METHODS OF RECRUITING AND TRAINING SURVEYING ASSISTANTS.

The Delegates to the 4th International Hydrographic Conference held in April 1937 expressed the desire that the International Hydrographic Bureau should institute enquiries as to the Method of Recruiting and Training Assistant Surveyors or other Ratings specially trained to this work adopted by the various Hydrographic Offices, and publish the result of such enquiries in the *Hydrographic Review.*

The Directing Committee therefore issued a Circular Letter requesting information under the following special headings :-

a) Whether applicants for the post of Assistant Surveyor are required to undergo any special course of instruction before being accepted.

b) If such special course is instituted, the syllabus of such course, where carried out and duration of same, also any other useful particulars regarding it.

c) If such special course is not instituted, the method adopted for training Assistant Surveyors and other special Ratings after entry.

d) The qualifications required by each grade of Assistant Surveyor and special Rating before they are considered eligible for advancement to a higher grade may also be supplied together with information as to the average number of years Assistants serve in each grade.

e) A list of Technical Publications supplied for the information and instruction of Assistant Surveyors or other special Ratings.

The following is a synopsis of the replies received up to the time the present number of the *Hydrographic Review* went to press ; other replies will be published in subsequent numbers as received :

ITALY.

a) The candidates are Naval Officers who attend a special course of instruction at the Istituto Idrografico, Genoa.

The said officers obtain the qualification for hydrographic service (Commission "I") in the rank of a Naval Lieutenant after a theoretical course of about 6 months, which is followed by an apprenticeship aboard a surveying vessel.

The examination subjects for obtaining Commission "I" are, in order of importance :-

Astronomy : With particular reference to the instruments and methods of observation.

Geodesy : Geodetical lines. Various developments. Transport of co-ordinates. Adjustment of topo-hydrographic triangulations.

Hydrography : Theoretical and practical.

Geophysics : With particular reference to meteorology and oceanography.

Magnetism : Which includes Ship's Magnetism, Terrestrial Magnetism and a course on Radiogoniometry.

b) The higher technical-scientific specialisation in Nautical Science and Hydrography (Commission "IS") is obtained by Officers already qualified for the hydrographic service after another theoretical course at the Istituto.

The examination subjects for obtaining the Commission "IS" are, broadly speaking, the following :-

Geodesy : Error theory. Adjustment of geodetical systems. Deflection of the plumb line. Gravity measurements. Orthometric levelling. Theory of cartographic projections.

Astronomy : More comprehensive examination on instruments and methods of observation.

Geophysics : Which includes a course of meteorology and oceanography together with one on radioacoustics.

Terrestrial Magnetism : With particular regard to the various theories of the terrestrial magnetic field and its variations. Relation between the same and the electric phenomena of the atmosphere and the solar activity. Measurement of the variations of the magnetic elements, etc.

Ship's Magnetism : Study of the construction of the compass and problems relating thereto.

c) The course "I" is held every year, whereas the course "IS" is held approximately every other year.

d) The text-books used by the Officers comprise pamphlets compiled from time to time by the instructors in the various courses.

DENMARK.

The surveyors of the Danish maritime survey are all naval officers on the active list. Two of them are heads of 1st and 4th Sections of the Hydrographic Office. A certain number of the others are serving as assistant surveyors.

Recruiting and Training: The surveyors are recruited from the younger officers who have been serving on board surveying-vessels and during this time have taken an interest in the work and have been commended for their ability. Those who wish to become surveyors then undergo a special Geodetic Course at the Army College and get the same theoretical training there as the Army officers and other personnel who later on work in the Service of the Geodetic Institute of Denmark. The course, which is the only one where Geodesy is taught, lasts 18 months. After that the officers serve on board the surveying vessels during the summer, and at the Hydrographic Office during the winter.

During the winter they undergo special training in Photogrammetry at the Geodetic Institute and one or two of them also act as instructors of Navigation at the Naval College.

In fixing the training programme the Danish Hydrographic Office has had in mind that the officers should have the greatest possible knowledge of Geodesy and Navigation before they can become heads of one of the Sections of the Hydrographic Office.

The scheme described is rather new, but since 1919 the Directors have had geodetic and navigational training, and since 1927 no officer has been appointed to one of the sections without having had a full geodetic training, and if possible they have had navigational training as well. It is hoped in future to continue on the lines now adopted as these have proven most successful.

GREAT BRITAIN
ROYAL INDIAN NAVY
AND AUSTRALIA

Surveying Assistants are recruited from the Executive Branch of the Royal Navy and are all Volunteers.

No special course of instruction is provided either before or after acceptance.

After acceptance, officers are appointed to Surveying Ships as vacancies occur, with the grade of 4th class Assistant Surveyors. They then receive instruction from the Officer in charge of the Survey and his senior assistants, and are provided with opportunities for obtaining the necessary all-round experience for each grade of Assistant-Surveyor.

The advancement of Assistant-Surveyors depends on the experience gained and the special aptitude shown by each individual, combined with the degree of reliability to be placed on his work. The normal minimum periods in each grade before advancement are as follows:-

As 4th class Assistant Surveyor	.....	1 ½ years.
As 3rd » » »	.....	2 ½ »
As 2nd » » »	.....	3 »

Advancement before the completion of the above periods is only made in cases where a special recommendation for accelerated advancement is specifically included in the report from the Commanding Officer. Advancement to the grade of Assistant Surveyor 1st class, is only granted to officers whose professional knowledge and experience fit them to direct efficiently the operations of a survey in the temporary absence of the Captain, and who are competent to take sole charge of a survey.

It is considered neither necessary nor desirable to hold any formal examination before advancement to a higher grade; opportunities occur almost daily of testing the knowledge and proficiency of an officer; the qualifications required by each grade of Assistant Surveyor before they are considered eligible for advancement to a higher grade are, however, as follows:-

For Assistant Surveyor 3rd Class :

1.— Sextant. Errors, adjustments and silvering glasses.

2.— Theodolite. Adjustments.
Methods of observing and ability to observe.
Topographical sketching.
Observations for true bearing of sun.
Levelling.
Heights.

3.— Heliostat. — Use of GALTON and other sun signals.

4.— Fixing Position. Principles involved in the resection of a point.

5.— Boat Sounding. General skill, thoroughness and reliability.
Ability to plan lines of soundings.
Effect of error in lead line.
Use of sounding machines.

6.— Coastline. Skill in delineating the features of a coast.
Skill in depicting the topographical features bordering a coast.
Accuracy and quickness of work.
Skill in sketching coastline from a boat.
Determination of heights along the shore line.

