

THE ISTITUTO IDROGRAFICO DELLA MARINA: THE PAST, THE PRESENT, THE FUTURE

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THE PAST

26 December 1872 is the date of the Decree signed by VITTORIO EMMANUELE II - First Sovereign of the recently created Kingdom of Italy - which established the Hydrographic Office, located in Saint George's Fort. The Hydrographic Office was primarily tasked with the survey of the Italian seas and the production of the relevant nautical documents. Was the latter a true necessity? Did adequate nautical charts not exist at the time? In fact, the numerous charts in existence before the Italian national unification, often privately produced and providing only regional coverage, did not satisfy the needs for safe navigation in the Italian seas, due to their varying sizes, scales, units of measure, and surveying methods. Tangible proof of this is offered by the many valuable documents preserved at the Library of the *Istituto Idrografico*, such as the chart of the Italian Coast between Nice and Civita-Vecchia, produced by the French Hydrographer ROBQUET (Fig. 1); the charts of the Tyrrhenian Sea, produced by Captain W. H. SMYTH of the British Navy; the charts of the Ligurian harbours and littorals, by Rear Admiral Giuseppe ALBINI of the Savoy Navy; the coastal charts of the Adriatic, produced by the Austrian General Staff; and the charts of the southern coasts produced by the *Ufficio Topografico* of the Kingdom of Naples. The Italian Government thus acknowledged the need of a homogeneous national production and, to this effect, instituted a Hydrographic Commission in 1867, whose tasks were eventually allocated to the *Ufficio Idrografico*, established in 1872 and renamed *Istituto* in 1899. From the continuous activities initiated by the Commission and further developed by the *Ufficio*, has resulted, in little over 30 years, no less than 230 charts of the metropolitan waters. To that period dates back the *Piano del Porto e della Città di Genova* 1:4,000 (Fig. 2), published in 1884 and re-edited in 1888. It is a copper engraving printed on a sheet of paper measuring 835 x 1040 mm., while the cartographic representation measures 765 x 915 mm. The windrose indicates magnetic deviation and elevations are rendered by slant hachures. A note below the inscription indicates that "heights and depths are in metres and are reduced to the medium level of the low waters, while topography was deduced from documents supplied by the Municipality". Due to the large size of the paper sheet, the result was extremely detailed and completed with place names. With respect to the formerly-mentioned chart produced by ALBINI, this plan represents the latest

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modifications which had occurred in the harbour, from the various wharves to the new piers with their lights; the dense soundings were measured with the mechanical sounder devised by Admiral MAGNAGHI, associated to position fixings obtained with the "Amici-MAGNAGHI" hydrographic circle: the latter, too, together with other hydro-oceanographic instruments, was produced at the *Istituto Idrografico* on Admiral MAGNAGHI's project. The high hydrographic quality of the document, and of the 200 charts or more representing the national portfolio at the close of the past century, show the significance of the intensive hydrographic activity of the time. Admiral MAGNAGHI, the founder of the *Istituto Idrografico*, had been working to the benefit of hydrography since the late 1860s, and succeeded in giving the service a technical-scientific "basis", which has maintained its worthiness to the present day.



FIG. 1.- Map of the Italian Coast between Nice and Civita-Vecchia by ROBIQUET, Hydrographer, Paris, 1857.



FIG. 2.- Plan of the port and town of Genoa 1:4 000, Genoa, Hydrographic Office 1884 Re-edited in 1888.



FIG. 3.- Rear Admiral G.B. MAGNAGHI.

