REVIEWS AND EXTRACTS

FURTHER INVESTIGATIONS UPON THE WATER MOVEMENTS IN THE ENGLISH CHANNEL — DRIFT-BOTTLE EXPERIMENTS IN THE SUMMERS OF 1927, 1928 AND 1929, WITH CRITICAL NOTES ON DRIFT-BOTTLE EXPERIMENTS IN GENERAL.

by J. N. CARRUTHERS, D. Sc
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Previous experiments with surface floating-drift bottles in the English Channel were made during the year 1897 by the Marine Biological Association and were described by GARSTANG in the *Journal of the Marine Biological Association of the United Kingdom* — Vol. V — N° 2, — 1898. — 430 bottles were sent adrift in 53 batches, chiefly in the vicinity of the Eddystone and when GARSTANG reported on the results, somewhat less than 1/3 of the bottles had been recovered.

During a whole year (1920-1921), surface drift-bottles were put out from the Sandettié Lightship in order to study the rate of exchange of water between the English Channel and the North Sea.

In July 1924, experiments were made in the Channel involving the liberation of 500 bottles at International Station *E*2, at International Station *E*3 (48°34' North — 5°13' West), and along three chosen short stretches on the steamer route between Southampton and Saint Malo. From these earlier experiments (1924) 52 per cent of the surface bottles were recovered.

Again, in 1927, drift bottle experiments carried out in the English Channel by the Author were published in the *Journal of the Marine Biological Association.*

The English Channel is an ideal place for carrying out experiments with different types of floating drift bottles. Bottles may travel 1000 miles and more with very good chances of recovery when they strand; no matter where they may go ashore short of this distance, the prospects of receiving the postcards from them are quite good.

In the experiments carried out during 1927, 1928 and 1929, different types of drift-bottles, described by the Author, were used. The percentage recovered varied, for the various years, with the different types of bottles used, from 20 % to 76 %.

From an analysis of the results, the Author concludes that a quantitative relation between the mean daily travel of the bottles and the mileage run of wind per day may be expressed by the following simple equation:

$$S = 1/18\ W.$$

In addition, the Autor gives some general remarks on drift-bottles and their use, with a list of the various types of drift-bottles used by other operators in previous experiments. In particular he mentions the works of SCHOTT, RYDER, NIELSEN, SCHMIDT, PLATANIA, GILSON, CUNNINGHAM, MARINI and HAUTREUX.

MARITIME GRAVITY SURVEY IN THE NETHERLANDS EAST INDIES: TENTATIVE INTERPRETATION OF PROVISIONAL RESULTS.

by F. A. VENING MEINESZ
K. Akad, van Wetenschappen, Amsterdam, XXXIII, N° 6 — 1930

We have here for the first time a tentative concrete geophysical interpretation of the results of numerous gravimetric observations undertaken in one of the most active regions from the tectonic point of view, that is, where the frequency of the seismic movements and several other phenomena manifest the most intense activity. It may be affirmed that if the gravimetric observations can be used to interpret an activity of this nature, it would probably not be possible to choose a more favourable region than that of the Dutch East Indies to bring to light the possibilities of this method. It is possible (at least judging by the anomalies of the kind found by H. Wolff — *Beiträge zur Geoph. XIV.* — when analysing the observations made by Hecker in the Mediterranean) that equally important and favourable research may be undertaken in the Mediterranean, and for that reason it is gratifying to learn that the Italian Minister of Marine has kindly authorised the employment of a submarine for conducting research; but even now it is of interest to study the results of the successful experiment of which Vening Meinesz speaks in his report, a synopsis of which is given below.

This concerns 234 gravimetric stations at which observations were made in the submarine with the Author's well-known pendulum apparatus; the observations were made at stations which were generally less than 50 to 60 miles from each other and on a trip covering 15,600 miles, in the vicinity of the islands of Sumatra, Java, Timor, Celebes, Borneo, New Guinea and Mindanao, in the course of about 4 1/2 months of work. The soundings opportunely taken with the ultra-sonic sounding apparatus in 1929 and 1930 by the Dutch Surveying Vessel *Willebrord Snellius* made the topographic and isostatic reduction of these stations possible.

Although the isostatic reductions made to date are not yet of a definite character, the anomalies encountered are still sufficiently great to enable us to state even now, as might have been expected, that, in regions of intense tectonic activity, perfect isostasy cannot be established and that, consequently, the crust of the earth is not floating in equilibrium on the denser subjacent fluid (sima). But, since the deviations from isostatic equilibrium bear no relation to topography, it may be concluded that the anomalies are not important, that they are not due to isostatic reduction (which, by its existence, should tend rather to cause the anomalies to be comparable with the topography) and the new concept which we are about to explain may be deduced from this.

By observations it has been found that there exists a strip of about 100 miles in width (of which the axis extends along the southern coasts of Sumatra, Java, Sumba, Timor, and curves to the north along the western coasts of Tenimbar and Ceram, passing over Majo and extending to the northward along the east coast of Mindanao), characterised by values of the acceleration of gravity which are *below normal*, and in which the anomaly reaches a value as high as 430 millidynes to the west of Halmaheira. Possibly it continues in one direction as far as the deeps to the west of Japan and to southward of the Aleutian Islands and, on the other, to the plains of the Ganges. It is bordered, on both sides, by zones in which the anomalies are in the contrary sense, that is, positive.

It would appear that the orogenic system of the Alps-Himalayas is not prolonged towards New Guinea, but probably curves towards the northward and the eastern coast of Asia and that, in consequence, the orogenic system of the Pacific, contrary to which has been accepted up to now, is a continuation of the Mediterranean system.

The absence of masses which gives rise to negative anomalies cannot extend to any depth on account of the narrowness of the band of negative anomalies; it cannot be superficial at all, owing to the fact that the isostatic correction does not produce an augmentation in mass and does not bring it in accord with local topography. Further, according to the Author, the anomalies thus established cannot be attributed to the forces which actually tend to raise or lower the crust, because the positive anomalies coincide with the emergent parts and the negative anomalies with the most depressed portions: the Author believes, in fact, that the islands do not show a tendency to sink and that the deeps do not show a tendency to raise their level. This being established, the Author shows that the explanation of the negative anomaly would be found in the downward inflexion of the less superficial portion of the crust; an inflexion which is entirely independent of the more or less narrow folds of thin superficial crust of a few kilometres in thickness, which would be re-folded into higher projections such as geologists assume for the formation of the Alps and the other mountain chains due to the plications of the earth's crust. This conception of the origin of the Indian Archipelago, which has already been put forward by geologists is in accord with the isostatic conception of Airy. The downward curvature would be, according to this point of view, the principal fact in the formation of mountain chains: the superficial plications would then be the necessary phenomena which give birth to mountains. In the course of the process which developed in the region under examination, this downward inflection would have given rise to the band of negative anomalies, which is the dominant characteristic of the gravity of this area: the superficial folds would then be more or less independent of these influences and not always compensated when taken separately, either for that reason or because they are due to erosion.

In so far as the positive anomalies which accompany the negative anomalies are concerned, the explanation seems very simple, if we take into consideration the fact that on the sphere the tangential pressure has a vertical component which tends to raise the layers; but also, independent of this elevation, just the augmentation in density of the compressed layers in the vicinity of the folds may also justify the excess of mass which has been observed. All this, at least with regard to its order of magnitude, is to be found in the very important report which is under consideration and which thus has such far-reaching influence. These novel conceptions open up a new era with regard to the deductions which may be drawn from the deviation in isostasy thus established.

