CLXXVI. *On Tribasic Boracic Æther.*

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A FEW months ago M. Ebelmen published an account of two compounds of silicic acid and æther, and announced that by subjecting them to the gradual action of moist air, he

had succeeded in obtaining specimens of hydrated silicic acid perfectly hard and transparent.

This was the first time silica had been obtained artificially in a state at all resembling quartz; and though it is anything but probable that nature ever manufactured her rock-crystal or hydrophane by the action of moist air on silicic æther, I felt interested in the subject, and prepared a quantity of the æther according to Ebelmen's directions, viz. by mixing together liquid chloride of silicon and absolute alcohol. I then placed a little of the æther in some test-tubes, closed them with corks having a small slit cut down the sides, to allow the access of air, and put them, with a small pan of water, under a bell glass.

In the course of a couple of months a thin ring of transparent silica was deposited round the inside of the tubes, an inch or two from the surface of the æther, apparently at the point where the æthereal vapour had come in contact with the moist air. This silica, though hard, is extremely brittle, and will scarcely bear removal from the glass on which it is deposited without injury. It appears destitute of crystalline structure, and is wholly without action on polarized light.

It occurred to me as highly probable, from the analogous properties of silicon and boron, that if chloride of boron were carried into absolute alcohol, a boracic æther would be produced by a decomposition similar to that of the chloride of silicon.

I passed pure and perfectly dry chlorine over an ignited mixture of charcoal and boracic acid, and purified the gas thus formed from the free chlorine with which it was mixed, by passing it through two U-shaped tubes filled with copper turnings. To the last of these I connected two of Liebig's bulb-apparatus charged with absolute alcohol.

As soon as the gas began to fill the first bulb, a heavy liquid was deposited above the surface of the alcohol, through which it sank and gradually mixed, forming a clear solution. The temperature of the liquid rose considerably during the formation of this heavy fluid, and to prevent it getting too hot I immersed the bulbs in cold water.

After some time the liquid in the bulbs became turbid, owing to the formation of minute globules of a new fluid immiscible with the first; this gradually increased considerably in quantity, and at length occupied nearly as much space as the other. This new fluid was considerably lighter than the first, and the globules as they separated rose to the surface, forming a distinct layer, similar to oil floating on the surface of water.

During the formation of this second fluid the temperature

did not sensibly change, though it had risen considerably while the heavy one was forming. The weight of the liquid in the bulbs increased during the operation about 50 per cent.

From the heavy fluid I have been unable to obtain, after repeated distillations, a perfectly homogeneous compound. It appears to consist chiefly of a chlorinated compound, and gives on analysis—

46.29 C	} nearly in the proportion of alcohol;
11.86 H	
32.32 O	
9.53 Cl	

and a trace of boracic acid.

100.00

When first distilled it gave off a large quantity of acid fumes, consisting chiefly of hydrochloric acid and chloride of æthule. Its boiling-point appears to be about 190° , and its specific gravity 0.901. Its smell is aromatic, its taste acid and pungent. It fumes slightly in the air, and is miscible with alcohol and æther. Ammonia decomposes it, with formation of muriate of ammonia, and solution of potash produces chloride of potassium. It is very combustible, reddens litmus, and turns turmeric brown.

Though the two fluids are apparently so completely immiscible, they nevertheless dissolve each other to a certain extent, and retain that small quantity with very considerable force; so that in almost every rectification of the heavy liquid a few drops of the lighter one distilled over.

The lighter liquid has furnished more satisfactory results. When first heated it gave off fumes of hydrochloric acid and chloride of ethule. It retained with considerable tenacity a small portion of the heavy fluid, with which it evidently mixes in small and definite quantity, and then refuses to dissolve any more, as is the case with many other liquids, as water and common æther.

In the fourth distillation I obtained a pure product, having a specific gravity of .871 and boiling at 250° . It is curious that though this is considerably the lighter of the two fluids, its boiling-point is 60° higher than the other.

I first attempted its analysis with oxide of copper, but found it impossible to obtain constant results. Four analyses with chromate of lead gave,—

	I.	II.	III.	IV.	Mean.
C . .	47.76	48.12	47.20	47.68	47.69
H . .	9.85	9.95	9.82	9.98	9.90
BO ₃ .	23.81	24.94	23.43	25.01	24.29
Chlorine		(accidental)			.18

It is therefore clearly a tribasic æther, the carbon and hydrogen being in the proportions to form æther, and the boracic acid being in slight excess. The calculated results would be,

Carbon	49·34
Hydrogen	10·27
Oxygen	16·45
BO ₃	23·94
	<hr/> 100·00

The density of the vapour confirms this view of its composition :—

Weight of globe filled with air	1550·93 gr.
Temperature of air	58°
Pressure	30·61 inch.
Temperature of bath when sealed	278°
Weight of globe full of the vapour	1573·14
Weight of air in globe (corrected)	8·068 gr.
Weight of vapour in globe at 278°	30·278 gr.
Weight of 100 cubic inches of vapour at 60° and 30 inches	164·81 gr.
Specific gravity of vapour	5·31
Calculated specific gravity of vapour, supposing it to consist of 3 equi- valents of æther and 1 of BO ₃ condensed into 4 oxygen vols. }	5·05

From this it appears that it has suffered the same amount of condensation as most of the monobasic æthers, notwithstanding it contains 3 equivalents of æther instead of 1. The theory of its formation from alcohol and chloride of boron is very simple :

Tribasic boracic æther is a colourless liquid, with a pungent, slightly aromatic smell and acrid taste. It fumes when exposed to moist air, owing to the decomposition of its vapour, and round the stopper of the bottle containing it, is generally formed a downy deposit of boracic acid.

When a drop of water is added to it, boracic acid is immediately precipitated, which is redissolved when more water is added. A similar decomposition takes place when mixed with solutions of ammonia and potash, borates of those bases being formed. With alcohol and æther it is miscible in all proportions. It burns with a bright green flame, giving off white fumes of BO₃, and leaving a residue of the fused acid. The colours of dry litmus and turmeric are not changed by

it, but when moist the first is reddened and the latter becomes brown, owing to the liberation of boracic acid.

I am now engaged in examining the effects of passing some of the volatile metallic chlorides into absolute alcohol; and I am not without hope that I shall be able in this way to form some metallic æthers.

Since writing the above I have seen in the last number of the *Annales de Chimie*, which has just reached us, a notice that M. Ebelmen has also succeeded in forming the tri-basic æther I have now described, and has also formed a similar compound with oxide of methyle. Our results appear to be almost identical, excepting that his numbers approach the calculated ones somewhat more closely than my own.