

## USE OF AERIAL PHOTOGRAPHS FOR REVISION OF LAND INFORMATION ON NAUTICAL CHARTS

by H. R. BROOKS, U. S. Coast and Geodetic Survey.

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A nautical chart is essentially an instrument of navigation which is effective and useful only if it is maintained up-to-date with changes. Much of the coastline of the United States is subject to rapid and continual change caused both by storms and by cultural developments. Consequently, the major part of the nautical charting effort of the Coast and Geodetic Survey is devoted to the revision or maintenance of the approximately 800 charts on issue.

While the depths of water and underwater obstructions are of primary importance, the land information on these charts must also be maintained up-to-date. This is particularly true for the more than 350 charts published at scale 1:40,000 and larger for navigation in harbours and inland waters where the shoreline and prominent topographic features near the shore assist the mariner in navigating. Aerial photographs provide excellent source material for revising the land information on nautical charts since they can be obtained quickly following changes and readily applied to the chart drawings.

In maintaining the topographic information on charts it is necessary to find where and when the changes occur, take aerial photographs of them, and correct the chart drawings as soon thereafter as possible. The procedures for correcting charts from aerial photographs are summarized briefly as follows and are then discussed in more detail in subsequent paragraphs. Topographic and planimetric maps described elsewhere in this issue by Bennett G. Jones provide the basic information for compiling land details on the chart drawings. Subsequent changes that affect the charts are reported by field survey parties and are detected by aerial reconnaissance of changeable areas. New aerial photographs are taken and are used to correct the chart drawing. Changes noted on the chart drawing are then applied to the glass negatives for that chart and a new issue of the chart is printed. The original engraved, wet-plate, glass negatives for each chart are permanently filed for use in revision and reprinting charts. When a revision is necessary, the changed areas are opaqued on these original negatives. A facsimile image of the revised area is then transferred from the corrected chart drawing to the glass negative and the new details engraved thereon. The revised negatives are then used for preparation of new press plates for printing.

Aerial photography for the revision of reported changes is taken in the spring and fall of each year by the Photographic Mission that takes mapping photography in the United States and Alaska. This scheduled photography is not sufficient, however, since small but significant changes often have not been reported and have not been photographed. Consequently, an aerial reconnaissance of the changeable areas is made about every one to three years with a light airplane. The coastline and the water front of harbours are examined by flying over them at altitudes of 2,000 to 3,000 feet, and are compared with nautical charts and changed areas not

previously detected are then photographed. Single-lens photography is used for most chart revision work and is usually taken at a contact scale ratio of 1:10,000, i.e. at a flight altitude of 5,000 feet. Higher altitude photography is taken occasionally where photogrammetric plotting is necessary for extensive changes and low altitude photography is sometimes taken for studying changes in aids to navigation or other special purposes.

New aerial photographs are indexed on copies of the various nautical charts of the area flown and are closely inspected for changes of immediate importance to navigation. These include such items as new piers of importance to shipping, piers destroyed, inlets and entrance channels closed by storms, and new inlets opened by storms. Changes that are of immediate importance to navigation are reported in the « Notice to Mariners » that serves as a supplement to the nautical chart until a new printing of the chart can be made.

The revision of chart drawings is scheduled according to a chart Exhaustion Report which predicts the date when the current supply of copies of each chart will be exhausted. When the supply for a chart reaches a particular point on this report, that chart is given a priority for revision which will permit revision of the drawing and a new printing at about the time all copies on hand have been distributed.

The first step in revising a chart drawing is to examine the photographs to determine the nature and extent of the changes. Many of the changes are of small extent and can be made directly from the photographs to the chart drawings. In this case the photographs are studied under a stereoscope and the information to be transferred to the chart drawing is inked on the photographs in red or white ink. Details are selected and generalized according to the scale of the chart which is always smaller than the photographs. The stage of the tide at the time of photography is computed from the predicted tide tables, or from actual tide observations when the latter are available, to guide the compiler in interpreting the shoreline (mean high-water line) on the photographs. The information inked on the photographs is then transferred to the chart drawing and is positioned thereon by holding to unchanged details visible on both the chart and the photograph.

