

**REMARKS CONCERNING
MATRICES AND PROCESSES OF REPRODUCTION SUITED
TO CARTOGRAPHIC ACTIVITIES OF FRENCH NAVY
HYDROGRAPHIC OFFICE**

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Surprising progress has been made during the past ten years in the technique of constructing, editing and reproducing marine charts. The desire to obtain charts rapidly and in vast quantities has led to the discovery of new products and processes, with a consequent radical change in methods used. In the midst of this abundance of means, one tends to lose sight of both the immediate and remote objectives that should be kept within view.

The purpose of the present article is an attempt to justify current (or planned) developments at the French Navy Hydrographic Office, in keeping with the particular goals of this establishment. If the various criticisms it may give rise to are assembled, analyzed and classified in a constructive spirit and with a desire for efficiency, it will not have proved altogether useless.

A. — *COPPERPLATE ENGRAVING*

There is scarcely need to look beyond the following reason for the use of this technique : when marine charts were first published it was the only process in current use for obtaining proofs by printing from an engraved model (whether or not the model was a work of art). Only later, as other processes came into being (as well as new substances that could be used for the master plate), could arguments be made for or against this primitive method.

These arguments may be classified as follows :

I. — *Pro* :

(a) *Fineness* of engraving ;

(b) *Security* (and relative convenience) in preserving master plates ;

(c) Major argument : the remarkable *plasticity* of copper, enabling rapid and constant changes (by erasing, embossing, planishing and re-engraving) to be made to the plates in order to keep them up to date, whether through minor corrections, correction blocks, or re-editions. A requirement that particularly applies to nautical charts — maps and other engraved reproductions are exempt — is that the *master plate*

of nautical chart be kept continuously up to date ; as important a consideration as its original construction in the selection of the technique to be employed.

Con :

(a) Gradual wearing of plates, following successive printings and correction by planishing ;

(b) Change in size of copper plates in consequence of proof-drawing and especially planishing ;

(c) Shrinking while drying of wet proofs (uneven shrinkage) ;

(d) Slowness and cost of proofs obtained by dry proof-drawing ;

(e) Impossibility of registering successive impressions from different plates, whether on the same chart (colours, etc.) or on a chart and the tracing diagram that may complete it.

(f) Slowness and cost of copperplate engraving ;

(g) Gradual disappearance of copperplate engravers.

B. — PRINCIPAL IMPROVEMENTS OF COPPERPLATE ENGRAVING SUCCESSIVELY INTRODUCED AT FRENCH NAVY HYDROGRAPHIC OFFICE

I. — *Stone Engraving*. — This process made it possible to correct the situation described in the foregoing paragraph (A-II, b, c, d, f, and g), but had to be discarded for the following reasons :

Weight, bulkiness, brittleness of stones ;

Limitation to small sizes ;

Difficulties involved in keeping stones up to date as regards important corrections (correction blocks or new editions).

II. — *Steel Plating*. — This limited the wear and tear due to proof pulling, but the deplating and replating that had to be done when making corrections complicated matters considerably.

III. — *Electroplating*. — The engraved matrix (or *master-plate*) is replaced by a matrix (or *galvano*) obtained by means of a double electroplating process. The galvano is used for pulling proofs, thus limiting wear on the master-plate ; but once the galvano has worn out, recourse must be had to the master-plate, which must be brought up to date of corrections occurring since the galvano was made. This method has the end result of doubling the amount of engraving work, which must be carried out both on the galvano and master-plate. The galvano moreover is rather brittle and is frequently apt to split.

IV. — *Helio-engraving on copper*. — This consists in making an exact duplicate of the chart on tracing paper and in exposing the suitably prepared copper plate through the tracing. Drawing is substituted for copperplate engraving and the disadvantages mentioned above (A-II, f and g) are eliminated.

It should be pointed out, however, that the engraving is not as fine ;
that tints must be engraved afterwards separately ;
that subsequent corrections are made by engraving the copper plate.

