HYDROGRAPHIC BIBLIOGRAPHY

RESULTATER AF VANDSTANDS-OBSERVATIONER PAA DEN NORSKE KYST.

(Results of Tidal Observations on the coast of Norway)
Part VI., in 8vo., 60 pages with 2 plates and chartlet.
Compiled by PROFESSOT GEELMUYDEN

Issued by the Norske Gradmaalings-Kommission.
W. C. FABRITIUS & SONNER A/S, Oslo (Kristiania), 1904.

The Chief of the Norges Sjokartverk, in forwarding the above-mentioned Norwegian work, which contains the results of the calculations of tides for different stations on the Norwegian coasts from Oslo (Kristiania) to Vardo, by the method of Harmonic Analysis, asks the Bureau to correct the information given, with regard to Norway, page 47, volume II, N° 1, of the HYDROGRAPHIC REVIEW (November 1924), upon the subject of the use of Harmonic Analysis of Tides, under paragraphs I and II.

In fact, the method of Harmonic Analysis was employed in Norway until the year 1904; after this date, however, its use was temporarily abandoned until 1925. From the latter date onwards, harmonic analysis has been re-introduced and full use is now made of the process.

THE PORTABLE AUTOMATIC TIDE-GAUGE

OF THE U. S. COAST AND GEODETIC SURVEY.

C. AND G. S. SPECIAL PUBLICATION N° 113.

by

Commander G. T. RUDE, *Chief of the Tides and Currents Section.*

Very varying types of automatic Tide-gauges have been made since the first (Fig. 1) was invented about 1831 by the British Civil Engineer H. P. PALMER.

In general the instruments consist of a float connected by a wire or a tape to a pen or pencil which draws a curve on a diagram. In another type the height of the water is recorded directly onto a sheet of paper at regular intervals of time, but this system was found to be less satisfactory in Hydrography.

The portable automatic tide-gauge constructed by the Coast and Geodetic Survey is intended for use in obtaining tidal observations during short periods. It is easy to transport, its working and handling is simple and it records continuously without any special attention being required.

It is specially adapted for field use, and may be carried in its case. A metallic cover, thickly varnished, protects the mechanism.

Figure 2 shows the upper part of the instrument with its cover on. Figure 3 shows the same portion but with the cover off.

RECORDING SYSTEM.

"The cylinder (*A.* fig. 3) on which the paper for the record is wound, is 7 inches in length and about 6 inches in diameter. The cylinder is geared to an eight day clock movement carried within the cylinder so as to rotate once in 48 hours, giving a fixed time-scale of 4/10 inch to the

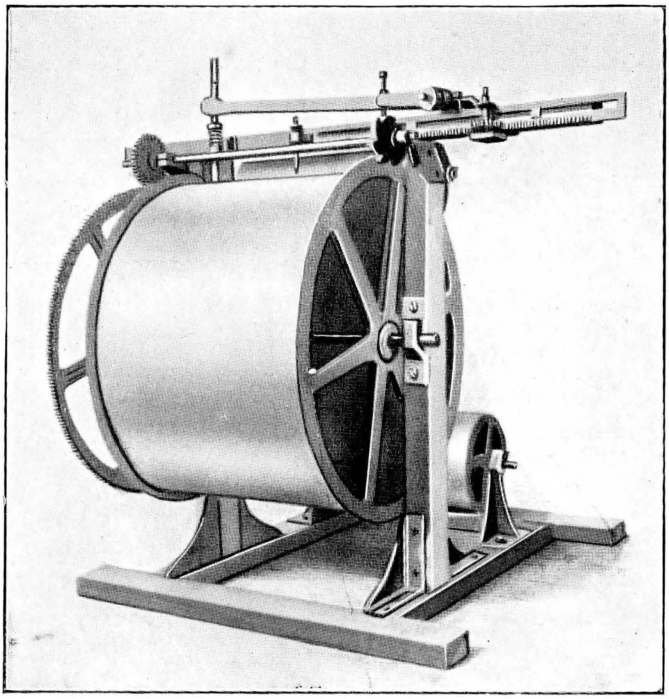


Fig. 1

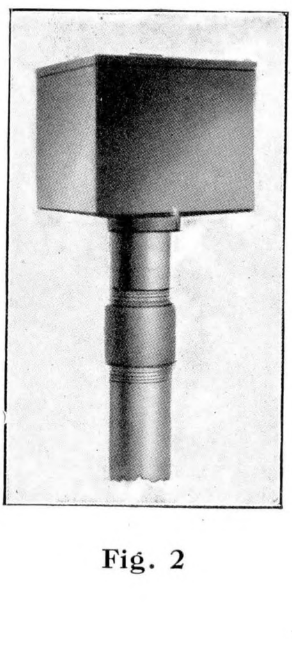


Fig. 2

hour. This cylinder rotates in such a direction that the top of the cylinder moves toward the stylus screw (*F*, fig. 3). In order to set the stylus accurately to the nearest minute, the stylus tangent screw (*W*, fig. 8) is used."

The same paper may be used for a whole week, for during each revolution of the cylinder the tidal curve advances sufficiently to avoid coincidence. The clock is regulated by means of a rachet.

FLOAT.

"The float (fig. 4) is a hollow brass cylinder 3 1/4 inches in diameter, and 15 inches long. Floating on the surface of the water in a pipe, it rises and falls with the tide, and communicates this motion to the mechanism of the gauge by means of a phosphor-bronze wire 0.012 inch in diameter. This float is weighted with shot to float with its upper end about 3 ½ inches above the surface of sea water and about one-half inch above the surface of kerosene oil, the oil being used in winter to prevent freezing of water in the float well. The weight of the float and shot is sufficient to wind the counterpoise spring on a falling tide and at the same time to actuate the recording stylus."

The float-pipe (fig. 5) consists of one or more pieces of galvanized iron tubing connected by sleeves. Water enters through a grating to the inlet coupling shown in figure 6.

TRANSMISSION.

The bronze wire is coiled round a grooved drum (*K*, fig. 3) 12 inches in diameter. "A train of three gears (*G*, *H*, *G*, fig. 3) connects the axle on which the float wire drum is mounted to the stylus screw. These gears determine the height scale for the operation of the gauge. The middle gear (*H*, fig. 3) is an idler which is used on the gauge for all scale ratios. The other two (*G*, *G*, fig. 3) are removable and, with several separate gears furnished with the gauge, provide for five different height scales, as follows :

SCALE	Maximum range of tide	NUMBER OF TEETH	
		Gear attached to float pulley axle.	Gear attached to stylus screw.
1:11 1/4	6	96	36
1:16 7/8	9 1/2	96	54
1:22 1/2	12	96	72
1:30	17	72	72
1:40	25	64	96

The counterpoise spring is coiled within the case of the float wire drum. It is controlled by a spring 18 feet long, 0.25 inch wide and 0.1 inch thick. The ratchet (*S. T.* fig. 7) permits the tension of the spring to be adjusted and also its position, to correspond to the amplitude of the movement of the tide, so that there will be no stoppage at the end of its travel. In practise the middle position is made to correspond with mean level.

The recording pen moves back and forth along the threaded member with the movement of the tide. This member is made of phosphor-bronze and its diameter is 0.433 inch. It is threaded throughout its length with a square thread the pitch of which is 0.4 inch and its depth is 0.04 inch. The ends are carried by ball-bearings. The carriage (*P*, fig.3) carries the recording stylus, which is composed of a glass siphon chronograph pen. The milled-head nut (*R*, fig. 3) allows the unclamping of the screw for regulating the height of the pen on the diagram, to the exact reading of any instant on the tide staff. Figure 8 indicates details of the pen carriage.

