

XI. *On the Decomposition of Fixed Air.*

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**A**S fixed air is produced by the combustion of charcoal, it has long been thought highly probable that vital air and charcoal are its constituent ingredients. This opinion is confirmed by the experiments of M. LAVOISIER, from which he discovered that the weight of the fixed air which is formed during the combustion is nearly equal to that of the vital air and charcoal consumed in the process; and that the small difference of weight may, with great reason, be attributed to the production of water arising from inflammable air contained in the charcoal. The composition of fixed air therefore seems to be determined, by uniting its constituent parts, with as much certainty as by that mode of proof alone it is possible to obtain. But as vital air has a stronger attraction for charcoal than for any other known substance, the decomposition of fixed air has not hitherto been attempted. By means, however, of the united force of *two* attractions I have been able to decompose fixed air, and thus to determine its constituent parts in consequence of their separation.

It has long been known, that when phosphoric acid is combined with calcareous earth, it cannot be decomposed by distillation with charcoal: for though vital air is more strongly  
attracted

attracted by charcoal than by phosphorus, yet in this compound it is retained by two attractions, by that which it has for phosphorus, and by that which the phosphoric acid has for lime, since the vital air cannot be disengaged unless both these attractions are overcome. As these attractions are more powerful than that which charcoal has for vital air, if phosphorus is applied to fixed air and calcareous earth, the vital air will unite with the phosphorus, and the charcoal will be obtained pure. These substances, in order to act upon each other, must be brought into contact when red-hot; and this may be easily effected in the following manner. Into a glass tube, closed at one end, and coated with sand and clay to prevent the sudden action of the heat, a little phosphorus should be first introduced, and afterwards some powdered marble. The experiment succeeds more readily if the marble is slightly calcined, probably because that part which is reduced to lime, by immediately uniting with the phosphorus, detains it to act upon the fixed air in the other part. After the ingredients are introduced, the tube should be nearly, but not entirely, closed up; by which means so free a circulation of air as might inflame the phosphorus is prevented, whilst the heated air within the tube is suffered to escape. When the tube has remained red-hot for some minutes, it may be taken from the fire, and must be suffered to grow cold before it is broken. It will be found to contain a black powder, consisting of charcoal intermixed with a compound of lime and phosphoric acid, and of lime united with phosphorus. The lime and phosphoric acid may be separated by solution in an acid and by filtration, and the phosphorus by sublimation.

Charcoal, thus obtained from fixed air, appears in no respect to differ from the charcoal of vegetable matters. On deflagrating

ting a little of it in a small retort with nitre, fixed air was immediately reproduced.—Since, therefore, charcoal, by its separation from fixed air, is proved to be one of its constituent principles, it can hardly be doubted, that this substance is present whenever fixed air is produced; and that those experiments, from which it is supposed that this acid may be formed without the aid of charcoal, have not been conducted with the requisite caution.

As vital air is attracted by a compound of phosphorus and calcareous earth more powerfully than by charcoal, I was desirous of trying their efficacy upon these acids, which may from analogy be supposed to contain vital air, but which are not affected by the application of charcoal. With this intention I made phosphorus pass through a compound of marine acid and calcareous earth, and also of fluor acid and calcareous earth, but without producing in either of them any alteration. Since the strong attraction which these acids have for calcareous earth tends to prevent their decomposition, it might be thought that in this manner they were not more disposed to part with vital air than by the attraction of charcoal. But this, however, does not appear to be the fact. I have found, that phosphorus cannot be obtained by passing marine acid through a compound of bones and charcoal, when red-hot. The attraction, therefore, of phosphorus and lime for vital air exceeds the attraction of charcoal by a greater force than that arising from the attraction of marine acid for lime.

