WATER POLLUTION RESEARCH

(SURVEY OF THE RIVER TEES).

The INTERNATIONAL HYDROGRAPHIC BUREAU has recently received, through the courtesy of the Department of Scientific and Industrial Research, London, Water Pollution Research, Technical Papers N° 2, 5 & 6 dealing with a survey of the River Tees. This survey was carried out for the purpose of obtaining reliable information regarding the effects on rivers of various polluting discharges, and the Tees was selected as a typical river flowing through an industrial area.

The work of the survey which was commenced in April 1929 was divided into two main sections, comprising the Tidal and Non-Tidal reaches respectively, and the work on the Tidal reach was further sub-divided into two sections, one to secure hydrographical data and the other to obtain biological and chemical information. For the Hydrographical work a hydrographical surveyor was appointed and this work was carried out in close co-operation with the Hydrographer of the British Navy. This work was principally to obtain information as to whether the time of change of the Tide was the same at all depths, regarding the relative strength of the Tidal Stream at the surface and on the bottom, the strength of the currents and volumes of water moving up and down the river at different times and places over all ranges of the Tide and at all depths, and on the effect of fresh water floods on Tidal movements in the estuary, also comparisons of water level at different states of the tide, and times and heights of High and Low Water throughout the estuary.

Technical Paper N° 2 gives a detailed description of the Hydrographical work carried out, and as this was of a more or less pioneer nature, it should prove of great interest to those Authorities who have similar problems to investigate in future, containing as it does a description of the movement of water towards the sea in a typical river estuary, water levels and times of High and Low Water in the Estuary and the deposition of silt in the River. The concluding remarks show that at some points there are considerable differences between the surface and sub-surface waters and that at certain times the flood is running upstream below the surface while the ebb is still running on the surface, this being due to the difference of density between fresh and salt water and would not occur if the sea water was fresh.

The following current meters were used:

(1) small WATTS Meter; (2) small GURLEY-PRICE Meter; (3) Large GURLEY-PRICE Meter; (4) MERZ-EKMAN Meter. Experience showed that the method of measurement of currents by means of floats is not suitable for a tidal estuary.

Technical Papers N° 5 & 6 contain accounts of the Chemical and Biological results observed in the Estuary and in the Non-Tidal Reaches respectively.

J. D. N.

NORTHERNMOST LABRADOR MAPPED FROM THE AIR

by

ALEXANDER FORBES, New York, N. Y., 1938.

N° XI, November 1931, of the *International Hydrographic Bulletin*, p. 274, announced the return of an expedition to Northern Labrador carried out under the auspices of the American Geographical Society. Further operations took place in 1932 and 1935, and the International Hydrographic Bureau recently received *Special Publication N°* 22 of the American Geographical Society which, in a well-brought-out volume, gives an account of the results of the expedition.

At the instigation of Sir Wilfrid T. GRENFELL, himself the author of charts of this area which are still in manuscript, very extensive use was made of aerial photography, which was particularly indicated for surveying intricate coasts cut up by deep fiords and accompanied by innumerable islets. Numerous and magnificient photographic reproductions show what valuable documents it has been possible to obtain in this way, which have enabled important errors on charts to be rectified and new charts to be constructed Four sheets to 1:100,000 are annexed to the volume; they show ground relief by contour lines 50 metres apart, there is also a general orographic chart to 1:300,000 coloured, intervals of 250 metres. A small appendix contains notes on navigation in those difficult regions.