RECORD PAPER.

The use of cross-section paper, 7×19.7 inches, of five different scales, corresponding to the scales of the tidal graphs, allows for the accomodation to scales of ranges of tide from 0 to 25 feet.

In order to centralise the tide curve on the diagram the auxiliary tide staff is used as before. A rubber stamp is carried by the observer, on which the hour of the visit and the height on the record cylinder are inscribed, and the position of the stylus on the marigram is also indicated.

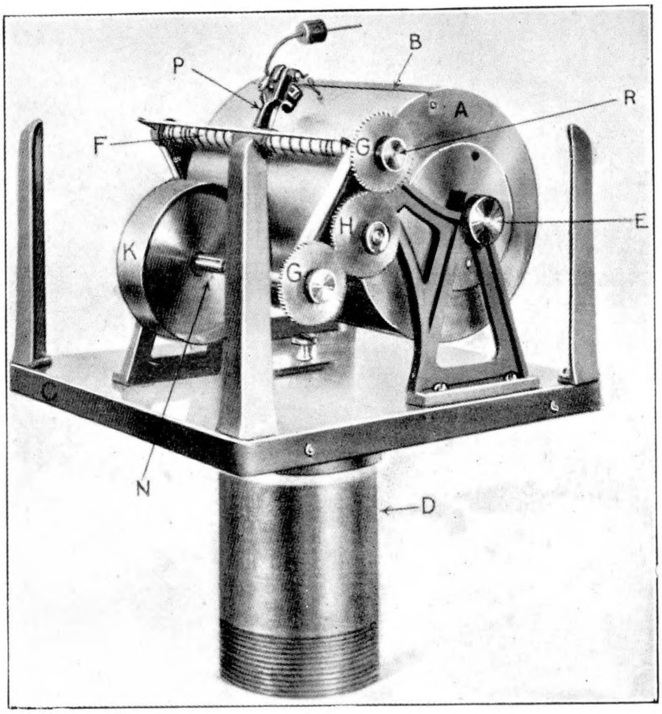


Fig. 3

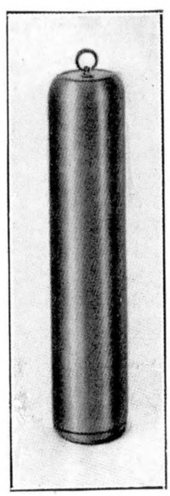


Fig. 4

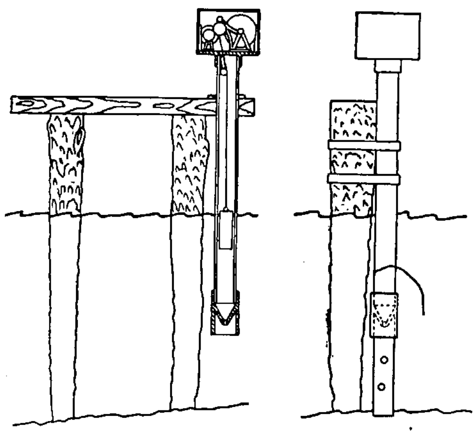


Fig. 5

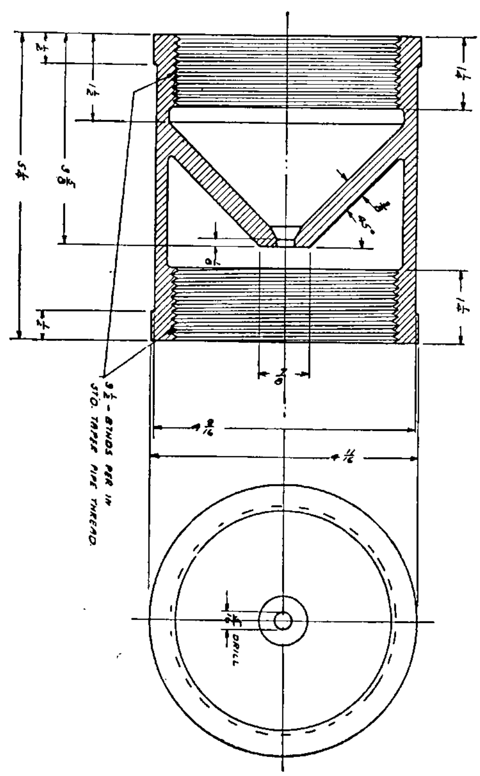


Fig. 6

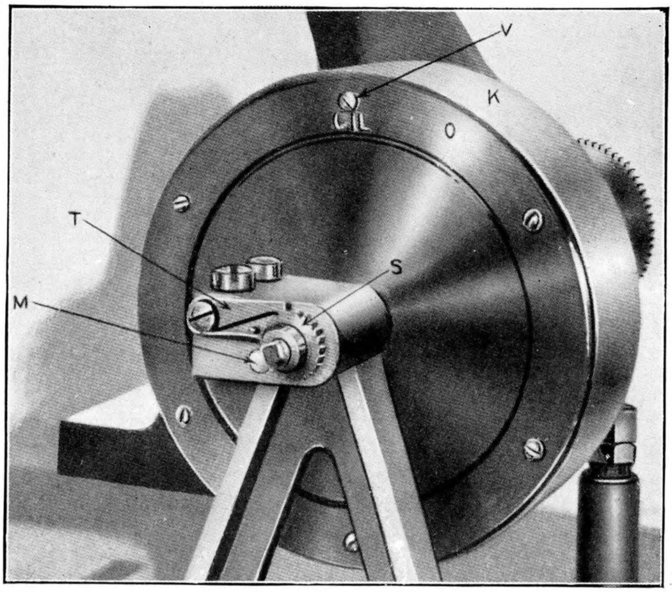


Fig. 7

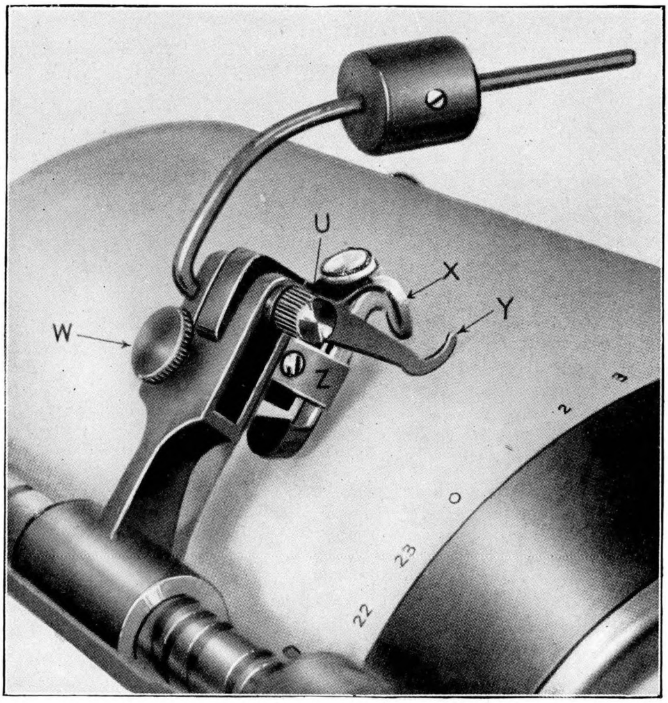


Fig. 8

THE NEW EDITIONS OF THE CATALOGUES OF SWEDISH AND NETHERLANDS CHARTS

by

DIRECTOR J. M. PHAFF.

