

of the liquid. This was effected satisfactorily by the use of a hydrometer (fig. 37), specially designed by Mr. Buchanan for the purpose.¹

The following is a description of the instrument used for the whole of the work done during the cruise. The stem, which carries a millimetre scale 10 centimetres long, has an outside diameter of about 3 millimetres, the external volume of the divided portion being 0·8650 cubic centimetre; the mean volume of the body is 160·277 c.c., and the weight of the glass instrument is 160·2128 grammes. With this volume and weight, it floats in distilled water of 16° C. at about the lowest division (100) of the scale. In order to make it serviceable for denser waters, a small brass table is made to rest on the top of the stem, of such a weight that it depresses the instrument in distilled water of 16° C. to about the topmost division (0) of the scale. By means of a series of six weights, multiples by 1, 2, 3, 4, 5, and 6, of the weight of the table, specific gravities between 1·00000 and 1·03400 can be observed. It is not necessary that these weights should be accurate multiples of the weight of the table; it is sufficient if they approach it within a few milligrammes, and their actual weight be known with accuracy. The weights of the table and of the weights in actual use were:—

Weight of table,				0·8360 grammes.
„ of weight No. I.	I.			0·8560 „
„ „ II.	II.			1·6010 „
„ „ III.	III.			2·4225 „
„ „ IV.	IV.			3·2145 „
„ „ V.	V.			4·0710 „
„ „ VI.	VI.			4·8245 „

For oceanic waters, the hydrometer is always used with the table, and either No. IV. or No. V. weight.

For using this instrument at sea, about 900 c.c. of sea water are taken, and the containing cylinder placed on a swinging table, in a position as near the centre of the ship as possible (fig. 38). The observation with the hydrometer, loaded with the necessary table and weight, is then effected in the ordinary way, the accuracy of the readings being but little affected by rolling; pitching, however, is found to have a distinctly disturbing effect, and when it is in any way violent, it is advisable to store the specimen of water till the weather improves.

The temperature of the water at the time of observation is determined by one of



FIG. 37. —Hydrometer.

¹ Phys. Chem. Chall. Exp., part ii., 1884.