HYDROGRAPHIC SERVICE OF THE JAPANESE IMPERIAL NAVY

ADAPTED FROM A JAPANESE BOOKLET

The International Hydrographic Bureau has already called attention to a booklet relating the history and work of the Japanese Hydrographic Department, published by the latter in 1923 (See *Hydrographic Review* Vol. 1, N° 2, page 185).

The buildings and property of the Hydrographic Department were destroyed in the conflagration in Tokyo which ensued after the earthquake in September, 1923, but the Department, practically and energetically, immediately quartered itself in galvanized iron structures in the space lately occupied by its destroyed buildings and, with new equipment, resumed all its functions according to the organisation described in a new book issued in 1926 and entitled " *Hydrographic Department of Imperial Navy* " which contains the history, present organisation, surveys accomplished and work performed in astronomy, terrestrial magnetism, tides, oceanography and meteorology, as well as the operations in chart making and the preparation and publication of the nautical almanac and the sailing directions, notices to mariners, lists of navigational lights, and hydrographic bulletins, organisation of Printing and of Personnel of the Office.

A concise extract of each chapter of this very interesting new booklet concerning the Japanese Hydrographic Service will be found below.

HISTORY

The earliest survey systematically carried out in Japan was undertaken in 1800 by Tadataka INO and lasted 17 years ; although the instruments used at the time would appear primitive nowadays, this survey reached a certain degree of accuracy and served as a basis for subsequent work.

The earliest maritime charts published by Japan date back to 1859. In 1869, Narayoski YANAGI, who became later the first Director of the Japanese Hydrographic Service, from 1872 to 1888, was appointed to carry out hydrographic surveying, the necessity and importance of which had been recognised, and the work started in 1870 with the warship " Daiiti-Teibô Maru " with which the British man-of-war " Sylvia " cooperated for one year, lending her duplicate instruments to the Japanese surveyers.

The work commenced in the districts of Matoya, Owashi anchorage, the Shiaku islands and Bisan Seto.

It is thanks to the unequalled energy shown by N. YANAGI in the course of 20 years' uninterrupted service in hydrography that the *Japanese Hydrographic Department* owes its origin and development.

This Department, founded in 1871, was originally dependent on the War Office, but it was soon transferred to the Navy. The first special regulation prescribed that it should:

" carry out hydrographic surveys. point out any recommended channels, be responsible for the construction and supply of " aids to navigation ", and appoint the necessary staff for the maintenance thereof. "

In 1876, the above regulating provisions were modified as follows: -

1. The Hydrographic Service will conduct sea and river surveying, publish charts and sailing directions and be entrusted with the surveying instruments. "

2. The Hydrographic Service will be divided into 4 departments, the functions of which will be ascribed as follows: - general hydrography, surveys, cartography, and accounts.

In 1874 the Naval Observatory was founded and placed under the supervision of the Hydrographic Service.

In 1882, a plan of the Hydrographic Service for a general survey of the Japanese coast, in 12 years, by several travelling parties, was approved.

In 1886 the arrangement of the departments was modified as follows: - Surveys, charts and books, surveying instruments, accounts.

In 1897, the Japanese Hydrographic Service was in a position to supply vessels with perfectly satisfactory coastal charts of almost the whole country.

In 1913, the Instruments Department was suppressed, its functions being transferred to the Arsenal Supply Office.

The complete survey of Japanese coasts was completed in 1918, and since then the Hydrographic Service has carried out complementary and new surveys *i.e.* along the Southern Islands (Mariana, Marshal and Carolina) placed under Japanese protectorate. This led to important research work relative to the study of currents, oceanographic observations and bathymetric measurements.

In 1919, a special Division for the preparation of Ephemerides was founded.

In 1920, the special Regulation which now rules the Hydrographic Service came into force (*See below*).

On 1st September, 1923, there occurred the great earthquake, apparently in the ocean bed of Sagami-Nada, which caused tremendous loss of life and property over a wide area comprising Tokyo, Yokohama and vicinities. Remarkable changes were observed both on land and sea bed through a preliminary survey of Sagami-Nada, Tokyo-Kaiwan and vicinities, and extended surveys were consequently undertaken by the Department for the purpose of obtaining exact data of these changes in the interests of practical navigation and scientific inquiry.

The survey was begun at the end of September. Four surveying ships executed the soundings in the deep waters off the coasts, while four surveying

parties surveyed the coast and the shallow waters. The work was completed by the middle of January 1924, the area covered being about 2500 nautical square miles.

The great earthquake and fire of 1st September, 1923, unprecedented in the annals of Japan in the immensity of the losses caused, completely destroyed the fruits of the long years of earnest and laborious efforts by the Hydrographic Department in the field of Hydrography.

Strenuous efforts were made to restore the activities of the Department, which had lost its entire records, plates, and materials, through the great fire following the earthquake.

The staff of the Department, however, soon rose to the occasion, and in spite of the immense difficulties besetting them they have steadfastly striven to regain their former activities, so that their work of restoration is now nearly completed, it only remaining for them to bring the internal equipment of the Department to a pre-earthquake state of replenishment.

At present, the Hydrographic Office is conducting its business in temporary barracks built on the old site of this Department at Tukisi, Tokyo, and all its activities are being gradually restored to their former condition. The new permanent buildings are expected to be completed within a few years.

The Japanese Hydrographic Office desires to take this opportunity of expressing their hearty thanks to the Hydrographic Services of other countries, and to the International Hydrographic Bureau, for their timely and much needed assistance rendered them immediately after the great catastrophe.