7.— Subtense methods including the use of tacheometers and 10 foot pole.

8.— Marking the coast. Skill in selecting proper positions for marks, and in choosing suitable objects by which to fix them.
Knowledge of the principles involved in fixing coast marks.
Celerity and resource in putting up marks with material at hand.

9.— Bases. Masthead angle base from two stations.
Measuring a base and correcting it.
Base by astronomical observations.

10.— Sun observations. In artificial horizon.
At sea.

11.— Comparing chronometers. Ability to obtain W/T Time Signals.
Ability to rig portable W/T set.

12.— False station. Knowledge of the principles upon which the correction is made and how to minimise it.
Facility shown in correcting angles.

13.— Handling boats. Judgment and skill under difficult conditions of weather, landing, tidal influence, etc.

14.— Ship Sounding.

15.— Deep sea sounding.

16.— Draughtsmanship. Neatness.
Squaring down from larger scales.

17.— Knowledge of horizontal and subtended angle at the same or different elevations, and how to correct to the horizontal.

18.— Knowledge of co-ordinates and their use and the simple calculations concerned therewith.

19.— Principles of plotting and computations.

For Assistant Surveyor, 2nd Class :

In addition to the foregoing an officer should have adequate knowledge and experience of the following subjects :-

20.— Tides. Determining datums.
Referring one tide gauge to another in places where establishment and range differ.
Familiarity with the Tidal Returns and information required by the Hydrographic Department.
Knowledge of the inferences to be drawn from the position of the sun and moon.
Precautions necessary in establishing a tidal station.
Knowledge of tidal stream and current observations and methods of rendering reports on them.

21.— Topography. Skill in sketching topography by walking over the ground. Plane tabling.
Skill in sketching topography from ship or boat.

22.— Star observations. Ability to prepare lists of stars, and to observe for geographical position with theodolite and prismatic astrolabe.
True bearing of a star.
Ability to observe stars in artificial horizon.
Ability to observe stars by sea horizon.
23.— Convergency of meridians. Familiarity with the subject and appreciation of the various ways and circumstances in which convergency has to be taken into account.
24.— Plotting. Ability to plot all the points of any plan.
Full knowledge of the use of co-ordinates.
25.— Survey of a river.
26.— Ability to frame Hydrographic Notes.
27.— Sound knowledge of all types of Echo Sounding Gear.
28.— Chronograph. Full knowledge of the use, etc. of the electric chronograph and its accompanying adjuncts.
29.— Knowledge of taut wire gear.
30.— General knowledge of sweeping gears.
31.— Ability to use a typewriter for the purpose of rendering trigonometrical data.
32.— Knowledge of W/T receiving sets and ability to obtain Rhythmic Time signals.

For Assistant Surveyor, 1st Class :

An officer should be thoroughly experienced in the whole of the foregoing, should be capable of conducting a survey independently and possess the following qualifications:-

33.— Running surveys. Familiarity with the methods of securing the best results from angles taken from a position not absolutely stationary, by the selection of suitable zeros, etc. and the principle on which such practice depends.
34.— Floating Beacon Surveys, the methods and refinements of which they are capable.
35.— Thorough knowledge of how to construct a coast survey without the use of a linear base, and use of taut wire base, in this connection.
36.— Triangulation. Quickness of apprehension in selecting most suitable spots for main and secondary stations, and ability to build up a comprehensive triangulation scheme for coast survey of large extent.
37.— Calculation of an extended triangulation, including the calculation of astronomical positions, treating the earth as a spheroid.
38.— Plotting and Graduation of Charts of the largest size.
39.— Ability to frame concise Sailing Directions.
40.— Knowledge of the errors involved by the deflection of the plumb line and how to minimise and avoid them.
41.— Ability to deal with difficult problems in practical surveying as they arise, by the display of initiative, and capacity to devise methods suitable to particular cases.
42.— Sweeping. Thorough knowledge of the methods adopted for sweeping for rocks or other obstructions.
Streaming and recovering a sweep, and a thorough knowledge of the gear.
43.— General knowledge of the methods of Chart Production.

In addition to the above details, all Assistant Surveyors are expected to have a knowledge of meteorology commensurate with their service.

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In addition to the Surveying Assistants above-mentioned, a certain number of Lower Deck Ratings are allowed to qualify as Surveying Recorders. There are three classes of Surveying Recorders and as a general rule each Surveying Ship working abroad carries three of those ratings, two being allowed to each Home Ship.

The following qualifications for advancement are intended mainly as a general guide, and Commanding Officers may, at their discretion, recommend ratings for advancement in class even if they have not *all* the necessary qualifications. At least two years' experience in each class is normally considered necessary before examination for advancement.

For Surveying Recorder, 3rd Class :

1.— A good knowledge of the names and uses of all surveying instruments used for hydrographical surveying.
2.— Ability to use the sounding sextant, and station pointer, to make adjustments and apply errors.
3.— A thorough knowledge of the boat's sounding machine.
4.— Complete knowledge of the making and marking of lead lines and checking their accuracy.
5.— Ability to set up a Tide Pole at a chosen site.
6.— Ability to erect and improvise surveying marks with a knowledge of the first principles of selecting suitable sites.
7.— A thorough knowledge of the selection and use of "transits".
8.— Ability to write down legibly and accurately any work in the field other than for astronomical observations; acquaintance with the symbols and abbreviations in general use.
9.— Elementary knowledge of Echo Sounding gear.
10.— Thorough knowledge of Sweeping Methods.
11.— Thorough knowledge of Taut Wire Measuring Gear.

For Surveying Recorder, 2nd Class :

As above, and in addition :-

1.— A thorough knowledge of the station pointer and all forms of protractors, with a knowledge of the situation of objects which will constitute a "good fix".
2.— A practical knowledge of, and ability to use, a theodolite and prismatic compass in the field, and straight edges, beam compasses, and other instruments used for plotting.
3.— Ability to use a GALTON sun signal and heliostats generally.
4.— A knowledge of the use of Oceanographical gear.
5.— A knowledge of the use of "special surveying stores".
6.— Knowledge of use and adjustment of the deep sea sounding machines.
7.— Ability to mark a simple stretch of coast.
8.— Ability to make rough tracings.
9.— Ability to record time accurately for astronomical observations.
10.— A practical knowledge of false stations and ability to use the false station corrector diagram.
11.— Competence to act as assistant to the officer-in-charge when "ship sounding".