With regard to the origin of the forces which give rise to the present activity in the Indian Archipelago and which determine the downward curvature which explains the established anomaly, these may be attributed to the trend of the Asiatic Continent towards the south-west; New Guinea and Australia, although taking no active part in this phenomenon, would have determined the form of the curvature by their contours; the maximum resistance should coincide with the salient part of this contour and, at these points, we should have the maximum pressure, and consequently the maximum positive anomaly. The epicentres of the earthquakes are found, in the greatest number, in the zone of positive anomalies; also the positions of the volcanoes in the Archipelago show a curious correlation with the line of curvature. In the concave part of this line, where the materials are also subjected to laminating and tractive effects, the fissures in the crust which permit the sima to become exposed should be most frequent and, in actual fact, the numerous volcanoes in this region are all *located on the concave side* of the band of negative anomalies. On the other hand, on the convex side of the band, in which the materials are subjected to pressure and not to tension along the axis of the band, it is observed that not only are such fissures not formed but that even superficial material is raised to form islets of a well-determined geological character, or else to form shoals, the existence of which on that particular side has been determined by surveys (the isles of Sula, of which the axis is normal to the line of curvature).

The Author invites attention to the fact that the hypothesis relative to the great folds of the crust appear to be in contradiction, not with the theory, but with the mechanism of the theory of the drift of the continents propounded by WEGENER. It is certain that one of the most difficult problems to solve in obtaining a satisfactory theory is that of discovering the nature of the forces which are assumed to be acting on the terrestrial crust. The pursuit of gravimetric research, associated with geological studies, studies of volcanic origins, seismic disturbances and topography may be, as we see from the above, one of the means of attacking this problem. The complete determination of the outline of the folds in the crust, thus identified, will not only be a great achievement, but we may add that the researches (analogous to those which have already been made by the Author at Porto Rico in the course of the Gravimetric American Naval Expedition in 1928, which were published in the same Report of the Proceedings in Vol. 32, N° 2, as well as those cited at the beginning of this report), may lead to more precise determinations regarding the origin and the mechanism of the most impressive phenomena of the terrestrial globe.

M. TENANI.

Genova, Istituto Idrografico della Regia Marina, Dec. 1930.

VARIATION OF COMPASS DEVIATION AS A RESULT OF SOLAR HEATING IN THE RED SEA

(*Review of various articles published on this subject in the* Annalen der Hydrographie und Maritimen Meteorologie, *Berlin, Heft XII,* 1930, *page* 440, *and in* De Zee, *Le Helder, N° 2, February,* 1930, *page* 100, *and N°* 10, *October,* 1930, *page* 652).

The variations in the deviation which appear regularly during a passage through the Red Sea moved Mr. F. BEECHER to publish the results of the observations made by him during seven voyages. It appears from these observations that the differences between the morning and the afternoon observations occurred principally between latitudes 14° and 22° N. and that these range from 1° to 2°, or at most 2.5°.

The principal cause of these variations seems to be the influence of temperature, since the variation occurs in such a manner that the north end of the needle is deflected towards the side of the vessel which is exposed to the sun.

While in courses 150° and 330° in the Red Sea, the side towards the sun in the afternoon is not only exposed for a longer period but also to more intense radiation, and therefore it should be found that the variation is greater in the afternoon.

When steaming, for instance, on the course 330°, the port side of the vessel will become heated and the north end of the needle be deflected to the left.

On 30th August 1927, on course 154° from latitudes 19° to 22° N., it was found that, in the morning, the deviation was 2.5° W. and in the afternoon, 4° W.

The daily variations are not always so great. During a voyage to the Southward in September 1928, no variation in direction was noted, while on the return voyage, in November, the variation was only 1°.

It is possible that, apart from the influence of temperature, there are other forces acting sometimes to reinforce and sometimes to weaken the directive force on board since, under identical conditions (meteorological conditions, fog, etc.), the variations are sometimes very different.

It has therefore been considered very desirable that investigations should be made by competent persons to determine to what point the susceptibility of iron to magnetic induction increases when it is heated and whether, within several hours, it is possible to detect its influence on the compass.

This incited Dr. P.-H. GALLÉ to study this subject in greater detail during 28 voyages in both directions, in four vessels of quite different construction belonging to the Stoomvaartmaatschappij Nederland. There was only one common condition, namely, that in each vessel the compass was situated in the best possible place. Choice was made of the *de Witt*, the *Sembilan*, the *Madoera* and the *Krakatau*.

Calculations were made first to determine at what moment during the different months of the year, in latitudes 30°, 23° and 15° N., the sun bore 150° and 330°. An examination was then made in the various compass observation logs — most of which were found to have been very well kept — for the deviations pertaining to the same day which had been determined at the same interval of time before and after the above mentioned moment. All these investigations were naturally made before the outward and return voyage through the Red Sea.

For the *de Witt*, the *Sembilan*, the *Madoera* and the *Krakatau*, the mean deviations noted during the outward trip through the Red Sea were as follows :-

	☉ to port	☉ to starboard
de Witt	+ 0.8°	+ 1.1°
Sembilan	— 0.1°	— 0.1°
Madoera....................	+ 0.3°	+ 0.3°
Krakatau....................	+ 0.6°	+ 0.6°

In all, observations at some 116 stations were available and the results were frankly negative.

If these 116 observations be considered individually, 52 give results in accord with augmentation of induction on the side exposed to the sun, 56 show the opposite of such augmentation, while in 8 cases the deviation in the morning and the afternoon was the same.

However, the differences, in almost every case, were smaller than the average probable error of observation, which was estimated to be of the order of 0.5°. On the return voyage 102 observation stations were available, 46 of which were favourable to the phenomenon, 49 against and in 7 cases the deviation was the same.

On the whole, therefore, in 98 cases the results were in favour, and in 105 cases the results were against the augmentation of induction, while in 15 cases the deviation remained the same.

On the return voyage the mean deviations were as follows :-

	☉ to port	☉ to starboard
de Witt	— 1.7°	— 1.6°
Sembilan	— 0.5°	— 0.7°
Madoera....................	— 0.4°	— 0.3°
Krakatau....................	— 2.2°	— 1.9°

Here again the mean differences, as well as the differences between the isolated observations, were smaller than the average uncertainty in the observations themselves.

Regarded from the point of view of the results obtained, there was no reason for carrying the investigation further with other vessels.

Dr. P.-H. GALLÉ concludes that the above study shows that, with the compass well located — a condition which may easily obtain in any vessel with a little care — the phenomenon of variation in the deviation resulting from the alternate heating by the sun of the two sides, of the deckhouse, etc., of the vessel, has not been established by careful observation.

But, on the other hand, in a recent article published in the *Annalen der Hydrographie und Maritimen Meteorologie* for December 1930, Dr MAURER points out that the case is not always as simple as that in which the sun acts first on one side of the vessel and then on the other, because, in addition to the general phenomenon, the intense accidental irradiation of certain isolated portions of steel and iron near the compass often becomes of great importance. In actual fact the inductive capacity of soft magnetic iron augments with heating whereas the magnetic moment of steel magnets diminishes. The compensating magnets have therefore a special influence, particularly, for example, if deviation due to vertical induction in soft iron of the vessel is compensated by magnets. In this case the two influences increase the error instead of mutually compensating each other. Such cases are not rare on bridges of vessels and if it has been necessary to compensate a strong induced pole in soft iron of the vessel by magnets, either powerful or close by, variations in the deviation of as much as 2°, due to very intense solar radiation, can easily be conceived.

Dr. MAURER determined the magnitude of such action by a very simple experiment. To the east of the compass a vertical bar of soft iron (34 c/m (13.5 ins) long by 25 m/m (1 in.) in diameter) was placed in a glass cylinder, with its lower extremity at the height of the compass. Its induced deviating pole had been reinforced by means of a powerful magnet which was placed about 5 c/m (2 ins) above the extremity of the vertical bar, so that the compass was caused to deviate 43° to the West. This corresponds therefore to a semi-circular deviation of 43° at the position of the non-compensated compass. Then magnets lying east-west were placed beneath the compass in a box of sheet zinc; these magnets compensated the deviation to within 6.0°. All was at the temperature of the room, *i. e.* 22° Centigrade (71° F.).

