

boiling, attention being paid to securing as steady and regular an ebullition in the flask as possible. The flask was heated for about two hours, if possible never less than an hour and a half, when connection was interrupted between the flask and the gas tube, the moment of doing so being chosen so as to leave as little air as possible in the distilled water bulb. The gas tube was then sealed off at the lower end. Connection was then re-established between the bulb and the flask, and air admitted into the upper part of the bulb. The water in the bulb was thus forced back into the flask, and as a rule filled it up completely and at once, without leaving a trace of air. Occasionally, however, a minute air-bell remained, but it was never larger than a pin's head. Although Mr. Buchanan had no fear that the results would be vitiated by the loss of this minute quantity, even supposing it to consist entirely of oxygen and nitrogen, he nevertheless on a number of these occasions attached a second gas tube and repeated the boiling. The results of the analyses of the contents of these tubes fully bears out the assumption that no loss of nitrogen or oxygen could have taken place if the residual air-bell had been neglected. The capacity of the gas tubes was from 35 to 40 cubic centimetres, and the volume of air extracted from the sample of about 900 c.c. of water varied from 15 to 20 c.c. when reduced to standard pressure of 760 mm. and temperature of 0° C. The amount of carbonic acid in the gas from surface water varied from 1 c.c. to 5 c.c. When a second tube was used and the boiling repeated, the reduced volume of the gas so extracted was usually under 1 c.c., and was completely absorbed by caustic potash. In only one case could it be said that there was any appreciable amount of permanent gas. In it the total volume of the gas extracted was 2.89 c.c., and 95.4 per cent. of it was carbonic acid. These observations prove that the air in the gas tube is completely eliminated by the steam from the bulb when its contents are kept in constant ebullition for ten to twelve minutes, and that the gas tubes so freed of air and having a capacity of not more than 40 c.c., are capable of receiving completely all the oxygen and nitrogen contained in 940 c.c. of sea water when boiled by Jacobsen's method.

The gas tubes were, through the kindness of Dr. Jacobsen, supplied from Germany. In order to comply with instructions prohibiting the use of straw in packing the apparatus put on board the ship, they were repacked in sawdust, without however having been wrapped in paper. The consequence was that particles of sawdust got into the inside of the tubes and could in no way be got out except by removing one of the drawn out ends of the tube and sweeping them out with a feather. This operation had to be performed on every tube that was used, as it was essential that the samples of gas collected should be preserved in perfectly clean vessels. Even if the tubes had been perfectly clean, the same operation would have had to be performed in order to remedy a defect in their construction at the point where they were intended to be sealed up. Here they were merely thickened instead of being drawn out. The consequence of