Mons. Delasalle, of Lille, 'And how,' said he, 'can your government have the face to talk to us about the impolicy of protecting our home industry, when it goes the tenfold greater length of prohibiting even the exportation of the articles which may indirectly aid the industry of another country? Let England abolish her prohibition on the export of machinery—let her abolish a protecting law of her own, more stringent and illiberal than that of any other nation in Europe, before she talks to us of the benefits of a free trade.' Mons. Delasalle is President of the Chamber of Commerce at Lille, and in constant communication with the government on these subjects. We had a very long discussion on the general policy of free trade. He adheres rigidly to the protective system, but not without many manifest misgivings in his own mind."

Mining Review.

Upon the mode of determining the quantity of Copper in ores and smelting products, by the humid way. By CH. KERSTEN, Professor of Chemistry and Metallurgy in Freyberg.

The copper assay by the dry way belongs to those operations of assaying from which it is desired that the most true and accurate results may be given, but it proves imperfect in the examination of ores and smelting products, which yield only few per cent. of copper, and which, besides, consist of nickel, cobalt, iron, antimony, and other metals of this kind; therefore, if the question was to learn the real richness of copper in any ore or smelting product, I have always chosen the humid way, and precipitated the copper from the solutions of substances under examination, by employing sulphuretted hydrogen. The sulphuret of copper, if only small quantities of it were obtained, was converted into an oxide by calcination, under the cover of a muffle; if more, then it was digested with aqua regia, and the dissolved oxide of copper was precipitated on introducing caustic hydrate of potass into the heated liquid. But this process is rendered still more complex, should the substance contain lead or silver (without the removal of which from the solution, the precipitation of pure copper cannot possibly take place,) and loses much in accuracy and exactness, should, in addition to the already named metals, antimony and arsenic, be contained in the substances, whose richness in copper is to be determined, as, for instance, in *bleystein*, containing copper and other metals.

The more satisfactory was it, on this account, for me to become acquainted with the process introduced in the laboratory of Mr. Sefstrom, and the Gustav silver smelting house, at Fahlun, for determining the quantity of copper in copper ores, which, from the experimental assays I have since made, proves itself so admirably adapted for the purpose, not only enabling the assayer to find out the quantity of copper contained in ores of poor quality, but also in ascertaining the same, with the greatest ease and accuracy, in copper, scoria, &c. The process consists, in general, of the treatment of the substances containing copper, with concentrated sulphuric acid, and precipitating the solution obtained with metallic iron.

Although it may seem to require but little explanation, the success of an assay will be found to depend much on address, and a strict observance of the rules practice has laid down is strongly to be recommended. I take the liberty, therefore, of communicating the process, which at the present time is adopted in the Metallurgical Laboratory in Freyberg for determining the richness of copper in ores and scoria. In order to obtain an ave

