HYDROGRAPHIC BIBLIOGRAPHY

I. REVIEWS

TABLES FOR OBSERVATIONS WITH PRISMATIC ASTROLABE.

In *Hydrographic Review*, Volume V, N° 2, pp. 235 and 236, a notice was given concerning the tables for observations with the prismatic astrolabe published by the Zi-ka-weï Observatory.

The attention of the Bureau has been drawn to the fact that these tables may, without modification, be used in the Southern Hemisphere; they may, indeed, be employed for all latitudes included between 46° North and 46° South. For the Southern Hemisphere, it is sufficient to change the sign of the declination given in the table. It should also be noted that these tables allow the settings to be prepared for another position and another epoch.

RADIO-ACOUSTIC POSITION FINDING.

in 8° 62 pages - 22 figures

Special Publication N° 146 of the U. S. Coast and Geodetic Survey.
United States Government Printing Office, Washington, 1928.

Price 20 cents.

During the World War, submarine listening devices and means of locating objects by underwater sound transmission were developed by the United States and other countries. In 1923, the United States Coast and Geodetic Survey, in cooperation with the United States Bureau of Standards, began experiments in the use of similar methods for position finding in hydrographic surveys. This work was successful, and the resulting apparatus and methods were first used for the control of hydrographic surveys in 1924, under the operating term " Radio Acoustic Ranging". The equipment and details of operation as first developed are described in Coast and Geodetic Survey Special Publication N° 107, "*Radio Acoustic method of Position Finding in Hydrographic Surveys*", prepared by members of the two services mentioned above, who were engaged in the development work, and published in 1924.

Since the date mentioned, this method of control has been used extensively by the survey ships *Guide* and *Pioneer*, operating on the Pacific Coast of the United States and, due to the zeal and ability of the officers and other personnel of these ships, a number of improvements have been made, all tending towards standardisation, simplification and increased efficiency.

This publication has been compiled from reports submitted by Hydrographic and Geodetic Engineers T. J. MAHER and R. F. LUCE, the commanding officers of the ships mentioned above

Its purpose is to describe the apparatus and methods in use at the present time and to assemble the knowledge regarding details of operation that has been acquired to date.

It should not be considered as presenting a completely developed and fully standardised engineering practice, suitable for use under all conditions and in every region. Like all radio and electrical apparatus, the equipment is subject to improvement, and a few defects in operation, such as the failure of sound to carry under certain conditions and interference at shore stations, are not as yet fully understood. Furthemore, many of the details of shore-station installation described herein have been worked out for a certain type of coast and may require modification for use in other regions.

Historical details regarding the early development of this means of control, the personnel engaged therein, and the division of work between the organisations concerned have been omitted. This information, as well as details relative to the changes that have been made, may be obtained by referring to the first publication on the subject.

The different items dealt with are indicated in the following extract from the Table of Contents.

Ship apparatus :— Bombs, Sound Receiver, Amplifier, Radio Equipment, Chronograph.

Shore-Station Apparatus :— Hydrophone, Hydrophone Block (Hydrophone Box, Construction of Blocks, Mounting Hydrophones), Cable, Amplifier, Automatic Key, Radio Equipment, Operation of Station.

Establishment of Shore Stations :— Selection of sites, Housing personnel and equipment, Cable Laying, Planting hydrophone block, Testing hydrophones and cable.

Details of Operation :— Routine of position finding, Chronograph record, Plotting positions, Velocity of sound (Determination of velocity, Frequency of tests), Faults in operation.

UNTERWASSERSCHALLTECHNIK GRUNDLAGEN, ZIELE UND GRENZEN. (SUBMARINE AKUSTIK IM THEORIE UND PRAXIS).

by

Dr FRANZ AIGNER.

(8vo - 322 pages - 134 figures - 169 notes)

published by M. KRAYN, Berlin, 1922.

The work compiled by Dr F. AIGNER in 1920 on submarine acoustics contains much theoretical and practical technical information on this subject, the application of which, as an aid to navigation, is daily increasing in importance.

The first chapter gives a résumé of the history of the question, of past experiments concerning the transmission of sound and the submarine bell.

The second chapter is devoted to the mathematical and physical study of the medium in which the sound is transmitted, to the question of velocity of sound in relation to temperature, salinity and density of sea water.

Chapter 3 considers the mathematical technique of the various methods and instruments for emitting sound waves :

Chapter 4 is a study of the various appliances for sending out submarine signals, bells, sirens, oscillators with vibrant membranes and electromagnetic emitters.

Chapter 5 deals with the different receivers used in submarine acoustics ; with microphones and the method of installation.

Chapter 6 describes a certain number of acoustic appliances for taking bearings and estimating distances, and is particularly concerned with the method of stereoscopic (binaural) listening and other combinations.

Chapter 7 describes the complete emitting-receiving apparatus, as well as the various methods of installation.

Chapter 8 gives some general ideas concerning the employment of submarine signals for submarine telegraphy, for echo-sounding, as an aid to avoiding collisions at sea, and as an auxiliary to navigation.

The work is completed by an appendix containing bibliographical notes.

MEASUREMENT OF SALINITY OF SEA WATER

by

JERRY H. SERVICE.

in 8° - 20 pages - 8 illust. and tables.

U. S. Coast and Geodetic Survey, Special Publication N° 147.
United States Government Printing Office, Washington.

Price : 10 cents.

This publication has to do with methods available for use on board ship for measuring the proportion of total dissolved solids in sea water. The adoption of echo sounding for hydrographic surveys made necessary a study of the speed of sound in sea and its variation with the depth and with the temperature and the salinity of the water. The effect of salinity upon the speed of sound is not great; a change of salinity through the whole range encountered in ocean waters produces scarcely more than 1 per cent change in speed. The accuracy requirements demand, however, that the hydrographer shall determine the salinity of the water in which soundings are being made to the nearest gram per kilogram (part per thousand); that is, to two significant figures.

It becomes necessary, then, to provide one or more standard methods that are simple of execution and that will give on board a moving ship and even in unskilled hands an accuracy such that there will be no doubt of the second significant figure of the result, and preferably a range of uncertainty in the third figure of not more than two or three units.