There is no question but that the Hydrographic Publications which, first and foremost, should be issued in such a form that the non-polyglot seaman may be enabled to understand them easily, are Charts and the Catalogues thereof.

As to Charts, increasing efforts have been made to find standardised symbols and simple and systematic abbreviations collated in the form of a table which gives the equivalents in various languages; thus the seaman who knows but one of these languages can understand a foreign chart. But, for the Catalogues of Charts which give information which can only partially be imparted by symbols, a certain acquaintance with the language of the country which publishes them is indispensable.

Taking into account the fact that the knowledge of Swedish is not very widespread throughout the world and it being admitted that the greater number of seamen who use Charts and Catalogues has some know ledge, even if superficial, of English, the Swedish Hydrographic Office was the first to insert, in its Catalogue for 1925, an English text alongside of the Swedish text for those parts where most required, *i. e.* for general information and for the headings of columns. There are added, also, an index of Sailing Directions, a concise list of signs and abbreviations and two specimen charts showing the simplification due to progressive reduction of scale.

The Netherlands Hydrographic Office followed this good example. The headings of columns are not inserted in English but, in addition to an English Introduction, a brief glossary of the most frequently used words will be found in Dutch, Malay and English and this may be used also for translating the headings of columns.

The list of provisional plans in the Malay Archipelago has been suppressed, the publications of the I. H. B. have been inserted and the scale of the Index chart of the Malay Archipelago has been doubled (1:3,750,000) thus making it more legible.

CURRENT OBSERVATIONS MADE BY MEANS OF A SELF-REGISTERING TIDE GAUGE

SUMMARY OF AN ARTICLE IN "*Marineblad*" OF SEPTEMBER 15th 1924,
by
CAPTAIN J. J. DE VRIES,
R. Netherlands Navy, (Retired).

The observations were made in the HELSDEUR, the TEXEL, in May 1922 and the current was registered automatically and without interruption by means of a portable self-registering tide gauge, established in a spherical mine which floated at slack water 2 m. below N. A. P. (2.5 m. below high water level and 1.2 m. below low water level) and was moored in a depth of 17 m. abreast of the permanent tide gauge.

The mine, and the instrument it contained, sank below this level as soon as the current set in, and sank deeper as the current became stronger, this increment of immersion being automatically registered by the floating tide gauge. The relation between this increment of immersion and the velocity of the current was established beforehand, so that the former could be converted into the latter. The first and by far the most important correction to be applied to the observations was that for the height of the tide which was specially observed at the permanent gauge in the vicinity and which was applied directly; the other corrections were due to the difference of pressure of the atmosphere and to the difference of temperature of the sea-water, and these were established empirically. After application of these three corrections, a diagram, indicating the actual depth of the instrument under the surface of the water due to the current, was obtained.

The consecutive velocities of the current, computed in this way from the observations of the floating self-registering tide gauge, were represented by a curve which has been analysed by harmonic analysis, exactly in the same way as is done for the tide. Observations, made during a period of 15 consecutive days in May 1922, were chosen for the computation of the current constants; during these days the tide, barometer and temperature of the air and of the sea water were observed and direct observations of the velocity of the current with JACOBSEN'S current meter at the beginning and at the end of the period were also recorded.

The various elaborations, laid down in diagrams I - IV, have given a satisfactory result.

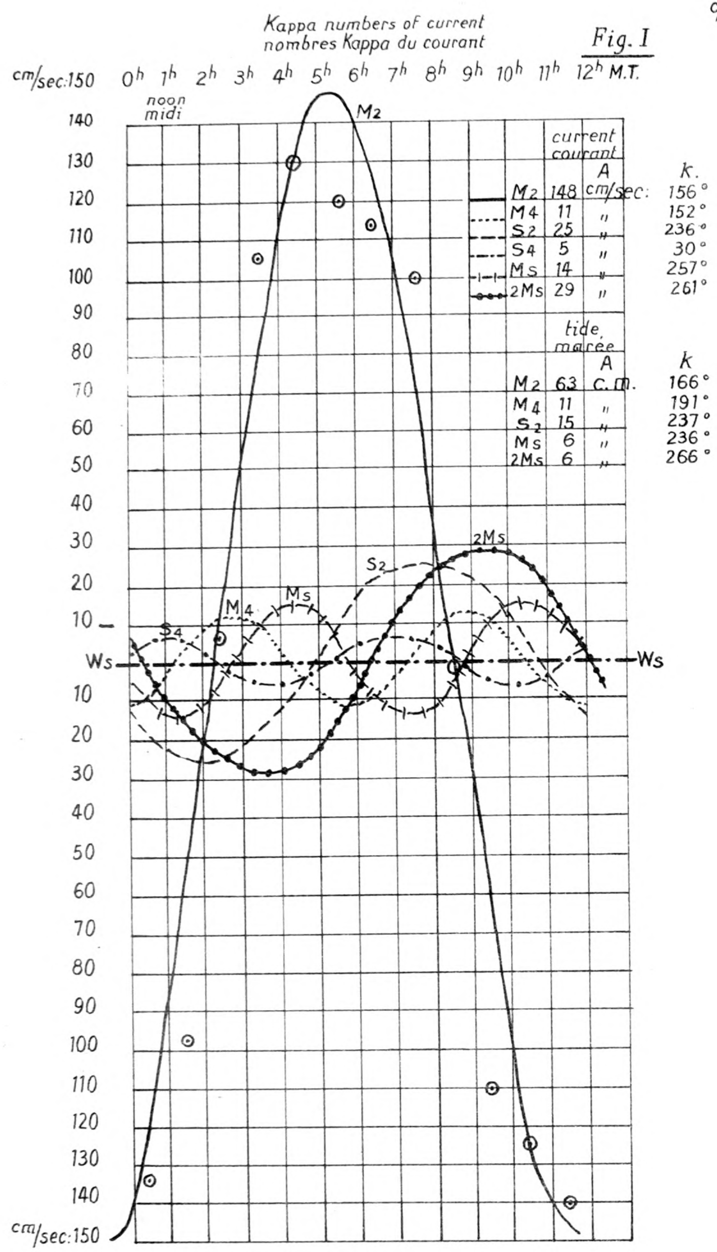
Diagram I respresents a complete revolution of the constituents M_2, S_2, and $2MS$ and a double revolution of M_4, S_4, and MS of the current ; 0^h corresponds with noon and the velocities are given in cm/sec. The upper part of the diagram gives the positive (Eastern) current, the lower part the negative (Western) current. The constants of the diurnal constituents of the tide and of the current could not be deduced from the observations and those of MS and $2MS$ are approximate only.

The mean value of all the observations (W_c for the current, in accordance with W for the tide) is 9 cm/sec., which points to an excess of current to the West and would indicate a permanent current to seaward if the profile of the channel were constant, which it is not. Taking into account the variable profile of the estuary, caused by the tide, this excess of Westerly current proves to be possible without a permanent current which sets to seaward.

The kappa numbers of the principal constituents of the tide and of the current are about the same, which means that the strongest current to the East occurs at high water, and to the West at low water and, since the profile of the channel is smaller at low water than at high water, the velocity of the current to the West *must* be greater than that to the East, in order that the same quantity of water should flow in and out.

Diagram II gives a normal type of current and tide and shows both the phenomena observed on May 18th 1922. The curve of the tide appears to be normal because Table IV shows no variation in the daily mean sea level of HELDER and hardy any in the level of DEN OEVER (13 nautical miles up the estuary), while both values almost coincide with that of the general mean at the two places *i. e.* respectively 15 cm. and 9 cm. N. A. P.

