CHEMISTRY

The Metals Boron and Aluminium

"Classics of Science"

Laboratory Experiments Which Gave Chemists Their First Glimpses of the Pure Elements

The practical method for isolating aluminium, which gives us the aluminum of commerce, will appear later as a Classic of Invention.

Boron

ON THE DECOMPOSITION AND RECOMPOSITION OF BORIC ACID; By MM. Gay-Lussac and Thenard. In Annales de Chimie, Paris, 30 Novembre 1808. Translated for the Science News Letter by Helen M. Davis.

WE announced in a note to the Institute the 21st of last June, and we published in the Bulletin of the Philomatic Society for the month of July, that in treating fluoric and boracic acids with the metal potassium there are obtained results which can be explained only by admitting that these acids are composed of a combustible body and oxygen. Nevertheless, since we had never recomposed it, we added that we have never claimed this composition as perfectly demonstrated. Since that time, we have continued and varied our researches; and we can state today that the composition of boracic acid is no longer problematical. In fact we decompose and we recompose this acid at will.

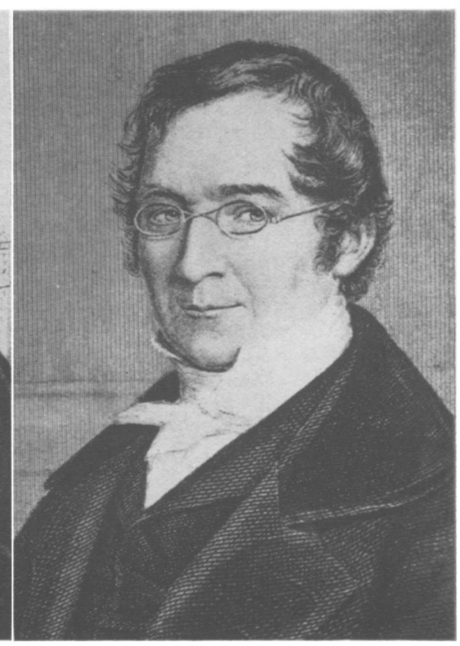
To decompose it, take equal parts of metal and of very pure and vitreous boracic acid in a copper tube to which a tube of bent glass is attached. Place the copper tube in a small furnace, with the end of the glass tube in a flask of mercury. When the apparatus is ready, heat the copper tube little by little until it becomes faintly red; hold it in this state for several minutes; then, the operation being ended, allow it to cool and take out the material. Here are the phenomena which are observed in this experiment.

When the temperature is about 150 degrees, all at once the mixture glows strongly, which appears in a striking manner if a glass tube is used. So much heat is produced that the glass tube cracks and sometimes breaks, and the air is almost driven out of the vessel with force. From the beginning to the end of the experiment only atmospheric air is released with a few bubbles of hydrogen gas which do not amount to the 50th part of that given off when the metal combines with water. The metal is used up decomposing part of the boracic acid; and these two substances are converted by their mutual reaction, into an olive gray material which is a mixture of potassium, potassium borate and the radicle of boracic acid. Extract this mixture in a tube by pouring water onto it and heating slowly. and separate the boracic radicle by washing with water cold or hot, that which does not dissolve is the radicle itself, which shows the following properties.

This radicle is a greenish-brown, fixed and insoluble in water; it has no taste, it has no effect upon the color of either litmus or syrup of violets. Mixed with potassium chlorate or potassium nitrate and projected into a red-hot crucible, a vivid combustion results, of which boracic acid is one of these products. When it is treated with nitric acid a great effervescence results, even in the cold, and when the liquid is evaporated, much boracic acid is obtained. But of all the phenomena produced by the boracic radicle in its contact with other substances, the most curious and the most important are those which it presents with oxygen.

On projecting three decigrams of boracic radicle into a silver crucible at a faint red heat, and covering this crucible with a bell-jar of about a liter and a half capacity, full of oxygen and standing over mercury, it usually burns and the mercury rises so rapidly that it suddenly fills half the bell-jar. Nevertheless, in this experiment the combustion of the boracic acid radicle is far from complete. That which prevents it is that the radicle passes almost entirely into the state of a black oxide, which we believe we are the first to recognize, and, the outer parts of this oxide then passing into the state of boracic acid, this remains and so prevents the inner part from coming in contact with the

BARON THENARD



JOSEPH GAY-LUSSAC

The French chemists who, among many famous researches, isolated boron

oxygen. So, to burn it completely, it is necessary to wash it, and put it again in contact with oxygen gas, always at a cherry-red heat. But this time it burns with less force and absorbs less oxygen than the first time, because it is already oxidized; and the exterior part always passes into the state of boracic acid which remains, hindering the combustion of the interior: so to convert all to boracic acid, it is necessary to submit it to a great number of successive ignitions and to as many washings.

In all these combustions, there is always fixation of oxygen without liberation of any gas; and all give acid as the product. Upon treating these products with boiling water there is obtained by suitable evaporation and cooling crystallized boracic acid, of which we have presented a sample to the Institute.

Finally, the boracic acid radicle behaves in air just as in oxygen, with the difference only that the combustion is less lively.

It follows then from all these experiments that boracic acid is actually composed of oxygen and a combustible body. We have proved conclusively that this body, which we now propose to call *bore*, is of a definite nature, which can be placed beside carbon, phosphorus, and sulphur; and we are led to think that to pass into the state of boracic acid it requires a great quantity of oxygen, but that before arriving at that state it first passes through that of the oxide.