For Surveying Recorder, 1st Class :

As above and, in addition :-

1.— A thorough knowledge of use and adjustment of theodolites.
2.— A thorough knowledge of the use of all special surveying stores and instruments.
3.— Ability to reduce soundings.
4.— Ability to select a site for, set up, and level up a Tide Pole.
5.— Ability to solve triangles by plane trigonometry and logarithms.
6.— Reasonable proficiency as a draughtsman.
7.— Ability to make a secondary triangulation station and ability to make a simple panoramic sketch.
8.— Ability to take sole charge of a boat for sounding on any scale up to that of 3" = 1 mile, and undertake coast lining including use of subtense instruments.
9.— Judgment and ability in handling boats under all conditions.
10.— Ability to operate a chronograph.

PORTUGAL.

Hydrographic Engineers are recruited from subordinate Naval Officers, and form a special branch under the Ministry of Marine. They direct and carry out the work of Hydrography, Oceanography, Seismology, Beaconage and Lighthouse Service.

The grades in this corps in order of seniority are :-

Captain Hydrographic Engineer.
Commander Hydrographic Engineer.
Lieutenant-Commander Hydrographic Engineer.
Lieutenant Hydrographic Engineer.
Sub-Lieutenant Hydrographic Engineer.

2. The recruiting of Hydrographic Engineers is effected by means of the written competitive examination between Lieutenants and Sub-Lieutenants of the Navy, those candidates being chosen who have obtained the best classification in the course at the Naval College for promotion to Sub-Lieutenant.

3. The course for Hydrographic Engineers comprises the study of the following subjects and practical apprenticeships :-

Subjects.

a) At the Naval College : Development of differential and integral calculus and of rational mechanics.

b) At the higher Technical Institute or at the Faculty of Engineering : General hydraulics, resistance of materials, stability of structures, maritime and river hydraulic engineering.

c) At the Faculties of Sciences : Geology, physical geography, refresher in astronomy.

d) At the Direcçao Geral da Marinha - Higher hydrography (1st Part), including : hydrography, geodesy, chart projections, rudiments of descriptive geometry, projective geometry and photogrammetry, astronomical hydrography and the respective practical training.

Higher hydrography (2nd Part) including : rudiments of oceanography and seismology, tides, shore problems, rivers and seas.

Terrestrial magnetism and correlative rudiments of heliophysics, electric meteorology and precision meteorology. Respective practical training.

Practical Apprenticeships.

a) At the astronomical Observatory of Lisbon, including observations of hearing and sight — three months which will be carried out immediately after the examination of the 1st Part of the course of higher hydrography.

b) At the geophysical Observatory of Coimbra - one month, or, in default thereof, determination of the magnetic elements on land and at sea.

c) At the Direcçao Geral da Marinha - five months and twenty - five days apportioned as follows : on board a surveying vessel : one month ; on board an oceanographic vessel : a fortnight ; at the Direcçao de Hidrografia, Navegaçao e Meteorologia Nautica e Direcçao de Farois : one month ; in field and sea work - sixty lay days followed by twenty - five days office work ; at the Vasco da Gama Aquarium, analysis service : a fortnight.

The final examination in higher hydrography (2nd Part) is held after the execution of the field and sea work.

d) At the Instituto Geografico e Cadastral : one and a half months for studies of photogrammetry, gravimetry and deflection of the plumb line.

e) At the Divisao or Secçao dos Serviços Hidraulicos where harbour engineering has been going on : two months.

4. The special requirements for promotion in the corps of Hydrographic Engineers are:-

a) For promotion to Lieutenant Hydrographic Engineer :-

1. To count 4 years in the post of Sub-Lieutenant in actual service in the Navy in ordinary commission.

2. To have served on a commission aboard as Sub-Lieutenant for a period not under 2 years and have accomplished 60 voyages in this post.

b) For promotion to Lieutenant-Commander Hydrographic Engineer :

1. To count 4 years in the grade of Lieutenant or Lieutenant Hydrographic Engineer in actual service in the Navy in ordinary commission.

2. To have served on a hydrographic commission afloat as Lieutenant or Lieutenant Hydrographic Engineer for a period not less than 2 years, having been for at least 6 months outside ports, have accomplished 30 voyages in this grade and have developed a complete hydrographic plan.

c) For promotion to Commander Hydrographic Engineer :-

1. To count three years of actual service in the Navy as Lieutenant-Commander Hydrographic Engineer in ordinary commission.

2. To have, as head of a hydrographic or oceanographic expedition, twelve months service in a ship, of which six in the capacity of Lieutenant-Commander Hydrographic Engineer.

d) For promotion to Captain Hydrographic Engineer :-

1. To count three years actual service in the Navy as Commander Hydrographic Engineer in ordinary commission.

2. To have conducted as Commander Hydrographic Engineer the studies of a port or headed one of the Bureaus of Lighthouses, or of Fisheries, or else any of the Departments of the Direcçao de Hidrografia, Navegaçao e Meteorologia, for at least one year.

SWEDEN.

a) The Assistant Surveyors are Officers or Warrant-officers in the Navy or Officials of the Hydrographic Office.

All the applicants have to undergo a small theoretical course before the surveying season begins and are then, during the first summer, trained practically on board the surveying vessels.

b) The theoretical course is carried out at the Hydrographic Office and has at present a duration of about one month, but the intention is to increase it to three months. The practical course continues during the whole surveying-season : about five months.

c) Those Assistant Surveyors, who are Officers or Warrant-officers, remain in the surveying service for three years, after which they serve periodically in the Navy. In all there are at present twelve Officers, five Warrant-officers and five Officials of the Hydrographic service employed in the surveying service each summer. Two Officers and one or two Warrant-officers are permanently employed at the Hydrographic Office.

The geodetic surveys are carried out by Officials of the Hydrographic Service.

Handledning i Sjömätning, published by the Hydrographic Office, is principally used for the instruction of the Assistant Surveyors. Other information is given by instructors attached to the courses.

CANADA.

In the Hydrographic Service of Canada applicants for the post of Hydrographer Grade I (Assistant Surveyor) are not required to undergo any special course of instruction before being accepted. There is, consequently, no syllabus of such a course. However, no candidate without a degree in science from a University of recognised standing is accepted.

New appointees are assigned to the various surveys under an Officer-in-Charge. In the beginning they are actually student assistants; their duties and responsibilities are increased with their experience and the aptitude which they show for the work. They are urged to become thoroughly familiar with the British Admiralty Reference Book, *Hydrographical Surveying* by WHARTON and FIELD, and to study such other text-books as may contain information useful to Hydrographers. The importance of higher mathematics is stressed.

The qualifications and duties presently effective for each grade are as follows, but it is likely that corrections will be made to these qualifications and duties in the near future.