Two inexpensive methods have been found that are satisfactory. When the motion of the ship is not great, hydrometers of good quality that have been calibrated have been found to give satisfactory results when properly used; and, for use in any ordinary weather suitable for hydrography, a chemical titration method has been worked out that requires little or no previous experience for its successful manipulation.

The writer has calibrated the dipping refractometer manufactured by the Bausch & Lomb Optical Co., to give salinity of sea water. Although the apparatus involved is rather expensive, it is quite simple and easy to manipulate and will give good results on board ship even in the roughest weather.

It seems probable that an inexpensive electrical conductivity method can be worked out that will be easy of manipulation and give adequate results. At the present time, however, with the possible exception of the apparatus of Monsieur and Madame CHAUCHARD, available conductivity apparatus is too expensive for the purposes of this bureau, principally because more precise than the requirements demand.

The method of obtaining salinity by the method of balancing columns of liquids is given brief mention. Finally, two standard laboratory methods, the pycnometer method and the sinker method, respectively, are discussed briefly.

Excepting the preliminary calibration of the dipping refractometer to measure the salinity of sea water and of boiler water, this publication merely studies methods already available. Such slight modifications have been made in these methods as seemed to make them best suited to hydrographic work.

THE TRANSMISSION OF SOUND THROUGH SEA WATER

by

JERRY H. SERVICE.

29 pages - 2 fig.

(*Reprinted from the Journal of the Franklin Institute*, Vol. 206, N° 6, December, 1928.)

A comparison of British Admiralty Tables of the Speed of Sound in Sea Water with the Tables of HECK and SERVICE, is given. The maximum discrepancy between the two sets of tables is about 8 metres per second, or about 0.5 of one per cent. The British Admiralty speeds are systematically lower than those of HECK and SERVICE by about 4 metres, or about one-fourth of one per cent, due simply to the difference in the methods of computation.

Tests of the Tables of HECK and SERVICE by piano wire and echo soundings have been made by the United States Coast and Geodetic Survey. It has been found that when computing echo soundings by speeds from the tables of HECK and SERVICE, the echo sounding practically never differed from the piano wire sounding by more than one per cent.

It is the opinion of the writer that sound speeds for *radio-acoustic position finding* would be more accurately obtained from the tables of HECK and SERVICE or of the British Admiralty rather than by direct measurement.

Concerning transmission of sound in radio-acoustic position finding, the author has proposed the following hypothesis: that the sound energy from the bomb makes its way to the hydrophone principally by multiple reflections between surface and bottom; the effective sound energy is propagated by very oblique reflections, so that the total length of path is not appreciably in excess of the distance measured along the surface from bomb to hydrophone; if the water between bomb and hydrophone is deep, fewer reflections and less loss of energy by reflection will occur than if the water is shoal, that is, a given quantity of sound energy released by a sound source can be transmitted practically to greater distances in deep water than in shoal water. Upon this hypothesis it would be expected that sound could be transmitted to greater distances when the surface of the sea is smooth, other conditions being equal, than in rough weather; such seems to be the case. Likewise, the distance to which sound could be transmitted would depend upon the material and configuration of the bottom.

Further, the correspondence between speed and mean physical conditions between surface and bottom, has at least a considerable mass of experimental data in support of it.

Professor COLE has suggested independently that, although the usual temperature gradient has the effect of refracting the direction of propagation downward (because the speed is greater in warm water than in cold), nevertheless, in deep water, the increase of speed with increasing pressure may well more than neutralize the temperature effect, so that the sound energy may follow a path through nearly all the layers between surface and bottom and yet be deflected upward toward the surface without reaching the bottom at all.

AIGNER has proved by calculation that the above explanation made independently by Professor COLE is feasible.

A discussion of experience with radio-acoustic position finding in various regions is given and mention is made of phenomena in connection with radio-acoustic position finding and echo sounding; for example, it has been suggested by some of the writer's associates on the basis of experience that, within reasonable limits of other conditions, cold water will transmit the sound more effectively than warm water, and that the amount of solid matter in suspension in the water is an important factor in sound transmission, transmission being poor (they state) when there is much suspended matter.

Attenuation with distance of sounds of great amplitude has been noticed and there will certainly be a limit to the range of a given hydrophone that cannot be increased, no matter how large or powerful the source of sound, because sounds of great amplitude have a greater

relative decrease of intensity with increasing distance from the source than do sounds of small amplitude.

An appendix gives a brief discussion of methods in use in the U. S. Coast and Geodetic Survey for the measurements of depth of water, and a list of bibliography pertaining to transmission of sound through sea water.

TOPOGRAPHIC MANUAL.

by

O. W. SWAINSON.

in 8° - 121 pages - 40 fig.

Special Publication N° 144 of the Coast and Geodetic Survey.

United States Government Printing Office, Washington, 1928.

Price : 30 cents.

This manual is issued for the purpose of giving the general requirements of the United States Coast and Geodetic Survey for the execution of topographic surveys, and to describe the instruments and methods used for topographic work.

The "*Plane-Table Manual*", Special Publication N° 85, and the Section pertaining to topography of the "*General Instructions for Field Work*", Special Publication N° 26, are superseded by this manual.

The topographic surveys carried on by the Coast and Geodetic Survey are usually for the purpose of compiling nautical charts and, in most cases, consist of a delineation of the shore line and of the territory immediately adjacent to the coast. This manual, therefore, deals chiefly with the methods used for this purpose and does not cover extensively the operations involved in the execution of inland topographic surveys.

The book is divided into four parts with an appendix.

Part I. — General requirements for topographic work.
Part II. — Instruments and Equipment.
Part III. — Field Work.
Part IV. — Office Work.

The general requirements for the topographic work of the Coast and Geodetic Survey, as prescribed by the Director, concern particularly :

Arrangement and identification of sheets -
Paper for topographic sheets -
Projections and scales.
Control of topography.
Adjustement and repairs of instruments.
Features to be located.
Magnetic meridian.
Plane of reference and Elevations.
Contours.
Information from other sources.
Shore-line reference.
Station symbols.
The high-water line.
Names and numbers.
Revision surveys.
Description of stations.
Coast Pilot Information.

Photographs.
Descriptive reports.

Part II gives a detailed description of :

Plane Table,
Alidade,
Telemeter rod,
Declinatoire or box compass,
Hypsograph,
Plane-Table sheet,

and a list of instruments and equipment usually required for topographic surveying operations.