Warm water was then poured into the container of the fixed compensation magnets The water was at a temperature of 60° C. (140° F.) and weakened the magnetic moment to such an extent that the deviation became 7.3° or, in other words, increased 1.3°. After that, hot water was poured into the glass container holding the bar of soft iron, as a result of which the inductive capacity was increased to such a point that the deviation increased further to 8.0°, *i. e.* an increase in all of 2°. While a reading was being taken of the temperature in the glass cylinder (about 83° C) (181° F.), the magnet fell from the experimenter's hands and broke the container and it was, unfortunately, impossible to make the contemplated observations while the water was cooling from this very high temperature.

Whatever the result of these may be, the experiment showed the reciprocal reinforcing effect of the two actions and gave some indication of the order of their magnitude. The water in the glass container was evidently much too hot but, on the other hand, the heating of the magnets alone had produced a deviation of 1.3°. Without seeking further, it may be admitted that the binnacle of a compass exposed to the intense rays of the sun in the Red Sea may reach a higher temperature than 60° C. (140° F.). But, above all, the semi-circular deviations at the position of a *non compensated* bridge compass are frequently more than 43°. It sometimes happens that the maximum deviation reaches 180° and it is only after the placing of powerful magnets that it becomes possible to determine the deviation in the position then held to be uncompensated. According to this, therefore, it appears possible that in particular cases, powerful solar radiation may give rise to variations in the deviation of as much as 2°.

Consequently, it would be of interest to receive from vessels which have observed phenomena of this nature, circumstantial details regarding the exact disposition of the whole magnetic system around the position of the compass and of portions of iron located in the vicinity of the compass which may be exposed to varying heating during the morning and the afternoon, together with their relative bearings and their distances from the compass. It would also be necessary to know whether the compensating magnets and the FLINDERS Bar were exposed to very differing solar heating, indicating in this case the maximum intensity of the action of the compensating magnets and the FLINDERS Bar, or else, the value of the coefficients B_1 and B_2 at the position of the non-compensated compass.

EL SERVICIO HIDROGRAFICO

(THE HYDROGRAPHIC SERVICE.)

by Lieutenant-Commander JUAN NAVARRO DAGNINO
(Revista General de Marina — *Madrid* — *October* 1930, *pp.* 601-603).

On the occasion of the transfer of the Spanish Hydrographic Office to the Observatory at San Fernando, the Author comments in this article on the recent autonomy in connection with its work which has just been granted the Spanish Hydrographic Office and on this point, he very opportunely reviews the operating conditions of the various National Hydrographic Offices, whether issuing complete sets of charts of all countries of the world, or confining themselves to the publication of original charts for their own coasts, or whether utilizing original charts for their own coasts and one of the world-wide foreign sets of charts for those of other countries.

Finally, he cites the work of the International Hydrographic Bureau which aims at bringing about uniformity in the symbols and abbreviations used on hydrographic charts.

GEODESY IN BRITISH INDIA

(Extract from *Nature*, London, 31st. January 1931.)

In the British Empire at the present time, geodetic operations are mainly confined to Canada, India and South Africa. The Dominion and the Union are working principally for the more pressing needs of development ; in India, on the other hand, apart from the necessity for revision, more attention is being paid to the interpretation of results. The Great Trigonometrical Survey of India itself being long complete, triangulation is now being carried on in the outer zones, in Burma and on the Siamese frontier at the date of the last Geodetic Report (1).

The main triangulation in 1928-1929 was executed with WILD theodolites, which gave very good results when the instruments were working. Their axes, however, *stiffened* in the field, causing serious loss of time. Surveyors cannot adjust the instruments in the field, and even the mathematical instrument workshop in Calcutta found adjustment difficult, though mere oiling is simple if the method is known. It was intended to keep the older and heavier 12-inch theodolites at hand during the ensuing season, in case of further failures.

Precise levelling is perhaps the most economically important section of the revisionary geodetic work ; of the new net of 16,000 miles proposed, nearly one-half was completed in 1929. Levelling on hilly circuits appears to show that the shorter sights thereon contribute to accuracy as against longer sights in flat country ; experience in precise levelling has given revised results on hilly circuits in Ceylon which are practically as good as on the plains. Indian investigations show that error due to differential refraction on steep slopes is negligible, and the greater part of the errors of closure is believed to be due to changing lengths of the staves. The results of levelling must lie within limits of accidental and systematic error which are strictly defined ;

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(1) *Geodetic Report, Vol. 5, of the Survey of India. From Oct. 1,* 1928, *to Sept.* 30, 1929. *Published by order of Brigadier* R. H. THOMAS, *Surveyor-General, 8vo., pp.* 150, 29 *charts.* (*Dehra Dûn : Geodetic Branch Office,* 1930.) 5s. 3d.

one notices that 55 per cent of one line was relevelled. On the several lines — not yet, of course, referred strictly to M. S. L. — the relative discrepancies between the the new and the old measures do not ordinarily exceed 6 inches; but there are interesting exceptions. Thus there is evidence of a sinkage around Ambala of about an inch per decade, attributed to removal of water from wells. On the line between Sukkur and Hyderabad the results of much levelling have given measures so discordant that it has been decided to abandon the line. India has hitherto used wooden staves, and it is not stated if these have been rendered non-hygroscopic; change in length, which appears to have a diurnal range, being attributed to temperature. In any event, staves with invar strips were to be substituted.

Heights are subject to orthometric and dynamic corrections, the former to take account of the non-parallelism of the equipotential surfaces at different altitudes, the latter to refer all heights to a standard equipotential surface of sea-level at a mean latitude, in India 24° north. The corrections are easily computed by formulae; in which case they depend on theoretical, not observed, values of gravity. The Director of the Geodetic Branch, Dr. De Graaf Hunter, discusses the question of a rigorous investigation, and finds that the effect at Mussoorie, 7000 feet, is 0.7 ft.; he concludes that the severe labour involved in applying a rigorous correction is not justifiable in hilly country and is unnecessary in flat country, even though in strictness values derived by formula give heights in an unknown unit above an unknown datum.

India controls tide-gauges at forty eastern ports and issues predictions. An outstanding discrepancy in 1928 was 4.6 feet at Basrah on a certain date — not surprising at the mouth of great rivers and at the head of a great gulf. By arrangement with the Admiralty, the tide-tables will be extended to sixty-eight ports in the Indian Ocean, and they will be issued in cheaper form — sufficient evidence of the success of the Survey in deriving harmonic constants in a region where monsoons and unique tides must sometimes give rise to peculiar conditions.

It has been decided to re-map at least a portion of the Dependency on areas of conical orthomorphic projection; in such an immense area the change-over will be gradual. The areas proposed are 8° in latitude by 16° in longitude. In this matter South Africa and India represent extreme views, the former adopting a width of 2° as against 8° in India. At the bounding parallels the scale error is about 1/400, which will be reduced one-half by a scale factor. The magnitude of the scale error and, perhaps more particularly, the rapid change of scale at the bounding parallels will doubtless evoke criticism.

The Survey has constructed a mural base for standards of length. Such bases already exist at Sèvres and Teddington; yet the writer doubts if this is the best form of construction, even though the thermal expansion of the wall becomes fairly well known after some years.

In the course of the longitude campaign the variation of latitude was studied; the results appear to show a well-marked correlation with the moon's age, as already described in *Nature* (1). The mean longitude of Dehra Dûn as derived from the Bordeaux and Rugby signals in 1928-29 is 5 h. 12 m. 11.79 s., precisely the same as in the longitude campaign of 1926. A Shortt clock was installed this year to supplement the Reifler.

