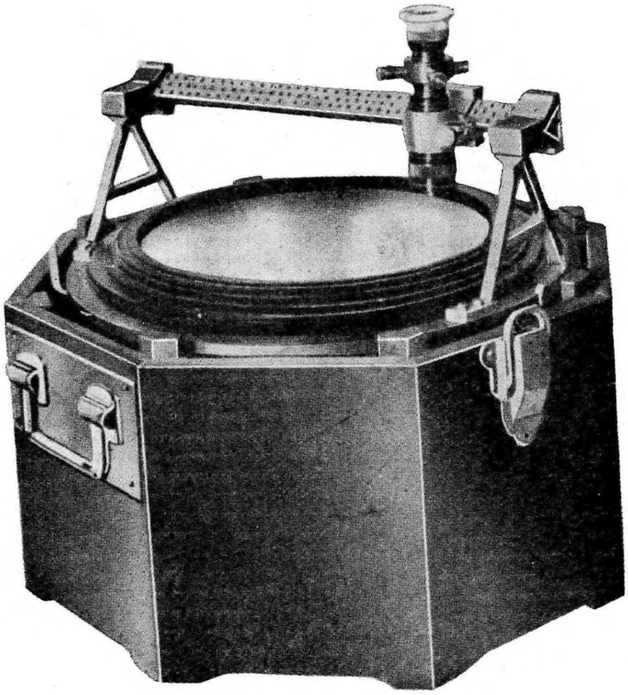

THE S. I. P. L. NAVIGATIONAL CALCULATOR.

This apparatus, made by the *Société Industrielle des Procédés W. A. Loth*, 20, Avenue Kléber, Paris, immediately solves the various problems which arise in navigation.

The principle of the calculator is to materialise the local and celestial spheres in conjunction with their network of co-ordinates, thus enabling a spherical triangle with three elements to be constructed. The possibility of constructing the triangle with three elements enables the unknown elements to be determined.

For this purpose, the two spheres are projected on their common Great Circle — the meridian of the place, that is to say, in one case, a skeleton network of spherical co-ordinates, graduated in altitudes and in azimuths (by quadrants), is projected on a plane representing the meridian of the place, and in the other case, this same skeleton network, graduated in declination and hour angles, is likewise projected on a plane representing the meridian of the place.

Suppose that these two planes of projection are superimposed, the centres coincident, and that one of them can turn in its own plane around its centre; their skeleton networks make an infinite number of spherical triangles, one of the sides of which is the arc *ZP* of the meridian of the place; their elements can be read off directly (with the exception of the interior spherical angle *A*).

DESCRIPTION OF THE CALCULATOR.

It is not possible to bring about the actual superposition of the two projections, but the same result is obtained by the following arrangement :—

(1) (*a*) The projections are drawn on two glass plates on the sides facing each other and these are arranged rigidly parallel, one centre being a few millimetres vertically above the other.

(*b*) This is arranged by means of a frame which permits the lower plate to revolve in its own plane around the centre of the projection.

(2) A reading microscope has its axis strictly at right angles to the plane of the plates, and it is movable

(*a*) parallel to the plane so as to be vertically over any point of the projections,

(*b*) up and down, in the direction of its own axis, in order to focus either on the upper or on the lower plate.

PLATES.

These are circular, the glass optically planed and with strictly parallel faces. On the lower face of the upper plate is the projection of the skeleton network of the local sphere; on the upper face of the lower plate is the projection of the skeleton network of the celestial sphere, this being in order that the projections, which are photographic reproductions, should not be spoilt.

The skeleton network is not, properly speaking, a geometrical projection; it is a mathematical representation obtained according to a certain rule.

The projection was obtained by drawing curves every 15' after engraving on a copper plate about 16,000 points to every quadrant. Then this quadrant was produced so as to form a complete circle.

Two complete identical projections of large dimension having been drawn, that which is to represent the local sphere is graduated throughout in degrees so as to enable azimuths and altitudes to be read off.

In the same way, the projection which is to represent the celestial sphere has its declinations graduated in degrees, but its hour angles are graduated in hours and minutes of time.

To approximate to within one minute of arc in reading off, which is the limit of accuracy, it is necessary to estimate the position of a point in one of the squares to within about $\frac{1}{15}$. It is easy to do this with a little training, the divergence of the curves seen through the magnifying reading glass being quite sufficient.

FRAME.

The stand contains, besides, the source of light which illuminates the plates. A glass, ground on one of its faces in order to diffuse the light, is secured to the lower part of the metal frame which rests on the stand.

OPTICAL ATTACHMENT.

This consists of an object glass and an eye-piece forming a microscope having a magnification of 30. (The images are reversed but the graduations are so inscribed as to rectify this).

Cross wires, composed of two lines at right angles, are arranged at the focus of the eye-piece, Each of the two lines can be moved to the right or to the left by means of a milled head.

The calculator thus constructed makes it easy to solve the following problems:

Determination of the variation of the compass.

Determination of a position line.

Calculation of the longitude G if the latitude φ is known.

Calculation of the latitude φ the longitude G being known.

Determination of the moment when circumstances are favourable for obtaining the time or the longitude.

Determination of the time and the variation of the compass at the rising or setting of a heavenly body.

Recognition of a star.

Determination of a Great Circle course and distance.

Making certain that a Great Circle course does not pass a certain parallel:

Laying off a radiogoniometric bearing on a Mercator's chart.

A complete description of the apparatus, of its theory and of its use for the different problems, will be found in a publication consisting of 30 pages of text, containing a number of figures and illustrated by means of stereoscopic diagrams compiled by A. BASTIEN, Professor of Hydrography, and published by the *Société Industrielle des Procédés W. A. Loth.*