

THE HYDROGRAPHIC INSTITUTE OF THE YUGOSLAV NAVY

by Stjepo M. KOTLARIC
Technical Assistant, Hydrographic Institute of the Yugoslav Navy

This article gives a brief review of the historical development, organization and work of the Hydrographic Institute of the Yugoslav Navy.

HISTORICAL ACCOUNT

On 1 September 1922, under the authority of the Preliminary Naval Officers Training School of the ex-Yugoslav Navy at Tivat in Boka Kotorska, the Hydrographic Office of the Navy *Hidrografski ured mornarice* was established with the small amount of hydrographic equipment and few specialized personnel inherited from the former Austro-Hungarian Navy. On the occasion of the establishment of the Naval Academy at Dubrovnik, in September 1923, the Hydrographic Office was transferred to Dubrovnik but remained under the command of the Naval Academy until September 1929. The Commanding Officer of the Naval Academy was at the same time the chief of the Hydrographic Office.

In October 1929 the Hydrographic Office became an independent institution of the Navy and was transferred to Split. On 1 May 1937 it was designated as *Hidrografski institut mornarice Kraljevine Jugoslavije* (The Hydrographic Institute of the Royal Yugoslav Navy) and continued its work until the capitulation of the former Yugoslav Army, in April 1941.

Upon arrival of the occupation armed forces at Split its work ceased. The greater part of hydrographic equipment, instruments, originals of charts, archives and library was taken away or destroyed by the occupation forces.

In November 1943, at the Navy headquarters of the People's Liberation Army of Yugoslavia, at Hvar Island, the Cartographic Office was established with the goal of carrying out special tasks in connection with war operations on the Yugoslav coast. On 1 January 1944, this Office together with the Navy Staff was transferred to Vis Island. At that time the Navigational Depot was formed to collect and supply to navy ships all navigational material. In March 1944, in Monopoli (Italy) at the naval base, the Hydrographic Department was established, which continued its work until 22 October when it was transferred to Vis Island. In April 1944, at Navy headquarters on Vis Island, the first coastal meteorological station during

the People's Liberation War was established to furnish meteorological data necessary for war operations along the coast and for the needs of the Allied Air Forces. Gradually it was developed into a Meteorological Centre which established and managed new stations on the liberated part of the coast and islands. Immediately after the liberation of Split, at the end of October 1944, the Cartographical Office, Navigational Depot, Hydrographic Department and Meteorological Centre were joined into one office and on 1 November 1944, transferred to Split. By order of the Navy Staff on 6 November 1944, the *Hidrografski institut mornarice NOVJ* (Hydrographic Institute of the Navy of the People's Liberation Army of Yugoslavia) was established from the above-mentioned offices and departments. The Hydrographic Institute received, in March 1945, the title *Hidrografski institut Jugoslovenske ratne mornarice* (Hydrographic Institute of the Yugoslav Navy) which it has retained to date.

The Institute so formed had the following organization :

1. Directorship and Secretariat.
2. Geodetic Department.
3. Air-photogrammetric Department.
4. Hydrographic Department.
5. Nautical Department.
6. Cartographic Department.
7. Meteorological Department.
8. Reproduction Department.
9. Navigational Depot.

During the year 1945 part of the hydrographic equipment which the occupation forces had taken away was returned to the Institute.

The Navigational Depot was separated from the Institute in 1947, and the Meteorological Department in 1948. The latter is now called *Pomorski odjel Hidrometeoroloske sluzbe N.R. Hrvatske* (Maritime Department of the Hydrometeorological Service of the People's Republic of Croatia), with headquarters at Split. This Department is managed today by the officers of the Navy and at present the Director of the Hydrographic Institute is also the head of this Department.

The Hydrographic Department from its beginning at Monopoli started to collect material, equipment, machines and instruments necessary for the work of the future Institute. Most of these were bought with its own funds from money obtained from the National Committee of Liberation of Yugoslavia and from the Navy Staff. At that time various machines, instruments, printing equipment including offset presses and a few airphotogrammetric instruments were purchased.