W - W' is the line of mean sea level to which that of the current W_c - W'_c is made to correspond ; the line of slack water lies 9 cm. above it and the point of intersection of the current curve and the latter line gives the time of turning of the current.


Kappa numbers of current
nombres Kappa du courant
Fig. I
noon midi
M.T.
current courant
A cm/sec.
k.
M2 148 156°
M4 11 152°
S2 25 236°
S4 5 30°
Ms 14 257°
2Ms 29 261°
tide marée
A c.m.
k
M2 63 166°
M4 11 191°
S2 15 237°
Ms 6 236°
2Ms 6 266°
Ws
cm/sec:150

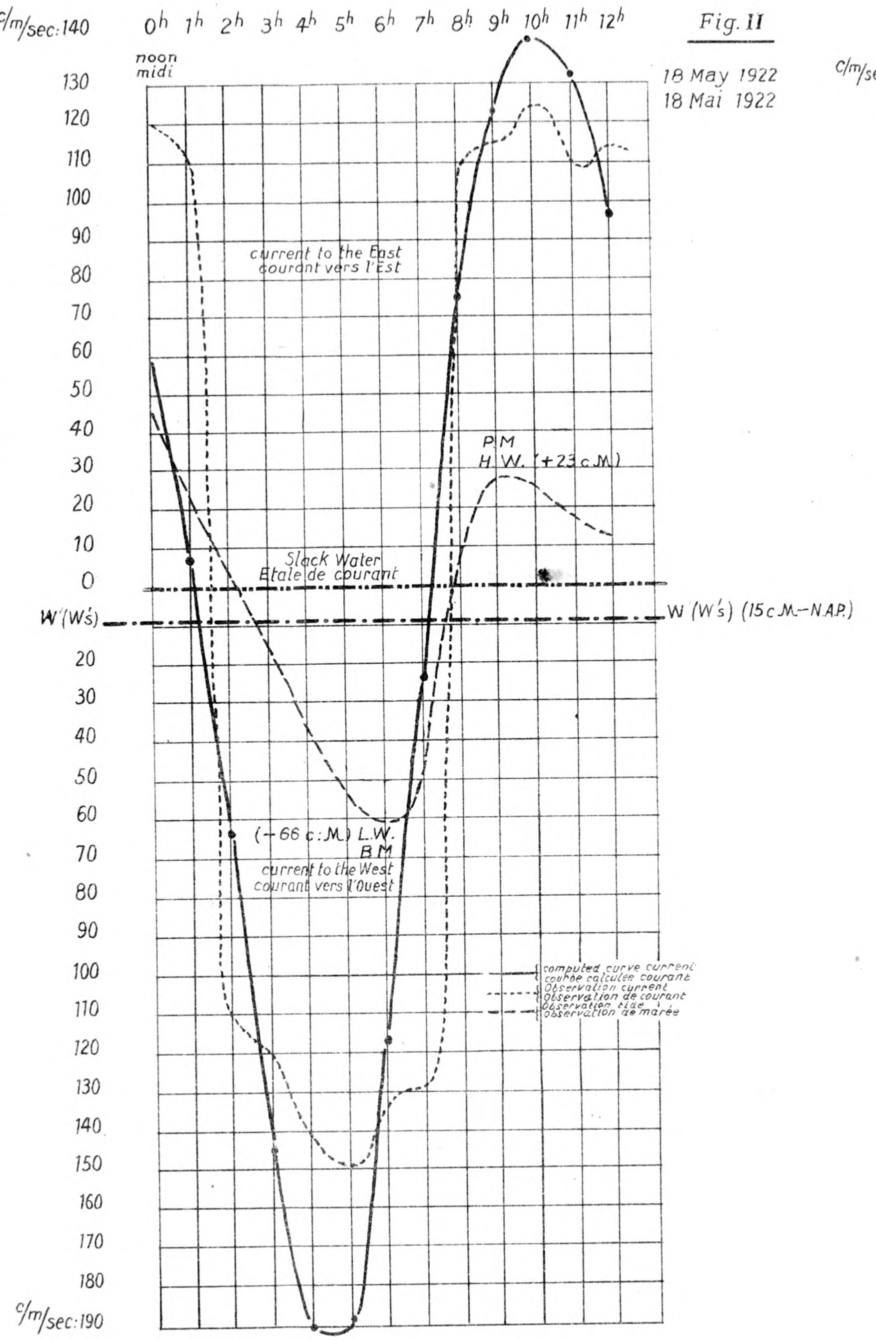
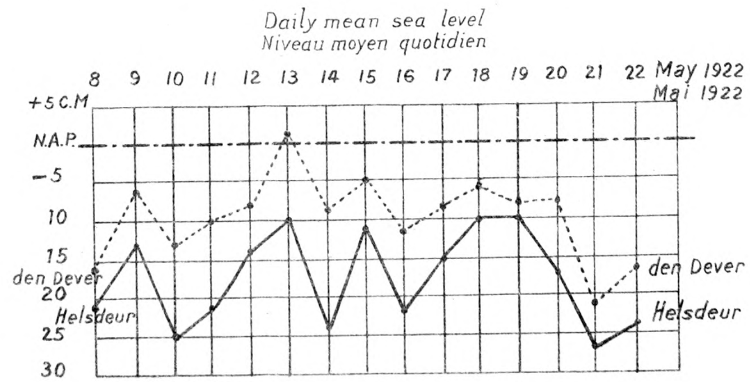
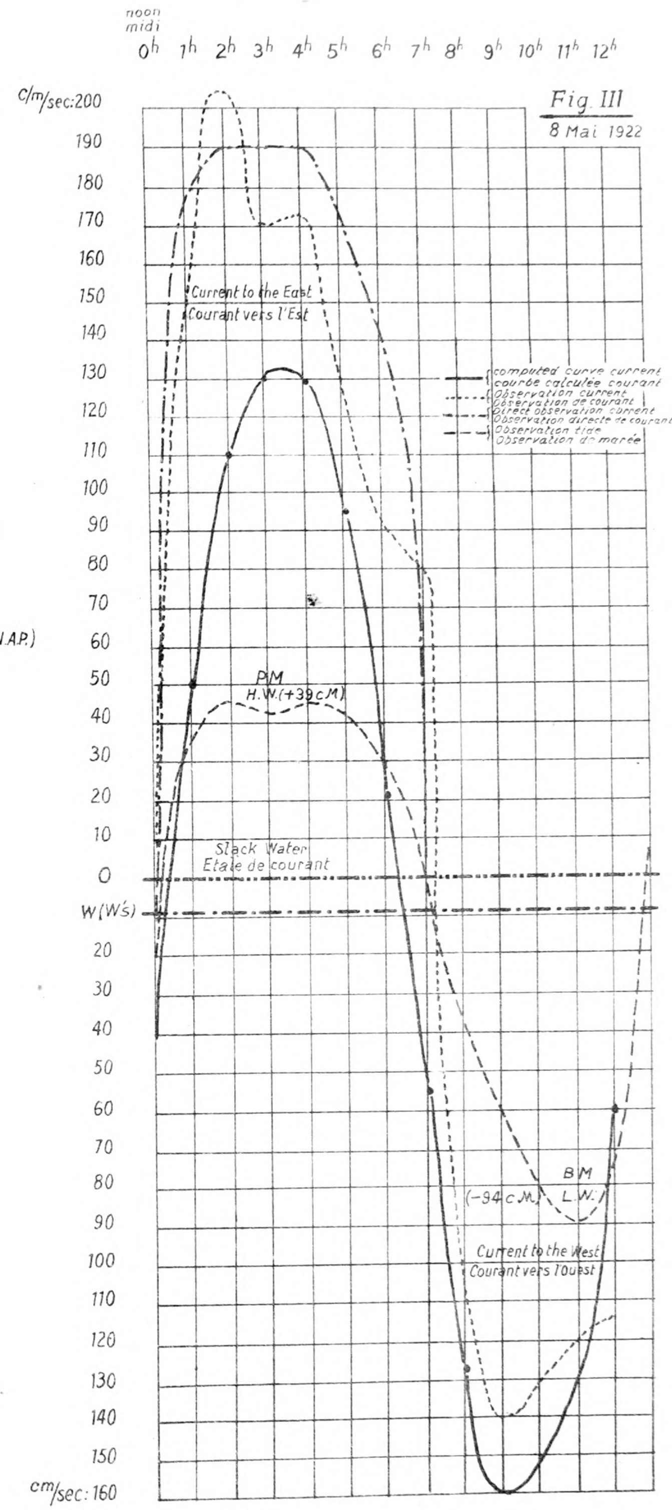