Aluminium

On ALUMINIUM, By F. Wöhler. In Annalen der Physik und Chemie, Leipzig, 1827.

TO learn to know the physical and chemical properties of the elements which in the oxidized state make up the greater part of the surface of the earth, is from many points of greater interest than the study of many of the true metals; for upon our knowledge of these bodies depends in part our ability to imagine the formation of the earth's surface from the original material of volcanic eruptions and so forth. Of all the radicles in the earth-substances in the most abundant kinds of soil, we have up to now learned to know only kiesel-earth, through Berzelius' experiments. H. Davy seems to have separated the radicle of alumina, both by the agency of the electric battery upon a fused mixture of alumina and potash, and by the action of potassium vapor upon alumina at white heat. But in both cases it did not occur to him to separate the reduced metal from the remaining mass; so he could not have studied its properties.

Some years ago Oersted discovered an easy method of combining chlorine with the radicle of alumina, by the application of a very ingenious method, which consists of allowing chlorine gas to stream over incandescent alumina mixed with powdered charcoal. From this compound there is obtained then, by means of potassium-amalgam, an amalgam of aluminium, which oxidizes very quickly in air, and by distillation of the mercury the remaining aluminium can be recovered. Of the aluminium so obtained he says only that it was a lump of metal, of the color and luster of tin.

I have repeated this experiment of Oersted's, but got no positive result from it. By distillation of the potassium amalgam, after it was heated with the aluminium chloride, there remained at the end a gray molten mass of metal, which, however, evaporated when the heat was increased into a green vapor and distilled over as pure potassium. After this I looked around for another method, although I do not wish to say that it is not possible to reduce aluminium by this one. Since Oersted noted at the end of his communication that he could not look upon his researches on aluminium as complete, it might seem, although many years have passed since then, as though I have forced my way into a research successfully begun by another but uncompleted, because they promise new and perhaps more brilliant results. I must remark here that Herr Oersted himself encouraged me to pursue this research further. . . . .

Metallic Aluminium

The method for reducing and exhibiting this metal rests, it seems to me, on the decomposition of aluminium chloride by potassium and on the property of aluminium of not oxidizing in water. If a tiny piece of aluminium chloride be warmed in a glass tube with some potassium the violent reaction, accompanied by fire, shatters the tube. I then tried the reaction in a little platinum crucible, which succeeded very well. The reaction is always so violent that the cover must be fastened on with wire, so that it will not be thrown off, for the reaction, which gives off only a moderate amount of heat in the open, will suddenly of itself raise the crucible to red heat. Platinum will scarcely withstand it. On this account, to guard against possible contamination of the reduced aluminium with any platinum which may be lost, I always afterward made the reduction experiments in a little porcelain crucible, and went about it in the following way: Put into the bottom of the crucible a little piece of potassium free from carbonate, from which the kerosene clinging to it has been carefully removed. Cover this with a little piece of aluminium chloride of about the same volume. Then heat the crucible, covered with its lid, at first gently, until the combustion appears, which keeps going by itself, then strongly when this last is over. The largest piece of potassium with which I have attempted to work at one time up to now is ten balls the size of peas; in a Hessian crucible one could manage to operate with larger amounts. With these quantities the amounts of the reacting substances must be arranged either so that there is so much potassium that the reduced mass is alkaline, or so much excess aluminium chloride that it can be seen to evaporate at the moment of reduction. The reduced mass is as a rule fully molten and blackish gray. The *fully* cooled crucible is dropped into a glass of water, in which the salt mass, under gentle heating releases evil-smelling hydrogen gas and a gray powder separates, which on closer inspection especially in sunlight appears as composed of little scales of pure metal. After it has settled, pour the liquid off, put it on a filter, wash it with *cold* water and dry it. It is the metal aluminium.

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PHYSIOLOGY

Fish Blood Found Rich in Phosphorus

STUDIES upon the composition of the blood of different animals which have just been completed at Cornell University show that the blood of the lower forms such as fish and turtles contain nearly three times as much phosphorus as that of higher vertebrates. Fish have long been reputed to be high in phosphorus but the various forms in the blood have not been studied previously. Most of the phosphorus of fish blood is concentrated in the red cells.

This high phosphorus value for fish blood is interesting in the light of the meat diets used for rearing trout in most hatcheries. Brook trout grow to maturity upon food that is very rich in phosphorus, such as beef liver. One might expect bloods rich in phosphorus among the carnivorous fish but not among the omnivorous, such as carp. The bloods of both pike and carp were analyzed, however, and found to be equally high in phosphorus.

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ARCHAEOLOGY

Hands of Clay Provided For Egyptian Burial

HANDS and feet modeled in terra cotta are a strange feature of the latest tomb discovery at Giza, Egypt, where Prof. Selim Hassan, archaeologist of the Egyptian University, is excavating near the great Sphynx.

The tomb that has been discovered belonged to a woman of the fourth dynasty, about 2900 B. C. The artificial hands and feet are believed to be a unique discovery in the archaeology of Egyptian tombs. It is speculated that they were placed in the tomb to be of use to the woman in the world of the dead.

To find so old an Egyptian burial not plundered by robbers is unusual, and great interest is manifested in the tomb furnishing of the period. The sarcophagus of white limestone lay in the center of the tomb chamber, facing east. Seventy-eight alabaster vases were counted in the room's furnishings, and pottery vases besides. Skeletons of two animals were near the sarcophagus, and also a table of offerings.

The woman buried here was adorned with gold necklaces, bracelets, and anklets, and on her head was a fillet of gold of unusual workmanship.

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