The most interesting portions of the Report deal with gravity and the geoid in India; it would be impossible to deal adequately in a short review with the wealth of material here provided. The Director reaffirms his conclusion that conditions of approximately perfect Hayford isostasy are not met with in peninsular India; but the interested reader must be referred to the Report itself for a description of the numerous investigations. Work with the Cambridge pendulum apparatus is being vigorously pursued, old values being revised and new stations added, with the object of having one station in every seventy-mile square.

The Survey of India has made remarkable contributions to geodesy in the past. It is doubtful if any single volume has approached in interest and instruction that of the year under review.

G. T. McC.

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(1) Bomford, G., Nature, *June* 8, 1929, vol. 123, p. 873.

LO SVILUPPO CONICO CONFORME DI LAMBERT, COME PROJEZIONE DI LAVORO PER IL RELIEVO IDROGRAFICO DELLA SIRTE

(THE LAMBERT CONFORMAL CONICAL DEVELOPMENT AS A WORKING PROJECTION FOR THE HYDROGRAPHIC SURVEY OF THE GULF OF SIDRA (LYBIA))

by Professor GIOVANNI FORNI

(*Istituto Idrografico della Regia Marina — Estratti degli* Annali Idrografici *Vol. XII, Genova* 1930).

This pamphlet, which an extract from the *Annali Idrografici*, Vol. XII, deals in a very simple manner with generalities regarding conical conformal projections and their various methods of representation, namely: by using a secant cone, a tangent cone or, as the limiting case, a cylinder. Formulae are stated very simple for the calculation of coordinates for the LAMBERT projection, by limiting them to terms of the third order.

After having examined the deformations due to this method of projection, the Author investigates of the conditions required to make the maximum elementary deformations as small as possible. As this type of projection lends itself very well to the representation of terrestrial areas which extend particularly in longitude, its selection for the working projection for the surveys in the Gulf of Sidra was almost obligatory. Therefore this type of projection was chosen by the Istituto Idrografico of the Royal Italian Navy for the considerable work which it has just completed in this vicinity. The international ellipsoid was taken as the ellipsoid of reference and the parallels at 30°00 N. and 32°30 N. as the limiting parallels, the central meridian of the projection being 17°50' E. Examples of calculations for the transformation of the coordinates are given in the pamphlet, and in the appendix there are four tables giving, within the latitudes used: (1) the convergence of the meridians, (2) the values of the arcs of meridians, (3) tables for interpolation, (4) the values of the coordinates X and Y of the projection for each 5' of latitude and for each 1' of difference in longitude for the first twenty minutes, and then for every 5' up to 2°50' in longitude from the central meridian.

THE LAMBERT SYSTEMS OF PROJECTION ADOPTED FOR FRANCE

(Extract from the *Mémorial du Service Géographique de l'Armée*, Vol. III, Paris, 1930.)

In August 1920, the *Service Géographique* was led to adopt for the work in France a different projection from that which had been previously employed for the maps of the General Staff (BONNE projection).

Choice was made of the LAMBERT conical projection of which use was made during the war for the establisment of the operation maps at the front and the calculation of the ranging maps required by the artillery.

But the particular systems of the LAMBERT projection which were in use from 1915 to 1919 did not correspond exactly to the aims which the *Service Géographique* expected to attain in resorting to this new type of projection. For this reason three local systems were substituted which, combined, cover the entire territory of France.

The systems are referred to the ellipsoid of CLARKE of 1880. They have their origin on the Paris meridian, in latitudes 55, 52 and 49 grades respectively.

These are called *secants*, which implies that in each system the scale is maintained along two parallels symmetrical with respect to the origin. These two parallels of constant scale are located at one grade on each side of the origin in each system adopted.

To distinguish the systems from each other they have been given the designation of the LAMBERT system – Northern zone, Central zone and Southern zone.

Instead of stopping the systems at the parallels of $33^{gr}50'$ and $50^{gr}50'$, situated at equal distances from the parallels passing through the three origins, provision has been made for an overlapping of one grade between the central system and each of the extreme systems.

These projections are employed particularly in the calculation of the rectangular coordinates of the geodetic points in the system of rectangular axes corresponding to each system of projection; in each case the axis y represents the initial meridian and the axis x is the straight line perpendicular to the meridian and passing through the origin of the projection.

Tables have been calculated and published by the *Service Géographique* for the interpolation of the rectangular coordinates as a function of the geographical positions or *vice versa.* These are tables of double entry with the latitude and longitude as arguments given for every 10 centesimal minutes. These are carried out to centimetres and give this approximation if use be made of the second differences in the formulae of interpolation which express x and y as functions of the geographic coordinates, which are supposedly known to one thousandth of a second (centesimal) (*).

To reduce the linear distortions, over the whole of each projection, the scale of the projection has been reduced in a constant ratio m in such a manner that the lengths are diminished on the initial parallel and augmented in the same ratio on the northern and southern boundaries.

The reduction of the scale is 1/8152,6 for the northern projection, 1/8157,9 for the central projection and 1/8163,3 for the southern projection.

GREAT CIRCLE AERIAL NAVIGATION CHARTS

The *Deutsche Seewarte* (*Seeflugreferat*) has recently published charts for Great Circle aerial navigation over various oceans and continents *(Grösstkreiskarten für Luftnavigation)* prepared by Dr. A. SCHUMACHER.

Four sheets have been issued: Sheet N° 1: Arctic Polar Region; Sheet N° 2: North Atlantic Ocean; Sheet N° 3: Central Atlantic Ocean; Sheet N° 4: Asia and Europe.

These charts are of interest for, in addition to the outlines of seas and continents, they show by means of contours and a buff coloured layer system, the heights of the land passed over. Information as to heights has been taken from the General Bathymetric Chart of the Oceans, issued by the *Cabinet Scientifique* of the Prince of Monaco. Oceans are shown with a blue colour-wash.

These charts for Great Circle aerial navigation are very serviceable when drawing up a plan and preparing schemes for transoceanic and transcontinental flights.

The usual diagrams for the conversion of courses and for estimating distances appear on the charts.

Details of the drawing-up of the different sheets are as follows: –

Sheet N° 1, which comprises the Arctic regions and extends as far as the 50th. parallel (approximately), is drawn up on the gnomonic central *polar* projection (R = 392 m/m. – Scale: 1 : 16 250 000).

Sheet N° 2, including the North Atlantic, from Iceland to the Canary Islands and Porto-Rico, is drawn up on the central gnomonic projection, with tangent point at Latitude 40° North and Longitude 45° West (R = 479 m/m; — Scale 1:13 300 000).

Sheet N° 3, which covers the middle Atlantic, is drawn up on the central gnomonic projection with tangent point on the Equator at Longitude 30° W. It comprises the whole of the Atlantic from the latitude of Ireland to the latitude of Cape Tres Puntas in the Argentine (R = 217.5 m/m. – Scale 1 : 29 300 000).

Sheet N° 4, Asia and Europe, is drawn up on the central gnomonic projection with tangent point at 30° N. and 75° E. It embraces Europe, Asia, the Mediterranean Sea, the Indian Ocean as far as the latitude of Sumatra, part of the Sunda Islands and the Sea of Japan (R = 205.5 m/m; – Scale: 1 : 31 000 000).

(*) *For the determination of the rectangular coordinates as a function of the geographic coordinates,* see *also* Annales Hydrographiques, *Volume* 1927-1928, *page* 289: *Report of the Algerian Expedition, by Ingénieur Hydrographe* MARTI.

THE " ALTIPHOTE " — LABRELY SYSTEM

APPARATUS FOR AERIAL PHOTOGRAPHY

MANUFACTURED BY THE ETABLISSEMENTS JULES RICHARD, 25, RUE MÉLINGUE, PARIS.

(*Extract from the* Revue d'Optique Théorique et Instrumentale, *Paris, August* 1930.)

