THE DARK - PLATE METHOD OF RELIEF PORTRAYAL

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ABSTRACT

The dark-plate method of relief portrayal was developed to provide in a one-color press run the maximum tonal range from highlight to shadow for application of relief shading to the nautical charts of the U.S. Navy Hydrographic Office. This tonal range is achieved by scraping away or intensifying with wax crayon a grey coating printed lithographically on translucent vinyl plastic. The method is described as being effective and economical, and especially suited for relief portrayal of areas presenting problems in relief shading by other methods.

INTRODUCTION

The Method in Brief

The dark-plate method is so named because it involves working on a sheet of white translucent plastic upon which is lithographically printed a uniform dark grey color. The draftsman works directly on this sheet or plate, adding darker shades in the conventional way to show « shadow » zones (from the conventional northwest sun) but scraping or erasing away the grey tone to indicate highlights on « sunlit » ridges and slopes. The highlight is also used to accentuate drainage systems and other features of importance. The combined effect produces a much more satisfactorily shaded chart than is possible with conventional shading only.

Characteristics of the Method

The dark-plate method greatly increases the scope of plastic relief rendering by making it possible to show features of the landscape not normally shown by relief shading. These are features which cast little or no shadow and therefore cannot be effectively represented by shading. When rendered on the dark plate, these features are considered as light reflectors and are shown by the use of the highlight. Included are such

features as plateaus, marshes, sand beaches and comparatively level flood plains.

The cost of producing a dark-plate original may vary considerably depending on type of terrain and the degree to which the work is carried. A very satisfactory original can be made of average terrain at considerably less cost than detailed contours or shaded form lines. Generally, the more rugged and complex the terrain, the greater is the saving effected by use of shading. The use of contours on low, smooth hills is more economical than the use of shading.

DESCRIPTION OF PROCEDURES

Materials Used

The vinyl chloride plastic sheets used by the Hydrographic Office are matte-finished with the reverse either polished or calendered. The white translucent sheets are selected in thicknesses of either 0.010 or 0.015 inch, depending on the degree of translucency desired. The more translucent the sheet, the less brilliant the highlights will be when the final manuscript is photographed. The less translucent the plastic, the more difficult it is tc see the compilation material beneath it.

A black, hard wax, pencil-type crayon is used to create the shadow areas. Highlights are created by scraping away the grey coating with a sharp scraper. For this purpose, the scraper should be hollow-ground with a smooth razor-sharp edge maintained by stropping on rouge paper. The more subtle highlights may be obtained by the use of a hand or electric eraser.

For the viewing of areas on the compilation which may be difficult to read under the dark plate, a dark room or hood should be available. If these are not available, a very satisfactory viewing hood can be made by cutting the bottom out of a large paper cup painted dull black on the inside. On the large rim of the cup, a half round opening is made through which a crayon or scraper may be used. A two or three inch magnifying glass can be placed over the inverted cup. With this method, it is easy to read a properly prepared compilation, even in a well-lighted room.

Applying the Dark-Plate Coating

The coating is done either on a lithographic off-set or proving press. At present, a grey is used to which black is added to obtain the desired shade. One-half ounce of cobalt drier, either liquid or paste, must be used with each pound of litho ink. If the drier is not added, the surface will be greasy and will not accept the crayon properly. Due to the use of extra drier, the coating may have a mottled or slightly streaked appearance. These imperfections will be « lost » in the shading processes and do no harm.

No standard as to the density of the shade has yet been determined. The nature of the average terrain usually governs the amount of « high-light » or contrast which is desired. The darker the tone of the coating, the more contrasting the highlight will be. For this reason, more detail

can be shown on the light-reflecting surfaces. Conversely, the darker the tone of the coating, the less contrasting the crayon shading will become. A tone intermediate between the tone of the uncoated plastic and the black crayon will prove very satisfactory for the average terrain.

The Compilation Guides

The primary guide should be in the form of contours or developed form lines in black on a transparent or translucent base, reduced and mosaicked to the scale of the chart. Whenever possible, stereo pairs of photographs or large-scale single sheets should be obtained.

Available text such as coastal descriptions should be consulted.

In many cases, the nature of the source material may make it advantageous to make a separate relief compilation. A good, systematized compilation which defines in color the ridge lines, drainage systems, marsh areas, lakes and depressions, beach areas, etc., will often be easier to « read », when rendering the relief, than contours alone. As yet no standard symbolization of ground features has been developed for the construction of the compilation.

