MODERN METHODS OF NAUTICAL CHART PRODUCTION

by Guillermo MEDINA
Chief Engineer, U. S. Navy Hydrographic Office.

With increased costs of operation and the imperative necessity that chart makers keep abreast of latest navigational methods, hydrographic services throughout the world are facing a dilemma. Should they continue to produce nautical charts by the classical method of engraving or should they adopt some other method of equal accuracy, more economical in labor and equipment, and so simple in operation as to overcome the prejudices of conservative administrators and technicians responsible for this vital service to the mariner?

From the start it should be made clear that engraving, whether on copper or glass, produces a nautical chart which, in addition to being a navigational tool, is also a work of art. The sharpness and clearness of its lines and the perfection of the hydrographic and topographic detail it portrays cannot be matched by any other method. Yet, we should ask whether the cost of engraving is justified when one considers that, unlike a map, a nautical chart is constantly under revision for maximum usefulness. Are there other methods adaptable to maximum production and rapid expansion ? Can they be used universally, even by a newly created service of limited means anxious to make a record of production in order to obtain increased appropriations for expansion and so better serve the mariner ? I personally do not believe in trying to achieve an impossible perfection, particularly in these times, if substitute methods are available which are more economical and have greater elasticity of operation.

Although the U.S. Navy Hydrographic Office had greatly accelerated nautical chart engraving by the introduction of the pantograver invented by Mr. John H. Larrabee, former Chief Engineer of the Hydrographic Office, and Mr. T. Peter Lampe of the same organization, it would have been a physical impossibility to increase production to meet the greatly expanded needs of the past ten years if we had to rely exclusively on traditional methods. Nautical chart engravers cannot be obtained through a civil service register. They have to be trained at great expense by the government employing them, as the apprenticeship period for proficiency in the art is normally about five years.

Realizing this, the U.S. Navy Hydrographic Office developed and adopted new methods which, beyond doubt, have been instrumental in vastly increasing our production. Although not all of these methods are entirely original, they are presented briefly in this article for the benefit of at least a few of the membres of the International Hydrographic Bureau, and in the hope that other services will publish material of similar nature. Only in this manner will the membres of the Bureau profit by the knowledge of other services throughout the world which are devoting their energies to the same cause.

THE DUCO METHOD.

In lieu of copper or paper (metal or linen backed) a piece of zinc or aluminum, sprayed with at least three coats of a high — quality oil paint, is used in the following manner to produce a chart original.

The first step consists in making film positives on a relatively stable film, such as topo-base, of the various hydrographic sheets or existing nautical charts selected as compilation sources. The film positives are made to the

scale of the chart to be produced. The same procedure is followed in the case of the topographic material available for the area. Topographic material (particularly that compiled by photogrammetric methods) is specially mentioned, as the results of such surveys are often ignored by the nautical cartographer. With the advent of radar it is mandatory for hydrographic organizations to improve the topographic detail on nautical charts as a vital aid to the mariner.

The second step is to draw an accurate projection on a stable transparent plastic. These plastics are manufactured in different thicknesses and degrees of opacity. Major horizontal control for the area is then accurately plotted in order to assist in positioning the hydrographic and topographic charts to be used in the compilation. This plastic base is then sprayed with an adhesive solution. This should be done in a well-ventilated space, exercising proper precaution as the solution is inflammable.

The next step involves the making of a mosaic on the plastic transparent base, utilizing the film positives mentioned in the first step above, by matching the various hydrographic and topographic pieces into a composite of the final chart. Care has to be exercised that the pieces are accurately fitted in accordance with the projection and horizontal control appearing on the plastic base. Minor distortions can be compensated by cutting the film positives into smaller pieces and distributing the error proportionally. The mosaic is then sent to the photographic gallery where a film negative is made by contact in a printing frame. In the meantime the Duco plate has been sensitized with a standard blue print solution.

The negative made by contact is then printed on the sensitized Duco plate, producing a clear blue-line print on the plate that serves as an accurate and stable guide for drafting of the final original. If the chart or map is in various colors requiring separate originals, a separate blue-line print is made for each color to be processed.

The following procedure is used in drawing the chart original. Borders and scales are drawn, followed by the coastline, drainage, planimetry, contour lines and fathom curves, utilizing regular black India ink. Drafting and ruling pens have to be sharpened at more frequent intervals than is customary, due to the dulling action of the enamelled surface.

No mention has been made thus far of the lettering and soundings which are such an important part of a nautical chart and where a major saving in time and money can be accomplished. Hand lettering is, of course, painstaking, time-consuming, costly and never uniform. In lieu of hand lettering, all geographic names, titles, notes, conversion and tidal tables, as well as sounding and other figures, are set in type and printed on one of two mediums : a specially coated white paper with adhesive on the back ; or cellophane to which beeswax is applied after the type impression is dry. The process of applying this material to the chart original is called stick-up work.