The names of the Officers who successively directed the Japanese Hydrographic Department since its foundation will be found below : -

NAME.	OFFICIAL RANK WHEN ENTERING AND LEAVING THE SERVICE.	PERIOD OF SERVICE.
NARAYOSHI YANAGI	Commander. Rear-Admiral.	1872 - April 1888.
KANETSURA KIMOTSUKI	Captain.	April 1888. December 1892.
MICHIAKI YOKO-O	Captain.	Dec. 1892 - June 1894.
KANETSURA KIMOTSUKI	Captain. Vice-Admiral.	June 1894. November 1905.
KAZU MATSUMOTO	Rear-Admiral.	Nov. 1905 - Nov. 1906.
HAZIME SAKAMOTO	Captain. Rear-Admiral.	November 1906. August 1908.
ODORU NAKAO	Rear-Admiral. Vice-Admiral.	August 1908. December 1911.
OTOJIRÖ ITÖ	Rear-Admiral.	Dec. 1911 - April 1912.
REIJIRÖ KAWASHIMA	Rear-Admiral. Vice-Admiral.	April 1912. December 1913.
RINROKU YEGUCHI	Rear-Admiral.	Dec. 1913 - Dec. 1914.
YUKITOSHI KAMIMURA	Rear-Admiral.	Dec. 1914 - Dec. 1915.
ROKURÖ KAMAYA	Rear-Admiral.	Dec. 1915 - Dec. 1916.
MUTSUZÖ NUNOME	Rear-Admiral.	December 1916. October 1920.
SUKEJIRÖ INUZUKA	Captain. Rear-Admiral.	October 1920. June 1923.
KOSABURÖ UCHIDA	Rear-Admiral.	June 1923. December 1924.
NOBUO UYEMURA	Rear-Admiral.	December 1924. December 1925.
SUEKI YONEMURA ..... (Present Director).	Rear-Admiral.	December 1925.

The following table gives the dates at which the different kinds of work were started.

KIND OF WORK.	YEAR	REMARKS.
Survey (unaided).....	1871	Notuke Anchorage, Goyomai Pass, Suttu Bay, and Otaru Harbour surveyed by Lieut. YANAGI, Commander of the Kasuga.
Hydrographic Descriptions.....	1872	An account of his « Hokkai Survey » voyage by the Kasuga written by Lieut. YANAGI.
Tidal Observations	1872	Forty days' observation made in Sinagawa Bay.
Magnetic Observations.....	1872	Magnetic declination observed at the temporary site of the Hydrographic Department.
Chart Engraving.....	1872	The chart of Kamaisi Anchorage engraved on copper plate.
Issue of Charts.....	1872	The charts of Miyako Anchorage, Suttu Anchorage and Otaru Harbour issued.
Sailing Directions	1873	The Hokkaido Pilot issued.
Notice to Mariners.....	1873	A shoal « Kamize » near Osima Anchorage noticed.
Astronomical and Metcorological Observations.....	1874	The Naval Observatory organized.
Storm-warnings.....	1881	From 1890 onward these warnings have been issued by the Central Meteorological Observatory, instead of by this Department.
Light Lists	1883	Including Japan, China, Tyôsen, Asiatic Russia and approaches.
The Naval Observatory	1888	Abolished.
Nautical Almanacs.....	1900	Two volumes, including a Tide Table.
Tide Tables	1921	Published separately from Nautical Almanacs.
Hydrographic Bulletins	1922	« Suiro-Yôhô » issued monthly.
Wireless Information.....	1926	Urgent notices to Mariners.

PRESENT ORGANIZATION.

The Hydrographic Department conducts the preparation and issue of hydrographic publications, undertakes the survey of coasts and seas, makes recommendations, and issues notices regarding safety and navigation with a view to rendering navigation easier and safer, and educates Hydrographic Officers and their assistants.

The Director is placed under the Minister of the Navy, and directs the work of the Department.

The Adjutant manages general affairs.

The Department is divided into five divisions, namely, the First, Second, Third, Fourth and Accounts divisions.

The First Division is in charge of the following:

1. Planning the compilation of charts and books and planning surveys.
2. Compilation of sailing directions, light lists and other hydrographic as well as miscellaneous publications.
3. Notices to mariners.
4. Investigation of terrestrial magnetism, oceanography and oceanic meteorology.
5. Information about fairways and harbours and study of routes.
6. Scientific researches in hydrography.

The Second Division is in charge of the following:

1. Actual conduct of surveys.
2. Preparation of original charts and hydrographic accounts.
3. Technical education of the hydrographic officers and subordinate assistants engaged in surveying work.

The Third Division is in charge of the following:

1. Compilation of charts.
2. Drawing of charts, photography, preparation of plates and printing.
3. Technical education of the personnel engaged in the foregoing work.
4. Provision, supply, exchange, distribution or contribution, lending and custody of hydrographic publications.
5. Correction and supplementing of hydrographic publications in the custody of the Division.
6. Sale of hydrographic publications.

The Fourth Division is in charge of the following:

1. Calculation of the positions of the heavenly bodies from the Tables of those bodies.
2. Investigation of tides.
3. Compilation of nautical almanacs, tide tables, and nautical tables (for astronomical navigation).

The Accounts Division is in charge of the following:

1. Revenue and expenditure.
2. Purchase and sale of Office supplies.
3. Receipt, custody and delivery of office supplies.
4. Correspondence and transportation.

