

of water as can be contained in the graduated tube increases very materially the amount of contraction produced by pressure. The instrument which was chiefly used contained 256.61 grammes of mercury in the bulb and stem immediately above it; the volume of the part of the stem filled with water was 0.1935 c.c. The apparent contraction of this mass of mercury and water was 0.000581 c.c. per 100 fathoms, and 0.0025 c.c. per degree (C.) respectively. A fall therefore of one degree (C.) in temperature produced the same effect as an increase of pressure equal to 430 fathoms of sea water. Hence (and this forms the important peculiarity of the instrument) as long as the temperature of the sea does not increase with the depth at a greater rate than 1° C. per 430 fathoms, the instrument will record the temperature correctly. The ratio subsisting between the rise or fall of temperature and the column of water, which produced the same effect on the apparent volume, is a constant for each instrument; in this it is $\frac{1}{430}$. By altering only very slightly the amount of water, the sensibility to pressure is greatly increased or diminished, while that to temperature remains practically unchanged. As the instrument described was

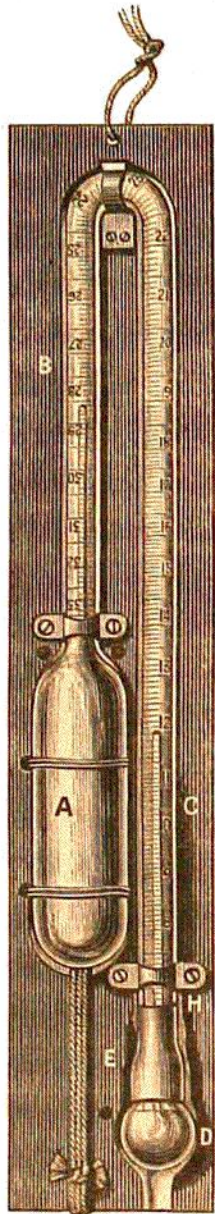


FIG. 33.—Mercury Piezometer.

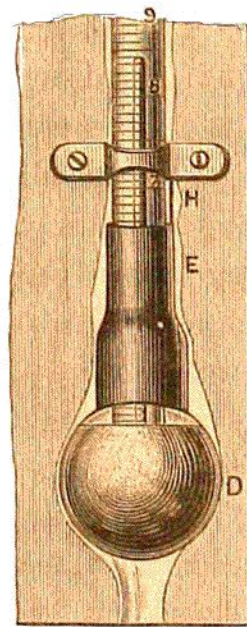


FIG. 34.—Enlarged view, showing attachment of bulb to end of Piezometer.

intended principally for bottom waters, the above ratio ($\frac{1}{430}$) was considered sufficient, and it proved practically useful. It must be remembered that the greater the value of this ratio is made, the greater is the error introduced into the determination of the temperature by any inaccuracy in the measurement of the depth.

This instrument was constructed entirely at sea, and though the chemical laboratory was specially lucky in its freedom from breakage, there seemed to be an exception in the case of the mercury piezometer. Four of them had to be made before one stood. The first was broken by accident, the second by a foul on the sounding line, the third in the receiver of the hydraulic apparatus by the collapse of a protected thermometer, which was being exposed to pressure along with it, and the fourth stood, being used as often as possible on the sounding line along with other instruments until the ship returned home, when it was broken in its turn by an over-curious instrument-maker who was employed to copy it. The filling of the instrument with so large a quantity of mercury was effected by means of an improvised