In the *Hydrographic Review,* Vol. VII, N° 2, of November 1930, page 182, a description was given of an apparatus for aerial photography called the *Planiphote*; this apparatus, which fulfils particularly the requirements of surveys on a very large scale, should be completed by a portable camera of great capacity permitting the photographer to register, at any moment, a fact or a detail which does not happen to lie in the field of the Planiphote, which is fixed rigidly on the airplane. Further, the need of such instrument makes itself felt in many other circumstances; for example for reporting purposes at landings during long flights. This type of apparatus might, in fact, become a camera for general purposes as a complement to instruments of the Planiphote type, the use of which is confined to a very special purpose.

The *Altiphote* fulfils the requirements of such apparatus; its characteristics are as follows :-

Weight: 5 kgs. (11 lbs).

Size: Length, 29 c/m (11.5 ins), height, 35 c/m (13.8 ins), width, 30 c/m (11.8 ins.).

Plates: 13 × 18 c/m (5.12 ins × 7.1 ins.).

Focal length of objective: 20, 25 or 30 c/m (7.87, 9.83 or 11.81 ins.).

Aperture: *F*/5.7 (Olor BERTHIOT), or *F*/4.5 (Flor BERTHIOT).

RICHARD-LABRELY Shutter (1) of 55 m/m (2.165 ins.) aperture, with high luminous efficiency and three speeds: 1/150; 1/300; 1/350 sec.

Emulsion on films.

Capacity: 100 exposures.

Focus: from 2 m. (6 ft.) to infinity.

Semi-automatic operation; simultaneous setting of all parts by a half-turn backwards and then a half-turn forwards of the handle on the right.

The light weight of the camera has been obtained by careful study of the shape and by the use of a new, very light metal called "Electron".

The use of the apparatus is so simple and convenient that an operator with a little experience can make an exposure about every three seconds.

GLASS FIBERS FOR RETICULES

(Extract from "*The Military Engineer*", N. 125, September-October, 1930, Washington - p. 478).

A more satisfactory type of cross wire material for precision instruments has recently been developed by D.-L. PARKHURST, Chief of the Instrument Division of the Coast and Geodetic Survey. He has substituted very fine glass fibers for the spider threads which have been very generally used for this purpose for many years. The glass fibers are superior to the spider threads in several respects, but chiefly as regards their relative ruggedness, the ease with which they may be mounted, and their straightness under all atmospheric conditions.

The fibers are spun by means of a simple catapulting device and are made of different sizes, even as fine as a ten-thousandth of an inch or less for use in precise level. They have a very pleasing appearance in the telescope, as they are smooth and straight, free from lumps or other unevenness, and are seen as dense black lines clear to the edges. They may be mounted with greater ease and speed than any other material experimented with.

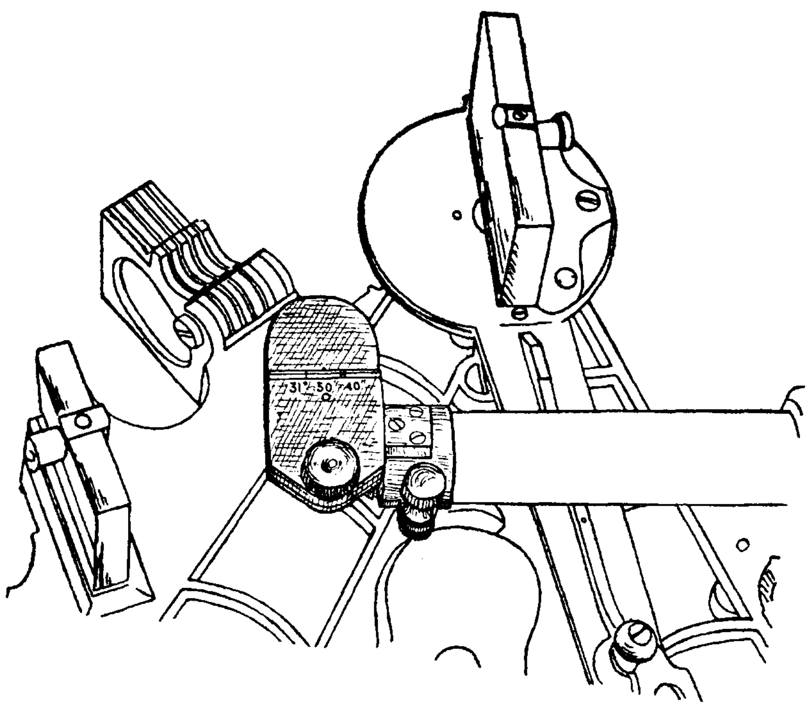
A description of these fibers and their use is given in an article by Mr. PARKHURST in the "*Review of Scientific Instruments*" by the *Optical Society of America.*

(1) Revue d'Optique, *Vol.* 6, 1927, *page* 245.

"HEZZANITH" PATENT CENTRING ERROR DETECTOR

(Extract from *The Nautical Magazine*, London, June, 1930, pp. 556-558)

Hitherto it has been a difficult matter to detect centring error in a sextant, except in observatories where there is special apparatus erected for the purpose. Often it happens that an officer suspects a centring error in his sextant but is unable to verify or otherwise his suspicion, owing to his being in parts of the world where there are no testing facilities at hand. In the "Hezzanith" Patent Centring Error Detector, made by Messrs. HEATH and Co., New Eltham, London, S. E. 9, a means has been devised whereby an officer can carry his own checking apparatus with him, and at any convenient time, on land or sea, can test the accuracy of his sextant, and find the necessary corrections, if any, to be applied to his readings. The instrument consists of a series of prisms which divert a beam of light through known angles. The prisms are attached to the C. G. end of the long sextant telescope where they cover the half of the field which is ordinarily covered by the unsilvered portion of the horizon glass. To view any sharply defined object *through the prism*, the telescope instead of being directed to the object must be diverted through an angle corresponding to the angle of the prism. If, with the instrument held thus, the object is also viewed by reflection from the sextant mirrors in the usual way and the two images brought into exact contact, the resulting reading on the arc will be the angle of the prism *as measured by the sextant*. Hence it will be evident that any difference between the readings on the arc and the known angle of the prism will be the centring error of the instrument round about that portion of the arc which corresponds to the angle of the prism. Four prisms are supplied to cover the whole of the arc at angles about 30° apart, viz., 30°, 60°, 90°, 120° prisms. As to the *exact* angles of the prisms, these are clearly marked on every prism, and give a reading to the nearest $10''$.



It is a self-contained checking device which can be used in as leisurely a manner as is desired to ensure confidence in the result. The manufacturers, Messrs HEATH & Co., New Eltham, London, S. E. 9, will gladly send further particulars to any interested persons.

APPARATUS FOR THE DETERMINATION ABOARD SHIP OF THE SALINITY OF SEA WATER BY THE ELECTRICAL CONDUCTIVITY METHOD

by FRANK WENNER, EDWARD H. SMITH, FLOYD M. SOULE
U. S. DEPARTMENT OF COMMERCE — BUREAU OF STANDARDS

(Extract from *Research Paper No 223* ; Reprint from *Bureau of Standards Journal of Research*, Vol. 5, September 1930).

The apparatus described furnishes a convenient means for the determination of the salinity of samples of sea water as they may be collected. It consists essentially of a Wheatstone bridge, conductivity cells of a type which may be filled and emptied during fairly rough weater, and the necessary auxiliary equipment, all built into a single cabinet.

A special feature is the use of two similar conductivity cells in adjacent arms of the bridge. When both are filled with samples of sea water, even though not of the same salinity, both have very nearly the same temperature coefficient, so the balance of the bridge is not greatly affected by small uncertainties of the temperature. Further, the complicated actions taking place at the electrodes, generally referred to as polarisation, are substantially the same in both cells, so the effects of polarisation are largely neutralized.