Typesetting for printing on these mediums can be done by a casting machine or by the standard hand set method. The style of type can match either the romanized lettering used in engraving, or some other style selected by the individual service. In this connection, I should like to invite attention to the fact that roman lettering, although beautiful in many respects, is not the most practical from a lithographic standpoint. After a few printings the image on the plate has a tendency to thicken with the result that some letters fill up. Time consumed in drawing new names on the lithographic plate is increased due to the serifs of roman-type lettering. It is, therefore, my belief that for lower cost, legibility, and ease of operation, consideration should be given by hydrographic services to the adoption of block lettering on new charts, a procedure which is being followed to a large extent on aeronautical charts and modern topographic maps. Printing of the type for stick-up work is

done either with a standard type press, or better still with one that will produce a sharp black impression on the obverse and reverse sides when cellophane is used.

The same press is utilized for the printing of cuts portraying such symbols as buoys, beacons, mangrove, palm trees, trails, railroads, submarine cables, current arrows, etc. It can thus be realized what added saving in cost may be achieved by utilizing such a simple procedure in lieu of the drafting of each intricate symbol and detail separately.

The next to the last step in the preparation of the chart original is the application of the names, symbols, soundings and other data set in type. For such stick-up work apprentice draftsmen or personnel of lesser skill are utilized. A sharp knife is used in cutting and applying the type whether printed on cellophane or adhesive-backed paper.

After the chart original is completed it is covered with a very thin sheet of transparent cellophane in order to protect the surface while undergoing revision and editing. All corrections are indicated on the cellophane.

THE PLASTIC METHOD.

For nautical charts this method is essentially the same as the one described above, except for the fact that a sheet of plastic is used in lieu of the Duco plate. This plastic is manufactured in various degrees of opacity, its principal characteristics being stability and flexibility.

The U.S. Navy Hydrographic Office has utilized plastics in nautical and aeronautical chart construction and reproduction work for a number of years, having been partly instrumental for the final development of this material for drafting purposes. In lieu of regular India ink, special inks manufactured in various colors can now be procured for drafting on plastics. However, if opaque white plastic is used, draftsmen prefer to use black India ink to which a few drops of glycerine have been added. The procedures for drafting and sticking up lettering, soundings, symbols, etc. are identical to those described for the Duco plate.

As a matter of added insurance, a facsimile black-line print on plastic can be obtained from the negative, a copy which will be sharp in all respects and possess all the qualities of a permanent original.

USE OF THE ENGRAVED COPPER PLATE.

It is not the intention of the writer to advocate the complete abandonment of the copper engraving process. On the contrary, services who have used this process are urged to preserve these irreplaceable holdings on which hydrographic surveyors, cartographers, and artistic engravers have recorded for posterity their efforts in charting the coasts and oceans of the world. More modern and less costly procedures, however, can be used or combined with existing methods to permit maximum utilization of operating funds.

We are all familiar with the time and expense consumed in making extensive erasures on copper in order to bring these plates up to date with the latest information. Each time this is done the plate is weakened. If, instead of going through such a laborious process, we were to combine drafting with hand engraving we would not only expedite the delivery of material to the mariner, but perform the work at a fraction of the former cost.

Let us suppose that new information has been received affecting as much as twenty-five percent of the total area of the chart. In lieu of erasing and re-engraving the original plate or patching it with a section of a thin plate containing the new data, the following procedure is recommended.

The first step is to procure the thinnest cellophane available, using a sheet about 12 by 18 inches, and treat one side with liquid paraffin. Next, place the cellophane wax side up on the source document, which contains the new information and which is to the same scale as the plate, and outline the boundaries of the revised area. This is done by scoring with a dry point so that the outlined area falls free from the main cellophane sheet.

The copper plate is now readied for inking and the impression paper prepared for the usual black and white copper plate print. Next, place the cut-out piece of cellophane wax-down over the inked-in copper plate in the exact position in which it appeared on the source material. Burnish the waxed sheet to prevent the tracing from slipping while the plate travels through the plate press. After printing, lift the impression carefully from the plate. The cellophane adhering to the plate can be removed by washing with the same preparation used to clean the surplus ink from the plate.

After the copper plate impression has dried, the blank areas are ready for drafting the new information directly on the paper, which then becomes a chart original for photolithographic reproduction.

Other methods and materials that are either in use or in the experimental stage also offer many possibilities to the chart maker.

In order to describe better the methods briefly outlined in this article, the U.S. Navy Hydrographic Office has in preparation a manual outlining the above-mentioned methods in great detail. In addition to step-by-step procedures, the manual will also contain chemical formulas used in the lithographic processes, as well as samples of the various mediums used, inclusive of a list of the principal United States firms engaged in the manufacture and distribution of the products mentioned. Sufficient copies of this manual will be furnished to the International Hydrographic Bureau for distribution to the various States Members.

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