during the deposition of the copper. He also gives five pages of his work to the discussion of the reduction of alloys in which, among other things, he mentions that zinc and copper have been deposited simultaneously by galvanic action, and afterwards alloyed by heat.

Mr. Walenn remarks that Smee was evidently not informed of Professor E. Davy's discoveries in 1830 (see "Phil. Trans," Vol. cxxi., pp. 147-164) or of the labors of M. de Roulz in 1841, or of Mr. C. Walker in 1845. Certain patented inventions also refer to electro-brassing at this early date, *e.g.*, Fontaine Moreau's invention, No. 10,282, A.D. 1844; De la Salzède's process, No. 11,878, A.D. 1847; Fontaine Moreau's plan, No. 12,523, A.D. 1849; Russell & Woolrich's discoveries embodied in No. 12,526, A.D. 1849; and Steele's patent, No. 13,216, A.D. 1850.

Smee undoubtedly believed that the evolution of hydrogen gas was evidence of the existence of the metal in the non-reguline form. At the present time, however, it is well known that there are solutions which deposit reguline metal during the copious evolution of hydrogen, and this generally takes place during the deposition of alloys. The views of Smee will not stand the test of vigorous experiment when alkaline solutions are employed.

In regard to alkaline solutions, Mr. Walenn remarks that if first principles be consulted, it will appear that, in alkaline solutions, the proneness to evolve hydrogen gas during deposition, arises from the joint action of two causes, one electrical, classified as such by Mr. Smee, the other chemical. The electrical cause is the small quantity of metal in solution in comparison to the electric power employed; this cause can be lessened or removed by using a solution that contains a greater percentage of metal than that usually employed. The chemical cause is the disposition of the metal of the alkali to go to the negative pole along with the heavy metal or metals, and thus, by being electro-deposited for an infinitely small space of time in contact with them, decomposing the water, thereby getting oxidized and setting free the hydrogen as a secondary effect; this cause can be eradicated by providing in excess a decomposable compound radical that will take a certain amount of combined oxygen with it to the cathode, and thus, when decomposed, will enable the hydrogen that would otherwise be evolved to be oxidized into water.

In the case of brass, a solution containing the cyanides of the component metals dissolved in excess of potassic cyanide possesses the remarkable property of furnishing the copper and zinc to the cathode in such a form that, during during deposition, they unite and form a true alloy; this tendency to form a true alloy is increased by the presence of a salt of ammonium, for in connection with copper the gas that would otherwise be given off is replaced by metal, this result being secondary, and, in so far, a chemical reaction. It is usually deemed sufficient to charge the solvent solution (the potassic cyanide and ammoniacal salt solution) with brass by electrolysis, but this will be found on trial to evolve gas, and to be only workable by two Grove's cells. The author finds that it is practically serviceable to add to a solution that is charged with not less than two ounces of brass per gallon, as much of the metallic cyanides as it will take up, and then it will probably take still more of the copper and zinc oxides respectively. Should this treatment not perfectly prevent the evolution of gas, the ammonide of copper is added—about two or three ounces per gallon.

In treating the ordinary cyanide copper solution for the prevention of the evolution of hydrogen, the zinc cyanides and oxides, mentioned in the instance of the brass solution, are left out. When the evolution of hydrogen gas has been stopped by the means above set forth, a single Smee's cell is sufficient to deposit the alloy, thus showing that an intense voltaic current is not absolutely necessary, but that the process requires a certain condition of solution to give a perfect result.

The author prefers to use a menstruum containing potassic cyanide and neutral ammonium tartrate in equal parts, and dissolved in five times their weight of water, to dissolve the brass in. This is then treated, as explained above, to prevent the evolution of hydrogen. This solution is employed in conjunction with heat, and a single Maynooth cell or a magneto-electric machine of suitable power. It has been found, with some electro-brassing solutions, difficult to deposit continuously a given quality of brass; with this solution, the regulation of the proportions of copper and zinc in the alloy is made by altering the heat accordingly. If the solution be kept uniform, as shown by a ready test, it is very easy to deposit a given alloy at all times.

In coating wrought or cast-iron work, it is often advisable to coat with copper prior to electro-brassing; the alkaline bath should be employed at above the temperature of the air, sometimes 160° Fah.; this method of working promotes the contact of the coating. The article should be well cleaned, so as to have a metallic appearance, with a pickle of weak sulphuric acid, scrubbed with sharp sand, washed, scrubbed with a portion of the depositing solution, and then placed in the depositing trough. The electrical connections may then be made, and the coating allowed to form for two hours or more. When a sufficient thickness had been obtained, the article is washed, and dried in hot mahogany sawdust. The "tarnishing" of the coating increases its beauty, and does not impair the article, for the tarnish is not corrosive rust, like the oxide of iron, but is a protective film. Two hours' coating will protect from rust in ordinary indoor work, but the best protection from rust (and this is serviceable even in damp air) is to give two hours' coating in an alkaline bath, and then let the article remain all night in an ordinary acid sulphate of copper bath. If desired, a brass coating may be given over the last-mentioned copper coating. By suitable mechanical arrangements, the articles in the acid bath, and the dissolving plates therein, may be moved—preferably by a to-and-fro movement—during deposition. This treatment shortens the time of the deposit, and makes the deposit uniform.