In some cases the problem of compilation is to simplify and clarify detailed and complex contouring. In other cases the problem may be to further develop the terrain from generalized contours, form lines, or hachures. For this reason, each chart may require slight variations in the method of construction of the compilation in order to record significant terrain features of a local nature.

Whether or not the following method of compilation is used, some method should be devised to bring out at least these items :

1. Ridge, valley, and slope definitions.
2. Location and relative elevations of peaks.
3. The drainage system in detail.
4. Level areas including swamp, marshland and valley plains.
5. Significant features such as lava, outcroppings, etc.
6. Cliffs, bluffs, escarpments, and depressions.

Where contours or other sources are complete in detail and at the approximate scale of the new chart, a separate compilation may not be necessary.

Analysis of Terrain Character

Elevation profiles of significant peaks, ridges, bluffs, and depressions should be made as a first step. These should be constructed accurately and used as a guide for shading density.

Using the 1:1 profiles as a guide for actual elevations and grades, a general study of the contours or compilation should be made. During this process, written or mental notes of the general characteristics of the terrain should be made and if possible the geomorphic constructional form determined.

If the depiction is concerned with relief features of the third order, the next step is to thoroughly analyze the ground texture of the area using stereo pairs of aerial photographs if these are available. Make notations on the compilation of any prominent features such as rock outcroppings,

minute but extensive dissections, faults, escarpments, etc., which may have been omitted on the contours.

These are factors which give character to the terrain and which are important in visual recognition. To illustrate their importance, imagine trying to recognize even close friends or relatives, having the same type of features, from contour drawings of their faces. It can be imagined they would all look pretty much alike.

In studying the photographs, keep in mind that terrain character information on them can be very misleading, despite a « realistic appearance. » In some light conditions, minor features may be greatly exaggerated and other features of importance may be barely perceptible. Further, where stereo pairs of photographs are used, allowances must be made for the vertical exaggeration of the photos.

Roughing-in the Shading

After analysis of the terrain characteristics, the shading should be « roughed in ». During the roughing-in process as well as during the detailed shading, advantage should be taken of the ability of the crayon and scraper to give an indication of the surface texture of the land forms.

For this purpose there are three types of shading strokes which are generally used :

1. A finely grained, vertical stroke perpendicular to the contours and running from the peaks and ridges to their bases is used for maturely dissected mountains and volcanic forms.

When detailed contours are used as a guide, each stroke can follow the contoured drainage. This will give a continuity to the drainage and ridge systems, and accentuates the « flow » of the terrain from the highest peaks to the shore-line. This type of shading most clearly defines the ridges and drainage systems.

2. Bold strokes trending in the glacial scar direction should be used for recently glaciated terrain which shows prominent and dramatic marks of glaciation. Such a stroke may also be used where drainage slopes are convex and represent the main relief feature.

3. For smooth hills and mountains an even blend of shading is used with just enough stroke marks to indicate the directions of the slopes. In general a good rule to follow is to use strokes which reflect the most apparent of the destructional elements to which the area has been subjected.

If the terrain is such that the first type of shading is used, the general practice is to begin at the highest peak and run the shading strokes downward, perpendicular to the contours until the drainage system is reached. This is similar, in principle, to hachuring except the strokes are continuous. When the first individual ridge or spur is reached, continue with this formation until it levels off at its base or until the two drainage streams forming its limits run together, thereby terminating the form. After this individual form is completed, start back at the original peak and continue until encountering another independent form defined by a drainage line on either side, and follow it to its termination.

When a second spur emerges from the first, digress and follow this

to its termination and then go back and pick up the first. The same holds true for all subsequent emerging ridges and spurs.

This technique will show a continuity of « flow » from the highest peak through all emerging forms to their bases or the shoreline.

Be careful that the shading does not go over the stream or drainage line separating this and the adjacent form as this will interfere with later treatment of the streams.

Final Shading

After the shading has been « roughed in », the terrain will begin to show its general characteristics. The final shading is designed to bring out the prominent details of the relief as well as to enhance the three-dimensional quality. The following procedures are employed :

Using the previously made profiles as a guide for grade and actual height, develop an overlay of the entire area to show about four hypsographic layers. This is necessary in order to control the tone densities of the various elevations.

For illustration, consider layers of 1 000, 2 000, 3 000 and 4 000 metres for the tone gradient control. The shading then should be a graduated tone from 4 000 metres to sea level so that each layer will itself have a slight range of gradation. The lightest one in the 4 000-3 000 layer will be equal to the darkest tone in the 3 000-2 000 layer, etc.