Admiral Giovan Battista MAGNAGHI, (Fig. 3) the founder of Italian Hydrography, was Director of the *Istituto Idrografico* from its foundation, in 1872, for the following 16 years, while at the same time commanding the HV WASHINGTON on its many missions, which supplied the skeleton of Italian cartographic production. He was awarded a gold medal for valour during the 1860-61 campaign, and a gold medal for his scientific merits, became a member of the *Accademia dei Lincei* and was appointed senator. His stature and deeds, and consequently the very activity of the *Istituto Idrografico* in its early years, were well portrayed on the occasion of his commemoration, in 1902, by the *Accademia dei Lincei*, partially recounted hereafter:

“... In 1872, Admiral MAGNAGHI founded in Genoa the *Ufficio Idrografico della Marina*, today renamed *Istituto Idrografico*, thereby wisely organizing every task demanded of, and pertaining to the Service. He maintained his post for sixteen years and gave the Office a sound scientific structure. He built in fact an astronomical observatory; set up a mechanical workshop for the construction and maintenance of geodetic and nautical instrumentation, as well as a workshop for the engraving of copper plates; started the signalling of midday by means of a gun fire; built a small magnetic observatory, primarily intended for the adjustment of windroses made in the neighbouring workshop; likewise established workshops for charts and nautical book production, chronometry, and activated tide

measurements, thus establishing tide gauges in Genoa, Venice and Sardinia. Such diversified and fruitful activity has given us a first-class Hydrographic Service, on a par with the best similar institutions abroad. It regularly performs astronomical observations to measure time and keep it by the pendulum-clocks and chronometers; it makes, maintains and adjusts its diverse instrumentation; it handles the drawing, engraving and printing of nautical charts and the updating of Italian and foreign charts; and finally disseminates Notices to Mariners and hydrographic news, publishes nautical books, and distributes nautical documents to the Navy. With this remarkable work not only did it respond to the urgent needs of navigation, but also established a school for officers training in hydrography, and courses for draughtsmen and engravers, thus creating professional specializations which did not exist beforehand..."

THE PRESENT

After 125 years, the mission of the *Istituto Idrografico* has not substantially changed. Today, also in its capacity as a governmental cartographic body, the Institute is responsible for the execution of hydrographic surveying and the production of official nautical documents covering the national seas. These primary tasks are complemented by oceanographic research, cooperation in the worldwide dissemination of nautical information, and training of hydrographic staff. To fulfil its commitments, the Institute relies on an operative component consisting of three hydro-oceanographic Units, plus a geodetic and hydrographic mission, mostly formed by mariners. The Units (Fig. 4), even though somewhat aged - the HS MAGNAGHI dates from 1974 while the smaller ships MIRTO and PIOPPO date from the late 50s- have been kept to a satisfactory operative level, with continual improvements of their technical outfit. Both the vessels and the missions are equipped with modern positioning systems, both radioelectric and satellite, with a precision of a few metres. As to the bathymetric instrumentation, they can rely on the latest equipment responding to the operational needs of modern hydrographic surveying. In particular, the HS MAGNAGHI has a multibeam echo-sounder which, enables the exploration of a very wide stretch of the sea-bed, even though in limited areas and has achieved what has been the hydrographer's ever-long dream, i.e., "total coverage" of the area to be surveyed. Modern positioning and sounding systems are interfaced with processing systems which permit registration and elaboration of a wide range of data.

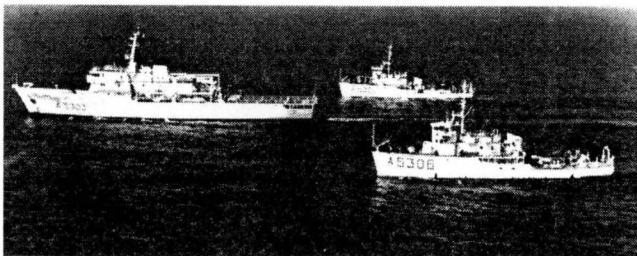


FIG. 4.- The hydro-oceanographic units of the Italian Navy:
A 5303 HS AMMIRAGLIO MAGNAGHI
A 5307 HS PIOPPO
A 5306 HS MIRTO