Ever since the liberation the Hydrographic Institute, an independent institution but directly subordinated to the Commander in Chief of the Navy, has developed under the new social conditions and with the full understanding of its superiors. Personnel have been specialized and new modern instruments and machines purchased. The work has been improved and issues of charts and navigational publications increased.

In the year 1950 the Institute became a State Member of the International Hydrographic Bureau, considering international cooperation in this

respect to be useful and of great importance for rendering navigation easier and safer in all seas of the world.

ATTRIBUTION

The Hydrographic Institute is the navy institution which by means of hydrographic and topographic surveys, airphotographs and other data from national and foreign sources collects, examines, compiles, publishes and dispatches, occasionally and periodically, hydrographic, navigational and oceanographic information in the form of charts and other navigational publications, with the goal to do the utmost in rendering navigation easier and safer for the vessels of the Navy and Merchant Marine.



FIG. 1. — Hydrographic Institute of the Yugoslav Navy

Moreover, waves and currents are examined and studied at the Institute, as well as the development and improvement of present methods of hydrography, oceanography, geodesy, cartography and navigation. In this connection the Institute keeps in close collaboration with national and foreign institutions dealing with the above-mentioned branches of science, and publishes the results of these studies.

For the time being the Institute is responsible for the safety of navigation in both the Adriatic and Ionian Seas. Notices to Mariners contain all information concerning changes in navigation data for the Adriatic Sea, while for the Ionian Sea they contain only data necessary for keeping the Yugoslav List of Lights, Pilot and navigational charts up to date. Radio navigational warnings are broadcast for urgent data affecting the safety of navigation along the east coast of the Adriatic and its approaches.

PRESENT ORGANIZATION

The present organization of the Hydrographic Institute is the following:

1. Directorship :
 - Director
 - Assistant for cooperation with the International Hydrographic Bureau and other institutions abroad
 - Assistant for supply and finance
2. Nautical Department :
 - Section of Maritime Security
 - Section of Nautical Publications
 - Section of Nautical Ephemeris
 - Section of Nautical Supervision
3. Hydrographic Department
4. Oceanographic Department
5. Cartographic Department
6. Reproduction Department
7. Surveying Vessels :
 - PH-11, displacement 90 tons
 - BM-28, displacement 20 tons
 - CM-68, displacement 10 tons.

Note : A new surveying ship is projected.

HYDROGRAPHIC SURVEYS

In the former Hydrographic Institute the Cartographic Department carried out not only work on chart construction, but also the tasks of the geodetic, hydrographic, topographic and airphotogrammetric branch. Because of the lack of technical personnel one junior officer was sent for specialization to the French Hydrographic Office in Paris for two years. In addition, two junior officers were sent for two years of specialization in the former Military Geographic Institute in Beograd. Later on, in the years 1929/30, an elementary hydrographic course was held in the Hydrographic Institute at Split, and in 1930/31 an advanced astro-geodetic course. One junior officer was sent for a two months airphotogrammetric course in Germany at the Zeiss factory in Jena; one junior officer completed a two months airphotogrammetric course in the former Military Geographic Institute in Beograd, and one other officer spent two years in specialization in oceanography and geomagnetism at the Technical Faculty in Zagreb.

Because of the lack of qualified personnel this former Hydrographic Institute did not start hydrographic work before 1929. The Austro-Hungarian geodetic net was used for the surveys, supplemented when necessary. The leadline and a Thomson sounding machine were used in sounding.

At the beginning of 1930 a fixed tide gauge was installed at Split and connected with the existing bench mark in the vicinity.

Inshore hydrographic surveys are now carried out by lead line from a pulling boat. Positions of soundings are determined by the direct or indirect method, i.e. by means of a leading line and the distance measured by

hydrographic wire, or by means of one sextant angle taken from the boat and an intersection from the shore. In this case such an indirect method represents, in fact, the combined intersection and resection method and has the following advantages over the two sextant angles method :

It requires a smaller number of men in the boat.