A further special feature, not really a part of the equipment but of a plan for its use, is that a supply of standard sea water, or sea water of which the salinity has been determined by laboratory methods, is carried aboard and used for periodic standardizations. Samples of sea water to be tested, together with a sample of standard sea water, are substituted one after another in the same conductivity cell. This gives a direct comparison of the sample of unknown salinity with that of a standard, almost if not quite independent of the cell constant, largely independent of other constants of the equipment and largely independent of systematic errors.

Apparatus of the type has been used during the past several seasons in the International Ice Patrol Service, also on the *Marion* expedition and on the last cruise of the non-magnetic vessel *Carnegie*.

GRAPHICAL PILOTING METHODS

by FREDERICK L. MOSHER, ELECTRICAL ENGINEERING DEPARTMENT,
THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

(Extract from *United States Naval Institute Proceedings*, Annapolis, December 1930, pp. 1080-1084).

The methods outlined in this article were designed as an aid in the solution of the large number of piloting problems that the navigator meets in work.

The author gives a series of three diagrams constructed on the alignment principle which allow the reduction of simple trigonometric formulae by the nomographic method The formulae on which the logarithmic graduations of the various diagram scales are based are also given and the diagrams themselves, a reproduction of which accompanies the article, supply all the explanations necessary for their use.

THE COPENHAGEN VARIOMETER.
MAGNETIC VARIOMETER FOR HORIZONTAL FORCE.

by D. LA COUR and VIGGO LAURSEN.

(*Communications Magnétiques, etc. N° 11, of the Danske Meteorologiske Institut, Kobenhavn*, 1930.)

At the Magnetic Observatory of Copenhagen (at Rude Skov), experiments have been carried out for some time on a new type of variometer for measuring the horizontal force. The results so far obtained being very satisfactory, the Danish Meteorological Institute has published a descriptive report of the apparatus in a pamphlet. The essential details are as follows :-

1. The magnet is small;
2. The magnet is suspended by a quartz thread;
3. The apparatus is optically compensated for temperature;
4. The apparatus may be adjusted without touching either the magnet or the suspension, once they have been set.

The total price of the instrument is about 700 Danish kronen.

In this variometer, which has been evolved by the Danish Meteorological Institute with a view to its introduction in the temporary magnetic stations projected for the Polar Year 1932-1933, emphasis has been placed on the use of light magnets of very small magnetic moment.

In the Copenhagen Variometer the magnet is made of cobalt steel, its length is 8 millimetres (0.315 in.) and its weight is a little less than 25 milligrams (abt. 4 grs). The magnet is artificially aged by a dozen successive immersions in boiling water and in the snow of carbonic acid. Its magnetic moment is about 0.8 (C.G.S.) units, which is about 32 per gram.

RIGID CONTROL FOR THE SURVEY OF AN OFFSHORE BANK.

(Extract from the *Bulletin of the Association of Field Engineers*, U. S. Coast and Geodetic Survey, December 1930, page 58.)

From Reports of O. W. SWAINSON.

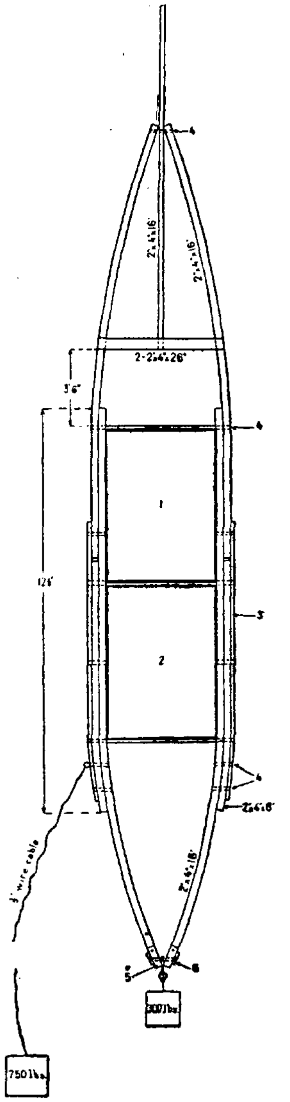
Work on Raita Bank was finished on July 11th. This Bank is twenty-one miles ong and nine miles wide. There are twenty fathoms over most of the area and a ten-fathom reef along the southeast edge. The control was by means of fixed positions on floating signals spaced three to four miles apart. The southern buoy was located by six sets of star fixes. The positions of the other buoys relative to this one were determined by R. A. R. distances between them and by sun azimuths. The velocity of sound used was that determined by measurements between two buoys located off Laysan Island, by triangulation from a base line on Laysan Island, and by measurement between two buoys cut in a plane table off Maro Reef from a plane table base line. The two determinations of velocity agreed within one metre per second.

Star fixes were also taken by two officers at the northern buoy. This fix agreed within two tenths of a mile of that as carried from the southern buoy.

Note. — Raita Bank lies approximately 100 miles northwest of Gardner Pinnacle and 125 miles east of Laysan Island, and somewhat more than halfway along the chain of shoals, reefs and islets that extend westward from the main group of the Hawaiian Islands to Midway Island, a distance of over 2,000 miles. The present programme calls for a survey of the entire chain, well over fifty per cent of which has been completed during the last three seasons. The floating hydrophone station equipment was mounted in a whaleboat.

TWO DRUM HYDROGRAPHIC FLOATING SIGNAL

(Extract from the *Bulletin of the Association of Field Engineers*, U. S. Coast and Geodetic Survey, December 1930, page 73.)



1-2- 55 gallon steel oil drum
3- strap iron 3/8" x 2" x 6'
4- Bolts
5- Plate 1/2" x 2" x 6"
6- Washer Plates 1/2" x 2" x 4"
Lumber required { 5 pieces 2" x 4" x 16' ; 2 » 2" x 4" x 8' ; 2 » 2" x 4" x 2'-2" }

In 1928 several buoys were built for use at *French Frigate Shoal* and for use on the shoals in the vicinity of Nihoa Island. It was found that these buoys had a decidedly top-heavy tendency. One was used successfully which was made according to specifications from the Manual but the others laid over almost on their sides. To remedy this it would be necessary to shorten the centre pole, which we did not wish to do for reasons of visibility, or to add more weight to the counterweight.

When we tried to increase the weight of the counterweight the buoys did not have enough buoyancy. We therefore eventually placed two barrels vertically over one another and increased the weight of the counterweight. These buoys were used during 1928.

Evidently the reason for the top-heaviness of the buoys made according to Manual specifications was that the lumber available out here (1) is decidedly heavier than that previously used in the United States.

In 1929 we resumed the use of the two barrel buoy as described above, but after a few weeks we encountered trouble due to the breaking of the lumber, either just below the two barrels or between the two barrels. We then started using the specifications as shown in the tracing, so that there was a double 2" × 4" the length of the barrels, reinforced by a piece of strap iron extending from a little more than a foot below the bottom barrel to a little more than a foot above the bottom barrel.

After adopting these specifications we had no more trouble with breaking; the buoys stood up much straighter than the one barrel buoy and were just as easy to handle.

NEW PROJECTOR FOR MAKING AN ALIGNMENT

A memorandum by M. Ch. Dévé, presented to the *Académie des Sciences* at Paris, describes a special projector which allows an alignment of considerable length to be marked out in a very simple manner.

This apparatus is described in the *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, N° 26 of the 29th. December, 1930, page 1444, from which we extract the following information:

(1) *Hawaiian Islands.*

In the focal plane of an objective are arranged two semi-circular sheets of glass, one red, for example, and the other blue. The plane sheets of glass are slightly bevelled in such a manner that a slit is formed analogous to that of the spectroscope. This slit is brilliantly illuminated by a lamp and its reflectors and its image is projected in the distance. The slit may be arranged vertically, horizontally or obliquely. Supposing it to be vertical, a marker who is looking into the projector sees it coloured red if he is to the right of the plane of alignment defined by the slit and the optical axis of the projector; he sees it blue if he is to the left and white if his eye is exactly in the sheet which defines the plane of the alignment. It is therefore a simple matter for him to mark out the plane of the alignment on the ground alone.