It is actually in the field of computer science that the Institute, on a par with major Services abroad, is evolving to keep pace with progress. Major developments concern, in fact, not only equipment but also the capability of processing all available data. The computerization of on-site operational processes, together with modern processing systems, limit the range of uncertainty typical of hydrographic surveys. Hydrographic instrumentation on board is complemented by adequate oceanographic equipment, used both for institutional needs and for the purposes of research in cooperation with other scientific bodies. Oceanographic data - from the physical and chemical parameters of the water masses to the quality of the sea-bed, and from magnetic values to meteorological data - are stored in data banks and serve various purposes, both naval and scientific. Furthermore, the Institute directly produces its own geodetic net, in support of surveying activity and cartographic production. The geodetic points are derived from, and linked to, the national geodetic net produced by the *Istituto Geografico Militare* - i.e., the body responsible for terrestrial cartography - on an average amount of one point every two kilometres on the coast, and become denser in the proximity of major ports. In this field, too, the latest instrumentation has brought about improvements and increases in the geodetic activity, thus leading to our contribution to the recent "IGM 95" project of the *Istituto Geografico Militare*, culminating with the production of a new three dimensional geodetic net of the highest precision.

Special mention should be made of the activity in Antarctica, within the National Antarctic Research Project, in which the Institute has participated from the outset, conducting geodetic, topographic and hydrographic surveying in this virtually unexplored area. Data collected during the first four expeditions have enabled two bathymetric charts to produce, at scales 1:50,000 and 1:100,000, of the area facing the Italian base, while current surveys will generate two nautical charts of the international series (Fig. 5). It should be noted that, in addition to surveying, our hydrographic team also provides support to the oceanographic teams, in terms of technical means and expertise in the field of position fixing and bathymetric measurements.

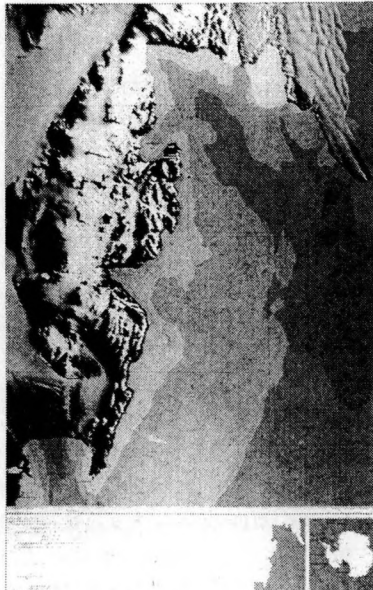


FIG. 5.- Antarctica, bathymetric chart.

Nautical documents cover the Mediterranean and the Black Sea, with obvious special reference to national waters. They include about 300 charts, 11 volumes of Sailing Directions, one radioservices book, one list of lights, and about 100 minor publications, both nautical and scientific.

Cartographic portfolio

The portfolio includes different "series", depending on the scale and/or on specific themes. Nautical charts are in part produced in accordance with the specifications of the International Hydrographic Organization, applied all over the world; accordingly, they are included in a IHO portfolio, intended to offer mariners, irrespective of their nationality, a homogeneous support - no matter who the producer country may be - for international and coastal navigation, and for port entry, everywhere in the world. The overall production includes:

General charts: 11 charts, mostly including international features, at scales equal to or smaller than 1:1,000,000, covering the whole Mediterranean Basin.

Coastal charts 1:250,000: the series includes 24 charts, mostly pertaining to the Italian coasts, which are being gradually transformed into international charts.

Coastal charts 1:100,000: represent the "basic series" and include 47 charts of the Italian coasts, 2 of Corsica and 11 of the Eastern Adriatic.

Large scale coastal charts, between 1:40,000 and 1:60,000: mostly concern major gulfs and a few islands.

Littoral charts: represent the main littorals, subject to their nautical-hydrographic relevance, especially in the proximity of major ports; their scale is generally 1:30,000.

Charts of ports and roads: representing the most relevant ones, 1:10,000.

Bathymetric charts: produced at different scales, represent various themes related to marine geophysics.

Mineralogical charts: intended to detect and allot areas for underwater prospecting.