At present, two chart bases are used for revision. First, a buff, drawing-paper copy of the chart which, when corrections are drawn on it with red ink, becomes known as a « Drawing ». Until recently, this base has been the standard revision copy. Second, a print of the chart on transparent plastic. The first type will continue in use until the present supply is exhausted. When corrections to be applied are quite numerous or complex, it is much cheaper to use the second type, so a transparency is always printed and used in this case.

When the compiler is using a buff copy for correction, the photographs are placed in an automatic focusing projector to correct the difference in scale. Photography normally varies from scale 1:10,000 to 1:30,000. Ninety-five percent of the charts corrected from aerial photographs are 1:40,000 scale, or larger, and the major portion of the other five percent are at 1:80,000 scale.

Practically no trouble is encountered in transferring information from the photographs to the base. Previous graphic compilation experience is a considerable help to the compiler in properly orienting the photographs for the best possible fix. At this point the compiler uses an electric erasing machine to delete unwanted or extraneous detail. If the area involved is not heavily congested he may be able to add new detail or make the necessary corrections immediately with ink. Usually,



Fig. 1. — Corrections compiled onto the base map of the area and then transferred to the chart drawing.



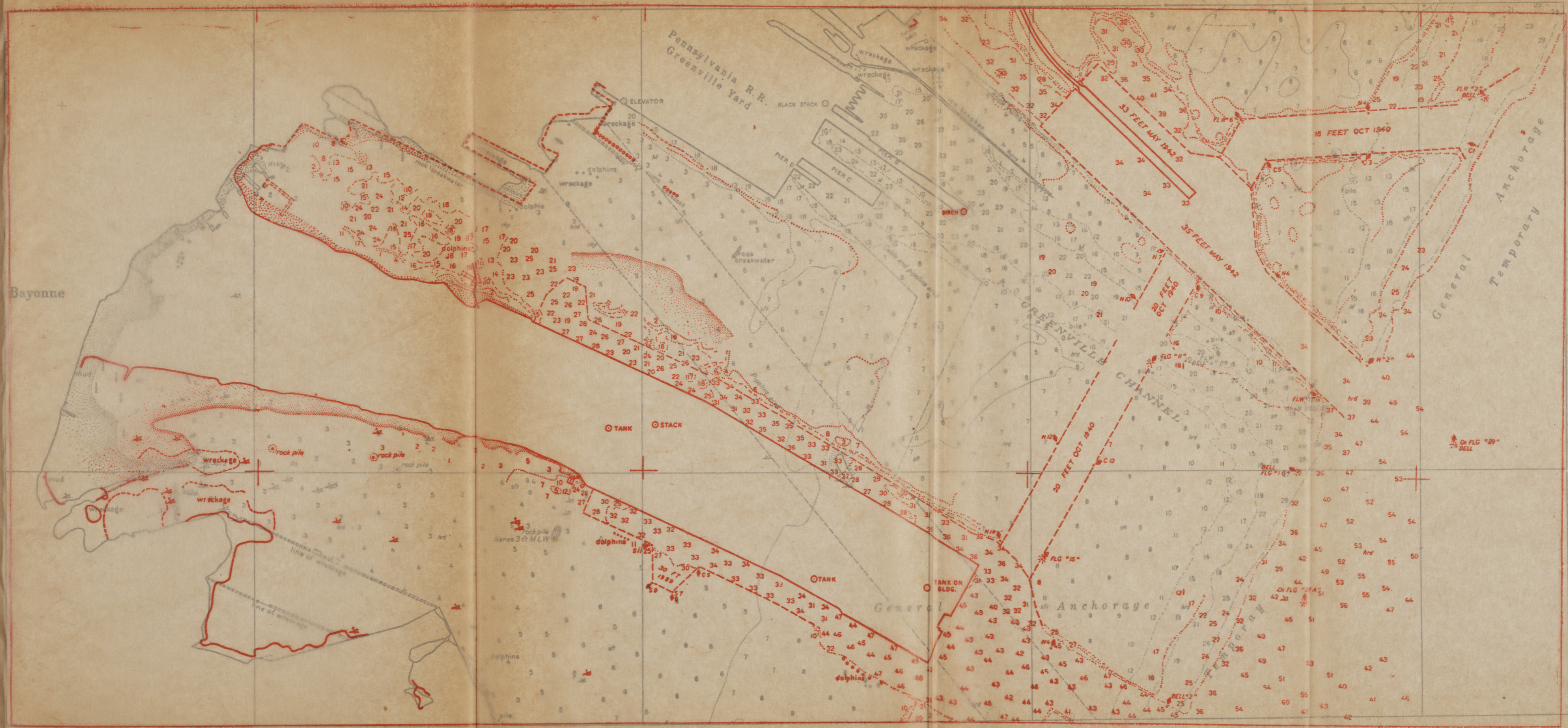


Fig. 2. — Large pier accurately located by radial plot.