Such a projector is useful in marking a range, a channel or any direction whatever; the alignment on the projector should be preferable to an alignment of two lights or two range marks, which are often difficult to locate and which may be confused with others. If we consider that a simple automobile projector of 50 to 75 watts is visible for a distance of about 2 kilometres in clear weather, we may estimate that a lamp of 100 to 150 watts should be sufficient for surface or subterranean topography.

For long vertical alignments, the same projector used in autocollimation with a vat placed at the bottom of a pit (or well) may determine the vertical plane with greater precision and greater ease than a long lead line. By simply placing the eye on the side of the projector and nearly in the vertical plane of the slit one may obtain an accuracy within a few seconds even without a sighting device.

CURRENTS ALONG THE COAST OF INDO-CHINA

(*Extract from the* Annales de Géographie, *Paris, 15th September,* 1930, *p.* 538).

The seas which bathe Indo-China, in their shores and their fisheries, are being actively studied by the *Service Océanographique des Pêches* of Indo-China, established at Cau-da, near Nha-trang (Southern Annam). This Service publishes annually a summary of its work as well as various monographs. The two classes of documents furnish much information of great oceanographic interest.

The researches of the Service Océanographique of Indo-China are all the more interesting on account of the new light which they shed on the question of currents in the seas of Indo-China. The Gulf of Siam has circular currents which keep the waters eddying and prevent close relations with those of the China Sea. The result is a sort of closed sea of stagnant waters. In the centre of the Gulf an area has been found where sea-weed, torn from the shores, accumulates and constitutes a Sargasso Sea; further, the fauna which grows in this central part is very reminiscent of that of the Sargasso Sea.

The China Sea appears to have a similar circulation. On the coasts of Tonkin and of Annam, a N-S current has been found which constantly carries cold water southwards, while along the coast of the Philippines there is a S-N current which displaces warm water. The centre of this circulation has not yet been sought, but it is possible that it will be found, as in the Gulf of Siam, to be a Sargasso Sea. Thus the China Sea and the Gulf of Siam each has a system of currents of the same nature, but independent of each other.

The masses of cold water which the current displaces from north to south along the coasts of Annam cause the China Sea to be colder than it otherwise would be in this vicinity, at least in winter. It is for this reason that fish caught in the vicinity of Cape Varella show the mark of very definite changes in temperature on their scales, and yet this is in a very low latitude. Beyond the Bay of Hon-cohé (some distance to the southward), the scales of the fish do not show any mark of this kind. From this the importance of the position of Cape Varella is seen, since it corresponds very nearly to the limit between the waters which undergo a seasonal variation of temperature and those in which the temperature is nearly constant. The coasts of Annam constitute a privileged zone for the study of marine fauna; there the fauna is modified from north to south, the cold waters coming from the north being gradually warmed.

MEASURING STRONG CURRENTS IN COMPARATIVELY DEEP WATER

by F. S. BORDEN.

(Extract from the *Bulletin of the Association of Field Engineers*, U. S. Coast and Geodetic Survey, December 1930, page 62.)

For making a lunar month of current observations in San Bernardino Strait, P. I., in a depth of 55 fathoms (rocky bottom) and a current at times reaching seven knots, special anchor gear and a mooring buoy had been provided. This never was entirely satisfactory, and when the vessel had to leave the station temporarily for fuel, it was found on returning that the mooring buoy had disappeared — probably towed under and crushed. As the time consumed in running for and procuring additional special equipment would have ruined the series, the ship was anchored with one of her bower anchors, using one shot of chain at the anchor and approximately 100 fathoms of six-inch Manila line.

When the current attained a velocity of about three knots and the line began to show evidences of parting, the engines were turned slow ahead to relieve the strain. By gradually increasing and decreasing the revolutions as the current increased and decreased and maintaining a resultant strain equivalent to that caused by a three- knot current, it was found that the ship could stay on station and obtain very satisfactory observations.

The series was completed without the loss of any of the ship equipment and without the anchor having dragged except on the last day of the series when, with the maximum current of the month at hand and a fouled anchor, the strain on the bight of the line alone was great enough to drag the anchor slightly, even though the ship held up its end.

Using the engines had no effect on the accuracy of the observations provided they were not made immediately after increasing or decreasing the revolutions of the engine and before the forces acting on the vessel had become balanced.

It might be interesting to know that during the series the engines turned over the equivalent of 350 miles with the ship at anchor and the steering wheel secured « amidships », that at times of maximum current the engines were turning as high as 64 r.p.m., that during the series the flood current passing the station travelled 1537 miles and the ebb current 560 miles. The duration of the flood current was 489.3 hours (70.3 %), whereas that of the ebb was only 206.7 hours (29.7 %). A general explanation of the type of currents experienced is given in the Pacific Coast Current Tables under Predictions for San Bernardino Strait.

WEEKLY SUCCESSION OF GULF STREAM TEMPERATURES IN THE STRAITS OF FLORIDA

by Charles F. BROOKS and Edith M. FITTON.
Clark University, Worcester, Mass., April 30, 1930

Monthly weather Review, United States Department of Agriculture, Weather Bureau, Washington, D. C., July, 1930, pages 273-280.

In this article the Authors discuss the data tabulated from sea-water thermograms of twice daily crossings of the Straits of Florida reduced to weekly means.

As a conclusion it must not be overlooked that the temperatures of the surface of the Gulf Stream in the Straits of Florida are simply surface temperatures of a faster or slower, more turbulent or less turbulent, stream as it passes a certain line near the entrance to the Straits. In summer, Harvey has found that times of light winds and little turbulence will be marked by higher surface temperatures, though less storage of heat, than will periods of stronger winds and more turbulence. These higher summer temperatures are likely to mean lower heat deliveries and, therefore, lower surface temperatures later farther along in the Gulf Stream. Nevertheless, a surface layer of unusually warm water may not have an opportunity to dissipate its heat by evaporation and radiation, as it would ordinarily do rapidly, for a hurricane, or even a gale, may stir it into a deep body of water, reducing the surface temperature so that the heat will be conserved till farther than usual along the course of the stream. British investigators might, in consequence, expect higher temperatures in the eastern North Atlantic some months after a period of numerous West Indian hurricanes. If the hurricanes occurred mostly east of Key West, the variations of Gulf Stream temperatures near Key West might have no apparent relation to those of the same water later observed two or three thousand miles along its course. Herein lies the importance of recording the temperatures, as it is now being done, accross the Stream on several lines after the Gulf Stream leaves the Straits. Therefore these tables are presented simply for what they are. It is hoped, through the navigational record of the car ferries, to get some knowledge of the current each day, and thus, with the temperatures, to provide some index to the thermal cargo carried.

PANAMA TIDES

by H. A. MARMER, U. S. Coast and Geodetic Survey.

(Extract from *United States Naval Institute Proceedings*, Annapolis, November 1930, pp. 1003-1008).

In this article,the very different characteristics of the tide at the two ends of the Panama Canal are brought to light. The observations were taken on the one hand at Balboa at the Pacific end and, on the other, at Cristobal situated at the Atlantic end of the canal.

Disregarding the very considerable difference in the range of the tide at the two ends of the Panama Canal, the difference in the characteristics of the rise and fall appears to reside in the fact that at Balboa there is very little daily tide, while at Cristobal there is relatively a great deal.

To explain this difference of regime the author invokes the aid of tidal theories that attempt to explain just how the waters of the oceans and seas respond to the tide-producing forces of sun and moon; and particularly of the stationary-wave theory exposed in the works of R. A. Harris and in the diagram which shows the oceanic oscillating systems as developed by him.