Lake charts: 3 charts representing the largest Italian lakes, i.e., Lago Maggiore, Lago di Garda and Lago d'Iseo.

Didactic charts: there are a number of one-colour charts of different sizes and scales, intended for tuition at nautical schools.

Charts of Antarctica: two bathymetric charts of the Ross Sea, based on the survey data collected during the expeditions conducted within the National Project of Research in Antarctica.

Military charts: in its capacity as a Defense cartographic Body, the Hydrographic Institute produces 11 types of charts for sole naval use. They are built on the "basic" nautical charts, whereby on the morphologic representation of the sea-bed additional information is superimposed, concerning amphibious and antisubmarine warfare. A few of these are produced in compliance with NATO specifications.

Publications

Beside the traditional nautical publications such as Pilot books, radioservices and Lists of Lights, the Institute produces a large number of scientific and technical publications including updates, fundamentals for keeping up-to-date charts and associated documents, which otherwise would lose part of their reliability.

Pilot books: 11 volumes, including two of general interest, three pertaining to the Italian coasts, 6 covering the rest of the Mediterranean and the Black sea. They describe the coast and provide detailed information for navigation, thus complementing the symbols given on nautical charts.

List of Lights: one volume, describing all the lights existing in the Mediterranean and Black Sea.

Radio services: in two volumes supply technical data on the radioservices in the Mediterranean and Black Sea. The first volume lists specific radioservices for navigation, port facilities, Notices, time signals, radiomedical services, rescue services, radionavigation and satellite systems. The second volume is mostly devoted to meteorological services.

Support publications: facilitate the conduct of navigation and the solution of nautical problems. They include, for instance, the *Manuale dell'Ufficiale di Rotta*, i.e., the Italian Manual of Navigation, the *Norme per prevenire gli abbordi in mare*, i.e. regulations for preventing collisions at sea, logarithmic tables, nautical tables, distance tables, conversion tables, *Basi misurate lungo le coste d'Italia*, i.e., measured distances along the Italian coasts, IALA system of maritime signalling... Of particular importance are two yearly publications, i.e., nautical ephemerides and tide tables.

Updates: unlike other types of maps, nautical charts need to be constantly updated. An office collects information coming from various sources, and disseminates it through appropriate channels: the traditional way is the biweekly booklet of Notices to Mariners, which reports the amendments to be introduced in all nautical documents, in order to safeguard navigation. It also includes pages and supplements replacing substantial portions of publications. A further means of dissemination is the "foreword to the booklet of Notices to Mariners", which contains general information on nautical documents, and the "check list" enabling users to verify that the necessary amendments have been registered.

Scientific publications: about 80 titles dealing with associated disciplines, such as geodesy, meteorology, topography and oceanography.

Miscellaneous: includes the Naval Almanac, published every two years, which describes the naval Units of the world, and the *Agenda Nautica*, i.e., by long a best-seller for professional mariners and yachtsmen.

Training

Ever since its foundation the Institute, though lacking a specific structure, has been training its hydrographers, who receive professional certificates recognized within the hydrographic community. Four courses, at different levels are provided:

Courses of hydrography for Naval Officers are open to officers from foreign countries. It lasts two academic years and includes two sessions of theoretical lessons - ranging from hydrography to data processing, from oceanography to cartography, from international maritime law to astronomy - and a practical training session on board hydrographic units. The course is recognized by the FIG/IHO and confers the highest international certificate of "A" level engineer-hydrographer (Fig. 6).

Course of hydrography for Naval Officers, of lower level. It lasts one academic year and includes a theoretical session followed by practical training period on board hydrographic units and on survey sites.

Course of hydrography for Petty Officers. It lasts one academic year and includes a theoretical session and practical training on board hydrographic units.

Course of compass adjustment. It lasts one month and is solely attended by Petty-Officers.



FIG. 6.- The "Work Experience" certificate is being delivered to attendees of the 1994-1996 Course "I" (Hydrography Class A).

