

the angles can be read off by the unaided eye in three or four seconds and the saving of eyestrain to the observer largely increases the amount of work capable of being carried out in a given time.

A pentagonal prism can be supplied to order which enables all observed angles to be increased by 90° . Thus, the plain sextant gives observations up to 140° which by sliding the prism attachment into place can be increased to 230° .

The prism is readily attached and detached by means of a simple slide fitting, the bridge which carries it being left permanently in place on the sextant limb. As the prism is of the double reflecting type, slight variations of position in placing it on the sextant have no effect on the angles observed.

SPECIFICATION.

Limb and Index Arm: Diamond pattern limb of 6 inch radius with inlaid brass arc divided to degrees and reading from 0° to 140° . A safety stop is fitted to prevent the index being swung so far as to strike the mounting of the horizon mirror. Special index arm with plain index arrow to read whole degrees on the arc and fitted with patent micrometer gear reading to single minutes which also serves as an endless tangent screw. The micrometer is thrown out of gear by pressure between finger and thumb on the end of the index arm where it is normally held for "sweeping". The micrometer reading is very open and plain (1 minute = $1/16$ inch : 1.6 mm.) so that no magnifier is required and readings are taken with the greatest ease and rapidity.

Mirrors and Telescope :

Index mirror.....	2 1/8 in. × 1 5/8 in.	54 mm. × 41.3 mm.
Horizon mirror	1 3/8 in. × 1 1/8 in., fully silvered.	35 mm. × 28.6 mm.

The fully silvered horizon mirror is of course the best for survey work. A spare pair of mirrors is provided. Large erect telescope with 1 3/4 in. (44.5 mm.) object glass having power $4\ 1/4\times$ and field 4° to $4\ 1/2^\circ$ with eyecup focussing mount and diopter collar. Thus, each worker's focus can be recorded and set up by the diopter scale without delay. A blank head is also provided. The telescope, or blank head, is mounted in a split collar with hinge and clamp screw and the sextant packs in its case with the telescope in position.

Case: A stout box of unpolished teak is supplied with the instrument, fitted with special packings for the adjusting keys, telescope, blank head, and spare pair of mirrors, the latter being packed first in a metal box which is then again packed in a teak box screwed into the instrument case. The case is fitted with sunk handle, recessed hooks and lock and key.

Sizes and weights :

Weight of sextant with telescope ready for use	4 lbs. 1.8 kg.
Weight of sextant complete with spares.....	12 lbs. 5.4 kg.
Outside dimensions of case.....	13 1/2 in. × 11 in. × 6 in. : 34.3 cm. × 28 cm. × 15.25 cm.

HUSUN IMPROVED BUBBLE SEXTANT.

BOOTH PATENT.

Within the last few years Messrs. Henry HUGHES & Son Ltd., London, have improved their model of bubble sextant described in *The Hydrographic Review*, Vol. VI, No. 2, November 1929, p. 140. In the following article details are given concerning the most recent model of this appliance.

The instrument consists of a micrometer sextant, having all the mechanical gear totally enclosed, in conjunction with a special bubble horizon of which the bubble, after

adjustment to size, will remain of constant size over a considerable period of time. Provision is made for use of the natural horizon, when required, by swinging the bubble gear out of the way. As the instrument is designed for use both by night and day, electric lighting for both bubble and scales has been provided.

THE SEXTANT PROPER. (See *Figures 1 and 2*).

The sextant proper consists of a box *A* in which are housed the micrometer worm with its fittings, and an arc in engagement with the same, the latter constituting the limb of the sextant. The limb is divided to single degrees and is read through a window *B* against a fixed index mark, while the minutes are read through an adjacent window *C* on the micrometer drum.

The movements of the limb and the index mirror are controlled in either of two ways :-

(a) For slow movement or fine adjustment by rotating the outer rim *E* of the right handle.

(b) For quick setting or searching by rotating the outer rim *E* of the right handle after pushing home below the edge of the left handle the lever *D*. On releasing the lever *D* the motion reverts to slow.

The whole of the mechanism of both the quick and slow motions is contained within the sextant box *A* and is protected from dirt and also accidental damage.

The horizon mirror is secured to the casing of the sextant work while the index mirror is secured to the pivot of the limb which is carried through the limb casing for that purpose. The horizon mirror is fully silvered, the index mirror *F* being unsilvered so that the sextant can be used in two different ways as will be explained later. The mirrors are protected by a guard plate, mounted on three pillars, which also serves to carry three shade glasses *G* and the left handle *H*.

The theory of the mechanism forming the bubble was explained in the above mentioned *Hydrographic Review*, p. 153, so we shall not revert to it here. The bubble gear *K* consists of the actual bubble chamber *M* which is in communication with the operating chamber *L* and the reserve chamber *N*. It is also known that the bubble is formed by manipulation of the screw *O*.

Daylight illumination of the bubble is provided by the white reflector *P* which must be folded down over the bubble chamber *M* at a slope of about 45°. In the photograph the reflector *P* is folded away to enable the chambers to be seen clearly.

At night illumination is provided by the lamp *Q* shining on the reflector *P* folded down as before. The light given by the lamp *Q* is controlled by the rheostat *R*, the adjustment being made by moving the small knob *S* till the bubble illumination is sufficiently dim.

Night illumination of the scales is given by the lamp *T* controlled by the lamp switch *U*. A 2-volt battery is connected by means of flexible cord and plug to the socket *V* when electric lighting is required. Three shade glasses *G* may be interposed as required in the path of the sun rays reaching the index mirror.

GRADUATION OF PRECISION CIRCLES. (*)

(Extract from the *Journal of the Franklin Institute*, Lancaster, Pa., November 1934, p. 623).

The Bureau's circular dividing engine and the type of graduating work done on it have been briefly described in *Technical News Bulletin* Nos. 128 and 149 (December 1927 and September 1929). This instrument has been used during the past nine months in

(*) *Notes from the U. S. Bureau of Standards : United States of America.*