HYDROGRAPHIC SURVEYS.

Apart from the complete survey of Japan by INO, which ended in 1916, the first real hydrographic survey of Japan was carried out by MATSUOKA and published by the Naval College of Edo in 1859 and completed by FUKUOKA in 1865.

The systematic hydrographic survey, however, was undertaken in 1869, at the instigation of KAWAMURA, by YANAGI and ITO and a number of Naval Officers.

From 1870 to 1882, foreign vessels were allowed to cooperate in the survey of the bays and ports of Japan, but from that date onwards their assistance was no longer required owing to the approbation of a general surveying programme proposed by the Hydrographic Service.

That is how, in 1870, as previously mentioned, the " Sylvia " and the " Daiiti-Teibô-Maru " worked together at Matoga, Owasi and Bisan Seto.

In 1871, the " Kasuga ", commanded by YABAGI was ordered to survey the North of Japan : Notuke anchorage, Goyômai passage, Suttu bay, Otaru harbour, Miyako kô and Kamaisi kô.

In the ensuing years, the surveying was continued by two or three vessels temporarily put at the disposal of the Hydrographic Service by the Navy, so that from 1878 the Hydrographic Service preferred to carry out the surveying of bays, anchorages and harbours by means of travelling parties living ashore and operating with the necessary craft. Thus was started the survey of Higo coast, Kyûsyû.

It was in 1881 that the " Raiden " systematically surveyed 300 miles of coast, *i. e.* 70 miles as the crow flies along the North Eastern coast of Honsyû.

At the end of that year, the general surveying programme put forward by YANAGI having been approved, a systematic survey of all the coasts was undertaken and actively carried on from that date, both by surveying vessels and coast parties.

At that time (1881) the situation was as follows : -

Total coast line of Japan.....	15.183	miles
Coast line surveyed	5.064	»
by this Department.....	1.448	»
by foreign ships.....	3.616	»
Coast line roughly surveyed	664	»
by this Department.....	121	»
by foreign ships	543	»
Coast line unsurveyed	9.455	»

The time limit allowed for the execution of the programme was increased, however, owing to the time required for the re-taking of soundings in parts surveyed by foreign vessels and for the surveying of the coasts allotted to Japan after the Chino-Japanese and Russo-Japanese war, up to 1917. From that date, Japanese surveyers have been taking new soundings and surveying the islands of the South Seas and of those under their protectorate, as well as a number of oceanographic soundings at great depths.

In 1870, the staff of the " Daiiti-Teibô-Maru " included only 7 naval Officers, not specialists, but eventually a staff was composed of officers and assistants specially trained in hydrography. From 1882 to 1885 the staff consisted of 12 and could be divided into two teams. From 1886, three teams could be used simultaneously to carry out the work.

A very severe blow was dealt this Department by the destruction of the valuable surveying data obtained previous to the great earthquake, which reduced the Department to the necessity of resurveying a part of those areas which were surveyed within recent years. The districts affected by the earthquake were resurveyed immediately after the disaster, as stated in the chapter on History.

At present, the Department has forty-five men engaged in its surveying service, from whom six or seven surveying parties can be formed, and over forty small surveying boats, most of which are equipped with oil motors, four or five warships being specially commissioned every year for the same service.

RESULTS OF SURVEYS

BY THE JAPANESE HYDROGRAPHIC OFFICE IN RECENT YEARS

Year.	Land area surveyed. (square miles)	Sea area surveyed. (square miles)	Coast Line. (miles).	Number of Soundings.
1917	543.0	7,836.8	849.3	118,566
1918	2,426.2	3,320.8	1,751.3	108,403
1919	5,172.0	22,408.3	1,638.1	56,534
1920	4,031.5	26,676.4	1,741.7	110,136
1921	2,847.9	41,313.4	1,235.3	100,964
1922	3,980.6	24,842.6	1,071.4	68,160
1923	2,679.4	14,802.2	1,204.3	152,458
1924	296.1	613.8	332.0	44,004
1925	602.3	8,279.2	599.2	77,837

DETERMINATIONS OF LATITUDES AND LONGITUDES.

Since the commencement of our work in 1871, whenever a survey has been carried out, the determination of the latitude and longitude of the district surveyed has always formed part of its necessary functions. The following table shows only the number of stations where the latitude or longitude was observed in or after 1876, with the results appearing on our charts.

REMARKS.

"*a*" means both latitude and longitude determined.
"*b*" means longitude only determined.
"*c*" means latitude only determined.

District.		Honsyô South. Islands.	Kyûsyû.	Sikoku.	Hokkaidô.	Karahuto.	Tyôsen Kwantung Prov.	Tai wan.	South Sea Islands.	Total.
Period.	Kind.									
1876	*a*	8	4	3	1					16
to	*b*	2			1					3
1887	*c*	3	1							4
	Total	13	5	3	2					23
1888	*a*	11	2	1	3					17
to	*b*	2	2		2					6
1897	*c*	22	4	2	6		1			35
	Total	35	8	3	11		1			58
1898	*a*	7	5		3		1	1		17
to	*b*									
1907	*c*	1	1		6	1	5	1		15
	Total	8	6		9	1	6	2		32
1908	*a*	9	4		3	1	1		4	22
to	*b*	2								2
1920	*c*	5	1			3	2			11
	Total	16	5		3	4	3		4	35
1921	*a*								6	6
to	*b*									
1926	*c*									
	Total								6	6
	a	35	15	4	10	1	2	1	10	78
Grand	*b*	6	2		3					11
Total	*c*	31	7	2	12	4	8	1		65
	Total	72	24	6	25	5	10	2	10	154

The secondary standard of longitude, which was adopted for the first time in March, 1872, was the longitude of the British Naval Hospital at Yokohama, 139°-39'-24" East of Greenwich. The following month, it was transferred to the longitude of a staff standing in the grounds of the Navy Department in Tokyo, which is 139°-45'-25.05" east.

