

CCCXIX.—*The Densi-Tensimeter.*

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EVER since Abegg (*Z. physikal. Chem.*, 1908, **61**, 455) emphasised the anomaly that ammonium chloride has the same sublimation pressure when perfectly dry as when moist, whilst the dried vapour was found undissociated and the moist almost completely dissociated, I have desired to repeat Johnson's experiments (*ibid.*, p. 457), but in a more trustworthy apparatus. The problem was to measure the vapour pressure and the vapour density simultaneously, but the insertion of a small baroscope into a vapour-pressure apparatus, with a glass-spring indicator, appeared to present insuperable difficulties, and it was not until the need for such an apparatus became imperative during our experiments on intensive drying, that one of my glass-blowers succeeded in the task. He introduced a quartz baroscope with a quartz knife-edge and also a graduated glass scale into a bulb of high-melting Jena glass of about 10 cm. diameter, so that this bulb formed part of a vapour-pressure apparatus having a glass-spring indicator, and a preliminary investigation was conducted on the "ammonium chloride" problem (*Rec. trav. chim.*, 1927, **46**, 445).

The apparatus has now been improved in certain directions. In the first place the pan on which the knife-edge rests was made from a tube which was cut in two lengthwise and turned up at the ends, to prevent the knife from slipping from the pan. This is seen in Fig. 1, which also shows a cross-piece in the right arm of the baroscope, the vertical tube of which is provided with a small steel rod embedded in powdered iron oxide; this steel rod serves to make the baroscope swing with the aid of a magnet, whereby it can be seen whether the deviation is reproducible.

The difficulty, however, was that in this form of the apparatus the pan could not be ground, whereas the knife-edge was. This was unfavourable, and I therefore changed the construction slightly (see Fig. 2).

Just above the knife-edge two thin quartz arms were sealed and bent down, so that these little arms prevented the baroscope from slipping from the pan, and consequently the pan could have an open V-form and thus be well ground, which was a great advantage. (The firm of Beckerson, Dieren, Holland, carried out the grinding of

FIG. 1.

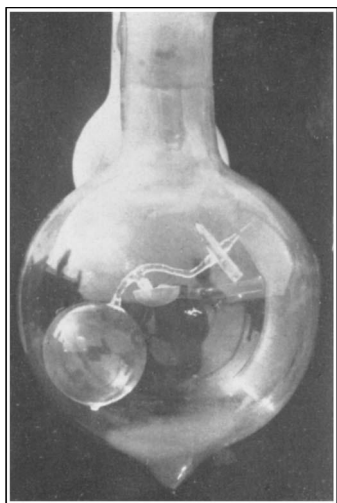


FIG. 2.

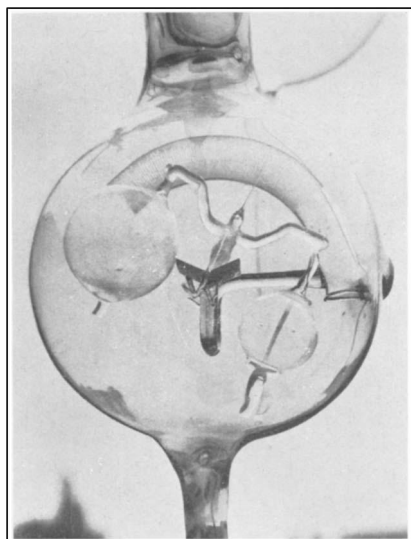
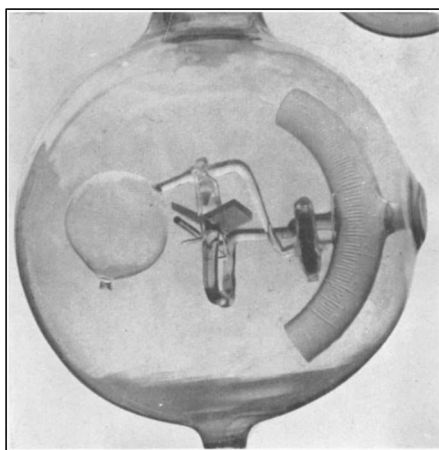


FIG. 3.

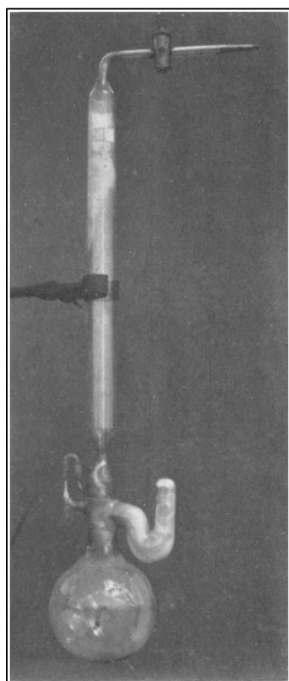


FIG. 4.

[To face p. 2409.]

the knife-edges and pans very efficiently.) The baroscope moved as regularly as a fine balance, and the calibration showed that the readings were exactly reproducible.

Another improvement was then made to ensure that, on cleaning, the baroscope is not removed from its place and made to float on the cleaning liquid. For this purpose the ends of the two little side arms, mentioned above, are bent horizontally, and a glass rod is sealed to the pan holder in such a way that, if the bulb of the baroscope is lifted by the cleaning liquid, the horizontal ends of the side arms are caught by this rod; the knife-edge now cannot be lifted up from the pan and the baroscope remains in the right position (see Fig. 2).

Although the apparatus was now very satisfactory, I thought that possibly the accuracy could be increased a little by changing the baroscope once more. In order to eliminate a possible source of slight error, caused by adsorption of vapour on the quartz surface of the baroscope, it was necessary to have, as accurately and symmetrically as possible, the same area of quartz surface on each side of the knife-edge. To ensure this, the baroscope of the latest construction contains two bulbs, but whilst the left one is closed, the right one has two or more holes, so that it can serve to enlarge the surface of the right part of the baroscope without impairing its function in the apparatus; moreover, since both the inner and the outer surface of the open bulb are exposed to the vapour, this bulb must be smaller than the other.

This principle is embodied in the baroscope shown in Fig. 3, from which we see also that the tube with the small iron rod is now sealed into the open bulb, that the needle is sealed at the middle of the arm of the baroscope, and that the scale is at the upper part of the apparatus.

Fig. 4 shows the bulb, containing the baroscope, sealed to the glass-spring indicator. The whole apparatus has been called a "Densi-Tensimeter."