Hydrographer Grade 1 :

Definition : Under direction, to assist in making surveys of shore lines, and sea, lake and river bottoms; to perform triangulation, traversing, sounding and tidal investigation work; when required, to have charge of the work of small parties; and to perform other related work as required.

Qualifications : Education equivalent to graduation in engineering from a school of applied science of recognized standing with at least two years of surveying experience

preferably in hydrographic survey work, or four years of engineering experience, two years of which shall have been in hydrographic survey work; tact, good judgment and ability to manage men; good physical condition.

Hydrographer Grade 2 :

Definition of Class : Under direction, to have charge of a sub-party engaged in making hydrographic surveys of inland or coastal waters; in some cases to assist the officer in charge of a party engaged in a minor or major survey and to perform other related work as required.

Qualifications : Education equivalent to graduation in engineering from a school of applied science of recognized standing with at least three years of surveying experience, preferably in hydrographic survey work, one year of which shall have been in a position of professional responsibility, or five years of engineering experience, three years of which shall have been in hydrographic survey work; knowledge of navigation; tact, good judgment and ability to manage men.

Hydrographer Grade 3 :

Definition of Class : Under the direction of the Chief Hydrographer to have charge of a minor survey party or a group of sub-parties engaged in making hydrographic surveys of inland or coastal waters; in some cases to assist the officer-in-charge of a major survey party, or to have charge of an auxiliary or detached party; and to perform other related work as required.

Qualifications : Education equivalent to graduation in engineering from a school of applied science of recognized standing with at least five years of surveying experience, preferably in hydrographic survey work, three years of which shall have been in a position of professional responsibility, or seven years of engineering experience, four years of which shall have been in hydrographic survey work; knowledge of navigation; tact, good judgment and ability to manage men.

Hydrographer Grade 4 :

Definition of Class : Under the direction of the Chief Hydrographer, to be responsible for the work of large parties engaged in making a major hydrographic survey of inland or coastal waters; to take executive charge of a ship engaged in survey work; and to perform other related work as required.

Qualifications : Education equivalent to graduation in engineering from a school of applied science of recognized standing; at least seven years of experience in surveying work, five years of which shall have been in responsible charge of hydrographic survey work; knowledge of geodesy; ability to navigate a vessel; firmness, tact, good judgment and ability to manage men; good physical condition.

The average number of years served in each grade is a question which cannot be answered accurately. It is determined by several factors of which meritorious service is only one. In the higher grades, of course, promotions are necessarily governed by available vacancies and the rate at which expansion of the survey may occur. However, an approximation, based on what has taken place during the past twenty-five years, might be stated as follows :-

Number of years an Assistant spends in Grade 1 ..... 13 years.
" " " " " 2 ..... 11 "
" " " " " 3 ..... 8 "

Advancement beyond Grade 4 is very limited as the only line of promotion is to Senior Hydrographer and the Chief of the Service.

Technical publications usually supplied are as follows:-

Hydrographical Surveying — WHARTON & FIELD.
General Instructions to Hydrographic Surveyors — British Admiralty.
British Admiralty Manual of Navigation.
British Admiralty Manual of Seamanship, Vols. I & II.
Wrinkles in Practical Navigation — LECKY.
Navigation — NORIE.
Practice of Navigation — RAPER.
The Practice and Theory of Navigation, Vols. I, II, & III — DUNRAVEN.
Theory and Practice of Surveying — JOHNSON-SMITH.

Hints to Travellers, Vol. I — Royal Geographical Society.
Field Astronomy for Engineers and Surveyors — CLARK.
Astronomy for Surveyors — CHAPMAN.
Spherical and Practical Astronomy, Vols. I & II — CHAUVENET.
Sun Azimuth Tables — BURDWOOD.
Tables for the Polyconic Projection of Maps — U. S. Dept. of Commerce.
Elements of Map Projection — U. S. Dept. of Commerce.
Formulas and Tables for the computation of Geodetic Positions — U. S. Dept. of Commerce.
Table of Logarithms — SHORTREDE.
Mathematical Tables (7 figures) — CHAMBERS.

UNITED STATES OF AMERICA.

HYDROGRAPHIC OFFICE

I. HYDROGRAPHIC ENGINEERS (CIVILIANS)

a) The positions of Hydrographic engineers employed on United States Naval surveys are filled by appointment from a list of eligibles furnished by the promotion from lower grades with the approval of the Civil Service Commission.

There are four grades of engineers employed, the qualification requirements for which vary as follows:-

Junior Engineer (*Professional Grade 1*).

Minimum Qualifications : Training equivalent to that represented by graduation with a degree from an institution of recognized standing with major work in courses tending to develop knowledge of the fundamentals of one or more of the major subdivisions of the engineering field.

Assistant Engineer (*Hydrographic*) (*Professional Grade 2*).

Minimum Qualifications : Same as for Junior Engineer with the addition of three years' experience in the particular major subdivision of the engineering field on which engaged or similar experience of equal value.

Associate Engineer (*Hydrographic*) (*Professional Grade 3*).

Minimum Qualifications : Same as for Junior Engineer with the addition of four years' experience in the particular major subdivision of the engineering field on which engaged or similar experience of equal value.

Engineer (*Hydrographic*) (*Professional Grade 4*).

Minimum Qualifications : Same as for Junior Engineer with the addition of five years' experience in the particular major subdivision of the engineering field on which engaged or similar experience of equal value, and demonstrated professional and administrative ability.

Original appointments to the Junior and Assistant Engineer grades are made by selection from a list of eligibles furnished by the Civil Service Commission from its register of Civil Engineers, preference being given to those with experience in hydrographic work.

No special course of instruction, other than that mentioned in "Minimum Qualifications" given above, is required.

b) None.

c) The training of hydrographic engineers, after entry into the service, for advancement in grades is confined entirely to actual experience in the field. The Hydrographic Office publishes a *Manual of Hydrographic and Geodetic Surveying*, which contains instruction and standard requirements for hydrographic and geodetic work as conducted on United States Naval surveys.

II. NAVAL OFFICERS.

Each year, two or three officers of the rank of Lieutenant (Junior Grade) are assigned to the Hydrographic Office, for a period of approximately one year, for a course of instruction in hydrographic and geodetic surveying under a senior hydrographic engineer (civilian) who has had wide experience in the field.

The course is directed principally toward preparation for field astronomical observations, hydrographic surveying, and the compilation of charts from survey sheets. Its duration is about a year, with eleven weeks at the Naval Observatory and the remainder at the Hydrographic Office.