Fig. II
18 May 1922
18 Mai 1922
noon midi
c/m/sec:140
current to the East
courant vers l'Est
P.M
H.W. (+23 c.M.)
Slack Water
Etale de courant
W'(W's)
W (W's) (15 c.M.–N.A.P.)
(–66 c.M.) L.W.
B.M
current to the West
courant vers l'Ouest
computed curve current
courbe calculée courant
Observation current
Observation de courant
Observation tide
Observation de marée
c/m/sec:190


Daily mean sea level
Niveau moyen quotidien
May 1922
Mai 1922
+5 C.M.
N.A.P.
den Dever
Helsdeur


noon midi
c/m/sec:200
Fig. III
8 Mai 1922
Current to the East
Courant vers l'Est
computed curve current
courbe calculée courant
Observation current
Observation de courant
Direct observation current
Observation directe de courant
Observation tide
Observation de marée
P.M
H.W.(+39 c.M.)
Slack Water
Etale de courant
W(W's)
B.M
(–94 c.M.) L.W.
Current to the West
Courant vers l'ouest
cm/sec:160

The conclusions which can be drawn from this diagram are that in normal conditions :

a) The Westerly current reaches a higher velocity than that to the East.

b) The mean of the profile of the Estuary during the period of this stronger current is smaller than that during the weaker current in the opposite direction.

Diagram III gives an abnormal type of current and tide.

The curves represent those for May 8th 1922; besides which the velocity of the current, obtained directly by JACOBSEN'S current meter, is given as a check. Comparing the latter with the curve of the current deduced from the observations with the floating tide gauge, one should take into account that the tide gauge gives the current at depths ranging from 2 to 5 m., according to the immersion of the mine, while JACOBSEN' current meter gives the same at a constant depth of 2.5 m. The two curves agree as long as the velocity is not great (small immersion), but they disagree as soon as the velocity is great (considerable immersion), which fact points to diminishing velocity as the depth increases. This is generally observed everywhere, although not necessarily in the same proportion.

The results of the observations may be said to give a fair mean value for the current at a depth of 3.5 m. in HELSDEUR, which depth appears to be appropriate to establish the character of the current.

Diagram IV gives the daily mean sea levels (*) for HELSDEUR and DEN OEVER. It shows the daily variations of this level and, merely on account of this reason, it can already be said that the current is constantly varying and oscillating on either side of a mean value. This diagram allows a day to be chosen in which the current will probably agree more or less with this mean value.

Diagrams I - IV give rise to the following remarks:

(a) The phases of the tide and of the current agree fairly well;

(b) Slack water of the current is observed at about the time the tide reaches mean sea level;

(c) The maximum of the current almost coincides with high and with low water;

(*) Daily mean sea level is the mean of the 24 (48) observations made at a self-registering tide gauge at every full (half) hour; under normal atmospheric conditions a mean of 15 days agrees already fairly well with a yearly mean.

(*d*) Under normal conditions (diagram II), the maximum of the computed current considerably exceeds that of the observed current, which is explained by the fact that the diagram of the latter is so much broader, this broad form being caused by the change in the profile of the channel.

In calculating the constants of the principal constituents of the current, the difference pointed out causes an exaggerated value for the maximum velocity and, in order to show this graphically, the hourly values which formed the data for the calculations of the velocity of the M_2 current are marked ⊙ in diagram I. These show at once that the maximum velocity, deduced from the curve, is too great.

(*e*) Under abnormal conditions (diagram III) the general agreement between current and tide continues to subsist (reference to *b* and *c*), although the coincidence is no longer reached. The interval of time, however, between the two phenomena is not considerable, but the calculated maximum velocity differs considerably from the observed.

A consequent correction for these differences is found in the changes of daily mean sea level.

(*f*) These observations show, — and for curiosity's sake it is mentioned here —, that in the HELSDEUR the current reaches its maximum at high water and at low water, while slack water almost coincides with half tide, exactly as this occurs in the open sea.

PHOTO-MECHANICAL PROCESSES OF MAP PRODUCTION

by

Lieut. Col. J. E. E. Craster, of the Ordnance Survey.

Cf. "*The Geographical Review*", Vol. LXV, N° 4, London, April 1925, (pp. 301-314).

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In the following article Lieut. Col. J. E. E. Craster, of the Ordnance Survey, reviews the photo-mechanical processes of map-production which are employed for topographic charts in the Printing Section at Southampton.

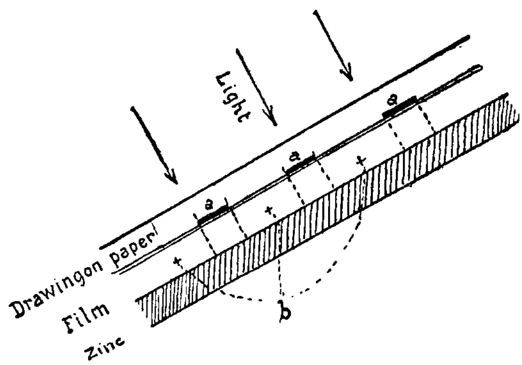
This Service, famed for the production of engraved charts of perfect finish, has however definitely abandoned engraving in favour of the photo-mechanical methods which have attained a high degree of improvement and which are as good as the one which, for reasons of economy and preservation of plates, is obtained by the transfer to zinc of plates engraved on copper.

After having recalled the general principle of all printing processes involving the use of zinc (or aluminium) plates, *i. e.* the affinity which metal has for fatty substances and, on the contrary, the repulsion of fatty substances for surfaces which have been made spongy and hygroscopic, the author describes successively :

the Vandyke Process,
the Helio Process, and
Photo Etching.

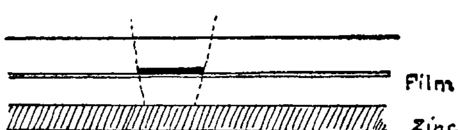
In the *Vandyke Process,* invented by the Geographical Survey of British India, a grained zinc printing plate is coated with a film of fish glue and ammonium bichromate (*) which is sensitive to light. This film is insoluble in water after it has been exposed to light (*b*, fig. 1).

