

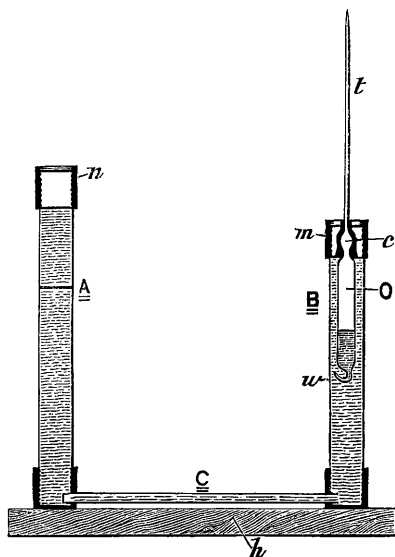
XXXVII.—*Note on a convenient Apparatus for the Liquefaction of Ammonia.*

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THE annexed engraving represents a piece of apparatus that I employ with advantage in illustrating the principle of Carré's machine, and in demonstrating the liquefaction of ammonia gas by pressure. It is so easily managed, strong, and inexpensive, that I think it will be found a useful addition to the apparatus of the lecture table, and as such I beg to lay its description before the Society.

A species of U-tube of stout wrought iron is made of the form shown in the figure, A, B, C. A is about 40 cm. long, B 30 cm., and each is 12 cm. in internal diameter; C is about 25 cm. long, and 5 or 6 mm. internal diameter, and is securely screwed into the two wider tubes.

The whole is fastened to the wooden stand *h*. *A* is provided with a stout screw-cap *n*, and the joint is rendered gas-tight by a leather



washer. *B* is also fitted with a strong screw-cap, *m*, provided with a deep head, through which a conical hole is bored; the long glass tube *t* of the apparatus *tO* passes through this hole to the expansion *c*, which should fit into the cone, and be there secured by any good cement. The screw-cap *m* therefore carries the glass apparatus, which latter is a form of pressure-tube now easily obtained through good instrument makers. The liquefaction takes place within the glass tube *t*, which must, of course, be sufficiently strong. The length of this tube is about 25 cm.; the wide reservoir *O* must have at least ten times the capacity of *t*; the reservoir *O* terminates below in a rather narrow curved tube *w*, which is always open.

The glass apparatus is filled in the usual way with dry ammonia gas by connecting *w* with an apparatus affording a current of the pure gas.

When the air has been expelled—and a good current maintained for ten minutes sufficiently effects this—the flow of gas is allowed to slacken, and the capillary end of *t* is securely sealed at the blowpipe. The tube is removed from *w*, and the latter at once dipped in mercury, which enters and so prevents escape of ammonia.

The cap *n* is now removed and mercury is poured into *A* until the

metal rises nearly to the top of B; O is then introduced into B, allowing the mercury displaced to overflow into a vessel placed to receive it, and the cap *m* is screwed home. This cap must, of course, be provided with a good leather washer.

We have, therefore, nothing but mercury between the gas in *o* and the surface of the metal in A. Next remove enough mercury from A by a pipette to leave a space of some 12 cm. between the surface of the metal and the cap; then fill up to the top with the strongest "solution of ammonia," and screw down the cap *n*. The apparatus is then ready for experiment, which is performed in the following way:—

Gradually heat the portion of A containing the solution of ammonia by a Bunsen flame occasionally applied. As the temperature rises, ammonia is expelled from the solution; but since the gas has no escape, considerable pressure is exerted in A on the surface of the mercury, and the latter, acting as a fluid piston, compresses the gas in O, which latter steadily diminishes in volume until at last the mercury rises into view in *t*; and if the heating of A be now carefully managed, a layer of colourless liquid ammonia is seen to form on the surface of the mercury in *t* as the compression proceeds.

If the joints are well made and the heating properly managed, it is easy to maintain a steady pressure for a considerable time, but anything like violent heating must at all times be carefully avoided. On allowing the apparatus to cool, the mercury recedes in *t*, and the liquefied ammonia disappears. This apparatus is always ready for experiment, though it is desirable to unscrew the cap of A occasionally, and change the solution of ammonia, as slow leakage from *w* is inevitable.\*

It is obvious that the principle involved is one of general application to the liquefaction of gases, as the mechanical effect depends upon the temperature to which the tube A is raised.

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\* This apparatus was made for me by Messrs. Yeates and Son, of Dublin.