rage assay of the ore or product, any discretionary quantity is to be pounded in a mortar, the same as every other copper assay. A small portion of the powder is then again pounded in a mortar of steel or calcedony, and from three to five grammes* taken away and weighed; this powder is now put into a bolt-head, the neck of which must be broken off, having a height of from two and a half to three inches, and then mixed with three-fourths of an ounce of concentrated sulphuric acid. In order to avoid weighing the sulphuric acid, we make use of a pipette, with India rubber. Any number of such bolt-heads are placed in the sand bath, which is filled an inch in depth with sand, and stands either in the open air or in a good draught. The fire under the sand bath is to be gradually increased till the sulphuric acid boils, and till all steam from the sulphuric acid disappears, and the mass has become dry: from six to twelve hours, according to the nature of the substances to be assayed, will be found necessary; into each bolt-head, one then pours twenty drops of sulphuric acid. After half an hour's digestion, the mass in the bolt-head can be poured over with hot boiling water, and then rinsed in a warmed precipitate glass. While the fluid is still hot, filter it likewise in a heated precipitate glass, and pour boiling water on the insoluble sediment till the whole solution amounts to 2 lbs. The precipitation of copper now takes place. We make use of an iron or steel plate, from eight to nine inches long, filed square, and about a quarter of an inch thick; on this occasion, however, before employing the same, it must be wrapped up in paper and laid in the sand bath to get hot. As soon as the hot copper solution is stirred with the bar, a strong ebullition of the hydrogen gas follows, and metallic copper will be precipitated. During the precipitation one must cover the precipitate vessel with a plate of glass. If no more hydrogen gas is evolved, and the previous greenish blue solution has become colourless, which generally takes place in one hour to one and a half, the precipitation which must take place in the sand bath is completed. If the fluid has been properly thinned, and reddened the litmus paper, and is hot, no copper generally will be found attached to the iron bar, it having detached itself and fallen to the bottom of the precipitate glass. The iron appears, as far as it has been immersed in water, to have covered itself with a thin coat of carbon. We transfer the same with a camel-hair brush into the liquid, and after washing it in this manner, dry, and quickly polish it with a fine file. The liquid is now decanted from the precipitate glass in which the copper lies, as long as the same can be managed without loss, and the precipitate glass is again filled with hot water, till the copper, by this process, has become quite pure. Through repeated decantation all particles of carbon which have loosened themselves from the iron plate during the precipitation of the copper will be entirely separated from the last, and appear as a uniform powder, of a beautiful red copper colour. After the last cleaning of the filter, we brush the copper with a fine camel-hair brush, or the beard of a quill, into a prepared filter, dry the same at 100 degrees, and determine the weight of the metal. With small quantities of copper, instead of filtering, I wash it in a previously weighed watch glass, drawing off the small quantity of water by a pipette. I let the rest evaporate, and then weigh the metal after drying it; the sooner this takes place the better, as the metal is easily affected by the moisture of the air. A precaution necessary to be observed in the management of the operation above described, is the avoiding of all such circumstances as tend to produce or

* The gramme is equal to 15,444 English grains.

accelerate a higher degree of oxidation of the dissolved iron in the solution. It is, therefore, indispensably necessary, as I have many times convinced myself, in order to insure success to the experiment—

1. That hot water, as free from air as possible, be used to soften said ore that has been treated with sulphuric acid.

2. That the solution of copper be highly diluted, and redden litmus paper. The precipitation of copper is hastened by adding a few drops of sulphuric acid to the liquid.

3. That the precipitation be made while it is warm.

4. That the iron be well polished and heated before using.

5. That the precipitated copper be quickly removed from the liquid above it, and in washing the same hot water be used. A copper assay of the above description requires two days for performance; one can, however, very conveniently, during this time, prepare twenty-four; when one has several of the same to make at once, it is advisable, in filtration, to make use of a shelf similar to that used with the re-agent glasses, on which each individual hole for the reception of the funnel is numbered. It is also desirable, to avoid confusion, to number the glasses in which the copper is precipitated. Should it be wished to determine the richness in copper, of copper-slate through these means, which are well suited for the purpose, it is necessary to heat the same red-hot, in order to drive off the bitumen. If it is supposed that the substance may not be perfectly decomposed by the sulphuric acid, for safety's sake we might put some drops of *aqua regia* to the dried up mass, before it is mixed with a second portion of sulphuric acid. This will happen, however, very seldom, for all those ores and smelting products I had the opportunity of trying, by this method, were always perfectly decomposed by the sulphuric acid, after they had been ground to powder, and a sufficient quantity of sulphuric acid applied; also, when the washed residuum was treating in solution with *aqua regia*, I never could detect the least signs of copper, examining and treating the solution with ferro cyanite of potassa, ammonia, and iron. If metallic sulphur, as, from the lead process (bleystein and bleispelse,) containing copper, are submitted to this assay, the component parts of lead and iron give in the state of sulphate, a white or yellow residuum, so that the solution will scarcely contain any thing else but sulphate of copper. Ibid.

FONTAINEMOREAU's new Alloys of Zinc—a substitute for Bronze, Copper, and Brass.

An invention of a new alloy of zinc, with small proportions of other metals, found to possess very peculiar advantages, has lately been introduced into England, where it has been patented in the name of M. Lacomte de Fontainemoreau. It is likely to prove of great utility in the manufacture of machinery; and in castings relating to the fine arts, as a substitute for copper and bronze, will be extensively adopted. We suggested it as a material for casting the Nelson memorial, and we beg to reiterate the suggestion to the various committees now engaged in the formation of that, and other national testimonials.

The proportions of metals which have been found most advantageous in forming varieties of the alloy, after very numerous and extensive experiments, are as follows:—