The uses to which electro-brassing may be applied have yet to be greatly developed; among the rest may be mentioned: the prevention of rust; the giving of an improved printing surface to type and electro-types; coating the poles of electro-magnets for the prevention of the "residual charge" therein; covering rams, plungers, piston rods, rollers, etc., with an adhesive and endurable coating; also lining cylinders, pumps, and iron vessels with copper or brass. The application of the processes that have been described to many purposes of ordinary life, such as railings, architectural ornaments, etc., will exemplify the good results to be obtained by the union of the strength of iron with the beauty of copper or brass.

THE USES OF APATITE.

Since the discovery of phosphate of lime in South Carolina, considerable attention has been bestowed upon the importance of working all similar deposits that may be found in any part of the country, and much inquiry has been made in consequence for mines of apatite, or mineral phosphate of lime. We understand that this mineral has been found in the neighborhood of Crown Point, in this State, also at some point on the Hudson, and quite extensively in Canada. As it is likely to become an important article of commerce, we propose to give some account of its properties and uses. In its crystalline form, the mineral closely resembles the beryl, or emerald; so slight is the difference that mineralogists have been constantly deceived by it, and it early received the name "apatite" from a Greek word signifying "to deceive." It occurs occasionally on our island of New York, in six-sided prisms, and we hear that it has also been met with massive, and in considerable quantity. It is one of our most valuable rocks, very little known to unprofessional men, and yet capable of extensive use in agriculture and the arts. It occurs in altered crystalline rocks, especially in granular limestone, and ores of tin, iron, and other metals, and with gneiss, syenite, and mica rocks. The color is not always the same, but the prevailing shade is green; we have also blue, grayish green, grayish white, and brown.

The Canada deposit is an extensive bed ten feet broad, three feet of which are pure, sea-green apatite. At Crown Point, the deposit is fibrous; in New Jersey, shafts have been sunk, and the apatite brought out in masses weighing occasionally 200 pounds.

The composition of apatite varies almost as much as its color, but it is essentially composed of phosphoric acid, 42·00; lime, 54·00; fluorine, chlorine, etc., 4·00. Many specimens, however, do not have more than 90 per cent of phosphate of lime. The occurrence of phosphorus in association with iron renders the ore useless for metallurgical purposes, but if the apatite be in sufficient quantity, it might be worked for superphosphates and fertilizers.

The uses of apatite are not many, but they are important. It has been proposed and used as a substitute for bone ash, and in the manufacture of porcelain and milk glass, and in England, the apatite from Estremadura is taken for this purpose.

In the manufacture of phosphorus, the pulverized mineral is mixed with twice its weight of silica, in the form of sand or ground quartz, and 25 per cent. of charcoal, in a closed vessel, or peculiarly constructed furnace, and the whole heated to approaching white heat. The phosphate of lime is decomposed, and silicate of lime produced, and the phosphoric acid is reduced by the charcoal to the vapor of phosphorus, which passes into proper coolers, where it is condensed. The latest improvement is to add some soda to the quartz, thus producing a silicate of lime and soda, which is more readily fusible and more easily handled than the simple silicate.

The operation is carried on in France in something like a blast furnace, and is made continual by feeding with alternate layers of ore and fuel. In England, a native phosphate from the West Indies, called sombrerite, is somewhat used in the manufacture of phosphorus; and as this material, together with the South Carolina deposits and the mines of apatite of Canada, is much nearer us, we ought to make an effort to introduce this industry among ourselves. At the present time, very little, if any, phosphorus is made in this country.

The acid phosphate of lime can be made, according to Horsford's patent, from native phosphates. The mineral phosphate is dissolved in nitric acid, of specific gravity 1·23, in the proportion of two nitric acid, by weight, to three of phosphate of lime; and to the filtered solution is added two parts, by weight, of oil of vitriol, diluted with water, for the purpose of removing the lime and other impurities. This process furnishes the acid phosphate of lime in superior condition, for medicinal and culinary purposes.

This use of apatite alone would be of the utmost importance, could it be carried out economically and on a large scale, as chemistry has introduced no compound of greater value in medicine and in food than Horsford's acid phosphate. But the use to which phosphorus has been applied more extensively than to any other, is in the manufacture of a fertilizer known as the superphosphate of lime. The manufacture of this article is carried on in England and Canada, and in some parts of the United States, and is of the utmost importance to our agriculture.