Part III is devoted to the organization of party, control and signals, preparation and care of sheets and to the different operations in topographic surveying by means of Plane-Table, location and orientation of the Plane-Table, traversing, adjustment of traverse, the three-point problem, the two-point problem, delineation of topographic features, determination of high-water line, representation of relief, auxiliary methods for inaccessible shore line, use of boat for hydrographic information, extension on subplan, and photographs.

In the appendix is to be noted a paragraph giving the important points to be remembered in using the plane table for topographic surveying, and the symbols used for works and structures, boundaries, marks and monuments, drainage, relief, land classification, aerial navigation, hydrography, dangers, obstructions, aids to navigation, etc...

TIDAL DATUM PLANES

by

H. A. MARMER.

in 8°. - 142 pages - 56 figures.

U. S. Coast and Geodetic Survey Special Publication N° 135,
United States Government Printing Office, Washington, 1927.

Price : 30 cents.

A tidal datum plane is a datum plane determined from the rise and fall of the tides. Various tidal planes may be derived, and each is designated by a definite name, as, for example, the plane of mean high water, the plane of half-tide level, the plane of lower low water.

Of datum planes that may be used as planes of reference for elevations, those based on the rise and fall of the tide have the advantages of simplicity of definition, accuracy of determination, and certainty of recovery, even though all bench-mark connection be lost. Tidal datum planes are, therefore, the basic planes of reference used in the hydrographic and geodetic work of the Coast and Geodetic Survey.

In the present publication, two objects have been kept in mind. It is aimed to provide a working manual for the determination of the more important tidal datum planes and, at the same time, to provide a sufficient discussion of the principles involved and accuracy attainable. Since no such discussion is elsewhere available, this phase of the subject has been treated in detail.

The first chapter of the book considers the various types of tide, variation in range, diurnal inequality and mean values.

The following chapters deal with tide observations, bench marks, tide recording apparatuses and tide records, namely interpolation of breaks in the record, time of tide, variations in lunitidal intervals, etc...

Then six datum planes are discussed, namely mean sea level, half-tide level, mean high water, mean low water, lower low water, and higher high water. They constitute the principal tidal datum planes. They are more easily determined than other tidal datum planes, and, from a given series of tide observations, they can be derived with a greater degree of precision.

For each of them, indications are given for deriving an accurate sea level, or primary determination, from a long series of tide observations extending over 19 or 9 or more years.

At all other places, a satisfactory secondary determination of this datum plane can be made by means of observations covering much shorter periods if the results are corrected to a mean value by comparison with the primary determination at some suitably located tide station. The precision with which sea level can be derived by a secondary determination from various periods of tide observations are illustrated by examples taken from observations made by the Coast and Geodetic Survey on the coasts of the United States.

Other tidal datum planes have at times been used. Thus, the planes of monthly lowest low water and spring low water and the Indian tide plane have been used in hydrographic surveying and in tide predictions. To determine accurately such datum planes directly from observations requires a much longer series of observations than is necessary for any of the principal planes, for spring tides or tropic tides occur but twice a month and monthly lowest low water but once a month. As a rule, however, approximate determinations of such planes are quite satisfactory, especially if their relation to mean sea level or half-tide level is stated.

Thus, if a plane below mean low water or mean lower low water is to be used, it is best to define it by its distance below either of these datums or mean sea level rather than seek some secondary tidal datum which approximates it.

Several such datum planes have been used heretofore and they are discussed briefly viz:—

Monthly lowest low water,

Spring low water,

Indian Tide Plane.

Datum planes from harmonic constants:— Formulae have been developed by HARRIS, "*Manual of Tides*", Pt. III (Washington, D. C., 1895) by means of which the various datum planes may be derived through the harmonic constants. These formulae are somewhat involved if it is desired to derive the datum planes accurately, but for approximate determinations the formulae may be be simplified considerably.

In the use of tidal datums as planes of reference for elevations, it is implied that such datums at any given plane remain constant over relatively long periods of time. Underlying this implied constancy are the tacit assumptions of coastal stability and constancy of hydrographic features. If changes take place in the relative elevation of land to sea or in the hydrographic features of the body of water on which the given place is situated, changes will also take place in the tidal datum planes, which are fixed by reference to local bench marks.

If a coast is undergoing a slow gradual subsidence the first effect would obviously be an apparent elevation of all the tidal datum planes with respect to local bench marks by the same amount, this being the amount of the subsidence.

But if the subsidence becomes sufficient to alter materially the hydrographic features of the coast, changes would ensue in the tidal regime of the coast, and as a consequence the different datums would change differently.

For instance, in inland tidal waters, because of the relatively limited areas and depths involved, changes in the features of considerably lesser magnitude are sufficient to change the range of the tide and thus bring about changes in datums.

See also: Hydrographic Review, *Vol. VI, No I, May,* 1929, *page* 37, "Hydrographic Datum Planes" *by* H. A. MARMER.

MEAN SEA-LEVEL DETERMINATION FROM SHORT SERIES OF TIDE OBSERVATIONS

by

G. T. RUDE.

(Extract from "*Geodetic Operations in the United States,*" January 1, 1924 to December 31, 1926 *Special Publication N° 134 of the United States Coast and Geodetic Survey. United States Government Printing Office, Washington,* 1927.)

While a long series of tide observations is necessary for a very accurate determination of mean sea level at primary tide stations, a fairly accurate determination has been made by the United States Coast and Geodetic Survey at a number of secondary stations in the last few years by comparison of simultaneous observations at the secondary stations with those at a suitably located primary station. A very close agreement, too, has been obtained in the results for the secondary stations from comparison with two nearby primary stations.

As is well known, sea level, as determined by observations over various periods of time, varies in height due to a number of causes, such as variations in barometric pressure, winds, etc. A mean sea-level determination for a month may vary as much as 1 ½ feet from a determination made from observations covering another month, and that made from one year's observations as much as one-fourth of a foot from that from another year. It has been found that these variations of sea level, however, are much the same at points near each other and subject to similar meteorological conditions. In fact, these variations may be somewhat similar along a considerable stretch of coast line.