SUPPORT AND COOPERATION

Within its many activities, the *Istituto Idrografico* gives its cooperation and technical support to the following governmental Departments, in the fields of:

Ministry of Transport and Navigation:

- production, updating and distribution of official nautical documents;
- dissemination of Notices to Mariners;
- advanced projects of electronic cartography, and updating IMO regulations;

Ministry of Foreign Affairs

- definition of maritime boundaries and exclusive economic zones;
- evaluation of international conventions in the maritime field;

Ministry of Public Works

- regulations pertaining to port surveying and technical evaluation of maritime works;
- management of the fundamental tide gauge of the national levelling net;
- maritime activities in cooperation with the National Technical Services;

Ministry of the Environment

- production of environmental information systems concerning national bathymetric charts;
- management of software and data banks for the study and prevention of sea pollution;

Ministry of Cultural Affairs

- location and retrieval of submarine archeological finds;

Ministry of Public Education and Research

- production of didactic nautical documentation for Nautical Schools;
- technical support to Universities and research Institutions.

THE FUTURE

Apart from the ordinary activities of the Institute a number of newly-started strategic projects will enable the *Istituto Idrografico* to keep up with progress. Particular reference is made to the recently established Oceanographic Center and to the Centre for Electronic Cartography; to a study on the automated management of nautical information; to the forthcoming acquisition of two new coastal hydrographic vessels; to the Bathymetric Digital System; and, last but not least, to a project of reorganization and enlargement of its premises.

Oceanographic Centre

The *Istituto Idrografico* has always been attentive to the oceanographic activity performed by national research concerns, for its potential significance to

naval applications and for its fundamental contribution to scientific knowledge in general.

In response to the expectations of the national scientific community, the *Istituto Idrografico* has assumed the role of reference point and manager of the Oceanographic Centre, intended to coordinate and integrate the collection and archiving of scientific data from naval units and from national and international research bodies. Thus, the ambitious but nevertheless feasible aim is that the *Istituto Idrografico* takes on leadership as concerns:

- collection, quality control, integration, and georeferenced structural archiving of marine environmental data;
- acts as a scientific reference point in whatever discipline is connected with the study of the sea;
- management of a naval Oceanographic Centre.

At present the *Istituto Idrografico* can rely on a remarkable quantity of meteorological and oceanographic data, preserved in old pleasant-to-read booklets dating from early 1900. Such data are being retrieved using modern technologies, and are being organized and archived into an information system based on a number of homogeneous and inter-related databases, which collect current digital data as well.

The Centre can rely on information sources which may be grouped into three main types:

- historical information coming from traditional paper archives, which are digitized and stored in the database;
- information coming from contributors connected to the Institute by a continual and systematic relationship, such as naval units;
- information coming from occasional contributors, such as research centres, universities, environmental associations and such like.

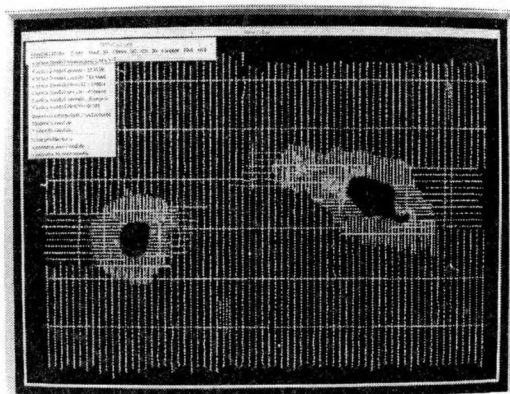
Keeping in mind the problems encountered in digitizing bathymetric charts, the Oceanographic Centre is oriented towards a productive philosophy hinged on a strictly geographically-based information management. Considering the close connection between the georeferenced database of the Oceanographic Centre and the other Departments of the Institute, incoming oceanographic data are automatically fed into a number of processing systems run by the Cartographic Department, the Nautical Documents Department, the Survey Department, the Geodetic Department, and the Hydrographic Units.