The course at the Naval Observatory embraces triangulation, traversing, levelling, the use and repair of surveying instruments including compasses, the care of chronometers, the transmission, reception, and use of time signals, the determination of latitude by the TALCOTT method, the determination of local time with the transit instrument, the determination of instrumental constants, and the reduction of stars to mean and apparent place.

The course at the Hydrographic Office is divided among the Divisions of Chart Construction, 29 weeks; of Air Navigation, 1 week; and of Maritime Security, 11 weeks.

Instruction in the Division of Chart Construction embraces triangulation computations pertaining to extended coast surveys, the plotting of smooth sheets from field notes, and the plotting of topography from aerial photographs. In addition, the whole process of making charts from survey sheets is taught step by step. The compilation of charts from all sources is studied both in this Division and in the Division of Air Navigation.

Instruction in other Divisions is concerned with compilation of notices to mariners and aviators, radio aids, ocean routes, pilot charts, oceanography, the correction, distribution, and publication of charts, and certain matters of organization and administration.

In general, officers assigned to survey duty are expected to familiarize themselves with the nature of the duty by reading the Hydrographic and Geodetic Manual, and, before sailing, are given a short reading and observation course at the Hydrographic Office. Those selected for the more intensive course described above keep formal notebooks, and with respect to studies in surveying, perform the computations outlined in the pamphlet entitled: "Short Course in Computations".

III. NAVAL RATINGS.

The enlisted men assigned to duty on surveying vessels receive their training in hydrographic work entirely through experience gained during their tour of duty.

URUGUAY.

a) No special course of instruction is required for applicants to the post of Assistant Surveyor before being accepted, these applicants being regular naval officers who have studied hydrography in the Escuela Naval.

b) Answered in (*a*).

c) Young officers are trained in the work by experienced officers.

BRAZIL.

a) The duties of Surveying Officers are discharged by Officers of the Corps of Naval Officers, qualified as specialists, of the rank of Lieutenant-Commander or Lieutenant, from the time of termination of the course of Navigation and Hydrography.

b) This course, which is conducted at the seat of the Directoria from April to November by instructors who are Surveying Officers, has functioned normally since 1933, but has been interrupted this year for the convenience of the service.

This interruption being exceptional, the authorities have arranged that in the meanwhile the Officers designated to specialise shall serve in a surveying vessel prior to the course being resumed. The subjects of the course are divided into 3 classes as follows:-

(1) Geodesy, Astronomy and Navigation;

(2) Topography, Photogrammetry and Cartography;

(3) Terrestrial Magnetism, Oceanography and Meteorology.

As a supplement to the course, each squad of Officer-Students carries out, under the direction of the Officer-Instructors, the survey of a small port, lasting approximately one month.

c) There is no special training in Hydrography for Petty Officers nor any special instruction for the subordinate personnel, which is trained on board the surveying vessel during service.

CHILE.

1. The staff for the hydrographic surveys is appointed by the "Oficialidad de la Armada" as there are no other qualified Hydrographers.

2. Without prejudice to his general studies an Officer may undergo a course which specializes him in Navigation and Hydrography.

3. At the Naval College the Cadet studies the theory of Navigation and Hydrography.

As a Midshipman he follows a course of practical instruction in the same branches.

As a Sub-Lieutenant he serves as Assistant in hydrographic surveys.

As a Lieutenant he may undergo a special course of Navigation and Hydrography and obtain the title of specialist. In this rank he has to carry out important work in the surveys.

As a Commander he is in charge of Hydrographic expeditions.

4. The whole of the hydrographic activity is directed by the Departamento de Navegacion e Hidrografia whose various Divisions are in charge of Officers on the Active List and retired Officers of the Navy who keep themselves thoroughly acquainted with their respective activities, and are under the Director of the Department.

The latter is assisted by a Mathematician with general knowledge of Hydrography and Geodesy who is, as far as practicable, an ex-Naval Officer.

5. To summarize, for the Hydrographic Service there are the Officers of the Fleet, and for the Directing Department, as Heads of Divisions and Assistants, Officers of the Navy on the active List, and a staff of retired officers of the Navy who devote themselves in particular to the branch of their respective Divisions.

6. The Departamento de Navegacion e Hidrografia draws up the instructions for each survey and the parties entrusted with their execution study them attentively prior to commencing operations in the field.

In these instructions is clearly set forth the degree of accuracy to be obtained in the various operations according to the conditions under which the work is going to be carried out.

This study, previous to the hydrographic expedition decreed, greatly facilitates the task as the Officers have thus only to go over, or recall to mind, that followed in the Naval College and reviewed in a more practical sense in the different courses for officers.

General Remarks.

Hydrographic training begins at the Naval College where the Cadet acquires all the theoretical preparation of that branch. As for the practical preparation, this is acquired in the field discharging various duties during the surveys, from the most simple, in the rank of Midshipman, to the most intricate in the ranks of Lieutenant-Commander and Commander. Nevertheless, some practical work is also carried out at the Naval College by those students to whom but little time is available.

Officers of the rank of Sub-Lieutenant on board the school-ship reperuse their Naval College studies, carry out a simple but complete survey and undergo an examination for promotion to the rank immediately higher. In this rank they have the opportunity of obtaining practice by taking an effective part in real surveys in the southern regions of the country. For their promotion to the next rank they have to pass an examination in Hydrography.

In the rank of Lieutenant they have to carry out important duties in surveys such as astronomical observations, higher order triangulations etc.

As First-Lieutenants and Lieutenant-Commanders they may become Officers in Command on scout cruisers and are commissioned generally in these craft to perform continuous surveys in unknown areas, having to navigate often in badly surveyed zones of which there exist only simple sketches which require rectifying.

This system of hydrographic activity has yielded very good results in practice, bearing in mind that the Departamento de Navegacion e Hidrografia has the full supervision of all the work and keeps in constant touch with the various vessels working in the field.

FRANCE.

1. *NAVAL OFFICERS.*

Lectures delivered at the *Ecole Navale* and the *Ecole d'Application* include a complete course on Astronomy and elementary courses on Surveys and Tides. The latter are frequently delivered by an officer who has participated in hydrographic surveys.

a) Some years ago, naval officers appointed to regular surveying expeditions outside the coasts of France followed courses on Hydrography, Geodesy, Astronomy and Tides drawn up for 3rd class *Ingénieurs Hydrographes*, at Paris. This method had to be abandoned for financial reasons. At present, officers, on joining surveying expeditions, are trained by officers who have already completed their training in accordance with the instructions issued by the Ingénieur Hydrographe, Technical Director of Surveying work.