Since a period of 19 years constitutes a full tidal cycle, it has generally been considered that the results derived from 19 years of observations constitute mean results. From a study of the variations in sea level, the existence has been found of a prominent variation in sea level with a period of about nine years, and that for practical purposes nine years of observations may be taken to constitute a primary determination of mean sea level.

For tidal control along a coast, however, primary determinations of mean sea level need be made at only a few places. Advantage can be taken of the fact of the general similarity in variations of mean sea level over a considerable stretch of coast line for satisfactory determinations of secondary mean sea levels by means of observations covering much shorter periods, if the results are corrected to a mean value by comparison with some suitably located primary tide station.

For use in checking a line of precise levels, a sea-level determination was desired for Anacortes, Wash. A tide gauge was established and maintained for a three-year period at Anacortes and a mean sea-level determination of 19.73 feet on the tide staff obtained from these observations.

The Canadian Government, at the request of the Coast and Geodetic Survey, very kindly furnished the hourly tide readings for Victoria, British Columbia, for the same three-year period. These data from Victoria, with similar data from the tide station at Seattle, Wash., were used for correcting the three-year determination at Anacortes to the mean sea-level datum determined from long series at these two stations by comparison of the simultaneous observations.

TIDES AND CURRENTS IN PORTSMOUTH HARBOR, N. H.

by

A. J. HOSKINSON and E. A. LE LACHEUR.

in 8° - 98 pages - 29 figures - 37 tables.

Special Publication N° 150 of the U. S. Coast and Geodetic Survey. United States Government Printing Office, Washington, 1929.

Price: 20 cents.

To complete and co-ordinate various tide and current data now on file in the archives of the Coast and Geodetic Survey, this Bureau started in 1922 a series of comprehensive tide and current surveys of the important waterways of the country. Several of the more important

harbours of the country have at this date been completed, and the work is progressing as rapidly as the available funds permit.

In order to preserve the results of these surveys, combine and compare them with earlier records, and make the results available to all concerned, and at the same time guard against the possible loss or destruction of valuable information by fire or other causes, a special publication for each area has been printed and distributed as soon after the completion of the survey as possible.

The waterways that have been surveyed under this plan and for which information has been published were undertaken in the following order: New York Harbour, Special Publication N° 111; San Francisco Bay, Special Publication N° 155; Delaware Bay and River, Special Publication N° 123; Southeast Alaska, Special Publication N° 127; Boston Harbour, Special Publication N° 142; and the present publication on Portsmouth Harbour and tributaries.

The data and tables presented in this volume are based on the results of all the surveys that have been made in Portsmouth Harbor from 1850 to date, the most recent results being obtained from the tide and current survey of the harbour in 1926, namely Table 15, which indicates Harmonic Constants (mean of 4 series) for Portland Me., nearest standard station to Portsmouth Harbor.

A discussion of the general characteristics of tides and currents will be found in the appendix of this volume, which is a reprint of the first two sections of Special Publication N° 111.

MARÉS E PROBLEMAS CORRELATIVOS.

by

ALIX LEMOS, ACTING DIRECTOR OF THE OBERSVATORIO NACIONAL DE RIO DE JANEIRO.

4to - 92 pages - Rio de Janeiro - Typografia Leuzinger - 1928.

This monograph, which has been made the subject of two professorial lectures delivered at the Polytechnical School of the University of Rio de Janeiro, was drawn up with the object of encouraging scholars of the higher schools to take an interest in the static and dynamic theory of tides, and to present them with a clear explanation of the principles of harmonic analysis as applied to the prediction of tides.

The work is divided as follows :—

Static Theory : Equilibrium figure of the Ocean.
Fictitious bodies and extension of LAPLACE'S formula.
Harmonic analysis and prediction of tides.

Dynamic Theory : Investigations by LAPLACE.
So-called "Canal" theory.
Standard problems on dynamic theory.

In this publication, reference is made to the various classical works by: LAPLACE, DARWIN, LEVY, H. POINCARÉ, HOUGH, LAMB, and others. Mention is also made of some other scientific works published by Mr. Alix LEMOS, particularly of :—

REDUCÇAO DAS MARÉS PELO METHODO HARMONICO - "*Revista Maritima Brasileira*", Agosto 1912.

A PREDICÇAO DA MARE PELO "TIDE PREDICTOR" - "*Annuario do Observatorio Nacional*", 1912.

THEORIA DO SISMOGRAPHO - "*Annuario do Observatorio Nacional*", 1923.

ESTUDO DE ALGUMES TEMPESTADES MAGNETICAS NOTAVEIS - Traduzidas e publicadas pelo "*Terrestrial Magnetism and Atmospheric Electricity*" de Dezembro de 1920 e Setembro de 1921.

DESCRIPÇAO E THEORIA DOS VARIOMETROS DE ESCHENAGEN, 1923 - "*Boletino Magnetico*", 1915 to 1925.

CRITICA DAS HYPOTHESES MARCIANAS, 1 vol. br., 1924.

WIRELESS LONGITUDE

by

GEORGE D. COWIE and E. A. ECKHARDT.

in - 8° - 52 pages - 28 illustrations and figures.

U. S. Coast and Geodetic Survey Special Publication N° 109.
Washington Government Printing Office, 1924.

Price: 15 cents.

This publication was intended to describe the instruments and equipment used by field parties of the United States Coast and Geodetic Survey in the wireless determination of longitude; the method of setting up this equipment; its operation; the methods of observing, recording, and computing; and some precautions for avoiding difficulties.

As wireless apparatus are continually undergoing change, no pretense is made of covering the field of equipment used in the reception of wireless time signals. Some general principles of wireless, which should be understood, are referred to, and specific description given of receiving apparatus which has been used with success during the past.

The reader is referred to United States Coast and Geodetic Survey Special Publication N° 1, pages 7 to 102, for information regarding time and longitude work, and to Special Publication N° 35 for much data pertaining to longitude determinations with the Bamberg broken-telescope transit which has been used on wireless longitude work.

Historical notes on wireless longitude up to 1924, are given together with the description of the principal instruments used for wireless longitude determinations, *i. e.*, Bamberg broken-telescope transit, with transit micrometer; sidereal break-circuit chronometers; chronograph, with differentially wound pen magnet; three-stage radio amplifier; radio recorder; wireless longitude switchboard.