The drawing to be reproduced is laid face downwards in a frame on the film (fig. 1) and exposed to parallel rays of light (such as diffused rays of daylight or those of electric lamps with parabolic reflectors). The parts hidden by the opaque lines remain soluble in water. After exposure, the plate is washed with water, uncovering the zinc surface. The plate is then covered with greasy ink which adheres to the zinc where it is exposed (fig. 2). The insoluble film of glue is disposed of by washing the plate with a diluted solution of sulphuric acid, which does not affect the inked parts. The details of the map appear in greasy ink on the zinc surface, and the plate is then ready for the printer.



(Fig. 1.) Section

(Fig. 2.)



(Fig. 3)

This process gives copies on the same scale as the original.

There is always a slight diffusion of light sideways through the film (fig. 3) which tends to reduce the thickness of the lines on the plate, and, as a result, very fine hair lines often fail to appear. They are nearly always weak and broken. This effect of diffusion can be diminished by using parallel beams of light, and uniformly illuminating the whole of the map by placing reflectors on both sides at the same time.

(*) See in *Les Reproductions Photo-mécaniques Monochromes* (*Monochrome Photo-Mechanic Reproductions*) by L. P. CLERC, Gaston Doin, Editor, Paris, 1925, page 242, a discussion of the best proportions of glue and bichromate.

The *Helio Process* allows for variations of scales, but a photographic camera with a suitable lens, free from any appreciable distortion, must be used.

The lens used at Southampton is a Zeiss objective, 8 inches in diameter, with a focal distance of 70 inches. Its value is about £ 3000. The design to be photographed, as well as the apparatus, must be placed on an isolated concrete flooring in order to eliminate all vibration.

In spite of the use in industry of gelatine-bromide, wet collodion plates are used in this process because the image lies entirely on the surface of the film, while on a dry plate the image is dispersed through the whole thickness of the film, and gives a print that is soft and woolly.

The four corners of the map to be printed are marked on a ground glass screen, to reproduce the drawing at the desired scale, and the copy board and camera are moved backwards and forwards until the image is in good focus.

The length of exposure is limited by the drying of the plate. The maximum exposure is about thirty minutes, and that only if the atmosphere is very moist.

After being developed and fixed, a glass plate, of the desired scale, is obtained, being easier to preserve than the original drawing, less subject to variations, and easy to retouch. As the glass is thick it is not easily broken, and from this negative a printing plate can be made in less than an hour.

A zinc printing is obtained by sensitizing a grained zinc plate with a film of bichromated fish glue, hardened with albumen.

Then, contrary to the Vandyke Process, the zinc plate is smeared with greasy ink, washed with water and gently rubbed with cotton-wool. All the parts protected from light by the negative disappear, and the drawing remains in greasy lines on the zinc plate. Here, slight diffusion of light tends to widen the lines of the map and make them appear rather coarse.

For purposes of revision, the Helio Process offers great advantages over any other, since revision can be carried out on the existing negative by simply painting over any obsolete detail with lamp black. New details can be cut on the negative film with a fine steel needle, and when corrections are completed, a new zinc printing plate can be made from it in the usual way.

In favour of the aluminium process it is saids for many reasons, that aluminium is a better substratum for printing because it eliminates almost entirely the tendancy to scum, and, in the course of printing it lessens the tendancy to thickness which is found objectionable in the Helio

Process. The opinion of the Ordance Survey is, however, that the grain does not stand so long, that the plates are inclined to take a polish in the machine, and that instead of remaining soft, like zinc plates, the aluminium plates, by their elasticity, form a sort of spring in the machine and once bent, are almost impossible to straighten out.

In the *Photo Etching Process* a positive is made under which a thin copper (or zinc) plate, covered with a film of bichromated fish glue, is exposed. After washing, the lines of the map appear as metallic copper.

The plates are then baked in an oven in order to turn the fish glue into a sort of enamel (enamelling process).

After baking the plate is etched with perchloride of iron, which eats away the metallic copper. The enamel is then removed with caustic potash.

A copper printing plate on which the lines of the drawing are cut in is thus obtained, but the lines must be intensified (*), and the deepening done by hand.

To print, it is first necessary to obtain a transfer to a zinc plate from the copper plate, by using a sheet of paper, This causes distortion. As the whole process is long and expensive, its use in rapid printing is limited.

Colonel CRASTER then gave a summary of the process used by the Ordnance Survey for obtaining coloured charts and to ensure the accurate registration of colours.

The advantages of the offset printing method are shown. In this case, in an offset printing machine a rubber-coated cylinder is interposed between the zinc plate and the paper, and the impression obtained from the zinc on the rubber cylinder is transferred from the rubber cylinder to paper. The zinc plates last much longer with this method because the rubber wears the surface of the plate much less than the paper. The impression is finer and more uniform, the output per hour of the offset rotary machine is about double, and one good zinc plate should give about 10,000 copies.

As this method demands the "turning" of the drawing, the Vandyke process can not be used as it gives plates which read from left to right, the east margin being to the left. The photo etching method however, can be applied, but if, on the contrary, a flat-bed machine is used, a prism must be fixed in front of the lens.

It is recommended that the following details be observed:

(*) For details see book mentioned pages 241 to 264.

1) The use, for the drawing, of hand-made paper which is "isotropic", permitting the correction of expansion or contraction either by drying or damping it, and, in any event with the camera(*), allowing corrections which are not possible in machine-made paper, which expands or contracts according to the atmosphere.

2) Drawings made on tracing paper photograph badly because the tracing paper is not pure white, therefore the film on the negative is not a dense black. The oil or resin used to render the paper transparent causes this opaqueness.

3) The Ordnance Survey has found that India ink can be rendered opaque by mixing it with cadmium-orange in order to avoid gray lines.

4) To prevent the lines from being drawn too close to one another, it has been found that they should never be less than their own width apart, and a light and open faced type should be used.

5) When drawing for reproduction by the helio process, it is advisable to: (1) — make the drawings on a larger scale (*e. g.* twice the scale), which intensifies the illumination of the plate; (2) — use very black lines drawn on very white paper; (3) — use as brilliant a light as possible, daylight in preference to artificial light.

(*) For example, the Roussilhe method of rectification of distortion of air photographs based on the optical principle described by an Austrian, Captain SCHEIMPFLUG, and which consists with certain modifications, of focussing a drawing upon a screen not parallel to the drawing.

DIEPTELOODINGEN IN DEN INDISCHEN ARCHIPEL.

(PUBLICATION N° 17. DEEP SEA SOUNDINGS IN THE E. I. ARCHIPELAGO).

Koninklyk Meteorologish en Magnetisch Observatorium te Batavia.

VERHANDELING N° 17.

Deep sea soundings in the Indian Ocean, South of Java, up to the parallel of 12° S. and between the meridians of 104° and 116° E., have been made by 4 submarines of the Netherlands Navy and their mother ship "Pelikaan". The submarines were too lively for soundings to be taken when navigating on the surface, so the observations were made with the receiver hanging at a depth of 10 m. under the hull, or on the vessel submerged at 12 to 30 metres ; at the latter depth the swell was still noticeable. Favourable astronomical observations constantly gave a trustworthy position.