Further, a few of those officers, before leaving for field work are admitted for a shorter or longer period to the *Service Central*, where they acquire useful supplementary knowledge.

b) Naval Officers in charge of certain distant surveying expeditions of rather long duration, are selected from amongst those officers who have taken part, with distinction, in the work of regular surveying expeditions. Before leaving for such field work they enter the Service Central for a period during which they gain information and improve their general knowledge. In this way they may supplement their knowledge by such questions which they consider necessary to study more thoroughly and, at the same time, they carry out all preparatory work for the survey with which they are entrusted.

c) Naval Officers placed in charge of temporary hydrographic work on board ships operating abroad, are selected, as far as possible, from amongst those who have previously taken part in Hydrographic Surveys. If circumstances allow, these officers also undergo a course of instruction at Paris before leaving.

2. *PETTY-OFFICERS.*

A part of the personnel of the crews of surveying vessels engaged in carrying out sounding, topographical, etc. operations, may receive the license of "aide-hydrographe", involving two degrees. Petty-officers classified "surveyor" are recruited from amongst the holders of this license after a course of instruction of one month at the *Service Central* and after a period of 5 or 6 months spent with a surveying expedition on the French coasts, at the end of which they undergo a theoretical and practical examination.

Surveying petty-officers may in some cases reach the rank of "Officier des Equipages" (Warrant Officer) surveyor.

3. *PROGRAMME OF SUBJECTS NECESSARY FOR OBTAINING THE LICENSE OF PETTY-OFFICER (SURVEYOR).*

Theoretical : Complex and algebraic numbers; Calculation by logarithms; Elements of plane trigonometry; Bearings and distances; Divided perpendiculars and auxiliary lines; Determination of the position by intersection of several geometrical loci; Accuracy of such determination. Calculation of the position by bearings. Tides, general knowledge, tidal streams.

Practical : Work at sea. Carrying out of a line of soundings following an alignment or segment, search for rocks. Sweeping operations. Current observations. Topography. Topographical survey of a part of coastline. Topography concerning rocks. Determination of the elevation of a station. Levelling. Plotting of topographical survey.

4. *INGÉNIEURS HYDROGRAPHES.*

The *Ingénieurs Hydrographes* form a special Corps of the Navy. They are mostly recruited from amongst the "élèves de l'Ecole Polytechnique" and, their period at this school terminated, they receive the grade of *Ingénieur hydrographe de 3e classe*; they participate in the training courses with the Naval Officers who have just completed their course at the *Ecole Navale*; they afterwards attend lectures on hydrography and geodesy at the *Service Central Hydrographique*, Paris. Each summer they are sent aboard surveying vessels operating off the coasts of France for practical experience. After two years in this grade, they are appointed *Ingénieurs-hydrographes de 2e Classe.*

A few naval officers of the rank of Sub-lieutenant or Lieutenant also enter the *Corps des Ingénieurs-hydrographes*, by competition. These are recruited from amongst officers who have participated in surveying work in the French colonies.

5. *TECHNICAL PUBLICATIONS,*

The Technical Publications used for the instruction of these various categories of personnel are:-

"Notions d'Hydrographie expéditive à l'usage des Officiers de Marine", 2nd Edition, by GERMAIN & HANUSSE (1904).

"Manuel de l'aide-hydrographe (1919)" (out of print).

"Description et emploi des dragues hydrographiques" by M. VILLAIN, Ingénieur hydrographe (1931).

The first of these works is to be revised. A manual of the "classified" surveyor is being prepared.

LATVIA.

All hydrographic work is carried out under the instructions of the Maritime Department of the Ministry of Finance, which is not a military but a civil institution whose officials have no military rank.

The Chief of all hydrographic surveys in Latvia must be an engineer who has completed his studies at the Latvian University, in the Geodetic Division.

Hydrographic surveys at sea are entrusted to a Master Mariner who has completed four years' study at the Maritime College and who has successfully carried out hydrographic operations during several years.

With regard to work along the sea coast, this is carried out by a topographic surveyor who must have taken a theoretical and practical course in lower geodesy, and who has also participated for a certain time in hydrographic surveys.

Assistant surveyors are selected from among student-surveyors who have taken a theoretical and practical course in lower geodesy.

No special rule is followed concerning promotion; when a post is vacant the most suitable candidate for the duties required is selected; the candidate may be already in the Service or selected from outside.

ARGENTINA.

The Argentine Navy has not yet initiated any specialisation in Hydrographic Surveying amongst its officers. At the Naval College courses in Astronomy and Navigation are held in the 3rd and 4th year, and in this latter year a course in Hydrography as shown below is also held. It is then considered that an officer is capable of carrying out the Hydrographic Work entrusted to him on board Surveying Vessels.

A *specialised Civil Staff,* numbering 50, are employed as subordinate Hydrographic personnel on board ship or in Hydrographic expeditions. They must be of over 21 and less than 30 years of age on admission, of good physical and medical health, and must pass the competency examination in accordance with the curriculum given below, but before being able to come up for examination the candidate must have served at least 2 years in actual employ and have obtained an average of 3.5 marks during his last year of service. These marks are given by the chiefs of the Hydrographic Missions twice annually or oftener if required after the assistant has served not less than 3 months with such expedition and are allotted as follows:

0 = very bad.
1 = bad or very poor.
2 = regular or fairly good.
3 = good.
4 = very good.
5 = excellent.

and the same system is adopted for promotion to the higher grades.

CURRICULUM OF EXAMINATION FOR ADMISSION AS ASSISTANT JUNIOR HYDROGRAPHER.

ARITHMETIC. — The four fundamental operations, with integers and decimals. Clear concept of each of them and problems applying and combining the four operations.

GEOMETRY. — *Lines:* straight, curved, horizontal, vertical, inclined, parallel, perpendicular and oblique.

ANGLES. — Sides, vertices. Classification according to magnitude.
Definition and classification of triangles and polygons.
When two figures are equal, when they are equivalent, and when they are similar.
GRAMMAR. — A composition on an easy theme will be made and classification will take place according to wording, orthography and caligraphy.

CURRICULUM FOR THE CANDIDATES FOR ASSISTANT HYDROGRAPHER.

SOUNDINGS FROM A LAUNCH. — Marking and checking of the lead line. Necessary boat equipment. Knowledge of the classification of bottom samples. Register of the work.
LOCATION OF SOUNDINGS. — Knowledge of the theodolite and care to be given it. Adjustment previous to fixing of position. Securing and checking of the zero. Rating of watches: individual cases which may occur. Notes to be entered in the register form. Installation of a camp; most convenient locality and necessary elements.
TIDES. — Graduation and setting up of tide poles. Observations of tides according to their use: for the study of the tides or for the reduction of soundings; recording of same. Checking of position of the tide poles with respect to sea level.
METEOROLOGY. — Knowledge of the apparatus used: barometer, thermometer, anemometer, psychrometer. Classification of clouds; nebulosity and weather conditions. Scales for classifying the wind and state of the sea. Register of observations.

