

XXXII.—*Behaviour of the more Stable Oxides at High Temperatures.* Part II.

By A. A. READ, Research Student, The Owens College.

SOME time ago (Trans., 1890, **57**, 269), Bailey and Hopkins published a short paper, in which it was shown that when cupric oxide is exposed in an oxidising atmosphere to a temperature of 1500° to 1700° , it yields up a large portion of its oxygen, and is transformed into a brown oxide, having the composition Cu_2O .

As so few observations have been made on the temperature at which the more stable oxides (those, for instance, that withstand exposure to the ordinary blow-pipe flame) undergo decomposition, I have subjected most of these, under as nearly as possible the same conditions, to a temperature just sufficient to melt platinum, and which may, therefore, be taken as approximately 1750° . Although many of the oxides fused or changed colour at this temperature, apparently without undergoing any noticeable decomposition, yet in the case of several, oxygen was evolved, and I have thus been able to carry to a higher limit the record of the dissociation temperature of oxides. The results must be regarded as approximate, but, at the same time, sufficiently accurate to admit of an estimate being formed of the relative stability of the oxides, taking the temperature of dissociation as an index of stability.

Method of Experiment.—A small quantity, usually between 0.1 and 0.2 of a gram, of the oxide was placed in a small lime crucible and exposed to the extreme tip of the oxidising flame* of an oxy-coal gas flame; where decomposition occurred, the bubbles of oxygen were seen to be given off freely from the oxide, and the heating was continued until the disengagement of gas ceased. The product was then allowed to cool down in an atmosphere of nitrogen, transferred to a crucible, and weighed. It was then heated over the Bunsen flame, with access of air, sometimes after adding nitric acid, so as to reconvert it into the higher oxide, when it was again weighed, the increase in weight indicating the amount of oxygen taken up, and, indirectly, the amount which had been evolved during the exposure to the oxy-coal gas flame. The method of analysis involved no transfer of material between the weighings, and was altogether so simple that it

* In order to be fully satisfied that the change was not due to *reduction*, I made numerous experiments with oxides, such as litharge and sesquioxide of bismuth, which are easily *reducible*, but which showed themselves stable in an oxidising atmosphere at high temperatures. In no case was there the slightest indication of loss of oxygen by exposure to the oxy-coal gas flame under the conditions indicated.

was possible to rely on the accuracy of the results, even when operating with very small quantities of the oxide.

Summary of Results.—The following oxides underwent no change of composition:—CaO, SrO, BaO, MgO, ZnO, CdO, Al₂O₃, In₂O₃, Di₂O₃, CeO₂, ZrO₂, TiO₂, SnO₂ (very slight loss), PbO, Bi₂O₃, Nb₂O₅, Ta₂O₅, and WO₃.

The oxides which dissociated, and the phenomena observed during the heating, are given in the following paragraphs.

Antimony pentoxide.—This, of course, even at a moderate heat, passes into Sb₂O₄, but at the higher temperature the oxide began to volatilise pretty freely, that which remained having a faint greenish tinge, and proving to be Sb₂O₃. Carnelly and Walker (Trans., 53, 99) have shown that Sb₂O₄ is stable at 775°.

Vanadium pentoxide fused and then began to give off bubbles of gas freely until it had passed into the sesquioxide. This very readily undergoes reoxidation during cooling, and I have several times obtained very beautiful steel-blue crystals of the tetroxide by allowing the oxide to cool down, freely exposed to the air.

Sesquioxide of Iron.—Even when heated in a platinum crucible over the ordinary blow-pipe flame this oxide becomes superficially darker in colour, due apparently to the production of a film of Fe₃O₄. At the temperature at which these experiments were made the *whole* of the oxide was transformed into Fe₃O₄.

Oxide of Cobalt, Co₃O₄.—On heating, the oxide fused and parted with the whole of its oxygen, leaving a globule of metallic cobalt. On cooling, this became coated with a film of oxide, or, if in the process of heating, any particles reached the relatively cool area outside the flame, they burnt with beautiful scintillations.

Oxide of Nickel, Ni₂O₃.—Under the oxy-coal gas flame, the behaviour of this oxide very much resembled that of the oxide of cobalt, the metal being obtained in this case also; decomposition occurred, however, more readily.

Molybdenum trioxide readily volatilised, and was partially transformed into one of the lower oxides, as was further shown by the existence of dark blue powder in the residual product.

Uranium trioxide was transformed into the oxide U₂O₅.