This will then develop the illusion of height, and separate peaks in the same layer will have the same tone density. As a result, however, a peak in the 1 000-2 000 gradient which has the same degree of slope as a similar peak in the 3 000-4 000 gradient will have a much lighter tone of shading.

Therefore, if advantage is to be made of tone gradation to give the illusion of height, the following assumption must be made in order to systematize the shading : *an even tone gradation, regardless of density, indicates an even slope.*

This will then permit a second assumption which is in agreement with the universally accepted theory of shading, i.e., the darker the tone, the steeper the slope : *a change in the normal tone gradation indicates a change in slope.*

It can then be assumed that the more abrupt the change in tone, the more abrupt the change in slope. Also, the darker the tone departure becomes from the normal tone, the steeper the slope becomes.

Dramatic changes such as cliffs and sharp ravines are better shown by symbolization. This can be done with pen and ink or a very sharp crayon. When shading the detail, careful study must be made of the contours in order to detect significant changes in slope. A very prominent natural feature such as a shallow ledge can easily be overlooked due to the subtleness of contours. When viewing contours, the observer is not likely to note that a contour departs from a « centred » position between two other contours, approaches one of them and then wanders back into position. Yet this may be indicative of a significant landmark on the terrain.

As one of the main objects of relief shading is to reduce the feature recognition time required in the use of the chart, it is the duty of the

relief cartographer to detect such features and « call their attention » to the chart user, who in all probability has far less time for study than the cartographer.

Highlighting

This is the additional process made possible by use of the dark-plate. It is accomplished by the use of a sharp scraper or eraser which is used to remove the grey coating and expose the white plastic underneath. Due to the grain of the plastics, the « tone » of the white can be graduated in the same manner as the shading. Two scrapers are required, one for making broad, subtle, tone gradations and one for sharp highlights and highlighting the streams.

One characteristic of the use of highlighting in obtaining the illusion of height is that it works just the opposite of shading. The whiter the tone, the higher the elevation; the darker the tone, the lower the elevation. This affords a contrasting medium which combines with the shading to give a complete picture of terrain forms. Also, the white is as potent as the shading in giving the illusion of height so that the relief will not invert when viewed from any angle.

The same procedures that were used on the shading can be used for the rendering of the « light side ». As most relief cartographers are used to working with the imaginary light source coming from the northwest corner of the chart, the whole chart can be turned around and the highlighting technique will be identical to the shading. The highlight can also be used to accentuate features such as cliffs on the shaded side.

While performing the shading and highlighting, it should be remembered that the original will appear much more contrasting than the final printing. The contrast is lost somewhat in the half-tone process and to a much greater extent as a result of the lighter colors used in printing. For this reason the contrast of the original may be purposely exaggerated to produce a printed chart in better balance than would otherwise be the case.

Treatment of Special Areas

The most difficult individual features to depict by plastic relief shading are those which cast little or no shadow. The use of shading alone in depicting these areas is unnatural and ineffective. Typical of such features are plateau tops, level valley floors, wide ledges, dry lakes, swamps, sand beaches, etc.

Other types of topography which are difficult to show by shading alone are round-topped hills and ridges (Fig. 1) and long gentle slopes where the stream lines are the most conspicuous relief feature (Fig. 2).

By use of the dark plate, these features can be given functional treatment which actively portrays their relief character. A level feature is shown by creating an evenly distributed highlight over the entire area with a soft rubber eraser. A slight tilt can be shown by slightly increasing the highlight on the high part of the tilt. A sharp highlight on a mountain summit will « pull » the summit up into a sharp peak. A broad, slightly subdued highlight on a mountain summit will spread the summit out into

FIG. 3

a broad round top. There should be no attempt to show elevation gradients on these features by the intensity of highlight, as would be done on peaks. The elevation of these individual features is indicated by the surrounding or adjacent terrain. The extent of erasure is determined by the light reflecting qualities of the feature itself. A sand beach can be very light, a coastal marsh almost as light, etc. A feature such as a plateau can be quite dark because of the sharp contrast on both the highlighted and shaded rims. A light reflector should never be pure white except for bodies of water or bluffs and sharp peaks on the lighted side of the slopes.

Areas with Congested Contours

There is the possibility, on very small-scale charts, that the congestion of detail of the contours will make it difficult to read reduced contours underneath the dark plate and time limitations do not permit construction of a new compilation.