Over 200 soundings show that the S. Coast of Java, eastward of the meridian of 106° E., dips to a trench which is over 3000 metres deep. The narrow north western point of this trench approaches the S. Coast of Java, West of Wynkoops baai, within 15 miles ; to the east, it becomes gradually wider, the distance from the coast increases, and, south of the Straits of Bali, the depth increases to over 4000 m. West of the meridian of 106°, the sea bottom continues its gradual slope to a depth of over 6000 m. ; east of this meridian it rises gradually, south of the trench, to a ridge, the highest part of which has a depth over it of 1200 m., and is found between the meridians of 110° and 112°. South of this ridge, and at the end of the sloping bottom SW. of Wynkoops baai, a trench with a depth of over 6000 m. is found, which is widest east of Christmas island and very narrow between the meridians of 112° and

113° ; the deepest part, with far over 7000 m., is found between the meridians of about 107°.5 and 111°.5 E. and also at about longitude 113°.5 E.

The northern slope of this trench is remarkably steep, about 1 in 6, over a length of about 11 miles. South of the trench, the depths decrease more or less gradually, except on the meridian of about 110e E., where the rise of the sea bottom is steep. Round Christmas Island the sea bottom falls most steeply on the east coast.

Except for one single sounding, these agree very well with the soundings of the "Planet" which, first of all, called attention to the deep trench.

The soundings have not been made with a sonic depth finder, but by measuring with watches the time which elapsed between the emission of the sound and its echo. As a rule, the observations were repeated about half a dozen times, and sometimes the reflected echo gave a check The accuracy of the time could therefore be estimated within 0.1 second which means an error of 150 m. in the depth given ; but even if the variations of the real time were greater, the accuracy of the sounding would be sufficient, even for scientific work, in a region where the sea bottom is so very uneven, and the sounding lines cross the ridges and trenches nearly at right angles, so that a maximum of information is gathered.

These soundings are not only valuable for the Oceanographer, but they are also of interest to the seismologist, the geologist and the geophysical student. In this part of the world, earthquakes are frequent, which proves that the process of rise and fall and cracking of the surface of the earth is continuously going on and the location of the centre of earthquakes, which are, as a rule, weak places in the terrestrial crust is very important. Many earthquakes have been located not far from the Wynkoops baai in a SW. direction, and the deep pit in the sea bottom of over 3000 m. with very steep slopes so near this shore may account for the phenomenon.

MODERN HARBOURS, CONSERVANCY & OPERATIONS

by Commander E. C. SHANKLAND, R. N. R.

(*Chief Harbour Master & River Superintendent of the Port of London*).

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"Modern Harbours" fills a real gap in technical seafaring literature, for it describes coastal and harbour pilotage and port facilities from the moment the ship gets into touch with a coastal radio station until she has entered the harbour and is again outward-bound. It forms a connecting link between the work of the harbour engineer and that of the port authorities in handling merchant marine traffic. It is, as it claims to be, "a work of descriptive and technical reference", for it is a compendium of up-to-date information on coast pilotage, harbour engineering, hydrography, hydrology, seamanship, coastal and port signalling, salvage, insurance, harbour regulations, port facilities, safety precautions, meteorology, docking and berthing, and the general question of harbour conservancy. We are made aware by the Author of the recent developments in radio; in direction finding; fixes by radio compass; broadcasted notices to mariners; storm warnings; radio telephony from lightships, lighthouses and shore stations; sound-ranging for preventing collisions at sea, radio beam transmission; echo sounding; echo detection; submarine signalling; time signals and leader cables.

As the author says: "The functions of a ship may be said to consists of (1) overseas navigation, (2) coastal and inland navigation, (3) harbourage, (4) docking, (5) to lie afloat for discharge and/or (6) loading of cargo, and (7) dry-docking for over haul and/or repairs to hull. Of these seven functions, five are within the jurisdiction of a port, its Board, Commission, or Authority."

At the present moment, the great increase in displacement, draught and speed call for a revision of the hydrographic safeguards to navigation and improvements in port facilities, and we may confidently look forward to several International Conferences to bring about these results, especially in the matter of greater uniformity.

The Author says " Modern harbours of the British Empire and of other countries do not differ in detail to any great extent; they are, on the contrary, similar to a marked degree ". The reviewer cannot agree with this statement as he has carefully perused most of the Sailing Directions of the world, and is, at present, engaged in tabulating all the data contained therein relating to Buoyage and Buoy Lighting, Storm Warning, and Coastal and Port Signals, for use in international conferences, as showing the appalling lack of uniformity in aids to navigation. As an illustration, the Buoyage of the British Isles is under three different Services, *viz.* Trinity House Corporation, the Northern Lighthouse Board and the Commissioners of Irish Lights. Under Trinity House juridiction alone there are three hundred local Lighthouse Authorities in England and Wales regulating upwards of a thousand buoys and beacons. These Local Authorities may change at will the colour of the channel buoys, as the rules governing the British Buoyage System prescribe only that the starboard hand buoys, on entering, shall be conical, and port hand buoys flat topped or can shaped. Nearly every port in the British Isles has a different system of port signals, traffic signals, docking and berthing signals, tidal signals, and nearly every lighthouse and light-ship has a different system of danger, warning and lifesaving signals.

The ports of the world are " similar to a marked degree " only in that they have an entrance channel, anchorage ground, berthing and docking facilities, a signal station, a pilot boat, a quarantine station, a custom house and a harbour master's office, but in other respects they are comparable to the Tower of Babel. There is so much that is beyond critisism in this book that one may take slight exception to some of the conclusions without diminishing its value. For instance, just as the gyro compass has not really done away with the magnetic compass, which is still required as a check, so are visual signs still a necessary check on radio and other new aids to navigation. The Author's enumeration of the advantages of employing pilots gives as one argument " changes in lighting and buoyage are frequent in some harbours ", but he leaves out the most important one which is, that the insurance companies require that a pilot be taken. The ships exempted, in Great Britain, from taking pilots, under the Pilotage Act of 1913, include men-of-war, pleasure yachts, fishing vessels, certain types of ships of under 3.500 tons *etc.*, but it is just these classes of ships that need the visual marks, which are different in nearly every port of the world.

It is only natural that the Author should present the harbour master's point of view rather than that of the shipowner and ship master, since there is always a tendency on the part of port authorities, pilot organisations, and those connected with port administration to feel satisfied with local conditions, for, if they were not, they would naturally want to change them. Great diversities in the ports of the world naturally encourage the employment of pilotage, which, of course, is not the object sought and which is especially not to the interest of those who have to defray the expenses which come out of the profits of the business.

The International Hydrographic Bureau, as previously stated, is tabulating all the data on the subject of Buoyage and Buoy Lighting, Storm Warning Signals, and Coastal and Port Signals, as given in the Sailing Directions or Pilots of the coasts of the world. The Bureau is sometimes puzzled to receive some drastic corrections to the data it has tabulated, because the source from which it is taken has given incomplete data of the coasts and harbours of the world. It is obvious that the signals and signs exist solely for the benefit of the mariner, and if the source of his information is incomplete someone is seriously to blame, but not necessarily the International Hydrographic Bureau, since it has access only to the same sources of information as the seamen. Not only are many coastal and port signals, for instance, different in different countries, but they are different in different ports of the same country. As this Bureau has, as one of its missions, that of co-ordinating " the hydrographic work of these Services with a view to rendering navigation easier and safer in all the seas of the world " it feels that there should be greater uniformity in all aids to navigation including coastal and port signals, which are appallingly and quite unnecessarily different in all countries.

A. P. N.

HYDROGRAPHISCH OPNEMEN

(Hydrographic Surveying)

by

J. L. H. Luymes, *Hydrographer of the Netherlands.*

This manual is intended to be a guide for the surveyor as well as for those Officers who wish to become conversant with surveying. It contains not more than one hundred pages, and this concise form is reached by entering in detail on no other subject than construction and drawing, and by referring to formerly published manuals : on tides, the method of the least squares and chart projections. Two tables are added : one giving the length of 1' of the meridian and of the parallel, and the convergency of meridians, (lat. 0° to 10° included), and one for the reduction to the horizon of angles measured between two objects of unequal altitude.