The outfit for Radio Longitude work comprises the following:—

LIST OF INSTRUMENTS.

Ammeter, pocket	1
Amplifier, radio	1
Batteries, storage, 6-volt	2
Batteries, B, 22 ½-volt	4
Batteries, grid C-3-cell flashlight, 4 ½-volt	12
Cases, leather, chronometer	2
Chronograph, with differentially wound pen magnet	1
Chronometer, sidereal, 2-second break-circuit	1
Chronometer, sidereal, hack, break-circuit preferred	1
Coil, 1,000-turn, with 3-foot leads for coupling	1
Compass, azimuth, prismatic	1
Condenser, chronometer	1
Condenser, 0.001 mfd. capacity as shunt for phones	1
Generator, or motor-generator, if batteries cannot be charged at service station	1
Headset, radio	1
Hydrometer	1
Lamps, hand electric	2
Micrometer for transit	1
Pens, fountain, for chronograph	2
Recorder, radio	1
Scale, glass, chronograph-reading	1
Switch, Lightning	1

Switchboard, longitude	1
Tape, steel, 100-foot	1
Theodolite, 4-inch	1
Transit, astronomical, Bamberg	1
Tubes, vacuum, radio-Western Electric N° 203 B	9
Tubes, vacuum, radio-Western Electric N° 209 A	3
Typewriter, folding	1
Voltmeter, 0 to 150 volts, Weston Instrument Co	1

List of Equipment.

Bits, screwdriver	2
Box, battery, for illumination of instrument	1
Box, for chronometers, felt-lined	1
Brace, carpenter's	1
Chairs, folding camp	2
Cots, folding	2
Desk, Army field	1
Drum for antenna and guy lines	1
Flies, tent	2
Ground, iron pipe	1
Hammer, claw	1
Hammer, sledge	1
Hatchet	1
Heater, oil	1
Insulator, lead-in	1
Lantern, gasoline, Coleman Quicklite	1
Lantern, common oil	1
Mercury, small bottle	1
Plaster of Paris, pounds	5
Pliers, combination	2
Poles, gin, set	1
Poles, antenna, set	1
Poles, tent, sets	2
Reel, for gin pole	1
Screwdrivers	2
Stove, oil, cook	1
Table, folding, camp	1
Tarps, bed	2
Tents, observing and living	2
Torch, gasoline, with soldering iron and solder	1
Tripod, aluminium, complete for mounting Bamberg transit	1
Wire, miscellaneous, for connections	00

Miscellaneous.

American Ephemeris and Nautical Almanac.
Baggage.
Bedding.
Chronograph sheets.
Logarithmic tables, Vega.
Mess gear.
Rations.
Record books.
Special Publication N° 14.
Stationery.

Instructions are given for selecting site and setting up antenna, installation of observing tents or wooden observatories, for astronomical work, and for the preparation and computation of time observations.

A few pages are devoted to theory of construction operation of radio set, and precautions in the use of radio-longitude outfit.

The use of wireless outfits to record time signals has made it possible to reduce the cost of longitude determinations and at the same time to keep the accuracy as good as, or better, than that by the best previous method, that is, the differential method by wire telegraph.

It is interesting to note that the cost per station of longitude by the wire method in 1921 along the triangulation arc from Little Rock, Ark., to Needles, Cal., averaged $ 700. The cost per station for wireless longitude in 1922 in Wisconsin, Colorado and New Mexico, using trucks for moving the outfit and personnel, was about $ 600.

A paragraph concerns specially latitude observations with Bamberg broken-telescope transit.

The Bamberg transit is arranged for latitude observations by substituting a latitude micrometer for the longitude micrometer eyepiece and adding a level attachment and counterweight to the horizontal axis of the telescope.

The HORREBOW-TALCOTT method should be used and the instructions given on pages 103-104 of U. S. Coast and Geodetic Survey Special Publication N° 14 followed.

The advantages in use of Bamberg instrument for latitude are that the instrument, when set up in the meridian for longitude work, requires about 15 to 30 minutes to change over for latitude work, so that both longitude observations, requiring 2 hours' time, and latitude observations, requiring 4 hours' time, may be made by a single observer in one night without undue effort.

TERESTRICKA NAVIGACIJA.

by

Commander JULIJAN M. LUTEROTI.

8vo, 335 pages, 175 figures.

"Jadran" printing office - Dubrovnik - 1927.

This handbook on Navigation was specially written for the information of the Royal Naval Academy of the Kingdom of the Serbs, Croats and Slovenes.

It was compiled taking all the modern improvements which go to make up latter day Navigation into account.

The book begins with General Remarks concerning the Earth and its magnetism. Dealing with these, it indicates the arrangement of various magnetic compass needles, such as the Bamberg compass, the Peichi compass, the Florian compass, etc....

It then goes on to study the various kinds of chart projections and the method of plotting bearings.

Chapter II contains a summary of the theory of magnetic compasses.

Chapter III deals with various methods of sounding, including echo-sounding, of various apparatus for recording the speed of a ship, such as the Walker, Cherub and Neptune logs, the Forbes log, etc...., and ends with a description of monostatic and stereoscopic telemeters.

Chapter IV deals with navigation within sight of land and of fixing position by submarine sound signals and by W/T.

Chapter V is given over to the study of great circle and rhumb line sailing.

Chapters VI and VII deal, at considerable length, with the determining of deviation of a magnetic compass, its regulation and a detailed account of its compensation.

Chapter VIII gives a brief account of the tides.

Chapter IX deals with the ANSCHUTZ gyroscopic compass and its accessories, particularly the automatic course tracer.

Chapter X explains some interesting problems in naval kinematics.

An Appendix gives some hints on the method of laying a course, on steering over it and on checking it, and on the method of keeping log books.

Two annexed tables give abbreviations and symbols used on English and German charts and their translation into Serbian and Italian.

NAUTICKE TABLICE ZA UPORABU U KRALJEVSKOJ MORNARICI.

(NAUTICAL TABLES FOR THE USE OF THE ROYAL NAVY).

8vo - 278 pages.

Drag., Gregorio Printing Office, Strahinjica Bana 93, Belgrade, 1928.