In August of the same year ,K. OTOMO, a naval officer, determined the latitude, longitude, and magnetic declination of the temporary site of the Hydrographic Department as follows, which became the base for navigational purposes for naval ships:

Latitude.....	35°-39'-24.46"	
Longitude.....	135°-45'37. 4"	
Magnetic declination	3°-58'-20"	westerly.

In July 1874, the Naval Observatory was constructed. The subsequent increase and development of the equipment of the observatory facilitated its meteorological and magnetic observations; and the results were published by this Department periodically.

In September 1874, several foreign astronomers came over to this country to observe the transit of Venus over tre sun's disc, and erected their own observation stations, American at Nagasaki, French at Nagasaki and Kôbe, and Mexican at Yokohama. First-class Sub-lieutenant OTOMO and several other members of this Department were despatched to these stations to study the advanced methods of observation as followed by these foreign astronomers and also to take their own observations.

In 1874-1875, Captain YANAGI, Prof. George DAVIDSON, and two other American astronomers observed by the telegraphic method the difference of longitute between Tokyo and Nagasaki from which, supplemented with foreign data, the basis for the determination of all longitudes of Japan was established.

In November, 1876, the latitude of the Observatory was determined.

In September, 1885, having received information as to the results of the U. S. naval officers' telegraphic determination of longitudes between Madras and Nagasaki, the Naval Observatory declared that the longitude of the Observatory should be 139°-44'-30.3" east. This value was adopted as the basis of all longitudes of this country during the next thirty-four years.

In June, 1888, the Observatory was transferred to and came under the charge of the Educational Department and was newly named " the Tokyo Astronomical Observatory ".

In 1915-16, this Department determined the longitude of the Tokyo Astronomical Observatory to be 139°-44'-40.9" E. of Greenwich by the weighted means of two independent values of its longitude, which differed by 1.4" and which were obtained by our observations taken in the opposite directions from Greenwich, one through Guam and the other through Vladivostok. This value of longitude has, since September, 1918, been adopted as the longitude upon which all longitudes in Japan should thereafter depend.

In 1919, this Department began to use, instead of a transit instrument, a small theodolite provided with an accurate Talcott's level, to observe the time

and latitude by the method of equal altitudes of two different stars. The longitude and latitude resulting therefrom are comparatively accurate. The special merit of this method lies in the fact that we were thereby enabled to dispense with the use of a heavy transit, the transporting and setting up of which had cost so much to all astronomical expeditions.

For the time determination by equal altitudes of two different stars, this Department has published " Table of Data Required in Observing 200 Selected Star Pairs for Every Complete Degree of North Latitudes 20°-40° and for the Epoch 1930. " (*The Bulletin of the Hyd. Dep.*, Vol. III, Tokyo, 1922), and " Determination of Time by Method of Equal Altitudes of Different Stars, and a Preparative Table for the North Latitudes 40°-60° and for the Epoch 1930. " (*The Bulletin of the Hyd. Dep.*, Vol. IV, Tokyo, 1923).

Lastly, in 1925, we printed in Japanese, for the use of surveyors, an auxiliary table for determining latitude by means of equal altitudes of two different stars, with an explanation of the method attached.

The charts prepared from the surveys executed by the Japanese Navy previous to 1922 made use of astronomical longitudes and latitudes and the measurement calculated from these by referring to Clarke's spheroid 1866. In the charts prepared from the surveys executed in 1922 and henceforward, however, geodetic longitudes and latitudes (those deducted by triangulation from the position of the Tokyo Observatory, Lat. 35°-39'-17.5" N., Long. 139°-44'-40.9" E and by referring to Bessel's spheroid) are used and the longitudes and latitudes of the charts based on the metric system are altered to geodetic measurements regardless of the year of observation, so that these charts are at a slight variance from the older ones.

MAGNETIC OBSERVATIONS.

The first magnetic survey in Japan was effected in 1912-13 in 331 stations scattered throughout the country (*See Bulletin of the Hydrographic Office*, Vol. II, Tokyo, 1918).

It was decided then that the magnetic survey of Japan should be repeated decennially by this Department for a complete study of the distribution of terrestrial magnetism in the seas near Japan.

In 1922-23, this Department carried out its second decennial magnetic survey over the large area extending to the Chinese coast and to the South Sea Islands under the Japanese mandate, with the main islands of Japan for the centre. The total number of stations was reduced to 148 and the survey, commenced in June 1922, was finished in August, 1923.

The Chinese Government, who accepted our invitation to co-operate in the survey of the Chinese coast, made observations of the three magnetic elements at 18 stations scattered along the coast and supplied us with the data thus obtained.

This Departemnt computed the distributions of terrestrial magnetism in the seas of the Far East from the above data, by duly referring to the results

of land and ocean magnetic observations by the Carnegie Institute of Washington and by the local magnetic observatories.

Thus the magnetic chart of the Japanese seas for 1923 was published in 1925-26 (*See* Vol. V *of Bulletin*).

