# VISUAL TOPOGRAPHY*

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WORLD WAR II made great demands on topographic maps of all types, demands which required greater refinement of standards, increased accuracy and versatility, and also brought to light overwhelming evidence of the need for maps which realized the fullest meaning of the word topography.[1]

In order to meet this need for more adequate maps, the Geological Survey has been experimenting with many different types of topographic representation. A map was sought which would offer " . . . an exact and scientific delineation and description in minute detail of any place or region . . . " and offer it in terms which have meaning not only for the technical man in the air or on the ground but also for the non-specialized user. The portrayed symbolism had to be of such simplicity, familiarity, and comprehensiveness as to convey immediate and accurate meaning to a wide variety of users.

The adequacy of the representation of a portion of the earth's surface by a group of symbols in the front of a map can not be judged entirely by an evaluation of each of the symbols. Each may be complete in every detail, accurate to a fine degree, and the resultant map still may be lacking in clear and unmistakable meaning. It is the blending of all the symbols into an easily understandable whole that determines the final evaluation of the product.

The concept of a truly graphic map is not new. Beginning with the earliest cartographic efforts, attempts have been made to produce a map that would visually describe a given area, and from these efforts we have inherited such varying visual symbols for indicating relief as hachures, form lines, layer tints, and shaded relief or plastic shading. But now, aerial photography has given us an opportunity to integrate these methods of representing relief and to supplement them in such a manner as to produce a much more complete graphic record. We submit our effort as an encouraging step toward realization of the full potentialities of a topographic map.

A map of this new kind has a greater descriptive vocabulary by the use of tone and color in addition to line as fundamental elements in its symbolism. And by making the relative tone and color correspond to the appearance of physical form in nature, these symbols at once become easily recognizable and almost universally understood (See Figures 1 and 2). This combination gives a complete and continuous description of relief, able to supplement as in Figure 3, or replace for most uses, the contour line which is only capable of describing the land form at spaced intervals. Such symbolism, properly applied, almost achieves the equivalent of an infinitely small contour interval. Also, many features which are often omitted or misrepresented with standard symbols.[2] can be easily and clearly delineated, thus insuring their appearance on the map in proportion to their appearance in nature.

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[1] Topography—The description of a particular place, as a city, town, manor, parish, or tract of land; esp., the exact and scientific delineation and description in minute detail of any place or region. (Websters Dictionary)

[2] Profuse intermittent drainage in desert country, for example, is frequently misrepresented by conventional symbols. Either a large portion of it is arbitrarily omitted to avoid a cluttered appearance on the map, or the entire area is covered with a blue stipple and enclosed in a blue line. If several wide braided sand washes, treated in this manner, happen to fall in any one portion of a map, an erroneous representation results. The prevalence of the blue color indicates a great deal more water than is actually present.