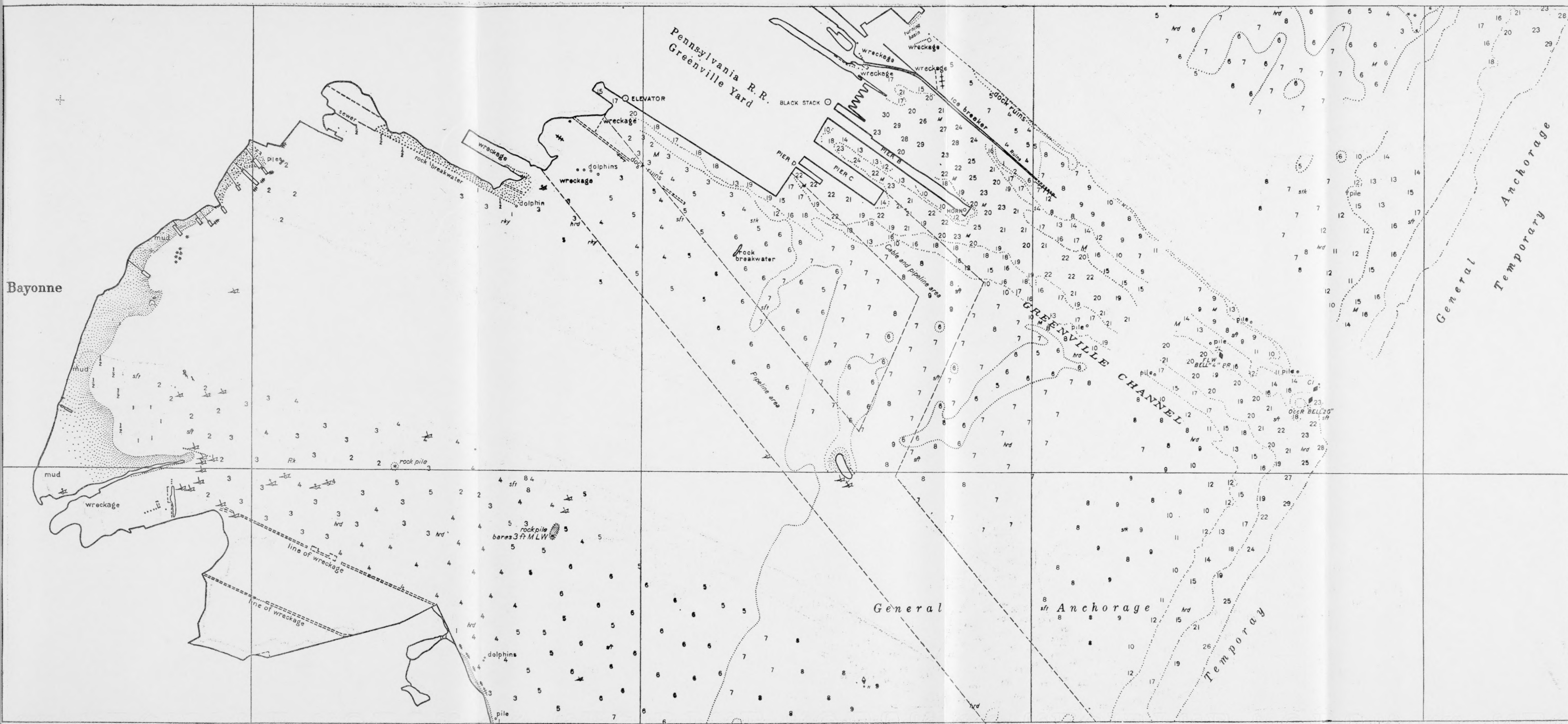
Bayonne

Pennsylvania R.R.  
Greenville yard

GREENVILLE CHANNEL

General Anchorage  
Temporary

General sft Anchorage  
Temporary



however, there are so many changes that inking at this time would cause too many smears, so the corrections are accurately made with thin lead pencil or crayon. Later these corrections are inked to better advantage with the chart spread on a drafting table.

When corrections are applied to a transparent plastic copy of a chart much time is saved in erasing alone. On the buff copy much of the surrounding detail is erased even when using an erasing shield and must be replaced in the same color ink, whereas, on the plastic even the tiniest item may be deleted with a scratch knife. The major timesaver, however, is that the photographs can be ratio-printed to the same scale as the chart, then with these photos marked up for correction, they can be placed under the plastic copy, oriented and detail can be removed or added directly.

An innovation that closely followed the plastic copy was the development of a transfer ink. This ink is readily transferred to another medium by burnishing. Four or five good transfers can be made without impairing the ink on the plastic print. This, of course, saves considerable time and money in the reproduction phase inasmuch as the new detail may be transferred directly from the plastic print to the glass negative.

In some instances the corrections cannot be made directly from the photographs to the chart drawings. The basic planimetric or topographic maps of the area are first corrected and the corrected map drawings are applied to the chart drawings. This latter procedure is necessary in locating aids to navigation and landmarks, and also where the changes are so extensive as to require a photogrammetric plot for accurate positioning