Remark. — In the part relative to "Soundings from a Launch" knowledge pertaining to the steering of a boat will not be considered as this belongs to another branch of work.

CURRICULUM FOR THE CANDIDATES FOR ASSISTANT SENIOR HYDROGRAPHER.

SOUNDING WORK. — Necessary equipment for sounding from a launch. Marking and checking of the lead line. Argentine sounder: installation and use. Sounding machine: knowledge, use and caution *re* the setting of the tube-carrier and the manipulation of the chemical tubes. Personnel necessary for sounding with each of the systems. Knowledge and classification of the bottom samples. Register of work.
LOCATION OF SOUNDINGS. — The same as that for Assistant Hydrographer.
TIDES. — Installation of an encampment for the observation of tides: necessary elements and personnel. Installation of a tidal station without considering the levelling. Tidal bench marks. Observations of tides according to their use: for the study of the tides or for the reduction of soundings; register of the same. Checking of the position of the tide poles with the level of the sea.
CURRENTS. — Knowledge of the current-meters used in the Navy. Measuring of currents with the float. Velocity and set of the currents. Register of observations and additional notes.
METEOROLOGY. — The same as for Assistant Hydrographer.
TOPOGRAPHY. — Knowledge of the surveying theodolite. Location of points by intersection and corresponding diagrams. Register of work. Use of the *Chesterman* tape. Levelling staves.

Remark. — In the part relative to "Sounding Work" the steering of the boat shall not be considered as this corresponds to another line of knowledge.

CURRICULUM FOR THE CANDIDATES FOR ASSISTANT CHIEF HYDROGRAPHER.

SOUNDING WORK. — The same as that for Assistant Senior Hydrographer.
LOCATION OF SOUNDINGS. — In addition to that for Assistant Senior Hydrographer, knowledge (not practical) of the method of location by sextant angles and bearings.
TIDES. — Complete installation of a tidal station. Levelling of the tide poles; sketches and register. Thorough knowledge of all that relates to the observation of tides. Datum for soundings, its definition and utilization.
CURRENTS AND METEOROLOGY. — The same as that for Assistant Senior Hydrographer.
INSTRUMENTS. — Knowledge of all the instruments used in hydrographic surveys for planimetric, topographic and levelling work.
TOPOGRAPHY. — Location of topographic points, roads, villages, ground features, etc. Intersections, tangents and sights. Practice of the "Three-point problem". Traversing. Sketches and register of all work.

TRIANGULATION. — Centring of signals. Marking stations. Standard bench marks. Preparing the ground for measurement of the base.

OFFICE WORK. — Rudiments of calculations. Use of logarithmic tables. Knowledge of the conventional signs used in cartography. Interpretation of scales. Plotting of a point on the sheet. Plotting of soundings on the sheet by the various methods.

CURRICULUM FOR THE CANDIDATES FOR HYDROGRAPHER, SENIOR HYDROGRAPHER AND CHIEF HYDROGRAPHER.

In addition to the curriculum for Assistant Chief Hydrographer :-

LEVELLING. — Geodetic and geometric levelling. Altitude curves ; their graphical representation.

TRIANGULATION. — Practice of the work for the measurement of bases. Knowledge of the geodetic theodolite. Practice in the measurement of angles by the regular method.

OFFICE WORK. — Computation of the triangles and of the plane co-ordinates of the vertices. Computing polygons. Reduction of soundings. Construction of tide curves. Cartography : complete compilation of the sheet corresponding to a hydrographic survey.

CURRICULUM OF COURSE OF HYDROGRAPHY CARRIED OUT AT THE NAVAL COLLEGE. (FOURTH YEAR).

FIRST TERM.

I. INTRODUCTION. — OBJECT OF HYDROGRAPHY. — General remarks on Marine Charts· Sailing Directions. Elements for the construction of a chart. Submarine relief. General information on the figure and dimensions of the Earth. Limits within which the surface of the Earth may be considered flat in planimetric work. Projections and skeletons used for the representation on nautical charts and their properties. Classification of the nautical charts.

II. BUBBLE LEVELS. — Theory. Sensitiveness. Determination of the angle made by an axis with the vertical in the meridian plane ot the level. Adjustment of the level and horizontality of a line. Horizontality of a plane. Levelling of an axis. Measurement of small angles with the level. Adjustment of the spherical level.

III. THEODOLITES. — General description of central theodolites. Geometric conformation of the theodolite. Error of eccentricity of the index arm. Diametral error of the indexes. Error due to imperfect graduation of the arc and verniers. Devices to increase the approximation of the readings. Vernier and plain microscope. Micrometric microscope. Optic micrometer. General remarks on the eye-pieces used in theodolites. Accessories of theodolites. Repeating and reiterating theodolite. Knowledge of the theodolites used in the Navy.

IV. ADJUSTMENT AND LEVELLING OF THE THEODOLITE. — Conditions with which a theodolite should comply. Setting up a theodolite. Adjustment of the eye-piece for observation. Adjustment of the theodolite with the level fixed to the index arm. Adjustment with the riding level. Residual errors of adjustment. Formula for the elimination or correction of residual errors.

V. MEASUREMENT OF ANGLES. — Horizontal angles. Errors which may be committed in their measurement. Influence of refraction on sights close to the ground and appropriate hours for the measurement of horizontal angles. Methods of repetition and reiteration. Measurement of independent angles and round of angles. Series of measurements. Analysis of the angles and series. Co-ordination of the angles with common vertex. Method of binary combinations. Vertical angles. Measurement by single pointing ; double pointing. Determination of the angular value of a graduation of the level.

VI. STAVES AND LEVELS. — General on staves. Levels. *Berthelemy* level, its adjustment and practical rules for its use. *Zeiss* level, adjustment and practical rules for its use. Reciprocal levelling for the adjustment of levels.

VII. MEASUREMENT OF DISTANCES. — Alignments. Metal measuring tape. Use of the tape. Invar tape equipment. Its use and correction. Stadimetric eye-glass. Determination of distances with the stadimeter. Tacheometer. Manipulation and use of the tacheometer. Indirect measurement of distances on sloping grounds.