It gives the possibility of inserting immediately, in pencil, the bearing from the control station on the smooth sheet. After the daily work, or later on in the Institute, the plotted bearings in pencil facilitate the accurate determining of the sounding positions.

Sounding by echo sounding machine is carried out from a motor boat, and the positions are determined by the resection method, i.e. by means of two sextant angles taken from the boat, and are usually plotted on the boat sheet immediately, thus permitting the boat to be kept on the planned sounding line.

The spacing of sounding lines depends on the character of the coast and the distance from the shore line; it varies from 10 up to 50 or 100 metres.

In all areas shallows are surveyed separately. Bottom samples are taken by arming the hand lead or by a mechanical sounding machine.

After the soundings are reduced and plotted on the smooth sheet, usually at the Institute, the selected soundings are transferred to the topographic sheets.

Hydrographic surveys have been carried out using the following instruments :

Hand leads.

Thomson mechanical sounding machine.

Hughes MS 21/F, MS 26/F, and RFS Carpentier echo sounding machines.

Kelvin & Hughes sextant (Challenger survey sextant Mark 2).

Spenger & A. Rost protractors.

Kelvin & Hughes station pointer.

Other requisites necessary for carrying out hydrographic surveys.

GEODESY

The Institute is engaged in many types of geodetic and topographic work as :

Additional third and fourth order triangulation.

Topographic surveys of coastal zones.

Determination of control points for hydrographic survey.

Topographic amendments of airphotogrammetric sheets.

Reconnaissance surveys.

Determination of heights of conspicuous objects.

Determination of junction points for charting by the airphotogrammetric method.

Determination of bases for measured miles and their indication ashore.

Determination of bearings for compass adjustment and their indication ashore.

Levelling.

Determination of geodetic datums on islands and their connection to the levelling system.

Transfer of elevations by water level.

The main instruments used in these works are the following : T2 Zeiss, Wild and Kern theodolites; Kern, Wild and Boskovic alidades; Galileo, Fenel and Kern levelling instruments.

AIRPHOTOGRAMMETRY

An airphotomultiplex, an airphotocamera (F : 20, size 18 × 18 cm) and mirror stereoscope with stereometer were purchased from Zeiss in 1936. Since then airphotographs have been used for correction of the shore line and charted detail such as new objects, roads, etc. At that time these duties were carried out by the Cartographical Department, and one officer had been specialized for that work through an airphotogrammetric course held at the former Geographic Institute of the Army in Beograd. During 1937 airphotographs were taken of the islands of the Middle Adriatic. Up to the beginning of World War II the Yugoslav Hydroplane Command carried out airphotographing of the coastal zone, and such airphotographs were used for the correction of nautical charts and plans by means of the stereoscope or stereometer.

With the beginning of World War II the personnel of the Hydrographic Institute destroyed the films by burning, and the instruments were confiscated or destroyed by the occupation forces.

After the liberation of the country and with the setting up of the Hydrographic Institute at Split in the year 1945, the Section of Airphotogrammetry was established. The airphotographs of the eastern shore of the Adriatic, taken by the Allied Air Forces during World War II, were given to the Institute (part during the war and the rest in 1945). The coverage was later completed with the airphotographs taken by the Airphotogrammetric Section of the Institute in cooperation with the Yugoslav Air Force.

The airphotographs were taken with an RC 5 airphoto camera from a relative height of 2 100 metres, yielding an approximate scale of 1/10 000. Sometimes the altitude was increased to 4 200 metres and accordingly the scale reduced to 1/20 000.

Before photographing, the terrain was prepared by marking the control stations and junctions for additional triangulation with white crosses so that at least 4 control stations are included in each pair of photographs.

An altitude of 2 100 metres and corresponding scale of 1/10 000 was the most suitable because this scale could be used for plotting sounding sheets as a base for nautical charts, and the correction of the existing sounding sheets facilitated in this way.

