SEXTANT FITTED WITH AN ARTIFICIAL HORIZON, BY W. LUDOLPH A. G. — BREMERHAVEN

Mention should also be made of various instruments which can be used for the observations of heavenly bodies during fog, or when rapid results, without too great accuracy, are required. The instruments are described in detail in the *Annalen der Hydrographie u. Mar. Met.* of 1925 pages 100-105.

The first instrument, the diagram of which is shown on Fig. 1, is fitted

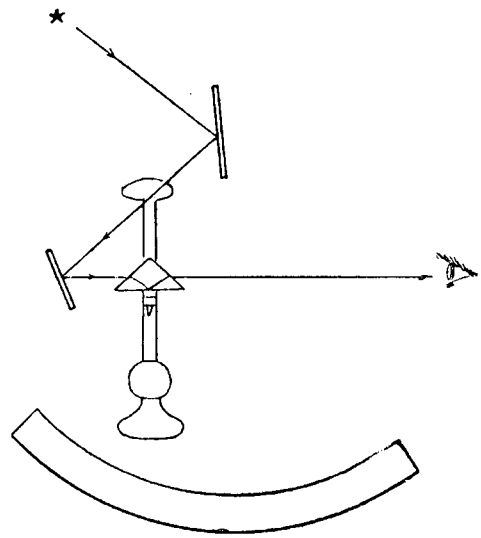

fig 1

with a compound pendulum, oscillating on two agate points, resting on sockets similar to those of compasses. This pendulum is fitted with a right angled prism with horizontal hypotenuse, above its axis of oscillation, which prism the rays proceeding from the observed body and reflected by the mirrors, traverse before reaching the eye. The pendulum, enclosed in a case, has a large moment of inertia, and its oscillations are damped by friction. It moves along the divided limb, and the graduation zero corresponds to the ray, twice reflected, proceeding from the horizon. Further, for the convenience of observations, this pendulum can oscillate 3° to 4° on either side of the plane of the limb.

Although at first a precision of 4' to 5' might be expected, the wear of the pivots quickly makes this degree of accuracy deceptive and, moreover, observations at sea with a pendulum are scarcely practicable.

For these reasons, another instrument with bubble level (fig. 2) has been introduced; it is a ship's sextant of modern type, to which a bubble horizon, carried by a plate parallel to the plane of the limb, has been added above the alidade, and rigidly fixed to the frame of the sextant.

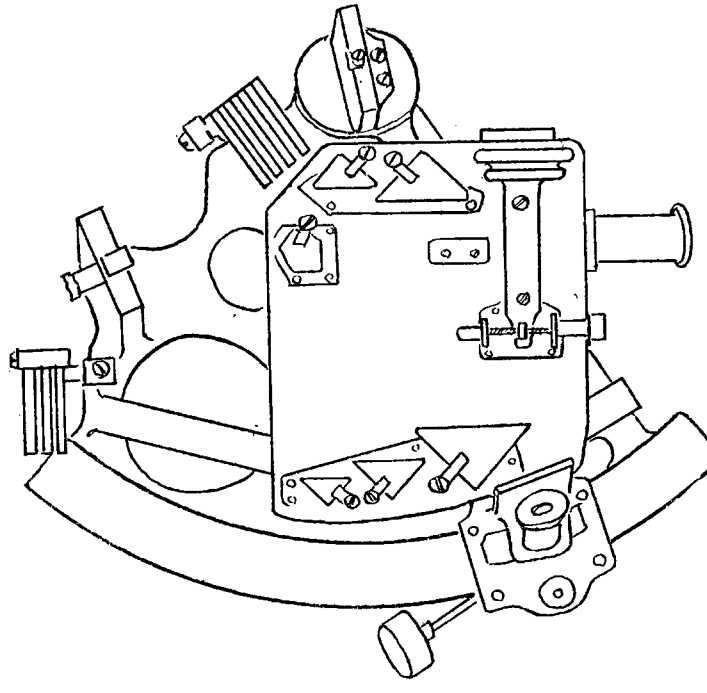

Fig. 2

The level itself is composed of a tube, the bubble of which is observed through the intermediary of a series of five orthogonal prisms and one pentagonal prism.

Fig. 3 shows the plan of the path of the luminous rays through these

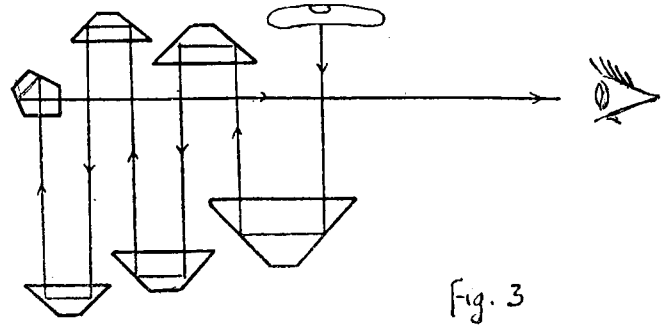

Fig. 3

prisms, which are arranged in such a way that the length of the luminous path is equal to the radius of curvature (86 cent.) of the tube. The double reflection betwen the prisms is such that an inclination of the combination

of prisms, in the plane of the instrument, does not alter the line of sight. Thus, the eye sees the image of the bubble in the pentagonal, reset vertically and to the horizon.

The upper plane of the prisms is adjusted so as to pass through the media plane of the tube in such a way that only half of the level and bubble are seen, as shown in Fig. 4. In taking the altitude of the sun, the image of the sun is brought into coincidence with the halved image of the bubble (fig. 4). These two images have approximately the same diameter.

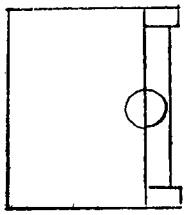

fig. 4

For stars—the centre of the bubble is estimated, or else the mean of coincidences with the upper and lower side of the bubble is taken.

A small auxiliary level, perpendicular to the plane of the instrument, is visible when the lateral inclination does not exceed 1°. This level, which is seen by the observer at the same time as the other, (since the observation is taken with the naked eye, without telescope), allows the verticality of the plane of observation to be assured.

For night observations, the instrument is fitted with an electric lighting apparatus with an adjustable rheostat.

The alidade is moved along the toothed limb by means of an endless screw.

Although the instrument is not made of aluminium, its weight scarcely exceeds that of an ordinary sextant.

Mr H. Coldewey himself has, on board the inspection ship *Weser*, with representatives of the firm Ludolph, carried out, under various conditions, tests of the first instrument in comparison with an ordinary sextant: other trials have been carried out on board several ships, at speeds of 21 knots. The *Deutsche Seewarte* has also undertaken further trials on board the surveying ship *Panther*. The mean error in good weather is from $\pm$ 2'. On small boats, observations are difficult when it is rough. The maximum errors have not exceeded 5' to 8'. These figures give some idea of what may be expected from this instrument.

Nevertheless, by choosing favourable moments and a suitable position in the ship, prolonged practice will give better results, it being clearly understood that in bad and rough weather, observations with the bubble level are impossible.

In addition, this type of instrument is free from errors of refraction, due to the direct sighting of the hoziron.