VIII. PLANIMETRY. — Triangulation. Orders of triangulation. Considerations on bases. Reduction of the base to sea level. Shape of the triangles. Development of the triangulation. Reconnoitring the terrain and selection of the stations. Marking of the vertices. Signals. Linking up of the base with the triangulation. Precision polygon.

SECOND TERM.

I. GEODETIC TRIANGLE. — Geodetic line. Local sphere. *Legendre's* theorem. Calculation of the spherical excess. Spherical co-ordinates. Rectangular geodetic co-ordinates. Shifting of geographic co-ordinates. Appliance of *Schreiber's* formulae.

II. COMPUTATION OF THE TRIANGULATION. — Reduction of the angular measurements to the centre of station and of signal. Adjustment of angles. Computation of the triangle. Plane rectangular co-ordinates of the vertices. Adjustment of the triangulation.

III. TOPOGRAPHY. — Traverse method. Radiating method. Method of the intersections and method of the co-ordinates. Coast lining. Angular closing of the polygon. Co-ordinate of the vertices of the polygon. Sketch of the polygon. Placing of auxiliary points by intersections and tangents. General remarks on aerophotogrammetry applied to the survey of coasts.

IV. ALTIMETRY. — Geometrical levelling. Geodetic levelling. Tacheometric levelling. Methods of levelling. Determination of the altitude.

V. ASTRONOMICAL OBSERVATIONS. — Determination of the azimuth by observation of heavenly bodies. Ex-meridian observations. Elongations. Determination of the longitude. *Stechert's* method.

VI. TIDES. — Characteristics of the phenomenon. Lunar and solar tide. Semi-diurnal luni-solar tide. Diurnal tides. Influence on the tide of the variation of distance of the Moon and the Sun from the Earth. General information on Harmonic Analysis. Tide prediction. Mean level.

VII. SUBMARINE RELIEF. — General. Hand lead. Deep-sea lead. Sounding machines. Closeness and distribution of soundings. Location of soundings out of sight of the coast. Location of soundings in sight of the coast. Use of vessels or boats. Method of carrying out sounding work; signals and "stops". Reduction of soundings. Effect of the wind, current and swell in sounding work. General remarks on acoustic sounding. Reconnaissance and development of the work in unexplored places. General remarks on aerial photography for discovering shallows and dangers. Reconnoitring and locating of shallows and dangers. General remarks on dragging. Reconnaissance and sounding of rivers.

VIII. COMPILATION OF THE SHEET. — Scales. Plotting sheet. Skeleton of the plotting sheet. Location of vertices of triangulation. Polygon. Coast line. Topographical features. Plotting of soundings. Hydrographic sheet. Inscriptions. Construction of the grid system for Mercator's chart. Location of the vertices of the triangulation. Copying of the plotting sheet. Hydrographic drawing.

PRACTICAL CLASSES. — During the development of the course each cadet has to accomplish the following practical work: measurement of bases, measurement of angles, levelling, traversing, sounding, location of soundings, tidal observations, determination of the azimuth and astronomical determination of the position.

Text books:

Hidrographia. — Cap. CANEPA.
Mareas (Notes). — Tte. MALEVILLE.

NORWAY.

Two different categories of Hydrographic Surveyors are employed at the Hydrographic Office of Norway, *viz.*

A) The Hydrographic Surveyors definitely engaged (fixed), on constant duty at the institution;
B) The Hydrographic Surveyors temporarily engaged, on duty only during the expeditions.

For both categories the Naval College examination is required, or a corresponding education.

Vacancies in each category are announced, and the Hydrographic Surveyors are nominated after a competitive examination.

The Hydrographic Surveyors of category *A* are appointed by the Royal Ministry of National Defence after proposal by the Hydrographer, whereas the Hydrographic Surveyors of Category *B* are appointed for each season (summer) by the Hydrographer himself. Some ability as draughtsman is desirable (but not indispensable) for all Hydrographic Surveyors.

After their appointment, the Hydrographic Surveyors of both categories follow a three months' theoretical and practical course at the institution and on board a surveying vessel.

The instruction aims at:

a) Widening the hydrographic knowledge already possessed by the Naval College Cadets, in order that they may, as soon as possible, take personally and independently charge of the hydrographic work.

b) Causing them to acquire a knowledge of the internal organization of the Hydrographic Office, including the work of its various sections, and a knowledge of similar institutions, both of scientific and practical (visits) scope, for example: The Geographical Service of Norway, the Service of the Norwegian Explorations of the Svalbard and Polar Regions, the Observatory, the School of Navigation, the University, etc.

After termination of this 3 months' course, the junior Hydrographic Surveyors are distributed on their own surveying craft and are charged with independent work in a fairly easy district as regards hydrography, but under the supervision of a senior Hydrographic Surveyor in the neighbourhood.

The Hydrographic Surveyors of category *B* are dismissed in autumn, on about 1st October, and remain as a rule out of touch with the Hydrographic Office during the winter.

The Hydrographic Surveyors of category *A* carry on their education at the Hydrographic Office, where they are employed for some time in each of the Sections, which are the following: Section of Charts, Section of keeping up-to-date, Section of Instruments, Terrestrial Magnetism and Tides.

Sometimes, when occasion occurs, the Hydrographic Surveyors of category *A* are, in certain cases, commissioned for a short mission with a geodesist and a field topographer.

During recent years the junior Hydrographic Surveyors of category *A* have also pursued their education by a 1 to 1 ½ year's term abroad with a hydrographic institution of wider range.

The Corps of Hydrographic Surveyors comprises three classes (ranks).

The cadets are commissioned IIIrd class Hydrographic Surveyors.

From Class III they are promoted by seniority to Class II, when vacancies in this class occur.

For Class I the promotions take place by selection (ability, qualifications, etc.).

On account of the small number of definitely engaged (fixed) personnel at the Hydrographic Office, it may happen that the stay in Classes III and II be unduly prolonged.

SIAM.

Having completed the ordinary course at the Naval College which includes every branch of the Theory of Surveying and a certain amount of practical instruction such as the use of Surveying Instruments, Tides and Tidal Observations, Measuring bases, Triangulations, Sounding, Coast lining, obtaining Heights, Projections and Chart Construction, Topography, Chart Drawing and other miscellaneous work connected thereto, some officers are appointed to the Hydrographic Service for training as Assistant Surveyors. These officers first undergo a more intensive course in surveying than they had already taken in the Naval College after which they are attached to experienced Surveying Officers for practical work in the field; after having completed this they are given the rank of Assistant Surveyor.

All technical publications supplied for the information and instruction of Assistant Surveyors are Foreign Text Books published in those languages with which they are already acquainted.

J. D. N.