During the process of charting, various shortcomings were noted. In the first years there was difficulty in recovering the control stations, but later on with better organization this was eliminated. Additional trouble was caused by the properties of film used in airphotographing, which after usage changed dimensions. Errors arising from regular shrinking of the film are eliminated by computing a new focal length for each airphotograph over 6 months old. To eliminate errors caused by the irregular shrinking

of the film glass, diapositives were made one month after photographing, i.e. when the film reassumed its original size.

Charting has been carried out on different scales as required.

The following instruments have been used in airphotogrammetric works : aerophotomultiplex; airphotocamera (F : 20 cm, size 13 × 18 cm); stereographometer; Nistri, Wild and Zeiss mirror stereoscopes; automatic airphotocamera RC5 (F : 213 mm, size 18 × 18 cm); redresser E2; stereo-cartograph A6 and stereoautograph A5.

OCEANOGRAPHY

From its foundation until 1935, the Institute had not engaged in specific oceanographic research, and no corresponding department or section was embodied in the Institute's organization.

Before World War II oceanographic observations were limited, generally, to current measurements in areas of hydrographic surveys. This was done for small areas covered by a few charts.

After World War II the increased requirements for oceanographic observations and researches resulted in the establishment of the Oceanographic Section at the Hydrographic Institute, which in 1956 was expanded into the Oceanographic Department. At the beginning, the work of this section was very limited because of the lack of instruments. After the purchase of new instruments (standard and portable recording tide gauges; Potomac and Eckman current meters; Nansen reversing bottles; Richter & Wiese thermometers; core samplers, etc.) the Institute increased the number of tide stations and started systematic observations of oceanographic data.

During the International Geophysical Year 1957/58 the Institute increased its activity in this area and in collaboration with the Institute of Oceanography and Fishery made periodical cruises in the central and southern Adriatic. During the cruises the following measurements were made and the characteristics of sea water studied : temperature, salinity, clearness, current measurements by current meter and drift bottles, oxygen, free phosphate, total phosphorus contents, sediments, and soundings by echo sounding machine. The work was carried out on the following profiles : Rogoznica-Ortona (5 stations), Split-Palagruža-Monte Gargano (8 stations) and Otranto-Kerkira Island (4 stations). For the most part these profiles coincided with those carried out during the cruise of the ship *Najade* from 1911 to 1914, thus permitting a systematic check of these earlier data.

Under the programme of the International Geophysical Year the Institute also undertook direct measurements of surface currents at 5 stations in the central and southern Adriatic, general current measurements in the Adriatic by drifting bottles, and measurements of surface temperature at a considerable number of points along the eastern coast of the Adriatic.

Oceanographic measurements (current, temperature, salinity, clearness and bottom samples) were also made in the Neretvanski Kanal, and experimental measurements of wave data on Vis Island; recording tide gauges are now operating at 10 tidal stations.

CHARTS

At the time of its foundation the Institute suffered from a lack of instruments and equipment, and the majority of smooth sheets of previous surveys was missing. Safety of navigation, however, required navigational charts, and there was no solution other than the reproduction of Austro-Hungarian charts, which started in 1928. Only the titles of charts were translated into the Serbo-Croatian language and all other details (geographic names, characteristics of lights, abbreviations for type of bottom, etc.) remained unchanged. In this way 4 course charts, 13 coastal charts and 9 chart plans, a total of 26, were reproduced by 1929.

