 35.1, foreign substances 11.9.

magnesia a product still more remarkable on account of the grain which it has and its strength.

Plaster of Paris mixed with magnesia undergoes alteration under water and diminishes its hydraulic properties.

My experiments on these mixtures suggested to me the idea of calcining, at a temperature of from 300° to 400° , (572° to 752° Fahr.,) dolomites tolerably rich in magnesia, to make them into paste with water and try them as cements. These materials differ from poor lime only in having been cooked at a temperature far below that of the kilns, and they have properties essentially differing from them. The dolomite treated at a low temperature set under water very rapidly, and gives a stone, the hardness of which is really extraordinary. The specimen which I have the honor to submit to the Academy was prepared with the dolomite which Messrs. Bell of New Castle, employ for making magnesia by the Pattinson process.

If the dolomite is heated more strongly, so that a little lime is formed in the mass, this lime does not yet interfere with the setting, but it separates in fine crystalline veins which are perfectly pure arragonite and free from magnesia. The crystals of this carbonate are perfectly visible under the lens and are all prismatic so as to leave no doubt as to their form. The complete absence of carbonate of magnesia from this material proves once more the correctness of my brother's observations upon the incompatibility of lime and magnesia when their compounds assume certain crystalline forms.

When dolomite is heated to redness the carbonate of lime is transformed into quick-lime, and the product entirely calcined, pulverized and made into a paste immediately loses all consistence in water.

In all these experiments the magnesia is the hydraulic material which cements, as it hydrates, the particles of intact carbonate of lime, exactly as in artificial mixtures of magnesia and marble, and makes a compact and homogeneous stone.

M. Paul Michelot has been kind enough, at my request, to expose all these magnesium materials to the action of the sea, at Boulogne, and up to this time, after a long trial, they have resisted. But these experiments are not yet finished, and I desire to leave this skilful engineer to publish his final results.

Other experiments have been tried, at my suggestion, upon feebly heated dolomites. According to the brief report which M. Michelot has been kind enough to make to me, they entirely confirm my results. The facts contained in this note prove the perfect hydraulic character of pure magnesia by the formation of a definite hydrate. They explain the successful attempts of M. Vicat to introduce magnesia into marine cements; and permit me to hope that by means of them the arts may utilize a substance which has been, thanks to the admirable processes of M. Balard, put at their disposal at a low price and in indefinite quantities.