floats on the top. The additional quantity of nitre allows of the fusion being continued a much longer time than when a small portion is employed, but with a smaller loss of bismuth. One fusion will generally be found sufficient. By oft repeated fusions the copper may be so far diminished as to be inappreciable in a dilute solution, but the process is not to be recommended, as incurring too great waste.

It was formerly thought that by dissolving bismuth in nitric acid, and precipitating the sub-nitrate by the addition of water, that any arsenic that might be present would be found in the supernatant liquid. It has been found that such is not the case, as by the action of the nitric acid, the arsenic is converted into arsenic acid, forming with the bismuth an insoluble arseniate, which is precipitated with the sub-nitrate.

The method of Wittstein consists in dissolving the metal in nitric acid, and boiling with a solution of caustic potash, or soda—the bismuth is precipitated first as a hydrated oxide, which loses water by boiling, and is changed thus to anhydrous oxide. In this state it can be used for most pharmaceutical purposes, even with greater convenience than the metal itself.

There is still another method which may be pursued to advantage, namely, purification by crystallization. This plan is particularly applicable to the preparation of liquor bismuthi. By evaporation of the nitric solution to the crystallizing point, crystals of the ternitrate may be obtained of tolerable purity. By repeating the process the greater part of the impurities—and especially the copper—are left in the mother liquor.

There is only one method, of which I am aware, for the perfect separation of copper. It consists in forming a solution of nitric acid, and adding liquor ammonia until all the oxide is precipitated. It must be remembered that this oxide is soluble in ammonia, and care must be taken that the precipitant be not in excess. The precipitate must be well washed with water, and may be easily reduced to the metallic state, but for preparing the compounds of bismuth it is preferable to the metal itself. Liquor bismuthi made from this oxide is perfectly colorless, and well repays the trouble expended upon it—being a credit to the manufacturer—and this is, otherwise, seldom the case.

ALUMINUM.

BY PROF. C. A. JOY.

Forty years ago a few grains of this metal were prepared by Professor Woehler, at the University of Goettingen. He sealed the little pellets in a glass tube, and it was not thought that the metal could ever have any useful applications. The discovery rested dormant for thirty years, when attention was called to it by the eminent French chemist, Deville.

The circumstances were as follows: The Emperor Napoleon, anxious to display some interest in scientific matters, appropriated fifty thousand francs to defray the expenses of researches into the properties and uses of aluminum, and Henry St. Claire Deville was authorized to make the experiments. We happened to be in Paris when this took place, and were one day invited by Professor Deville to witness the preparation of the metal in the presence of the Minister of War, Professor Dumas, and of other celebrities. Deville, who is the most genial, popular, and successful of the French chemists, received his guests with great cordiality, and explained, in the clearest possible manner, every step of the operation. He extracted a pure, silver-white metal from a lump of clay. The way he did it was very simple. Chlorine gas was passed over heated clay mixed with charcoal, and the chloride of aluminum thus produced was driven over melted sodium. The chlorine first extracted the metal from the clay, and was in turn decomposed by the sodium. In chemistry, might makes right, and every compound can be attacked and forced to capitulate, if the proper weapons are brought to bear upon it. The aluminum was first seduced from its strong citadel of clay by the chlorine, and was then attacked and captured by the sodium.

The experiments, in a small way, having proved successful, extensive works were established in the neighborhood of Paris, where aluminum was manufactured on a large scale. At the Paris exhibition of 1867, Mr. Paul Morin exhibited numerous objects manufactured from pure aluminum and from its alloys.

The specific gravity of the metal is 2·67. It is tin white, fusible at a red heat, brilliant, malleable, ductile, sonorous, an excellent conductor of electricity, insoluble in dilute sulphuric acid, and in concentrated nitric acid; easily soluble in hydro-chloric acid and the alkalies. It does not decompose water, as was at first supposed, and does not oxidize materially in the air.

Professor Henry Wurtz, of New York, has recently discovered that if it be rubbed with mercury it oxidizes so rapidly as to produce great heat. It was at first found impossible to solder the metal, but this difficulty has been at length overcome. When fused with iron it forms a crystaline mass not malleable. Mixed with copper in the proportions of ten parts of aluminum, and ninety parts of copper, it forms a beautiful alloy, possessed of the color and many of the properties of gold. This alloy is called aluminum bronze, and is now frequently employed for the manufacture of watch cases, watch chains, and imitation jewelry. Nearly all the aluminum now manufactured is converted into the above alloy and the interest in it, which at one time began to flag, is once more revived, and several new establishments have arisen for its manufacture.

Four hundred pounds a month are now manufactured in France, and sold at twelve dollars a pound. It is largely produced in England.

Aluminum is one of the most abundant metals on the earth. It is found in brick and porcelain clay, in feldspar, in cryolite, in granite, in slate rocks, in the ruby and sapphire. When iron rusts, it turns to a red