Later on the Hydrographic Institute started its own survey operations

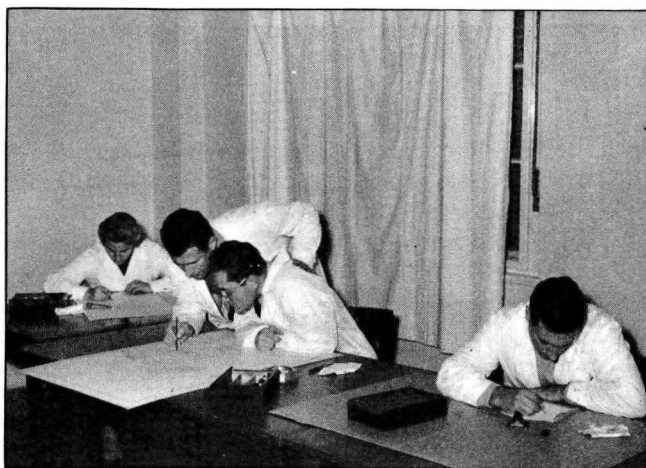


FIG. 2. — Drafting of Charts

and from the smooth sheets so obtained new charts have been constructed. Up to 1941 the Institute issued 25 different charts (3 general charts, 2 course charts, 9 coastal charts, 5 chart plans and 6 auxiliary charts).

During World War II many mines were laid along the Yugoslav coast of the Adriatic, and navigation in these waters was difficult. To make navigation safer and easier the Hydrographic Institute started constructing six charts in scale 1/200 000, with danger areas plotted thereon. In 1945, six charts in this series numbered from I to VI were published, covering the coast from Cape Tagliamento (in Italy) to Cape Pali (in Albania), and in 1949 the seventh chart in this series, No. VII, was issued, covering the Albanian coast.

After World War II several new editions of these charts (Nos. I-VII) were issued as they were in great demand by mariners. The main task of the Institute was to issue its own navigational charts, first the coastal charts covering the whole Yugoslav coast of the Adriatic Sea, and later on other charts for the entire Adriatic and Ionian Seas. The existing coastal charts of series 200 printed in the German language showed certain deficiencies; they had to be corrected and national geographic names inserted.

Airphotographs added greatly in correcting shoreline and topographic details on these charts. Some charts needed partial new surveys and others the checking of previous data. Several field parties were organized for investigating the national geographic names which should be inserted on charts. All these amendments have been inserted and in 1952 the Institute completed the task of issuing its own coastal charts for the eastern shore of the Adriatic (from the Gulf of Trieste to the Albanian coast). These charts, serially numbered from 200 to 222, are intended for coastal navigation; their scales vary from 1/60 000 to 1/80 000 and include plans of harbours and anchorages on larger scales. Some differences in the coordinates for the same point on the overlapped area of two charts of this series were noted, but this deficiency can be eliminated after the new survey of the whole coast is completed.

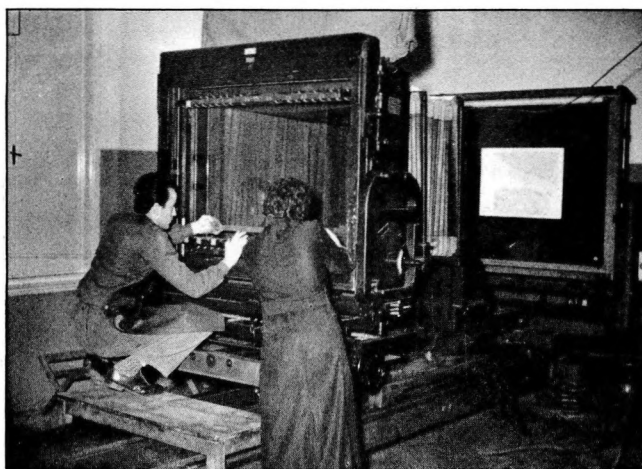


FIG. 3. — Photo Camera for Charts

The Institute's work in constructing and issuing charts continued. 13 chart plans of the series 500 were published showing harbour plans, passages and anchorages on the Yugoslav coast of the Adriatic. Four general charts of series 100 for the Adriatic and Ionian Seas and 10 harbour plans of the Italian coast of the Adriatic of series 300 had also been published by 1959.

The Institute's activity in this respect is also shown in constructing and issuing a new set of 11 track charts covering the whole Adriatic Sea on scale 1/200 000. These charts are numbered from 151 to 161, and were completed in 1955.