These tables, which complete the Navigation course previously mentioned in a most satisfactory manner, are made out, as concerns notation, for use in conjunction with the British "*Nautical Almanac*", and typical examples of the most important nautical calculations have been included.

In an early part of the book logarithms of numbers to 5 places of decimals, trigonometrical functions and some versines, and the natural values of some trigonometrical functions, are given.

In the second part are the usual tables for astronomical navigation, azimuth and amplitude tables.

In the third part tables for navigation near land are given, that is to say tables of position and distance to an object.

The fourth part gives some auxiliary tables: tables of distance by subtended angle, the various units of measurement used in various countries with conversion tables, the geographical positions of some of the principal places in the Adriatic and in the Ionian Sea; tables of distances from port to port for the Mediterranean and a diagram giving distance run according to time and speed.

INSTRUCTIONS TO MARINE METEOROLOGICAL OBSERVERS

in 8°. - 99 pages - 30 illust. and plates.

CIRCULAR M OF THE MARINE DIVISION OF THE WEATHER BUREAU, FOURTH EDITION.

Published by the *Department of Agriculture*, Washington Government Printing Office, 1925.

The provision that observations over the entire ocean should be made at the same moment of time is to make possible the construction of synoptic weather maps of large areas. While this object has been attained in part, nevertheless, owing to the varying observational requirements of different countries, the hope of a world synoptic weather map has never been completely realized.

The value of simultaneous observations has received fresh recognition with the development of radio communications. The exchange of weather advices at sea and the growing practice among ships' officers of constructing weather maps has had the effect of renewing interest in the entire subject.

Development in radiotelegraphy does not act to diminish the demands of meteorology upon seamen, but rather to increase them. There is compensation for this, however, in the form of weather bulletins and warnings broadcast by different meteorological services, the value of which has been amply testified to by recipients.

The material contained in these Instructions has been restricted for the most part to information considered essential or helpful in observational work.

For information on the general subject of meteorology, observers are referred to the publications named in the bibliography given on pages 79 to 81 of the Instructions.

Instructions for the transmission of observations by radio are contained in a separate publication, "*Radiographic Weather Code for Vessel Weather Observers*".

The book is divided into five parts :

Part I. — Instructions for the taking and recording of observations.
Part II. — Instruments.
Part III. — Clouds and Fogs.
Part IV. — Optical Phenomena.
Part V. — Utilization of weather data at sea.

This book contains a very complete glossary of the different terms employed in meteorology, a list of works on meteorology and a table of international meteorological symbols.

BAROMETERS AND THE MEASUREMENT OF ATMOSPHERIC PRESSURE

by

C. F. MARVIN.

in 8°. - 107 pages - 31 figures and tables.

CIRCULAR F, INSTRUMENT DIVISION- FIFTH EDITION N° 472 OF U. S. *Department of Agriculture.* Weather Bureau - Washington Government Printing Office, Reprinted 1919.

Price : 15 cents.

A pamphlet of information respecting the theory and construction of barometers in general, with summary of instructions for the care and use of the standard Weather Bureau instruments, containing : general principles concerning barometers and the measurement of atmospheric pressure, mercurial barometer, aneroid barometers, miscellaneous barometers, barographs, general instructions concerning the elevation of stations, a summary of special instructions for observers of the Weather Bureau, and numerical barometric tables.

THE THEORY OF THE GYROSCOPIC COMPASS AND ITS DEVIATIONS

by

A. L. RAWLINGS.

in - 8° - 191 pages - 65 figures.

MACMILLAN AND CO, LIMITED, St. Martin's Street, London, 1929.

Price : 10/6d net.

In the present volume, the author, late Principal Scientific Assistant in the Department of Scientific Research, Admiralty, formerly Superintendent of Instruction and Experiment at the Admiralty Compass Department, attempted to do for the Gyro-Compass what has already been done for Electricity and Radio, the theory of which has been so fully expounded by popular

books and journals that many of the mathematical formulae are known and understood by every enthusiastic amateur. The Gyro-Compass is now the centre of a considerable industry employing large numbers of people in England, America, Germany, and other countries. The efficient maintenance of the instrument in a ship calls for considerable theoretical knowledge on the part of the engineers of the firms who make the compasses and on the part of the sailors who use them. For a full understanding of the subject, an elementary knowledge of the Differential Calculus is necessary; but, at the same time the entirely non-mathematical reader has not been forgotten, and alternative explanations in plain language have been given wherever possible.

An attempt has been made, in the course of the book, to give some account of the development of the various forms of the Gyro-Compass and the inventors responsible for them.

The first three chapters are largely a re-statement of existing knowledge, but the remainder of the book is chiefly made up of new and original matter which has not yet been confirmed by other workers. The contents are as follows :—

I. — *Mathematical introduction :*

Vectors, angular momentum, effect of applying a couple. Precession of a gyroscope. Moving axes. HAYWARD'S equations. Differential equations.

II. — *General Theory of the simple Pendulous Gyroscopic Compass :*

North-seeking gyroscopes. Why the axle is kept horizontal. Application of HAYWARD'S equations. Directive force. Elliptical motion of the gyro axle. Speed and course error. Ballistic deflection. Canonical period of oscillation. Damping by couples round the vertical. Damping error. Damping factor. Damped and undamped periodic times. Viscous fluid damping. Conditions for stability. Classification of different types of compasses.

III. — *The Mode of Oscillation of the Gyro-Compass. :*

The graph of the compass oscillations. The equiangular spiral. Effect of damping on the period. Comparison between magnetic and gyro compasses. Effect of a gyroscope on the earth's rotation. Effects of friction.

IV. — *The Anschütz Compass :*

Description. Simplified analytical model. Comparison with the SPERRY compass. The new ANSCHUTZ compass.

V. — *The Brown Compass :*

Description. Equations on motion. Graph of the oscillation. Patent litigation.

VI. — *The Sperry-Harrison-Rawlings Compass :*

Development of compasses using liquid. Comparison with HENDERSON'S compass. Description. Equations of motion. Righting moment. Arithmetical constants. Effect of viscosity of liquid.

VII. — *Compensating Weights :*

Effect of asymmetry in a rolling ship. Analysis of the cause of consequent deviation. Equations and arithmetical values. Practical method of adjustment.

VIII. — *Intercardinal Rolling Error :*

First discovery. Quantitative analysis of the cause. Numerical results.