Continuing the method adopted in the manuals quoted, the author gives nowhere hard and fast rules to which one should stick implicitly, but he gives a thorough account of each subject, which enables the student to get a clear insight of the matter and to draw his own conclusions. These accounts are illustrated by examples, taken from actual surveys made in the East Indian Archipelago.

The introduction contains a full discussion of the scale of the survey, in connection with that of the chart planned, and this discussion points out that the establishing of the scale demands great experience in surveying and a clear mathematical conception of the surveyor. Exactly in the same way as greater speed for a ship requires continually increasing quantities of fuel, a larger scale of the survey means highly increased accuracy of base-measurement, of triangulation and of sounding work.

So the result of too large a scale is a considerable amount of unnecessary work, which means loss of labour, time and money. The progress of the survey depends on the way the triangulation and the sounding work are drawn up and executed, and this way should of course be the most efficient, profitable and economical.

Chapter I discusses the various methods of measuring a base. Considering that every survey, except that which is meant to be inserted between existing surveys, requires the determination of the astronomical position of some points, the choice of these points, the accuracy of their determination and the influence of errors in this position, in the base and in the triangulation, are fully explained, and a good many examples are given.

It is further recommended to make a preliminary examination of the ground, in order to be able to draw up a plan for the triangulation, in which should be taken into account: (*a*) the disposition of the ground, and (*b*) the weather conditions which decide of the epoch in which the work should be done.

It should not be forgotten that, though the triangulation should be carried out for preference between terrestrial objects and with quadrangles or large triangles the sides of which do not differ considerably, the ship at anchor and even the ship which has no way on her, may be of frequent use as a triangulation point. Special attention is given to this expedient when working round projecting angles of various form and structure, and when the sides of the triangle opposite the ship are very unequal, of which cases several examples are given. The accuracy which can be reached in triangulating with the ship having no way on her is also stated.

The measuring of angles by instruments other than theodolites should be limited to a minimum, and angles smaller than 30° should be avoided. The calculation of coordinates of the triangulation points is made according to flat triangles and with 5 decimals only; the manual on the method of least squares indicates in which way observations are balanced out. The form of the earth is taken into account by introducing the actual length of 1' of the meridian and of the parallel, and the convergency of meridians.

Astronomical bearings are then discussed and the very ingenious way of taking such a bearing between two points which are not visible one from the other, as applied in the Straits of Makassa, is mentioned These bearings may also be connected with astronomical determination of latitude and sometimes even with that of longitude, since time signals by W./T. allow of this determination with a far greater accuracy than formerly. The triangulation should be kept up with about the same accuracy during the whole survey; it should be constantly checked by astronomical coordinates, and even by measuring a base for control. If the indications, given in the manual on the method of the least squares with a view to test the errors of the triangulation, are followed, the surveyor will have no difficulty in detecting the moment when this control is required.

The hydrographic reports should give a detailed account about the triangulation ; these should enable the Hydrographic Office to correct the scale of the survey if required, and constitute, besides, an excellent material to be studied by future surveyors.

Sounding demands a good deal of experience, routine and attention. A thorough surveyor should form a clear idea of the submarine relief while he is taking soundings, and every indication of irregularity on the sea-bottom should be investigated at once carefully. A man aloft will often be able to detect shoal patches by sight, and an aeroplane will be of great help to fill in the coast line, and sometimes to locate dangers. When running the sounding lines, these should be gone over in such a way that maximum information about the feature of the sea-bottom be gathered; the fixing of the positions of ships and boats is done by angle measurement, but boats often get in positions in which the triangulation points, and the secondary points derived from these, are no more visible. Therefore auxiliary points should be fixed in time.

On a high coast, or at a great distance from the triangulation points, good results are often reached by the simultaneous running of parallel sounding lines by the ship and the boats, the former fixing her positions by angle measurement, even from aloft, and the latter deducing theirs from the ship. Soundings in comparatively shallow water, out of sight of the land, can be made round the ship at anchor, the position of which is carried on by pushing seaward a boat and the ship alternately, and by deducing the position of the one from that of the other. Various examples of these procedures are fully described and the accuracy reached is mentioned.

As a rule, soundings are continued up to a depth of 200 metres or 100 fathoms, because the connected dangers are generally found on this part of the continental and insular shelves. Tables, founded on a great many observations, give the gradual decrease of depth, but these should be applied with the necessary circumspection. In regions where exceptionally steep pinnacles and pillar rocks are found, special attention should be paid to these, of which illustrations are given. Soundings by sweeping and by machines, including those for deep water and the accuracy reached, are discussed, but no description of the machines is given. The necessary information about the reduction of soundings is found in the manual on tides.

More or less detailed indications for fixing the coast and the topographical points, together with examples illustrating the way in which the annotations should be entered in registers, form the end part of this chapter.

The last work of the surveyor is to carry out the navigation on the coast minutely, according to the Sailing Direction he has compiled, in order to test its completeness and efficiency.

Running surveys covei a wide field, which begins at a series of bearings taken from a ship steering one course, and ends very near a regular survey. Running surveys of extensive areas have frequently been applied formerly in the East Indian Archipelago, and have given fairly satisfactory results, of which examples are given; of late, however, it is thought more economical to chart at once, accurately, the unsurveyed part of the Archipelago, now greatly reduced. The method is still frequently applied for a part of the coast, which is unimportant from a navigational point of view. The main triangulation of a similar part i carried on with the indispensable number of triangulation points, till another important part of the coast is reached, or sometimes round another way, and the running survey, including the soundings, is inserted later on between the two accurate parts. Examples of this work are given for old and more recent surveys.

The survey of a river, the accuracy of which depends on the demands, is then discussed; special attention should be given to the observations on the tide in the various seasons.

It is obvious that charts and sailing directions should be continually tested and corrected if required. The test can be made by every seaman but the correction should be left to the Hydrographic Office, to which the complete original observations should be handed over. Examples are given of valuable charts which were gradually spoilt, on account of not complying with this rule.

Construction and drawing, the last chapter, is the only one which goes into detail. The Surveyor of the Netherlands makes a very scanty use of the station pointer, and prefers to draw the arcs of the circles, to test the value of the fix; if the observer stands very near the points between which he has taken his angles, the usual construction is no longer possible, and ingenious auxiliary constructions are given. The same instrument which is used for the finding of the center of arcs is adopted for the accurate laying off of angles, bearings and triangulation points on the construction sheet.

The soundings are worked out on board on the rough drawing sheet, and both sheets are sent, together with all the original data gathered during the survey, to the Hydrographic Office. These data should enable a cartographer, who has not been present during the survey and who has not visited the coast, to test and control the work and even to reconstruct it entirely if required.

Though this excellent and, owing to the manuals quoted, complete guide for surveyors has been more especially schemed for the Dutch Naval Officers, it is of very great value for surveyors of other nations. The author's extensive knowledge of mathematics and of the theory and practice of surveying enabled him to give a clear and correct exposure of every subject, to point out to the surveyor the dangers which he incurs and the difficulties he meets, and the interesting sport by which to avoid or overcome them. A good many ingenious examples are given to show how this can be done, and to entice the surveyor to find new solutions of his own.

A translation into a language which is more generally understood than Dutch would undoubtedly be appreciated.

J. M. P.