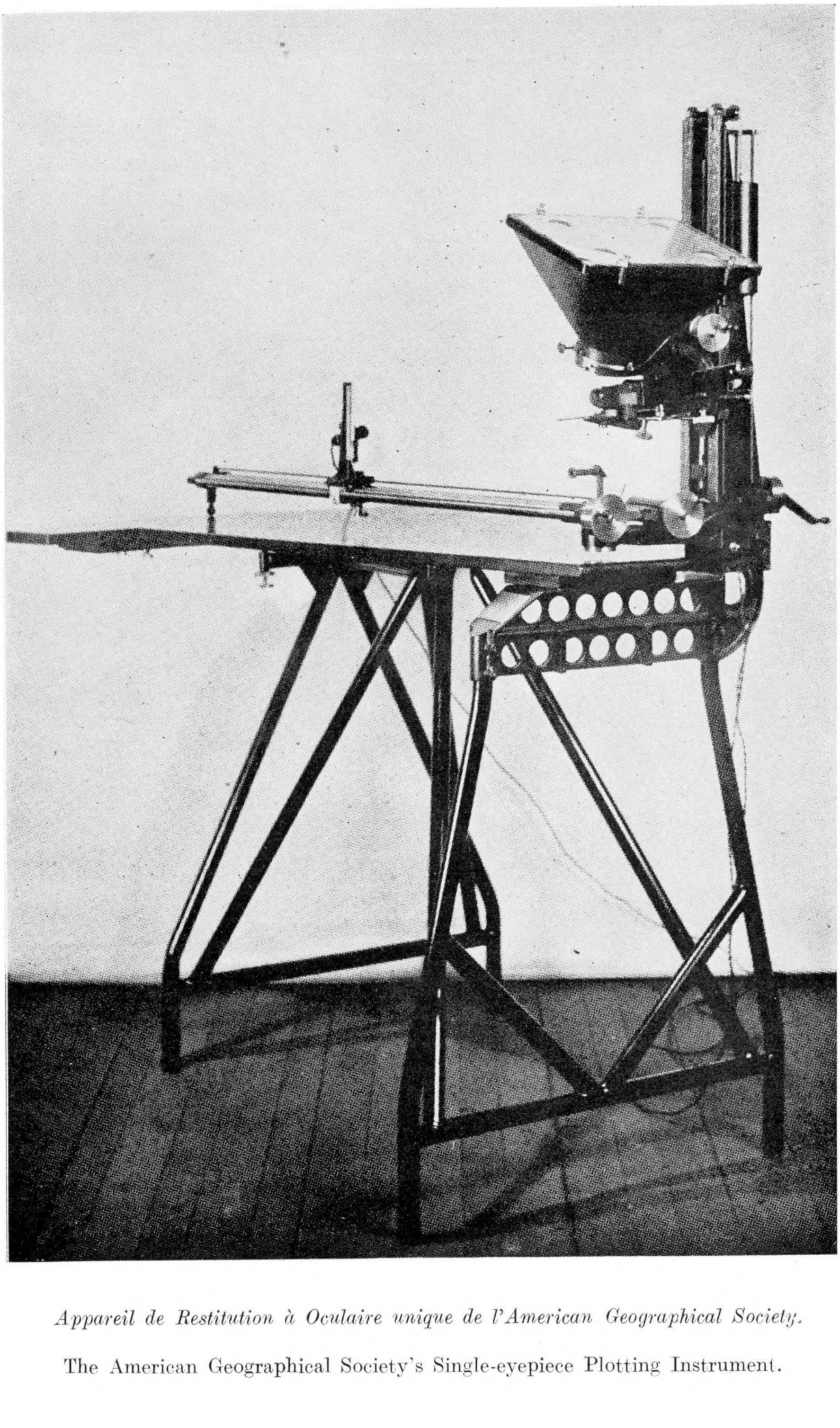
The datum for the altitudes was obtained from a recording tide-gauge loaned by the Coast and Geodetic Survey. The positions of ground control points, their latitudes and longitudes and the azimuths of the sides, were given by triangulation. Several soundings were made in the Kangalaksiorvick Fiord. It is particularly necessary, however, to note the almost exclusive use of "high oblique" aerial photographs for which the optical axis had a large tilt on to the vertical

— which allows the apparent horizon to appear in each photograph. The expedition had two seaplanes at its disposal and a 10 inch single lens FAIRCHILD camera. Mr. O.M. MILLER was more especially in charge of the photographic surveying operations. He has explained the methods used in two articles which appeared in the *Geographical Review*, 1931, pp. 201-212 and pp. 660-662; these methods are derived from the well-known method used in connection with photographs taken ashore with a horizontal optical axis. Several photographs with vertical axis were, however, taken in Seven Islands Bay in order to complete certain details. The stereoscopic effect was not used for the restitution of the photographs, (photomapping). High oblique aerial photographs were extensively used in Canada in almost absolutely flat areas, which simplifies the problem of mapping to a singular degree. The mapping is then carried out by means of a grid giving the perspective of the rectangular spacing of the chart. The problem is more difficult in the case of undulating terrain; numerous studies regarding it have been undertaken since those of O.M. MILLER. The Survey of India has adopted a similar method, a description of which is given in the Report of Air Survey Committee N° 2, 1935, War Office, London, 1936, Appendix I, pp. 164-172. Research work has been carried out on several occasions in Canada also:— E.L.H. BURNS and R.H. FIELD: *A Plotter for High Oblique Air Photographs, Canadian Journal of Research*, Vol. 13, 1935, pp. 22-33; R.D. DAVIDSON: *A Plotter for Oblique Photographs*, Proc. of the 29th Annual Meeting of the Canadian Institute of Surveying, Ottawa, Feb., 5 and 6, 1936; Canadian Surveyor, *Special Edition*, pp. 20-29. These authors, however, regard very oblique photographs more as a help for fixing altitudes and facilitating the drawing of the contour lines. O.M. MILLER reopened the question and arrived at the method which he describes in: *Experiments at the American Geographical Society in Small-scale Mapping from "High Obliques", News Notes of the American Society of Photogrammetry*, Vol. 1, N° 5, 1935, pp. 25-34. Further, he had an instrument manufactured to his order by the Mann Instrument Company, namely, the photogoniometer of the American Geographical Society, which allows rapid and direct reading of the horizontal and vertical angles deduced from a very oblique photograph. After having rendered admirable service, this instrument was afterwards replaced by an improved device:— the single-eyepiece plotting instrument of the American Geographical Society, a complete description of which is given in the Journal of the Optical Society of America, Vol. 25, 1935, pp. 185-189. The following is a summary given by the author:—

"A photograph is placed in the holder shown near the top of the accompanying illustration and viewed through the eyepiece, which appears just below and to the right of the uppermost of the three drums. The observer sees a point of light superimposed on the photograph and, by turning the handles on the drums, he can make this point appear to move up or down or to the right or left of the photograph. When the light is so manoeuvered, a pencil attached to it is moved on the drawing board, and, if the photograph is properly set, shore lines may be plotted, points intersected, and heights determined. Resecting can be done with the plotter even more easily than with the photogoniometer.