V. — *Zinc transfers*. — This process consists in transferring the copper-plate engraving to a zinc plate used for printing purposes. The drawbacks mentioned in A-II, a, c and d, and A-II, e disappear if extra zinc plates based on the original zinc plate are made for additional steps in printing (colours, spot colouring, and *tints*, that no longer need be engraved on the copper plate).

The method has been extended to include four-fifths of the charts on file that are issued in fairly large quantities, and has proved extremely useful.

It should however be pointed out that it becomes necessary to :

- (a) Make a double set of minor corrections (on the zinc and copper plates) ;
- (b) Make a new zinc plate each time important changes are made on the copper master-plate (correction blocks or new editions) and that ;
- (c) The transfer is not always perfect (tints and even the lines may not come out well or may be overinked) ;
- (d) Size may not strictly be retained when transferring from copper to zinc.

VI. — The simultaneous adoption of remedies IV and V eliminates the disadvantages enumerated in A-II, a, c, d, e, f and g.

VII. — *Helio-engraving on zinc*. — The same tracing obtained by drawing-enables a zinc plate to be acquired directly for printing purposes. A greater degree of fineness is obtained, intermediate steps are eliminated, and the disadvantages of paragraph A-II no longer prevail.

However, the advantage of A-I, c disappears. There is no longer any master-plate capable of receiving successive corrections, for the zinc plate is quite unsuited for this purpose. One may, of course, use the same tracing in order to helio-engrave a copper plate, but then the drawbacks described in paragraph IV become operative. The tracing itself is too flimsy to be kept for very long, and even when new can scarcely withstand more than a couple or erasures and a new drawing over the same area.

VIII. — *Master-Plate on Transparent Base (Plastic)*. — This process consists in substituting a stronger transparent material for the tracing capable of withstanding an indefinite number of erasures and drawings over the same area. The first material selected was Kodatrace, as we had no other materials to choose from.

C. — USE OF KODATRACE IN PUBLISHING NEW CHARTS

I. — *Description of Method*. — After preparing the chart to be issued (computation of grid, choice of soundings and features to be retained, reduction tracings, reduction to scale, etc.) :

- 1. Draw by hand on a sheet of Kodatrace (with India or "Crat" ink) :
 - a) the grid (meridians, parallels, frame)
 - b) the shoreline

- c) soundings
- d) inland topography
- e) place-names, legends, title
- f) other printed information

(It is advisable to coat the drawing with a thin layer of Kodak varnish to prevent flaking).

2. Obtain a *No. 1 zinc plate* from the Kodatrace by the bichromate gum and exposure process.

3. Obtain a *No. 2 zinc plate* by key transfer from the *No. 1 plate*, to be used for land tints on the chart.

4. Print the charts by overprinting with the two plates

Note. — A *No. 3 zinc plate* may also be used to overprint spot colours (lights, aeronautical lights and radiosignals).

Note 2. — Instead of Kodatrace any other transparent plastic material may be used that can take ink and be erased (Dyrite-Rhodoid, Astralon, Vinylite, etc.). The *thickness* of the material has no bearing as regards the quality of the zinc plate but it plays a part when proofs are made on Ozalid, used during the operations described in paragraph 1 either for checking previous steps or preparing those to follow. The thinner the base the better the Ozalids.

II. — *Advantages of Process*

- a) Elimination of copper engraving.
- b) Easy re-editing : the amended sections are erased by means of a special product (Fedoroid, cleaner, etc.) and an indefinite number of new drawings can be made with as much ease as the original.
- c) Minor corrections of detail can likewise be made indefinitely, by scraping.
- d) Drawing is made easy since tracings are made of the original charts by transparency (not transference).
- e) Easy obtaining of proofs while work is going on by the Ozalid process (since the material used is transparent) for checking or preparation.
- f) Making the zinc plates becomes easy by transparency, instead of a transfer on India paper having to be used as for copper plate : size is accurately retained.
- g) Elimination of all large-size photographic equipment in proceeding from the design on Bristol board to the zinc plate (as done in the United States and England) through the medium of negatives on glass, film or plastic.
- h) Easily preserved. No scratching, oxidizing, or cracking. Travels easily.
- i) Possibility of partially substituting printing, stickup and Varygraph stencilling of letters and numerals for hand lettering.
- j) Possibility eventually of directly obtaining a zinc plate by reversing the matrix before exposure, provided the transparent material is thin enough, which would enable a zinc plate for offset reproduction to be obtained immediately.
- k) No difficulty involved in obtaining correction blocks. After the matrix has been brought up to date, a fullsize photograph of the section needed is taken, which supplies the block.