The Department is utilizing every opportunity presenting itself to take occasional magnetic observations, when it sends out hydrographic surveying parties to any quarters. This kind of magnetic observation has recently been extended to most parts of the Mariana, Caroline, and Marshal Islands, where no thorough magnetic survey has yet been secured.

On the other hand, in order tostudy more exhaustively the magnetic elements at different quarters of the country the Hydrographic Department has entrusted a number of the meteorological stations as shown in the following list with the absolute measurement of the magnetic elements.

Meteorological Station	Locality	Element Measured	Year of Commencement.
Zinsen	Tyôsen	Decl., Dip, Hor. Intensity.	1918
Otomari	Karahuto	Declination	1920
Taihoku	Taiwan	Declination	1919
Palau	Caroline	Declination	1926

The measurements are to be made 4 times at fixed mean times on a fixed day of each week. The number of such stations will be increased when circumstances permit.

WORK ON TIDES

Observation of tides and harmonic analysis.

Since 1883, the hydrographic missions observed the tide in 500 stations for fifteen days or for several months, and from the results obtained 6 of the harmonic components were calculated by the Darwin method.

Since 1909, 17 tide-gauges have been set up to work for over one year in order to obtain more accurate information.

It was thus possible to calculate 28 components for about 40 stations.

Tide currents.

During these latter years the Hydrographic Service had the currents observed by special missions in such parts as are of special interest to navigation. - Studies have been made for 10 places, 9 of which are in the Inland Sea, and the Hydrographic Service published current charts for 7 places and predicted the currents of 3 straits by means of the harmonic method.

Publications.

Since 1921, the Tide Tables have been published separately, whereas they were previously included in the Nautical Almanach.

These tables contain predictions for 26 principal ports in Japan and the Far East; 19 were calculated with the 15 component Kelvin Machine of the Japanese Hydrographic Service; 6 were borrowed from the British Admiralty and one from the " *Deutsche Seewarte* ".

These tables give differences by means of which the tides of 1200 minor ports can be computed.

Special mention should be made of: " Tides and Currents in Japan and the adjacent waters " by S. OGURA, 1914, which gives all the tidal constants for the Japanese coasts.

METEOROLOGICAL AND OCEANOGRAPHIC WORK.

Although the Meteorological Service was separated from the Navy in 1888, the Hydrographic Service still published the Japanese " Pilots Charts " from 1904 to 1906 and the " *Meteorological Tables of Japanese Coasts* " in 1907

In 1909 the Hydrographic Service was allowed to increase the number of its staff as required for the purpose of examining the reports of oceanographic and meteorological observations of vessels received since 1901 and for the revision of the " *Pilot Charts* ".

Since 1909, a number of ships have cast drifting bottles for the observation of currents in the Japanese seas.

In 1913 it was stipulated that any maritime meteorological research work would be included in the functions of the Hydrographic Service.

From 1916 to 1919, the Hydrographic Service was able to collect the data for the publication of meteorological and current charts of the North Pacific and Indian Oceans.

In 1911 and 1912 two vessels undertook the measurement of currents, and since 1919 surveying vessels have taken advantage of their cruises to carry out oceanographic investigation such as : sounding at great depths, measuring the temperature and density of sea water as well as other chemical properties of sea water.

The " Mansyû " has been specially detailed for measurements of this kind in the Japanese South Seas since 1925.

PREPARATION OF NAUTICAL ALMANACHS.

The Naval Observatory founded in 1874 intended to publish a Nautical Almanach in about 1886. But, in 1888, owing to a change in administration by which the publication of almanachs was confined to the Astronomical Observatory of Tokyo, the purpose could not be realised, and the Hydrographic Service had to buy nautical almanachs abroad to meet the demands of the navy.

This state of things could not, however, be maintained in an important maritime country such as Japan and, in 1906, it was decided, subsequently to

a report made by a Committee of experts under the Chairmanship of the Director of the Hydrographic Service, that dating from 1907, the Department of Charts and Sailing Directions should prepare the publication of a summarised nautical ephemeridis.

Professor K. ASHINO, of the Naval Staff College, was appointed for a mission to Europe and America in 1909, concerning the procedure to be adopted for the preparation and publication of ephemerides, and towards the end of 1909, they were first published in their present form. In 1919-20, the Department of Ephemerides was separated from the others and made up the fourth Department of the Hydrographic Service.

In that department, in October 1920, the Hydrographer, S. OGURA, invented and arranged the " New Tables of Height and Azimuth " for the determination, in a simple manner, of Sumner lines at the sea.

The earthquake and conflagration of 1st September 1923 reduced the originals and calculation tables to ashes, but this loss was partly compensated for by gifts from abroad and particularly from the Naval Observatory of Washington (U. S. A.) which supplied several copies of the " *Astronomical Papers of the American Ephemeris* ".

At the present time this Department computes data for the sun, a number of stars, 4 planets and the moon.

CHART MAKING WORK.

The first charts of Japan were compiled according to the Dutch system of signs and abbreviations from the survey charts prepared by Instructors of the Naval Training Station in Edo and issued by the Station in 1859, but, needless to say, these charts can in no respect bear comparison with those prepared by this Department. The Department, which commenced coastal survey in 1871, issued its first charts in the following year. With the subsequent progress of our surveying work, the Japanese coast charts increased from year to year, while several charts for China and Russian Tartary were compiled mainly from foreign data, so that by 1897 the Hydrographic Department charts numbered 288 and enabled mariners to navigate the neighbouring waters of Japan in safety.