IX. — *Prevention of Intercardinal Rolling Error :*

ANCHUTZ and SPERRY methods. SPERRY floating ballistic gyro. HARRISON-RAWLINGS method. Laws of flow of mercury. Flow factor. Surface tension. Amount of reduction of error. Numerical results. BROWN'S method. Effect of gimbal dampers.

X. — *Damping-Acceleration Error :*

First experimental discovery. Cause and extent. Numerical results. Best damping ratios. The error exists with all damping systems. Effect of intercardinal accelerations.

XI. — *Gimballing Errors :*

Explanation of the cause. Calculation of the amount. The best arrangement of gimbal axes. Repeater compasses.

XII. — *Accuracy of the Gyro-Compass at Sea :*

Difficulty of accurate observations. Diverse conditions of service. Success of the gyro-compass in passenger ships. Record of deviations on an actual voyage in a small ship.

A special list of mathematical symbols used in the text is given.

THE ST. HILAIRE METHOD IN PRACTICE

by

W. E. SOMMERVILLE.

in 8°. - 102 pages - 37 figures.

BROWN, SON & FORGUSON, LTD., *Publishers*, 52 *to* 58 *Darnley Street, Glasgow*, 1929.

Price : 5 sh.

The object of this little book is to present officers of the Merchant Service with an exposition of the St. Hilaire or Intercept Method in its practical application at sea.

Written at sea, and primarily for the man at sea, various points have been dealt with as they have cropped up in practice, and the explanations submitted to officers on board before being passed. It is hoped from this manner of dealing with the subject to give some help with the numerous little perplexities and difficulties the average officer experiences when on the bridge or in the chartroom.

It is one of the first textbooks to use the *R* and *E* data, as now tabulated in the "*Nautical Almanac*", and, in explaining their relation to *R. A. M. S.* and Equation of Time, the author points out that both *R* and *E* are always + in the St. Hilaire problem, and gives the formulae for using them.

The author explains that the St. Hilaire method of finding the position line consists in calculating the *Z. D.* of the observed body from the *D. R.* position, and then comparing it with the *Z. D.* of the true position as obtained from sextant observation. The difference between them, called the "intercept", is the correction applicable to *D. R.* for the point through which the position line does pass.

He also illustrates how the intercept may be plotted on the chart.

The true interpretation of a set of sights is frequently missed because the worker deduces the value of the observations from the figures in the calculations instead of plotting the lines, or visualising them as they would be plotted. Particularly is this the case with a single sight.

For working the *C. Z. D.* problem, Captain SOMMERVILLE recommends and uses the Natural Haversine θ (theta) formula, worked from Tables giving log. havs. and nat. havs. side by side, though he also shows how it can be worked otherwise. Besides what may be called the typical Example, he gives a number of other worked Examples of combined altitudes of the Sun with the run in the interval, of simultaneous altitudes of several Stars, of combined observations of Sun and Land bearing, and of various other cases. There is also a chapter on High Altitude Observations with a special Table, and an Appendix dealing with Position by Meridian Altitudes and Equal Altitudes.

HANDBOOK OF BOAT NAVIGATION ON THE RHINE.

by

JEAN LHOTELLIER.

8vo, - 186 pages - 22 figures.

Edited by "*La Navigation du Rhin*", 10, place Gutenberg, Strasbourg, 1928.

This little handbook is published for the use of the Practical School of Rhine Boatmen conducted by the Chamber of Commerce of Strasbourg.

It was compiled by an old Master pilot of the Rhine flotilla, and contains general information on the Rhine regime, its characteristics, speed of current, low water, details relative to the various bridges and ferries and the navigational rules on this river.

The particular characteristics of the various sections of the river are explained with some details.

A chapter is given over to the study of the Rhine boats, with information concerning the more common manœuvres.

The last chapter and the Appendix explain the usual legislation concerning the licencing of boatmen and pilots, as well as the Police and Transport regulations on the Rhine.

ANNALES HYDROGRAPHIQUES.

(3rd SERIES. - EIGHTH VOLUME. - YEARS 1927-1928).

8 vo - 372 pages. - figures and plates.

Published by the *Service Hydrographique de la Marine* - Imprimerie Nationale - Paris - 1928.

This volume of the "*Annales Hydrographiques*" contains the preliminary report of the voyage of the *Pourquoi Pas?* for the years 1926 and 1927, and the reports of the French Hydrographic Expeditions to Algeria-Tunisia (1923-1925) and Indo-China (1925-1927).

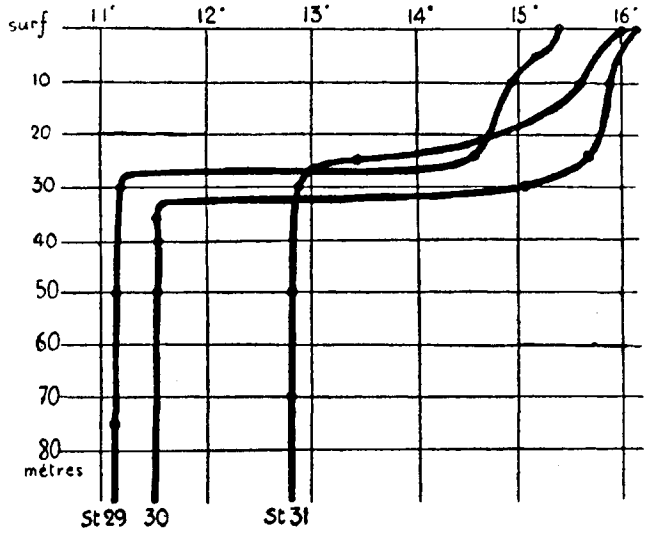
Besides this, there is an article by M. BERTIN on the radio-position line (*Droite-Radio*) which gives a simple and rapid method of employing radiogoniometrical bearings for fixing a ship's position, and a geometrical study by Commander MARGUET on the subject of the "spherical subtended angle" (*Segment capable sphérique*).