III. — *Criticism of Drawbacks*

The main drawback is as follows :

Kodatrace is not overly fragile, but if a cut should unfortunately occur, the tear may grow larger indefinitely.

This situation may be corrected by using an extremely sturdy transparent plastic material (such as Dyrice, Rhodoid, etc.) or by making an extra zinc plate.

Instead of a single zinc plate (see paragraphs C-1, C-2) two are made. The second one is kept in reserve ; in case of an accident to the matrix, it may be used (since no proofs are pulled from it, it is in excellent condition) for a Kodatrace print, which becomes the new matrix.

Current Improvements

With no change as regards principle, which consists in finally acquiring a master on strong transparent material, a so-called mechanical photocopying process is at present available which facilitates its production. This consists in transferring a drawing on one transparent base to another previously sensitized transparent base.

A final master can then be obtained following the production of a temporary master, which has the following advantages :

- Drawing on ordinary tracing paper ;
- Use of mosaic in composing title and part of lettering ; possibility of printing legends and drawings ;
- Previously printed cellophane stick-up for part of lettering.

D. — *TRANSFERRING MASTER PLATES OF EXISTING CHARTS TO PLASTIC*

The foregoing remarks apply to the use of plastics in making master plates for newly constructed charts.

But while the advantages of master plates made of plastic as opposed to copper are evident, whether upon the occasion of the first edition or subsequent editions of the same chart, the problem now arises (preferably when re-issuing a chart) of proceeding from the existing master plate to the plastic master in the most practical way possible, particularly avoiding the necessity of re-drawing the entire chart by hand.

This problem has been solved in the following cases :

Zinc master

Master tracing

No master

Stone master

Copper master

We shall describe these various operations in detail and indicate the precautions that must be taken in making *new editions of the masters*.

I. — *Replacing Zinc Master*

Actually the zinc master is only a plate for making proofs, as normally it cannot be obtained directly. This means that the corresponding master plate has been lost.

In this case a print will be made from the zinc plate on plastic, which will become the master plate. The degree of deterioration obtained thereby will generally be reasonably small, and in any case preferable to a complete re-drawing by hand of the chart.

(If need be, however, a very pale blue ink (or one that is washable) may be used in making the plastic print, and the lines re-traced without difficulty).

II. — *Replacing a Master Tracing*

A new zinc plate will be made from the tracing (the old worn plate, if one exists, being discarded) and a plastic print will be made from it (this will be the master plate).

III. — *No Master*

A « copycat » negative will be made from a chart on issue, then a positive on film; a zinc plate will be made from the positive and then a plastic print (which will become the master).

A much greater degree of fineness will be acquired if it is possible to sensitize the plastic with photographic emulsion and obtain a print directly on the sensitized plastic from the copycat negative.

IV. — *Replacing Stone Master*

A print is obtained directly from the stone on plastic, and this becomes the new master plate.

V. — *Replacing Copper Master Plate*

A new zinc plate is made from the copper master (be careful not to use the worn zinc plate in operation). A plastic print will be made from the new zinc plate. This is the new master plate (1).

VI. — *Re-editing a Chart with a Copper Master Plate.*

This can also be done when plastic is used merely to expedite the re-issuance of a chart, and elimination of the copper master is not desired.

One should then proceed as described in the following paragraph, but the copper master plate must be brought up to date, which means that there must be an engraved duplicate of the drawing.

VII. — *Re-editing a Chart on a Plastic Master*

This is the method that must be followed in re-editing a chart, whatever the origin of the plastic master.

Benzine or some special product (depending upon whether the plastic is printed or drawn) is used in effecting erasures, or the sections to be amended are scraped following indications appearing on a previously worked out buff model.