In this case, the procedure is to render the shading on a transparent matte-finished plastic. After the shading is completed, place a dark plate of .010 thickness over the transparent plastic sheet containing the shading. Then remove the coating as a means of highlighting the shading. The transparent plastic containing the shading is sprayed with a plastic to further increase its transparency.

These two plates are then combined and photographed together with the highlighted dark plate underneath the transparent plastic which contains the shading.

Abrupt Terminations

In the rendering of regular shading it is difficult to show abrupt form terminations. Usually the shading is darkest at the peak and graduates to a lighter tone at the base of the form with no definite, concise, termination. An example of such a termination is the ending of a weathered cliff and the beginning of relatively smooth landslides at its base. The most common terminations are the stream or drainage lines which form the boundaries of individual relief forms.

To accomplish these terminations and more clearly define the individual terrain features, the dark plate is erased slightly at the stream and drainage lines whether they consist of a sharp line or a wide flood plain. Where drainage lines are deeply incised, the stream line itself can be shaded and highlighted by single strokes with a sharp crayon and scraper.

Masking

A satisfactory method of eliminating the tint on the water and border areas of the chart is to make a blockout mask using for a guide the chart original which contains the shoreline and border neat-lines.

If an opaquing method is used, the chart original containing the shoreline should be on transparent or translucent plastic. The original is « flopped » and overlaid by a transparent plastic sheet. This should preferably be the matte-polished or clear type for maximum transparency.

The water and border areas are outlined in ink. The outlined water areas are then painted out. The most suitable opaques are the pre-mixed

commercial types which are canned or bottled in small amounts. If these are not available an emulsion consisting of two parts lamp black, one part asphaltum, all diluted with turpentine to a workable consistency, can be used.

As the mask contains the opaque on the back side, the mask will have direct contact with the relief negative during the plate-making process. The mask should therefore be identified on the top side to avoid the possibility of its being reversed during the plate making.

The « strippable » coated plastics may possibly replace this procedure and they have the advantage that, due to the thinness of the material, the emulsion does not have to be in contact with the halftone negative for satisfactory results. Also, some of the strippable emulsions are translucent enough that opaque chart originals can be seen easily through the emulsion. The mask can be used to obtain a « flash » of white by inking in the area, object, symbol, or pattern.

Pre-printed patterns can be used on the mask to obtain lighter tones in place of erasing. Printed patterns on cellophane such as sand, etc., may also be used on the shade plate. Special effects such as fields, woods, and roads can also be obtained by either hand drawing or pre-printed patterns.

Possible Applications to Map Design

Symbols other than relief can be shown to good advantage on the relief overlay. (See Fig. 3). The relief overlay could be used to show features such as roads, streams, and sand beaches in a very realistic manner and at the same time relieve the black plate of some of these details. Experimental projects are under consideration to determine the effectiveness of showing tone patterns such as fields, orchards, rock outcropping, etc., by the use of pre-printed patterns printed on both black and white. It is planned that these patterns be especially made and consist of two parts, one half printed in black and the other half printed in white. These could then be combined with each other or with the tones of the dark plate to obtain a symbolization which would combine with the relief and also effect a relief of the individual features.

Large scale photographs and photomosaics can be substituted for the dark plate and the same principle of shading and highlighting can be used to produce a relief effect on the photograph.

Due to the fact that each small segment of relief is more or less « self contained » and does not require adjacent forms for its effectiveness, bathymetric relief can be shown by shading. For example, a crater can be shown effectively by ordinary shading only when it is combined with the surrounding cone. The dark plate can show relief of the interior of the bowl with no shading of the cone required.

Reproduction

The finished original is reproduced by the half-tone reproduction process, using a 133 line screen. Due to the comparatively large size of navigational charts, a film negative is used. This film may not retain its exact dimensions, so the black-out mask which is made from the plastic base original is used instead of opaquing out the water areas on the film negative. This gives a much better fit to the shoreline and lakes.

CONCLUSION

No one system of relief depiction can fully satisfy all the possible uses for which a chart is required. The degree of usefulness of each system varies with the needs of the chart user. To place a degree of importance upon any one system would be the same as placing a degree of importance upon the user.

An engineer building a dam would in all likelihood have little need for the most perfect relief shaded map. A jet pilot would probably have little need for finely detailed contours on his chart.

Whatever method of showing relief is used, it must be systematized in some reliable and consistent form to be of any real practical value to professional users.

The dark-plate method is one which lends itself to an inexpensive, systematic treatment. It can be easily rendered and shown in one color, and is being used on new or revised Hydrographic Office charts to the maximum possible extent, with enthusiastic user reception.