On the same scale, i.e. 1/200 000, the Institute plans to cover the whole Ionian Sea and Malta Island with 9 charts serially numbered from 171 to 179. Already 5 charts of this series have been printed.

On account of the issuance of new charts or new editions of charts, the following obsolete charts have been cancelled : auxiliary course charts with plotted mined areas Nos. I to VII; track charts Nos. 104, 106, 107, 108, 112 and 115; and auxiliary charts Nos. 000, 002 and 004.

PRINTING

The Hydrographic Institute had no offset printing press before World War II, and all charts were printed in the Geographical Institute of the Army in Beograd. Book printing and binding, and lithographic work were only available in the former Institute.

Today all printing, of both books and charts, is carried out in the Institute itself. The new offset printing and book printing presses are purchased. The reproduction of charts has been greatly facilitated; plastic sheets are already in use in the lithographic process and originals for reproduction of charts are made on this material.



FIG. 4. — Type Setting Room

NAVIGATIONAL PUBLICATIONS

In 1922, immediately after the foundation of the Institute, Notices to Mariners appeared as typewritten copies reproduced in a duplicating machine. The first printed Notices to Mariners were issued on 1 January 1924 and continued until April 1941, ceasing because of the War. In the former Institute the following publications were also published: List of Lights for the Adriatic Sea, Distance Tables for the Adriatic Sea, Catalogue of Charts and Publications, preliminary edition of Sailing Directions and Nautical Tables.

During the war, on 1 January 1945, the issuance of Notices to Mariners started again. The first five monthly editions were issued as confidential.

After the war the Institute published several editions of the special pamphlet describing danger areas due to mines and routing instructions for the Adriatic Sea. Since the year 1955 this publication has been discontinued as unnecessary because of cleared mine areas.

Since 1 June 1945, Notices to Mariners have no longer been confidential

and continue in regular monthly editions under the title *Oglas za Pomorce*. Several changes in the system of compiling Notices to Mariners were made after the war period, and on 1 October 1952, a new system of editing was introduced which largely facilitated the navigator's work in keeping navigational publications up to date. Corrections by hand (writing and erasing of corrections, or pasting on of coupons) are completely avoided; keeping navigational handbooks up to date is carried out by means of printed additions with an up-to-date index of corrections.

The Institute's present publications are grouped as follows :

- Periodicals;
- Navigation manuals;
- Other publications.

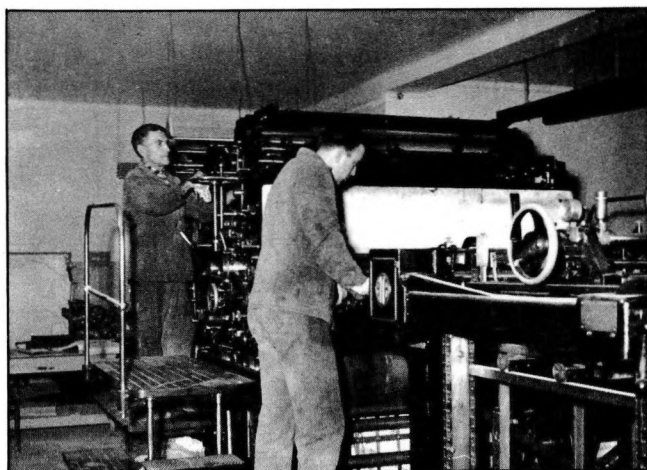


FIG. 5. — Offset Printing Press

Periodicals :

1. *Oglas za pomorce* (Notices to Mariners) are published regularly at the beginning of every month. The pamphlet of *Oglas za pomorce* is divided into several sections corresponding to the different type of documents to be corrected. The sections are now arranged according to the following subjects :

I. Geographical index of all places affected by Notices promulgated in section II and in other sections dealing with the corrections of different navigational handbooks. Under this section also appear the tables showing the charts and other nautical documents to which the corrections contained in that same pamphlet of Notices to Mariners should be applied.