(1) The attempt to obtain a plastic print directly from the copper plate, although not yet successful, has not definitely been given up.

New features are then drawn in with India ink (or special ink) according to the indications on a red model previously made.

A blackprint zinc plate is made by helio-engraving, which is used as the main printing plate. An additional zinc plate for tints is made from the first by transfer and key transfer, which is used in printing the tint and which by overprinting enables concealing missing portions of tint resulting from erasure of the amended sections. There is no question of re-drawing the tint in the amended sections.

By successively printing with these two zinc plates (and additional plates for colours, spot tints, etc), the chart is obtained.

E. — GENERAL PRINCIPLES THAT MAY BE DERIVED

Whatever the conditions prevailing, the foregoing considerations enable important conclusions to be drawn ; the various items successively dealt with in chart production may be classified as follows :

I. — *Master Plate*

This is the physical basis enabling preparation of the main printing plate ; it is the foundation for successive sets of corrections, and a new main printing plate is made from it each time a set occurs.

There should always be a master plate, and one only ; it should be easy to keep it up to date, and this should be done continuously.

II. — *Main Printing Plate*

Use of the master plate as a printing plate is exceptional (stone or copper for limited chart editions). Normally a zinc plate (blackprint zinc plate) is made from the master plate, which is used as the main plate for the actual printing of charts.

III. — *Auxiliary Printing Plates*

These are used for tinting, colouring, etc. They are made of zinc and are obtained by key transfer from the main printing plate.

IV. — *Reserve Plate*

This is a zinc duplicate of the main printing plate and is made at the same time. It is kept in reserve in case of loss or deterioration of the master plate. It would then be used for making a new master plate. This practice should be considered as a last resort, as the two additional transfers involved are bound to cause a certain amount of deterioration.

The reserve plate should never be used for making prints : it is not kept up to date. A new one is made whenever a new main printing plate is prepared.

The practice of keeping a plate, in reserve, which was instituted for reasons of security at the time master plates on a transparent base were introduced, is one which could progressively be abandoned.

F. — COMPARISON WITH METHODS IN USE OUTSIDE THE FRENCH NAVY HYDROGRAPHIC OFFICE

With the help of the preceding classification, it is easier to compare the methods now being developed at the French Navy Hydrographic Office with those prevailing at other establishments such as the French National Geographic Institute, the United States Coast and Geodetic Survey and U.S. Navy Hydrographic Office, and the Hydrographic Department, British Admiralty.

I. — *Account of Methods Used*

Apart from engraving on copper, which still prevails to some extent at the N.G.I., U.S.N.H.O. and British H.D., here are, in very rough outline (1), the methods in use or being tested in these establishments. We respectfully request that any possible errors of detail be excused.

1) *N.G.I.*

- a) Drawing of model on Bristol board on larger scale than chart ;
- b) Glass negatives reduced to scale of chart ;
- c) Zinc printing plates obtained by helio-engraving from glass negatives.

2) *H.D., Brit. Adm.*

Same as N.G.I., except that sheets of enamelled zinc replace Bristol board.

3) *U.S.C.G.S.*

- a) Model on scale of chart prepared on Bristol board ;
- b) Glass negatives of model ;
- c) Aluminium printing plates obtained by helio-engraving from glass negatives.

A variation being considered consists in replacing glass negatives by plastic negatives coated with an opaque substance sensitive to light (such as Scribe-rite) (b')

4) *U.S.N.H.O.*

- a) Preparation of mosaic on opaque or translucent plastic for line-drawing ;
- b) Negative on film (by contact if plastic is translucent) ;
- c) Blueprint on plastic. Lines gone over in black ; soundings, lettering, etc., by stickup or by hand. Result is a model on plastic.
- d) Contact negative on glass of model.
- e) Zinc printing plates obtained by helio-engraving from glass negatives.

II. — *Criticism and Comparison of Methods*

1) *Optical Aspects.* — It should first be pointed out that the operations described in (1) b, (2) b and (3) b require the use of a very large camera with excellent optical qualities. Operation (4) a requires delicate photographic reductions attaining an extremely high degree of accuracy and the use of high-quality lenses.