We find in the *American Chemist*, for February, an article by Mr. Gordon Broome, giving the methods employed in Canada for the manufacture of superphosphates from apatite. The mineral is ground by an engine of fifteen horse power, which also turns the agitators during the treatment of the mineral by acid, and supplies steam to the sulphuric acid chambers adjacent to the mill. After the apatite is well pulverized, it is thoroughly mixed with oil of vitriol of the strength known as pan acid, in a suitable vat or tub, where it is thoroughly agitated until the conversion is deemed to be complete. The pasty mass is allowed to flow out of the bottom of the converter over the floor, where it soon becomes sufficiently dry to be fit for transportation in barrels, each containing about 286 pounds. It is, in this condition, only suited for agricultural purposes, as it is very impure. In a sample analyzed by Mr. Broome, there were found: Superphosphate of lime, 20·33; sulphate of lime (gypsum), 63·84; water, 5·50; other constituents, 10·33. The soluble phosphoric acid amounted to 12·33 per cent.

It is evident that this manufacture cannot be carried on profitably unless the same establishment manufactures its own sulphuric acid. As pan acid can be used, the expense of concentrating in glass or platinum vessels is saved, and the cost of packing and transportation avoided.

There is one serious difficulty encountered in the fumes of hydrofluoric acid that come off during the digestion of the mineral. These are very suffocating and dangerous, and it would be a valuable improvement if they could be condensed and made use of in the arts. This is done where fluor spar is employed as a flux in blast furnaces, and important applications are made of the acid thus economized.

In countries where hydrochloric acid is very abundant and cheap, it is substituted for sulphuric acid in the decomposition of apatite; but the resulting chloride of calcium absorbs water so rapidly, and keeps the mass so wet, that it is difficult to handle, and objectionable in every way. Manufacturers of artificial fertilizers sometimes remedy this evil by mixing various refuse animal matters with the mass, and then drying it, and at the same time adding to its value.

The chief importance of apatite is as a manure upon our crops. The strength of lands in the Eastern States has deteriorated so much that few crops can be profitably raised upon them, and it is becoming a serious question to decide what fertilizers are best adapted to remedy the evil. There seems to be no doubt that the phosphates are among the best enrichers of soil, and it is, therefore, important to have this industry more fully developed. To sum up the case for apatite, it will be seen that it has the following important uses;

1. In the manufacture of phosphorus.
2. Acid phosphate of lime.
3. Superphosphate of lime for manure.
4. Manufacture of porcelain.
5. Manufacture of milk glass.
6. Hydrofluoric acid, as an incidental product.

THE AVERAGE CITY DWELLING HOUSE.

The average city dwelling house of 1871 is not what it ought to be, when contrasted with the vast improvements made in all other departments of construction. Built to make as much show as possible with the least expenditure, it is a delusion to the inexperienced buyer, and a snare to the tenant, who has not yet learned the defects that a year or two of use will be sure to develop.

A young couple beginning their experience in house hunting and house keeping, after spending a week or two in discouraging search, at last find a tenement which seems adapted to their wants, at a rent which does not, perhaps, greatly exceed what they can afford to pay; or the house is, perhaps, purchased at what seems a reasonable price. The house is prettily painted, the walls are clean, white, and unbroken (being new), the modern improvements—including bath room, water closets, and gas fixtures—are seemingly convenient and substantial, and the courtyard is laid out with some show of taste. But ere long the walls show ugly seams and cracks; the doors shrink incontinently; the water fixtures obstinately refuse to be kept in order; the floor planking begins to creak, and the entire structure shows decided evidences of weak constitution.

The boiler which supplies hot water to the bath begins to develop troublesome leaks. The plumber is called to the rescue, and loads it with unsightly heaps of solder, which might almost be silver at the prices charged. It is astonishing how the specific gravity of solder increases in this sort of patching.

Then, by and by, the water is drawn off, and the goddess of the kitchen, through ignorance or neglect, lets the boiler collapse. The plumber is again called, who gives the comforting information that its thinness will not permit it to be re-rolled, at an expense of ten or twelve dollars, but that it is, and always was, a shabby affair, and if the luxury of warm bathing be continued, it must be at the expense of forty or fifty dollars for a new boiler.

Winter comes, and a new difficulty is experienced with the water pipes. Relying upon the fact that these are carried up between two buildings and inclosed in the walls, it is supposed they cannot freeze; but they *do* freeze, and burst; and walls, carpets, and furniture are injured, if not ruined, by the flood. Again the plumber is called. You can find plumber's shops as plenty as drug stores. No wonder; there is plenty of business going. The plumber is all smiles. He proceeds to demolish the plastering to reach the pipes, so that in addition to the damage by water, there is the damage by lime-dust. His labors completed, and his not small bill settled, the plasterer follows, careful not to let his work be speedily forgotten, by bespattering with mortar every available spot of floor and paint upon which his mark can be left.

Why water pipes should be placed under the plastering is a mystery to us, especially as they seem artfully contrived to give as much trouble as possible to the inhabitants of the average city dwelling house.

© 1871 SCIENTIFIC AMERICAN, INC.