II. Notices giving corrections to be made on charts. To this section also belong all Notices covering the publication of new charts and new editions of charts and other nautical documents, as well as their cancellation.

III. List of Radio Navigational Warnings, containing the number and text of all warnings which are still in force.

IV. Light List Corrections. This section contains information that

corrections relating to the Light List are printed in the enclosed monthly addition, which contains on the last page an up-to-date index of all corrections since the issue of the Light List. This index provides an easy method of keeping the book up to date (and of making use of the book). The corrections from the monthly addition need not be rewritten, or cut and pasted into the Light List; the whole monthly addition (usually one or two sheets) may be inserted in the Light List Supplement, after the last page, and the index of corrections shows at first glance if there is a correction for a certain light; if any, it will be shown in the index by the number of the light and against it the serial number of the correction.

V. Pilot Corrections. This section is similar to section IV with the difference that instead of a monthly addition containing the Light List corrections, two monthly additions relating to two volumes of Pilots are printed and enclosed in the Notices to Mariners pamphlet. The index of corrections appearing on the last page of each monthly addition contains the numbers of pages which are affected by corrections, and against these numbers are shown the serial numbers of corrections. With this serial number the corresponding correction is found in the Supplement or monthly additions.

2. *Nautički godišnjak* (Nautical Almanac), yearly edition, containing astronomical data necessary for navigation. Ephemerides of the sun, moon, 4 planets and the first point of Aries are given for two dates on each page, tabulated at two-hour intervals. The sidereal hour angle of brighter stars and their declinations are given on two separate sheets. One common interpolation table is applied for all celestial bodies and the first point of Aries.

3. *Grafikoni izlaza i zalaza Sunca i Mjeseca* (Diagrams of Sun and Moon rise and set), yearly edition, containing one diagram for each month. Data are computed for Vis Island as the central point of the Yugoslav Adriatic coast. From each diagram the following data can be obtained : beginning of morning twilight (astronomical); sunrise; sunset; end of evening twilight; moonrise; moonset; moon's azimuth at the time of rise and set; the time the moon's azimuth is SE, S and SW; the time when the altitude of the moon is over 60°; and the moon's phases.

4. *Izveštaj o mareografskim osmatranjima na jugoslovenskoj obali Jadrana* (Report of Tidal Observations on the Yugoslav Coast of the Adriatic Sea), yearly edition, contains four tables for ten tidal stations with the following data : Table I : times and heights of high and low water for each day of the year; table II : monthly and annual average of high water, low water and tidal ranges; table III : daily and monthly averages of heights of tide and their annual average; table IV : extreme monthly and annual values of heights of tide and tidal ranges.

5. *Hidrografski godišnjak* (Hydrographic Annual), yearly edition, started in 1954, describing work carried out by the Hydrographic Institute and other authorities engaged in research in the Adriatic, as well as the technical papers relating to problems of these agencies and other related subjects of interest.

Navigational Manuals :

6. *Peljar po Jadranu, I dio, istočna obala* (Pilot of the Adriatic Sea, Volume I, East Coast), issued in 1952.

7. *Peljar po Jadranu, II dio, zapadna obala* (Pilot of the Adriatic Sea, Volume II, West Coast), issued in 1953.

8. *Peljar Jonskog mora i Malteških otoka* (Pilot of the Ionian Sea and Malta Island), issued 1958.

9. *Popis svjetionika Jadranskog i Jonskog mora* (List of Lights for the Adriatic and Ionian Seas), new edition 1957.

10. *Pregled pomorskih karata i drugih navigacijskih publikacija izdanja Hidrografskog instituta JRM* (List of Charts and other Navigational Publications issued by the Hydrographic Institute of the Yugoslav Navy), new edition 1958.

11. *Znaci i skraćenice na pomorskim kartama Hidrografskog instituta Jugoslovenske ratne mornarice* (Symbols and Abbreviations on the Navigational Charts of the Hydrographic Institute of the Yugoslav Navy), new edition 1955, size 24×20 centimetres, 24 pages, arranged according to the recommendation of the International Hydrographic Bureau for achieving the greatest possible world-wide uniformity in this type of publication.