of the new details. A red or blue line print of the base map is made on transparent plastic sheeting (vinylite or mylar) from the glass negatives of that map. This transparent print is then used as a manuscript on which the revised details are drawn in black. The map revision may be done by graphic methods, that is, by means of a radial plot and graphic delineation of details or it may be done with the stereoscopic instruments. In this case the base maps are not completely revised nor are they reprinted, but are used as a vehicle for obtaining the necessary corrections for charts. See figures 1 and 2.

The corrections in figure 1 were first compiled by stereoscopic instruments onto the base map of the area. The map was then placed in the projector and the corrections were transferred to the chart drawing.

This large pier situated in a major harbor shows the need for very accurate positioning of detail. With the assistance of a small radial plot it was quite simply though positively located on the base map of the area and then transferred to the chart.

Occasionally, photographic detail is so difficult to interpret that it is necessary to have it field inspected for clarification. This condition is most commonly found in congested port facilities. A field party is dispatched to the site to make a thorough investigation. They are supplied with a copy of the chart containing the corrections made by the compiler and photographs covering all the questionable areas. Upon completion of the field work this data is returned to the compiler for application to the chart drawing. See figure 3.

While the shoreline and large piers were readily discernible on the photographs, the small piers and piling in this area were almost completely obliterated by log booms, houseboats and smaller craft. Field inspection afforded the necessary clarification.