Thanks to increased expenditure granted the Department and to the constant improvement in the technical education of members, the chart-making work rapidly progressed so that the total number of charts published up to April 1st, 1926, reached 1,486 sheets, covering the entire areas of the North and the South Pacific Ocean and the Indian Ocean. It is intended to issue in the near future charts for the whole world, at least those necessary for passage along the main routes of our merchant ships and the charts of principal commercial harbours.

This Department had been using practically the same signs and abbreviations as those of the British charts; the size of a sheet had recently been standardized at 38 x 25 inches; soundings had been charted in fathoms or feet, and height in feet; till in October 1920, in consequence of the alteration of the Law of Weights and Measures, the Department adopted the Metric Sys-

tem and decided to revise gradually on the basis of that system all its charts previously issued. The Department published fifty-seven charts on the Metric System before April 1st, 1926.

Charts based on the surveys by the Japanese Navy are generally prepared in the form of plans for all scales larger than 1/50,000, and for smaller scales Mercator's projection is used.

As far as possible, charts of the same scale are used for those covering contiguous areas, and for the scale of the projection the ratio of 1° of longitude on the chart to the actual longitudinal length of the earth at 35° of latitude is adopted.

The scale of a plan is indicated by fractions of the actual length.

The foregoing observations generally apply to the charts prepared by the Department for foreign regions.

The following table gives the numbers of the new and revised editions, etc., of charts in the recent years.

Year.	New editions.	Revised editions.	Second editions.	Editions cancelled.
1917	50	38	8	108
1918	67	65	23	61
1919	130	58	27	100
1920	56	51	31	85
1921	135	59	25	128
1922	122	49	25	14
1923	42	8	1.024	7
1924	79	34	242	38
1925	193	147	117	157

SAILING DIRECTIONS - NOTICES TO MARINERS - LIST OF LIGHTS.

The first hydrographic description of Japan is the " Kasuga Kiko " set up by Yanagi in 1871 while he commanded the " Kasuga ". From 1874 the Hydrographic Service was regularly supplied with reports from ships which enabled it to publish at first a few limited sailing directions concerning the South Islands, Formosa and Hokkaido, which completed the English or American Directions in those waters.

In 1876, the " Suiro Zassi " (*hydrographic magazine*) Nos. 1 and 2 were issued, the former containing the hydrographic accounts of Korea obtained by an officer of the " Nissin ", and the latter of the Tisima Islands by the same officer. These publications may be called the precursors of the " Suiro Hôdô " (*Hydrographic information*).

In 1877 ; the "Suiro teiyô" containing explanations of hydrographic terms and signs and abbreviations appearing on foreign charts, was published.

In 1879, this Department decided that Notices to Mariners should there after be issued immediately on receipt of any valuable hydrographic information, instead of as formerly, occasionally, and subject to much delay, through the medium of the " Suiro Zassi " *etc.*, and that these Notices should be not only forwarded directly to Naval ships but also published in two daily newspapers. The publication of Notices to Mariners in newspapers was continued until the medium of the *Official Gazette* was utilized for the purpose.

At present Notices to Mariners are published weekly and also, as a general rule, inserted in the *Official Gazette* of every Saturday.

All Notices of an urgent character have been broadcasted since February, 1926, from the Tokyo W/T Bureau and continue to be so broadcasted.

The translation of foreign sailing directions was commenced from 1880. In the following year, a volume of such translations covering parts of the Chinese coast was issued, and by 1886 twelve volumes, including two for the whole coast of Japan, had been issued. Since, however, our warships generally carry no charts for foreign coasts except those for our neighbouring waters, the sailing directions issued in 1889 and onwards were confined within the limits of these latter.

In 1890, a supplement to the Japan Pilot was issued, being the first of such supplements.

In 1897, the sailing directions for Japan, Tyôsen (Korea), and the Russian Maritime Province were issued, and in the following year the China Pilot was completed.

These sailing directions, together with those for Bengal, Philippine, Borneo, the western and eastern sides of the China Sea, most of the Eastern Archipelago, and Hawaii are published in 30 volumes. It is projected to publish the sailing directions for the whole Pacific Ocean and the Indian Ocean in future.

The light list for this country was at first issued from the Light House Division of the " Kobu-Sho " (*Engineering Department*) (now defunct) and this Department published in 1874 a list of light houses and light ships for the Chinese coast. Since 1883, the light list for the Orient has been issued from this Department.

This Department began publishing " Suiro-Yôhô " (*Hydrographic Bulletin*) monthly from the first of September, 1922, .It contains supplementary notices to mariners, important information on routes, and other matter for reference by mariners and the results of research work.

PRINTING METHODS. (*)

1° Copper-Plate Printing.

Formerly only the Dutch etching process on copper was in use at this Office for chart preparation, whereas copperplate engraving came into use in

(*) *Note of the Bureau :* Although certain information concerning impression processes by copper or zinc plates have already been given in the *Hydrographic Review* Vol. I, n° 2, page 32, to which we refer for complementary details, we reproduce them here for the sake of keeping this monography on the Japanese Hydrographic Service entire.

1907 for the first time. These two processes were solely used together until 1915, when the development and extensive use of an etching process with photographic application had relegated these processes to some special charts and small amendments only. In this etching processes with photographic application, a print was, prior to etching, to be made on the sensitized surface of copper-plate by exposure to the sun together with a positive plate obtained by photography from an original chart. Since 1918, a more developed process has been in use in which a print on the sensitized surface of copper can be obtained, without requiring any positives, by exposing it to the sun together with a translucid paper original chart.