The preliminary report of the voyage of the *Pourquoi-Pas ?* contains a report on the tests of the new temperature and current-meters. The Current-Meter is M. IDRAC'S model which has already been described in "*Hydrographic Review*", Vol. V, N° 2, November, 1928, page 163. With regard to the *Temperature Recorder*, its object is to register the fluctuations of the temperature of the sea according to depth, without requiring that the ship be stopped as was often necessary on account of the state of the sea. It is based on the great sensitiveness of the bimetallic thermometer and its instantaneous reaction.

The thermometer is connected to the water by means of a small copper tube and its readings are registered on a blackened drum moved by a clockwork mechanism and surrounded by a thick box made to resist the great pressures of deep water. It takes up the sea temprature, within about two tenths of a degree, in less than three minutes.

In the neighbourhood of the Lizard, when the temperature varies greatly with the depth, the Temperature Recorder was lowered as far as 100 metres, then hauled up gradually to the surface by means of a windlass. Thus the curve of variation of temperature was obtained and

from this it was deduced that the sudden change in temperature of 2°, found on several occasions by the *Pourquoi-Pas ?*, took place in an extremely thin layer of water of two or three metres in thickness.



These tests of the IDRAC Temperature Recorder enabled the vertical curves of temperature, which in this privileged region have an altogether exceptional aspect, to be determined with more accuracy than before. The instrument enabled the exact trace of the *S*-shaped curves, already many times observed at the Lizard stations, to be obtained; the bends are not equally rounded and there is a very sharp hook at the moment when the temperature, after remaining constant from the bottom, begins to rise. From this it is concluded that the change from one layer of water to the other is much more sudden than one would venture to suppose, and that the warm waters truly glide over the cold waters called "Scilly Waters", without any noticeable trace of mingling or of exchange in temperature.

This sharp change on passing from one zone to the other had not been revealed in all its suddenness by taking the temperatures, even very close together in depth, by means of the ordinary reversing thermometer.

It may be affirmed that this is not a case of an occasional distribution, but of a peculiar condition which occurs regularly each summer, in spite of the violent tidal currents in that region.

The report on the Hydrographic Expedition to the coasts of Algeria and Tunisia, compiled by Ingénieur Hydrographe Principal MARTI, describes a certain number of new methods of which use was made during the work of the expedition; these methods having enabled a large amount of work to be done, it seemed interesting to make them known. Consequently, before the description of the work itself, the report contains some general notes on the methods put in practice, particularly :

Method of employing *survey beacons.*

Sounding from boats by means of the *fish-lead* to depths of 30 metres (98 ½ ft.).

Sounding by echo in depths between 35 metres (19 fms.) and 200 metres (109 fms.), which correspond to the limits of graduation of the receiving apparatus in use.

In the course of these operations, an auxiliary olive shaped sounding lead was used specially to obtain the *nature of the bottom.* A lead was used of the intermediate type of 30 kilogrammes (66 lbs) weight, with some holes bored in the fore-part of the lead in which tallow was inserted. When these leads are allowed to fall through the water, with the suspending wire, running out freely, they will reach the bottom at considerable speed and at a fairly steep angle on account of the small fins on the tail. When the bottom is of mud, the nose of the lead penetrates as far as the relatively solidly packed mud and the layer of plastic and sticky matter which remains on the lead does not become detached when it is hove up again because of the

regularity of its movement in the water; it is even necessary to use a brush to clean the lead before letting it go for a new cast. When the bottom is covered with sand and gravel, a sample of this nature of bottom sticks to the tallow.

It was noted during the Algerian expedition that echo-sounding sometimes failed to record when the gradient of the bottom became excessively steep and was more than 20 %. It was equally clearly shown that the ultra-sonic sounding apparatus is greatly superior, from the point of view of accuracy, to the lead line (it is, as a matter of fact, just about as good up to depths of about fifty metres (27 fms.) and superior at greater depths).

From the point of view of certainty it is clearly superior to the lead line, provided that attention is paid to certain elementary checks on the apparatus while in use.

The Officer in charge of the Expedition expressed himself as follows on this subject:

"It is quite unnecessary to take comparative soundings (by ultra-sonic apparatus and by lead line) with the object of checking the former; the question was considered in detail at the Centre d'Etudes de la Marine at the time of introducing the ultra-sonic sounding apparatus, and one can be quite certain that, if the apparatus is functioning normally it will give a correct sounding. All the same, comparative soundings obtained in the course of the work have the great advantage of acting as a check on the working of the apparatus; they act as a guarantee against some defect in the apparatus which might escape the attention of those working it. We believe therefore that, even though it be unnecessary to take many of them, it would be imprudent to neglect them completely. It seems to us that one comparative sounding per week should be laid down as the rule for surveying expeditions, it being understood that this check in no way interferes with the daily checks which should be carried out by the surveyors, and which, as will be seen later, are of the greatest importance for the proper conduct of the work. Comparative soundings should be taken with the vessel stopped, and, if possible, at depths of between 50 and 100 metres (27 and 55 fms.); the results should agree to within a metre (or at the most to within 2 metres); there should be no question, except for some definite reason, of taking any difference found between the two methods of sounding, as a regular correction of the acoustic system.

Since 1924, an arrangement has been fitted on board the three vessels of the expedition enabling the *ultra-sonic sounding* apparatus *to be used in heavy weather.*

It is known that the presence of air bubbles which are formed under the vessel in such weather is a complete obstacle to the passage of acoustic waves.

An arrangement is fitted which throws the air bubbles away from the hull to prevent them from collecting in the sleeve which connects the sluice valve of the ultra-sonic sounding apparatus to the hull. The sleeve is fitted with a lid making it water-tight and it is filled with water from inboard. This arrangement clearly does not prevent clouds of air bubbles from affecting the working of the sounding apparatus when they form under the sleeve, but it limits the effect of each cloud to the instant during which it covers the entrance to the sleeve.

Deep-water soundings were obtained in depths of over 200 metres (109 fms.) and up to 2,000 metres (1094 fms.) *by using the detonator sounding apparatus.*

BULLETIN OF THE OCEANOGRAPHIC INSTITUTE

FOUNDED BY ALBERT I, PRINCE OF MONACO

N° 528 - 15th November, 1928.

SCIENTIFIC CRUISE ON BOARD THE "HIRONDELLE II"

End of 1914-1915

LIST OF STATIONS.

(in 8° — 7 pages)

This Bulletin gives a list of 54 oceanographic stations made off the coast of Provence.