More specifically, the instrument consists of a horizontal plotting board on which a pencil is made to move by means of polar coordinate movements centered about a vertical axis passing through a perspective center. Vertically above the point of the pencil and fixed rigidly to it is an illuminated index mark. A photograph is set in a holder about the perspective center so that it occupies a position that corresponds in miniature to the conditions of exposure — i.e. a position that is correct in relation to the horizontal datum plane with respect to swing, tilt, focal length, and height. By means of an optical device called a pinhole mirror situated at the perspective center the observer views the index mark and the photograph simultaneously through a telescope. The telescope functions solely as a viewing apparatus and has little to do with the accuracy of the measurements that are made with the instrument. The fine adjustments for swing and focal length are measured with verniers, but all the other movements are measured from multiple-geared drums, which makes the reading of the measurements very rapid.

The operation of the instrument is simple. To plot planimetry once the photograph has been correctly oriented, the operator merely moves the index mark so that its image follows the outline of the feature on the photograph. The scale of the drawing is determined by the ratio between the height of the perspective center above the map and the height of the camera station above the ground. To intersect a point above the map datum level it is necessary first to plot on a plotting sheet the relative horizontal positions of the two photographs in which the point appears and the directions in which the camera was pointing at the moments of exposure. The first photograph is taken and correctly oriented, and the sheet is then oriented on the board so that the direction of the plotted camera axis points at right angles to the tilt axis and the plotted position of the camera station lies directly under the perspective center. The image of the index mark is then superimposed on the image of the point to be intersected, the pencil placed in operation, and a line drawn on the paper by moving the index mark in towards



Appareil de Restitution à Oculaire unique de l'American Geographical Society.

The American Geographical Society's Single-eyepiece Plotting Instrument.

the operator. The same process is repeated with the second photograph, and where the two lines intersect on the paper is the position of the point on the map. Then, by placing the pencil at this intersection and lowering the perspective center and the photograph as a unit the image of the index mark again covers the photographic image of the point, one may read the difference of height between air station and point directly on the height scale without computation. The distance from the air station to the point can also be read on the distance scale, and the necessary correction to the height for curvature and refraction can be applied at once from tables."

However, the use of a photograph invariably necessitates the determination of its position and orientation in space; and for this purpose three control points are required. An approximate value of the tilt of the axis below the horizon is first assumed and also the swing of the horizon in respect to the sides of the photograph. This enables values of the horizontal angles between the control points to be measured and a position of the station in horizontal projection to be obtained. If then the values deduced from each control point for the altitude of the station should not be in agreement, the first approximate values used for this determination will be corrected by means of a differential equation based on its actual measured differences. In cases where more than three control points can be used, it is recommended to select those most distant for the determination of tilt and orientation, and those nearest for obtaining the horizontal projection of the station. Again, points situated relatively near each other may be grouped, and the mean of the results furnished by the group may be used as if coming from a single point. Photographs containing common points may also be used in this manner provided agreement between their results is assured through the solution of simultaneous differential equations. The errors then entering are generally sufficiently small to allow relatively easy calculation, yielding valuable results.

. . . .

On this same East coast of Labrador, but a little farther south, in the vicinity of Nain, a hydrographic survey was undertaken in 1932 by the British Admiralty surveying vessel *Challenger*.

More recently, in Spring 1935, Mr. E. P. WHEELER of the Cornell University crossed the Labrador peninsula, starting from Tsiuyarsuakh Bay south of Nain, following the course of Whale River to Ungava Bay, then returning to Saglek Bay on the Atlantic Coast. Astronomical observations by the author of this journey led him to the conclusion that there existed an important displacement of Whale River towards the west when referred to the position indicated on Canadian charts (about 17 miles towards the S., 56 W. near the mouth).

(See *Geographical Review*, July 1938, pp. 475-481).

P. V.

TABLES FOR CALCULATING THE SPECIFIC VOLUME OF SEA-WATER UNDER PRESSURE

by

DONALD J. MATTHEWS.

(Published by the *Conseil Permanent International pour l'Exploration de la Mer*, Charlottenlund Slot, Denmark: sold by Andr. Fred. HOST & Fils, Copenhagen. Price Kr. 5.00).

On the gram-millilitre system the density of pure water at 4°C under atmospheric pressure is equal to 1.000000.

Where s is the specific gravity it is usual to give the value of the expression $1000\ (s - 1)$; this expression is denoted by the Greek letter σ.

$\sigma = 1000\ (s - 1)$, at any pressure.

In the same way,

$\sigma_0 = 1000\ (s_0 - 1)$ where s_0 is the specific gravity at 0°C under atmospheric pressure.

$\sigma_0 = 1000\ (s_t - 1)$, where s_t is the specific gravity at t°C under atmospheric pressure.

At 0°C $\sigma_0 = \sigma_t$.