A number of puzzling tidal features in various parts of the world are nicely explained by the stationary-wave theory. Applying it to the tides at Panama we see first, that the Atlantic end of the canal opens into the Caribbean Sea which is effectually cut off from the oscillating system of the open Atlantic by the girdle of islands that mark off the northern and eastern limits of the Carribean.

Furthermore, the Gulf of Mexico and the Carribean constitute an area of such length and depth as to have a period of oscillation of approximately twenty-four hours. Hence this area will respond beat to the daily tide-producing forces, and here we have the explanation of the relatively large daily constituent of the tide in the Carribean Sea.

The basin comprising the Carribean Sea and the Gulf of Mexico is much smaller and much shallower than the basins of the Atlantic and Pacific Oceans. Hence the tides raised by tide-producing forces in the former are much smaller than in either of the latter. The Atlantic end of the canal therefore lies in a region characterized by small tides and by a relatively large daily constituent. The Pacific side of the canal, however, is situated at the end of an oscillating system of the semi-daily tides. This means that the range of the semi-daily tide here must be considerable.

A NEW CURRENT MEASURING INSTRUMENT: THE CARRUTHERS' DRIFT INDICATOR.

A FURTHER NOTE ON THE INSTRUMENT WITH WHICH THE OBSERVATIONS WHERE MADE (*)

(Extract from the *Journal du Conseil Permanent International pour l'Exploration de la Mer*, Vol. V, N° 2, Copenhagen, August 1930).

The *Drift Indicator* was previously described in the *Hydrographic Review*, Vol. VI, N° 1, May 1929, and although its main features have in no wise been departed from since that time, yet a few alterations needing mention have been made. These have been directed to one end only — to enhance the instrument's ability to "stand up to" the very rough usage for which it is intended, so ensuring that it shall not need to be brought away for repair more frequently say than every ten months or so. After being in use for this length of time, exposed to what is in a way a veritable sandblast, the brass cover becomes worn down to such an extent as to be almost puncturable by the finger. Hence one could not hope to have any one instrument at work continuously for more than a year — the maximum time yet achieved. Any reader interested is referred to the Writer's recent paper in the *Rapports et Procès-verbaux* (Vol. LXIV, 1930, pp. 24 et seq.). There a critique of the instrument's work is given, judged from what is held to be a rational viewpoint.

It is useless to contemplate employing in the continuous current measurements necessary in fishery research, any instruments which cannot function under all the bad working conditions imposed. One has to choose between the use of current meters which, though perfect from an instrument maker's point of view, cannot possibly survive really severe usage, and instruments which, though having shortcomings in respect both of sensitivity and accuracy, can both do this and be operated by the personnel of light-vessels.

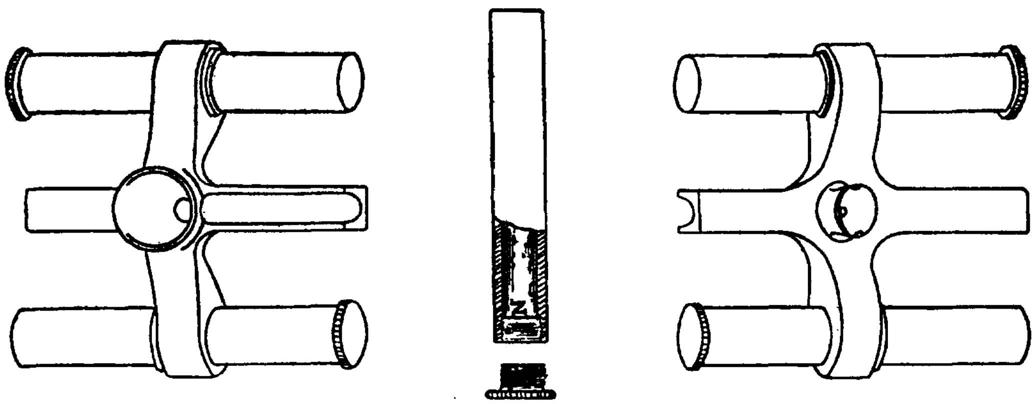
Now the *Drift Indicator* as previously described had a regrettable fault in the too frequent jamming of the balls in the large hopper. Balls consequently failed to drop, and too many observations were spoilt. This fault was soon completely remedied as follows. Instead of balls being carried round from the hopper into the delivery spout by means of three equidistant holes on the periphery of a rotating wheel turning in a vertical plane at the bottom of a slot, the dropping of balls is now effected by a rotating brass solid sphere of ample size which occupies the present cone shaped bottom of the hopper. This sphere turns on a horizontal fore and aft spindle, and has three suitable equidistant holes on its surface in the vertical plane (perpendicular to the spindle) bisecting it; the rotation of this sphere gives adequate agitation to the balls in the hopper so preventing them from jamming. It is rare to have any trouble nowadays on this latter score.

Two other new features of the new mechanism are the following :—

Sliding inspection doors are now fitted and the cups are much more conveniently and satisfactorily attached to the arms by means of winged screws. The rotator is now three armed instead of four armed. A device resembling a cistern ball valve has been employed to prevent rotation of the cups when the instrument is drawn out of the water.

An exceptionally useful new feature concerns the chief accessory of the *Drift Indicator* — its compass. This compass, which has been in use since 1926, is shown in detail in figure below which is self explanatory. Everything save the magnets and the agate cup is of vulcanite. These compass systems need practically no attention save for an initial filling of oil in the magnet tubes; new magnets can be put in as required, but this need not be necessary in the course of two years work. The compass system weighs 1 3/4 ozs. (50 grams) with its magnets, 3/4 ozs. (25 grams) without them, and its magnet tubes are 2 1/2 ins. (63 m/m) long.

(*) *Hydrographic Review*, Vol. VI, N° 1, May 1929, pages 193-196.



The Vulcanite Tube Compass used with the Drift Indicator

The entire *Drift Indicator*, as at present in use, weighs about 77 lbs. (35 kg.) but to this has to be added the weight of the three or four 7 lbs. leads which are shackled into the fore and aft balancing bar before the instrument is put outboard for an observation. Thus, as it hangs out ready for use, the instrument weighs about 7 1/2 stones (47.5 kg.). The various dimensions of the Indicator may be judged from the statement that the vertical length of the main door is 19 1/2 ins. (49 c/m). The total length of the Indicator in the fore and aft line is about 34 ins. (86 c/m); its height, exclusive of the swing handle, is about 28 ins. (71 c/m) whilst, with the swing handle held vertically, the overall height of the instrument is about 33 ins. (84 c/m).

DETERMINACION PRACTICA DE LA ALTURA DE LA MAREA RESPECTO AL NIVEL MEDIO UTILIZANDO LAS CONSTANTES ARMONICAS

(PRACTICAL DETERMINATION OF THE HEIGHT OF TIDE WITH RESPECT TO MEAN LEVEL, BY THE USE OF HARMONIC CONSTANTS.)

by Lieut. Commander José M. SANCHEZ Y FERRAGUT.

(Revista General de Marina — *Madrid* — *October* 1930, *pp.* 577-592)

On the occasion of the publication of harmonic constants in the *Derrotero de la Costa Norte de Espana*, the Author points out, in a few pages, the practical use of harmonic constants for the determination of the height of the tide at any given instant. He summarizes the practical conditions of the harmonic method and gives a type of very simple calculation accompanied by three classic tables which give, for the 8 principal waves :-

1. The arguments for the 1st January (Table I).
2. The hours during each day of the year at which the argument has the same value as at 0 h. on 1st January (Table II).
3. The values of the arguments and the hundredths of the ordinates of the waves for every 2/10 of an hour, from 0 h. to 26 h. 8.