On the other hand, electro-type printing and copper-plate printing by transfer from lithographic stone were also used on a small scale; and, to cut such figures as compasses, scales in border lines, or shading of land, some instruments have been used.

2. LITHOGRAPHIC AND ZINC-PLATE PRINTINGS.

In this Office, lithography was in use for chart publication for years, from 1879 to 1915, and was regarded as essential for quick preparation, although it was not able to supplant copper-plate printing which had superiority in clearness of print. The lithography in the use of this Office was that of the transferring method,except for a short period in the early days when actually drawing process was used.

On the other hand, zinc-plate printing was investigated from 1894, and aluminium-plate printing from 1905, and, while the latter proved to be of no practical use, the former made so great a progress that in 1914 lithography was entirely replaced by this. But the development was more remarkable after that; in 1915 it became possible for the outline of the chart to be produced on zinc-plate from the negative plate which was obtained photographically from a fair copied original chart, and since 1919 the work has been produced on zinc-plate directly from the fair copied original chart.

The latter process of producing positive figures directly from positive work, ensures perfect clearness of charts and is at present used by the Department in preference to the other processes.

3. In a word, both copper-plate and zinc-plate are now prepared in this Department, that is, charts are first produced by zinc-plate, and afterwards engraving on copper is, if necessary, commenced. To state more fully, it is a custom of the Department to preserve zinc-plate as the fundamental, and not to prepare copper-plate unless it is either for very complicated topography or for highly detailed surveys.

As to presses, copper-plate printing presses were used from the early days, while lithographic ones were introduced later on. At present, prints are generally obtained by zinc-plate printing or zinc-plate printing by transfer from engraved copper.

As chart paper requires moderate teracity and the least possible liability to contraction and distortion, offset printing is preferable to direct printing; this Department, therefore, has used it since 1921.

4. The number of printed charts in the course of these latter years is shown by the following table :

Year.		1917	1918	1919	1920	1921	1922	1923	1924	1925
Charts		286.783	571.395	289.815	199.176	175.469	116.801	59.072	179.566	206.813
Miscellaneous Charts		51.054	104.856	106.822	200.209	236.735	76.646	58.761	256.975	459.667
Books	Copies	17.005	16.560	21.928	53.205	17.356				
	Pages.	2.410.720	2.871.330	5.243.356	7.112.280	4.067.755	27.805	19.720	25.554	50.010
Notices to Mariners	Copies	153	127	94	102	104	78	59	66	680
	Pages.	648.880	663.960	578.080	717.930	931.610	1.040.400	172.700	168.550	172.550

BUDGET EXPENDITURE AND NUMBER OF STAFF.

Originally the budget of the Hydrographic Service was approximately 21.000 yen in 1871. In 1886, it was nearly 97.000 yen. From 70.000 yen in 1892, the credits rose to 126.000 yen in 1897, 200.000 yen in 1900 and reached 350.000 yen in 1910, 850.000 yen in 1920 and one million yen approximately since 1922.

From 1912 to 1925 the number of naval officers belonging to this Service varied from 22 to 28 ; civil officials of the rank of Sônin from 4 to 16 ; of the rank of Hannin from 38 to 64. The number of employees increased from 162 to 325 and that of assistants from 35 to 146, which makes a total of 266 to 572 persons on the Staff of the Hydrographic Service.

VARIOUS STATISTICS.

On the first of April 1925, the Catalogue of Publications of the Japanese Hydrographic Service recorded : 1486 maritime charts, 102 various charts and 68 books of Sailing Directions.

The following table shows the publications exchanged with the other Hydrographic Offices, in the course of the last nine years :

Year.	Forwarded.			Received.		
	Charts.	Notice to Mariners.	Books.	Charts.	Notice to Mariners.	Books.
1917	426	37.216	16	250	5.246	164
1918	449	25.010	39	339	4.861	149
1919	887	13.640	13	350	5.983	149
1920	885	9.435	69	491	5.279	235
1921	1.003	20.375	122	1.523	5.654	289
1922	1.595	11.142	238	918	5.780	306
1923	0	8.865	283	5.844	5.480	434
1924	1.476	10.049	1.065	7.333	6.939	518
1925	1.950	10.514	848	1.727	9.100	371

And the following table gives an idea of the importance which the sale of documents published by the *Hydrographic Department* may reach.

Year.	Charts.		Books.	
	Copies.	Price (Yen).	Copies.	Price (Yen).
1917	108.032	76.443.25	10.559	12.005.85
1918	378.494	316.077.75	14.419	17.873.55
1919	121.206	119.383.25	12.116	19.792.40
1920	113.992	125.138.60	15.930	34.778.00
1921	48.036	58.212.05	8.090	14.667.50
1922	61.301	76.958.10	7.560	10.196.50
1923	87.745	114.181.70	12.395	12.148.50
1924	109.628	128.354.40	15.030	21.226.00
1925	96.352	132.844.80	14.670	20 798.50

Besides the Offices of the Hydrographic Service which are situated at N° 1 Yontyôme, Tukizi, Kyôbasi-Ku at Tokyo, there are seven agencies for the sale of the publications of the Hydrographic Service and for the gratuitous distribution of Notices to Mariners at Tokyo, Kobe, Osaka, Nagasaki, Hakodate, Mozihusam (Korea) and one agency at Shanghai.

