

and along with it the levers, closing both stopcocks simultaneously. The plate then falls into the position seen in the right-hand figure. This simple arrangement allows of enclosing a water-sample at any depth required. This water-bottle has done very good service; it was much used on board the "Challenger," and has also—with a few small improvements—been employed a good deal in later times.

In a stopcock water-bottle of this construction the temperature of the water-sample may alter during the hauling-up process, and it is impossible to get a record of the temperature *in situ* with the water-sample, without having a special apparatus for the thermometer. Buchanan himself, and later on Nansen, modified this water-bottle by adding an arrangement for a thermometer, which would be reversed the moment the cocks were closed. In the meanwhile Otto Pettersson had adopted F. L. Ekman's old idea of making a water-bottle which should be insulating, so that the water-sample would retain its temperature unchanged, even when drawn up from a great depth. Pettersson availed himself of the circumstance that the water itself is an excellent insulator, its power of conduction being small and its capacity for heat very great. This water-bottle consisted of a bottom-piece, a cylinder, and a lid; these three parts could be separated by lifting up the cylinder and the lid along two brass rods forming the sides of the encompassing frame. The cylinder is a composite one; inside a strong cylinder of ebonite there are various other cylinders of celluloid and brass, one inside the other like a set of Chinese boxes. Between these concentric tubes are narrow cylindrical spaces which fill with water when the apparatus is lowered into the sea, and in this way a system of excellent water-insulators is formed. The outer cylinder may alter in temperature considerably in the course of hauling-up, the inner ones less and less, until in the central chamber the temperature will not change at all for some time, although the water-bottle be strongly heated from without. On the bottom and on the lid Pettersson attached a number of parallel plates, which likewise enclose insulating water-layers.

Nansen has introduced several improvements, and the latest model—the so-called Pettersson-Nansen water-bottle—is an excellent apparatus, which is now very widely used (see Fig. 162). On the left it is seen open, as it is let down into the water; the lid is suspended in the upper part of the frame, and supports the cylinders as well as a weight hanging below the

Pettersson's
insulating
water-bottle.

Pettersson-
Nansen
water-bottle.