A feature peculiar to the data and information stored in the Centre is that they both have a graphic and an alphanumeric component. The graphic component is meant to position a phenomenon in space, whereas the alphanumeric one, or metadatum, is intended to describe and qualify a phenomenon, give it a temporal dimension and finally verify the soundness of the data itself. Users needing to consult the oceanographic database, may accede to an initial metadata level, where the various information available is displayed together with the areas where they can be found, thus speeding up research. As for the information outflow, subject to

the architecture of the system (OSI), the Centre may both represent a series of phenomena in a bi- or three-dimensional mode, and communicate with all the simulation mathematical models elaborated by the different scientific bodies studying or interpreting such phenomena.

Electronic cartography

On the bridge of a modern ship control operations are conducted with the help of data processing systems, while the only traditional instruments are the compass and the nautical chart. If a magnetic compass may be integrated, although not replaced, by a gyrocompass, can a traditional paper chart be replaced by an electronic one? In the affirmative, *what kind* of electronic chart? For a number of years, in fact, the market has been offering various electronic systems produced by commercial firms, sophisticated but not quite reliable, and in any case not complying with the law which, in line with international conventions, obliges mariners to use official charts produced by governmental agencies. Therefore, in order to offer the market analogous digital products, as reliable as traditional charts, since the mid-80s major Hydrographic Services, under the guidance of the International Hydrographic Organization and of the International Electrotechnical Commission, have set up various working groups tasked with the formulation of technical specifications and with the necessary amendments to the existing legislation, in order to set up production and control of electronic cartography. At the same time much work was begun to define the features of the display equipment known as ECDIS (Electronic Chart Display and Information System). The *Istituto Idrografico* has participated in the work of various International Commissions from their creation onwards, and in the meantime has improved and updated databanks which are the fundamental tool for correct production of electronic cartography.



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FIG. 7.- The isles of Alicudi and Filicudi
Electronic display of a sounding plotting sheet.

In early 1995, the Istituto produced 12 digital nautical charts compliant with international standards, to be tested in an ECDIS installed on board the naval unit *San Giorgio* (Fig. 7). This year the *Istituto Idrografico* has set up a Centre of Electronic Cartography which, even though in its very early stages, intends to pursue the project and manage a portfolio of 50 charts compliant with international

standards, in order to improve specific knowledge and acquire expertise in a conceptually innovative field.

NEW COASTAL HYDROGRAPHIC UNITS

Two hydrographic units will replace, in two or three years time, the old minesweepers MIRTO and PIOPO, which have satisfactorily responded to their hydrographic tasks from the 1960s onwards. The new units will have the following features:

- fiberglass-plastic catamaran hull, 400 t displacement
- length: 36 m
- width: 12 m
- draught: 3 m
- range: 1700 M
- speed: 13 n
- diesel propulsion, two propellers, dynamic positioning system;
- crew: 4 officers, 4 petty-officers, 16 recruits;
- facilities to accommodate 4 scientists

Hydro-oceanographic equipment:

- echosounders, max. depth 5000 m.
- multibeam echosounder, breadth 150°, max. depth 5000 m.
- side tow echosounder, max. depth 600 m.
- VHF differential GPS, two frequencies
- middle range radiopositioning system
- 1 short range radiopositioning system
- CTD and multisampler system for measuring chemical-physical parameters
- up to 1500 m. depth
- sound profiler to measure underwater currents
- meteorological apparatus
- system for acquisition and processing of hydrographic data
- meteo-oceanographic data
- hydrographic launch

The Units will be able to perform:

- high-sea hydrographic surveying and definition of bottom morphology, for nautical and bathymetric cartographic purposes;
- port surveying, with special reference to entry routes and channel sweeping;
- search for underwater wrecks and obstacles;
- oceanographic surveying with special reference to chemical and physical parameters of water masses and bottoms;
- oceanographic surveying in cooperation with research Institutions employing specific equipment for the study of biology and marine geology.