Navigators may also consult gratuitously the collection of Notices to Mariners at the County Council Offices in Korea, at Tinnampo, Mokudo, Wam san tin, Zinsen, Husan, Tyonsin, also in the Japanese Consulates at:

Bombay	Han-kow,	Singapore,
Hang-choo,	Fu-chow,	Chifu
Tientsin,	Niu-chuang,	Vladivostok,
Manila,	Hongkong,	Bangkok,
Amoy,	Swatou,	Shanghai
Vancouver,	Seattle,	San Francisco.
Sydney,	Honolulu,	

After having analysed the organisation and work of the Japanese Hydrographic Service, it would be useful also to say a word about the Geodetic Service of Japan, created in 1887 and which, for 39 years, in spite of the difficult periods of the Chino-Japanese and Russo-Japanese Wars, has been able to carry out successfully the survey of the territory of Japan proper (*).

The Personnel of this important Service is composed of about 600 members. Apart from the Instruments and Administrative Sections, the "*Land Survey Department*" has one subdivision for Triangulation and Geodesy, one for Topography, which is also responsible for the revision of originals, one Cartographic Section which carries out the drawing, engraving and printing of charts and one Training School for topographers and cartographers.

(*) This information is taken from the booklet "A brief outline of the work of the Japanese Land Survey Department", Tokyo, published by this Service in July 1926.

TRIANGULATION AND LEVELLING.

From 1882 until to-day, 20 bases each of 4 to 5 kilometres in length have been measured with precision in Japan. They are referred to the International Standard Metre kept in Japan.

The sides of the principal triangulation vary from 40 to 50 kilometres and exceptionally reach 100 kilometres.

The calculation of the triangles is made with the following accuracy :

Order of Triangle.	Log of Distance.	Angle.	Coordinate metre.	Longitudes and Latitudes.	Closure of Triangle error.
Primary triangle.	Eight ciphers of log.	Three ciphers after decimal of second.	To millimet.	4 ciphers after decimal of second.	1 second of arc.
Secondary triangle.	Seven ciphers of log.	Two ciphers after decimal of second.			5 seconds of arc.
Tertiary triangle.	Six ciphers of log.	One cipher after decimal of second.	To centimet.	3 ciphers after decimal of second.	10 seconds of arc.

The position of origin of the triangulation is the centre of the meridian telescope of the Old Astronomical Observatory of Tokyo, the geographical coordinates of which are :

Longitude.....139°-44'-40.5020'' E. (*)
Latitude..... 35°-39'-17.5148'' N.

The bench mark of levelling is situated in the garden of the Service itself, 24.50 metres above the mean level which results from observations made during a period of 24 years, at the self-registering tide-gauge station of Aburatubo (35°-09' N - 139°-37' E.)

In order to determine the mean levels of the seas surrounding Japan, 13 self-registering tide-gauge stations were established. At the present time, 6 of them work for this Service, the others were turned over to the Marine Observatory.

When an isolated island cannot be connected to terra firma by levelling, an ordinary self-registering tide-gauge is installed there in order to compute the mean level from observations taken during one year or several months.

(*) to be compared with the value given above, on page 32 admitted in September 1918.

TOPOGRAPHY.

The fundamental survey of the Japanese Empire is established on the scale of 1/50.000 by polyhedric projection; for important places the scale of 1/25.000 and 1/10.000 has been chosen.

Photographic methods have recently been employed for surveying. The Zeiss photo-theodolite and stereo-autograph have given satisfactory results for making the charts of mountainous districts of Formosa.

CARTOGRAPHY.

The chart-printing plates are prepared by the photo-mechanic process, by electrotype photo or by copper engraving; the plates are kept as originals and the actual printing is carried out by transferring the original on zinc.

The Cartographic Section keeps over 11.000 different charts. They are printed by zincography, by means of either revolving machines offset, or flat presses, or even hand presses, when only a small number of copies are required.

In 1925, this Department delivered for sale about 3.500.000 sheets of charts.

The different kinds of maps and the printing methods thereof are generally as follows:

(1) Normal maps:

A. TOPOGRAPHICAL MAPS { 1:10.000, 1:25.000, 1:50.000 } are produced by photo-electrotyping or copper plate engraving

B. COMPILED MAPS { 1:200.000 General map of Japan; 1:500.000 Geographical map of Japan; 1:M International maps of the world } are produced by copper plate engraving or photo-etching

(2) Accessory maps.

(i) PROVISIONAL MAPS
(ii) MISCELLANEOUS WORKS } produced by photozincography, vandyke process or autography.

The plates are constantly corrected according to revision so that they may always be kept up to date. The revising work is generally carried out on the original plates, and in cases when this is impossible, the plates are completely renewed.

The progress of map publication is made in accordance with that of the field work. In the normal programme all preparations for printing will usually be completed within two years of the completion of the field sheets, but any which require rapid publication are constructed as provisional maps and are engraved direct from original field sheets, fair drawing operations being omitted.

TRAINING SCHOOL.

Japan has the only specialised school for the teaching of geodetic and topographic surveys, cartographic drawing and chart printing.

The school is a centre of recruiting for the personnel of this Department.

Teaching comprises two degrees.

There are about 105 pupils in the Senior Class and 406 in the Junior.

With a view to improving their specialised branches, the pupils attend the Lectures given at the Imperial University and Technical College of Tokyo.

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