(1) For details see Report No. 345 S.H.1. of June 25, 1948 : (Mission d'information de M. Chavanier aux U.S.A.).

The French Hydrographic Office at the present time possesses no such equipment, nor trained personnel for its operation ; nor has it the space necessary for its use. Present appropriations make it impossible to expect any improvements in this respect for a number of years.

2) *Types of Charts Produced.* — Methods of the N.G.I., U.S.G.C.S. and U.S.H.O. are mainly adapted to the construction of *land* maps in the case of the N.G.I. and *aeronautical* charts in the case of the other two establishments. Aeronautical chart production far exceeds marine chart production at these two offices. It is therefore quite natural that construction of nautical charts should have been patterned after that of aeronautical charts, with certain marked advantages (bathymetric and hypsometric tints), although these are not essentially required in our case (they could nevertheless be procured through use of our own method, if desired). The French Hydrographic Office produces none but nautical charts, and it is incumbent upon it to discover the methods that are best suited to its type of production.

3) *Re-editions.* — The definitions appearing in Chapter E enable the various items used in making up the chart according to the methods described to be classified as follows (there may be exceptions, of course, in particular cases) :

	N.G.I.	U.S.C.G.S.	U.S.H.O.	H.D. Brit. Adm.	French Hydr. Office
Preliminary items (not retained)	Glass negative		Glass negative	Glass negative	
Preliminary items kept in the files		Bristol board model	Mosaic		
Printing plate ..	Zinc	Aluminium	Zinc	Zinc	Zinc
Master plate	Bristol board model	Glass negative	Glass negative and Bristol board model	Enamelled zinc	Transparent master
Extra master plate				Copper (sometimes)	

The types of master plates used give rise to the following consequences in the case of subsequent editions :

a) *N.G.I.* — Only a limited number of editions can be made from the Bristol board model, which is of no importance as new editions (and corrections) rarely occur at the N.G.I. (every 30 years or more).

b) *H.D., Brit. Adm.* — Enamelled zinc is probably better suited in the case of successive editions. Reservations should probably be made, however, as to the resulting satisfactory reproduction of the drawing and preservation of the plate.

c) *U.S.H.O.* — Difficulties due to the existence of a duplicate master plate (preservation and especially keeping up to date) arise. Moreover, the Bristol board model, as we pointed out, will only take a limited number of successive corrections ; and it is difficult to keep glass negatives up to date unless suitable equipment and a trained staff are available.

Moreover, both the H.O. and N.G.I. are prepared to publish a completely new edition of their charts rather than correct the master plates.

d) *U.S.C.G.S.* — Here, where equipment and personnel for negative engraving are available, facilities are better. This process is unquestionably simpler than engraving on copper or drawing on Bristol board. However, a long trial period and the gradual development of a system were needed before efficiency was acquired, and it would not be possible to set the method up at a moment's notice.

4) *Preservation of Master Plates — Transportation.* — Bristol board models are fairly fragile, and enamelled zinc plates probably even more so. Glass negatives are cumbersome, heavy and brittle.

III. — *Comparison of Methods with System at present being set up at French Navy Hydrographic Office.*

Referring to the list of advantages enumerated in Chapter C (II) above, we believe that the advantages of the process we recommend in relation to those of other establishments mentioned can be briefly outlined as follows :

- 1) Advantages over N.G.I. :
b, c, d, e, g, k ; fewer intermediate operations.
- 2) Over H.D., Brit. Adm. :
d, e, g, h ; fewer intermediate operations.
- 3) Over U.S.C.G.S. :
d, e, g, h ; fewer intermediate operations.
- 4) Over U.S.H.O. : b, c, e, g, h, k ; far fewer intermediate operations ; less delicate optical operations.

On the other hand, we fail to see where these methods show any marked advantage over the procedure we recommend, except occasionally in the more extensive use of mechanical lettering through the application on Bristol board of printed transparent stick-up.

Such are the seemingly very favourable conclusions with regard to the measures we advocate. We again apologize for any errors that may have crept into this paper, and any suggestions or criticisms will be gratefully received.