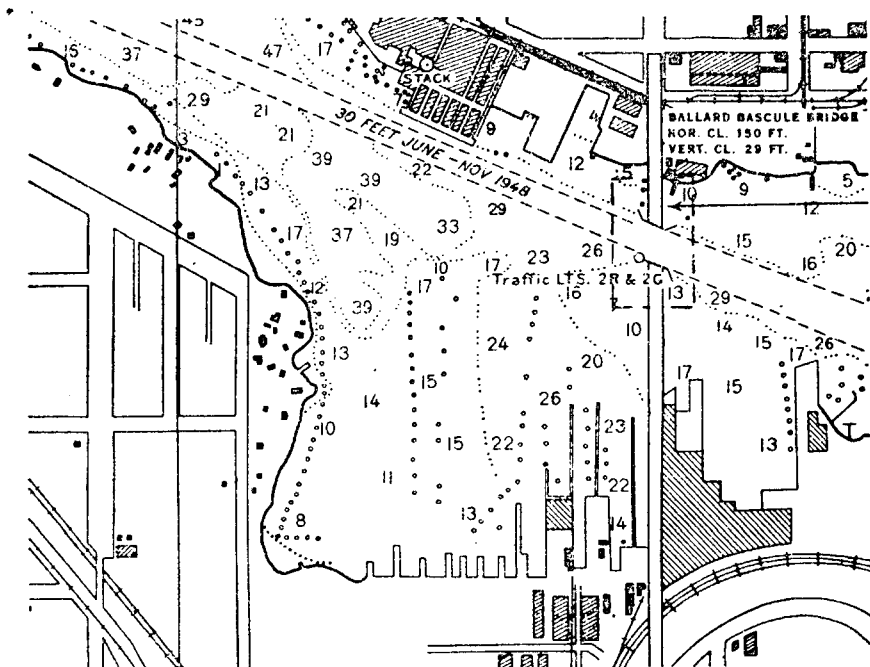


Figure 3 A

Photographic detail difficult to interpret readily clarified by field inspection.

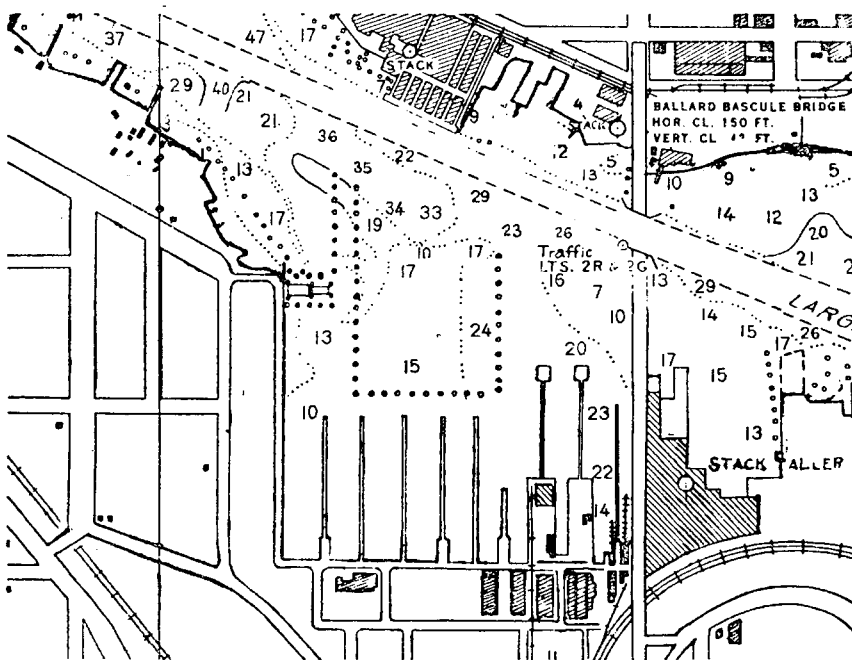


Figure 3 B



If there is a great deal of field work to be done the supply of charts on hand might drop low enough that it will be necessary to print a Tide-Over. This is a small reprint of the current issue without change which will adequately bolster the supply on hand until the chart is revised.

A project currently in progress is the revision of the latest available base maps of the Florida Keys. New photography is applied to these planimetric and topographic maps and they are then incorporated with other source material to compile new 1:40,000 scale nautical charts of the area. At a later date these base maps will be field inspected, reprinted and filed as new base maps of the area.

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