12. *Daljinar Jadranskog mora* (Distance Tables of the Adriatic Sea), issued in 1954, containing distances in nautical miles between 136 principal ports throughout the Adriatic, and distances between smaller ports for 16 different areas on the eastern coast of the Adriatic Sea.

13. *Identifikator zvijezda* (Star Finder), by S. Kotlaric, published in 1956, containing 18 star charts, size 24×30 centimetres, and one transparent diagram (template) representing the visible hemisphere. Each star chart comprehends a 20° -interval of the local hour angle of the first point of Aries. Equatorial stereographic projection is used for construction of both the star charts and template. The identification of a star by this Star Finder is very simple. It is carried out by plotting the position of the star (azimuth and altitude) on the template carrying the horizon system of coordinates, superimposing this template on one of the star charts which corresponds to the local hour angle of the first point of Aries, and reading out the corresponding name of the star. An extensive explanation of the method and instructions for use are given in Serbo-Croatian and English.

14. *Tablice za skraćeno računanje zenitne udaljenosti i azimuta nebeskih tijela* (Tables for Abbreviated Computation of Zenith Distance and Azimuth of Celestial Bodies), by F. Fležo, issued in 1957, containing 335 pages. These tables are based on the solution of two right-angled spherical triangles, using on the celestial equator one auxiliary arc of hour angle. The zenith distance is obtained by combining two computed arcs of the vertical circle of the celestial body, while the azimuth is obtained directly and is reckoned through 180° from the elevated pole of the observer.

15. *Tablice K₁ — Kratki postupak računanja visine i azimuta u astronomskoj navigaciji* (Short Method of Computation of Altitude and Azimuth in Astronomical Navigation), by S. Kotlaric, issued in 1958, containing 238 pages. These tables are based on the solution of three right-angled spherical triangles formed by the intersection of the celestial horizon, celestial equator, the lower branch of the celestial meridian, the vertical circle and the hour circle of the celestial body. These three triangles have one common pole at the point where the hour circle of the celestial body intersects the celestial horizon. Tables are computed for every whole degree and half-degree of entering arguments, and all tabulated values are given in arcs. The arrangement of the tables affords a quick and easy method of working sights from both an assumed (chosen) position and the dead reckoning position. With two openings of the book the altitude and azimuth angle are obtained, and the third opening of the book provides the altitude corrections for the neglected minutes of arc of the entering arguments. An extensive explanation of the method and instructions for use are given in Serbo-Croatian and English.

Other publications :

16. *Granice morskih predjela uz Istočnu obalu Jadrana* (Limits of Sea Areas along the East coast of the Adriatic Sea), issued in 1954, containing a description of the limits of the sea areas from the Gulf of Trieste to the Roadstead of Bar, and enclosing 4 charts on which these limits are plotted.

17. *Razvedenost obala i otoka Jugoslavije* (Coastal Developments of the East Coast of the Adriatic Sea), issued in 1955, containing in tabular form the length of shoreline of the mainland and islands.

18. *Nove metode astronomskog odredjivanja pozicije broda* (New Methods of Ship Position Finding from Celestial Observations), by S. Kotlaric, published in 1955, containing 180 pages. This book deals with new and concise methods for fixing the ship's position at sea. In the first chapter, which introduces the main work, a description is given of the principles of celestial navigation, beginning with Sumner's position line and ending with the Marcq de St. Hilaire method. In the second chapter new short tabular methods for computation of altitude and azimuth are given. The third chapter deals with a new tabular method for obtaining directly the latitude and longitude of a ship by celestial observations, and independently of the conventional Marcq de St. Hilaire method, or longitude and latitude methods. A fairly detailed synopsis in English appears in the latter part of the volume, and enables some conception to be had of the subject-matter involved, as well as of the formulae and figures included in the work.