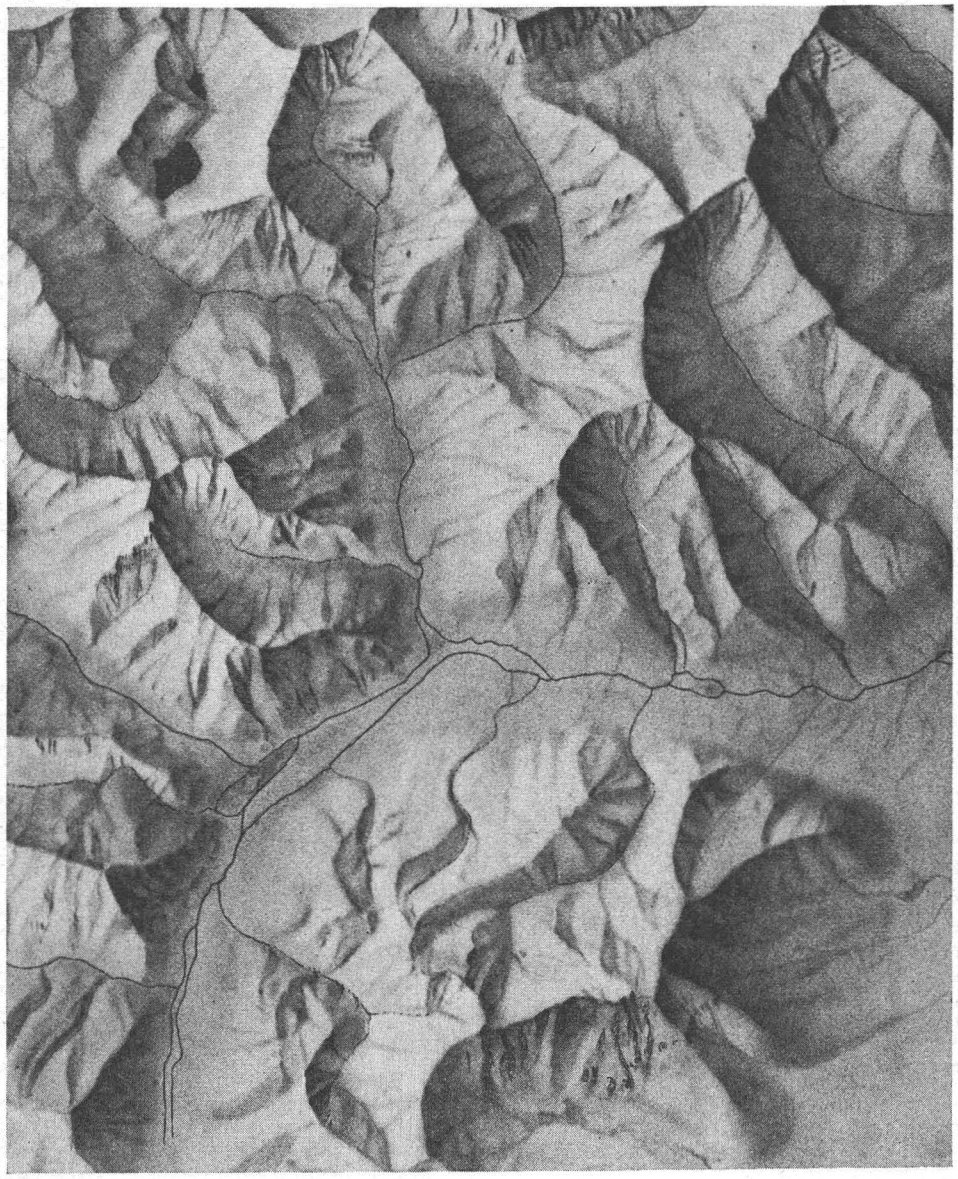

FIG. 1. Sample shaded plate made on planimetric base, from high oblique shown in Figure 2.

Tone, as a symbol, can delineate more than physical shape by accurately indicating light and dark areas as they appear in nature. Such indication is often a vital portion of the description of a place—particularly to the air navigator. Regardless of relief, tone can vividly describe such features as dark rocks protruding from light sand areas, dark lava flows, light sandy washes, alkali lake shores, etc. (Fig. 3). By combining natural color with tone, an even clearer representation can be made of such features as cultivated or, woodland areas, and timber lines.

The construction of this type of map, because of its accuracy and great descriptive quality, requires more exhaustive research and greater draftsmanship for compilation and production than a map of lesser delineation. Experience thus far has indicated that to achieve this type of map representation requires the utilization of the highest cartographic skills. It demands a synthesis of the impersonal scrutiny of a scientific interpreter of geometric measurements, with the sensitive evaluation, organization and representation of a trained artist.

An accurate contour base can be used as control for the tonal representation of relief. Aerial photography, however, and particularly Trimetrogon Photogra-

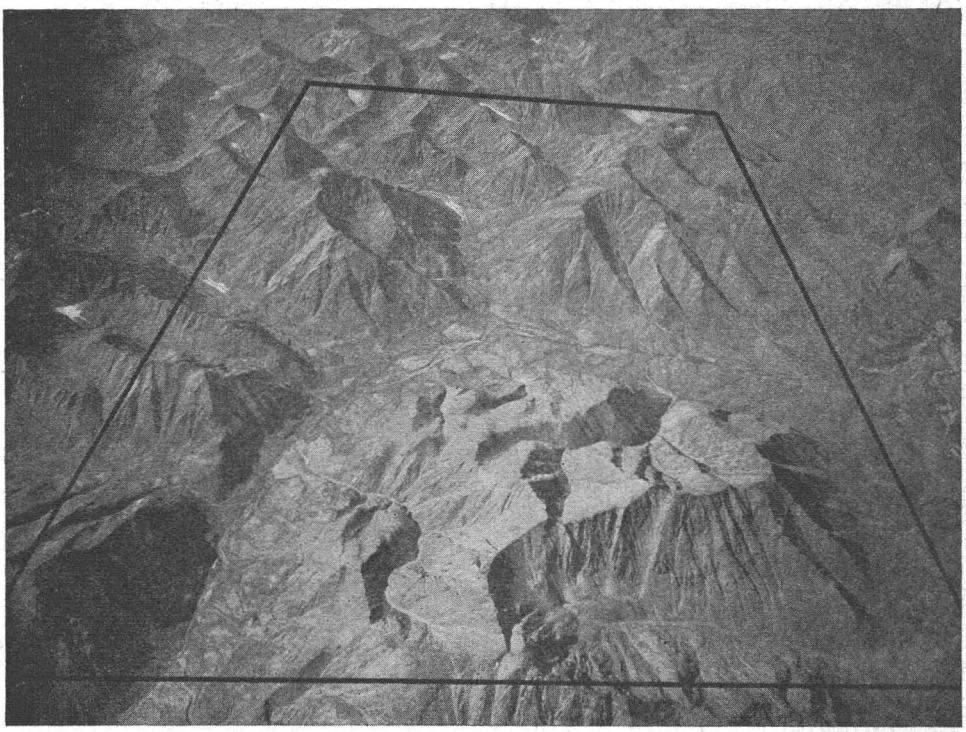

FIG. 2. Photograph used as guide in preparation of Figure 1. Black line indicates area sketched.

phy, led our efforts in an evolution from relief shading (achieved by putting a little tone on one side of all the hills) to an increasingly complete visual description of a prescribed area. The photographs afford abundant descriptive detailed information, especially suitable as a source for graphic maps designed as air navigation charts. Photogrammetrically, this information can be compiled in such a way as to afford planimetric and vertical control for the tonal representation. With the pictures themselves in hand for the final step, the artist-cartographer's job becomes a carefully planned operation.

A valuable quality of the Trimetrogon pictures is the similarity between the oblique pictures and the navigators' view. Features which appear important on an oblique aerial photograph are almost invariably important to the navigator doing pilotage. Thus, because the point of view is the same, the oblique

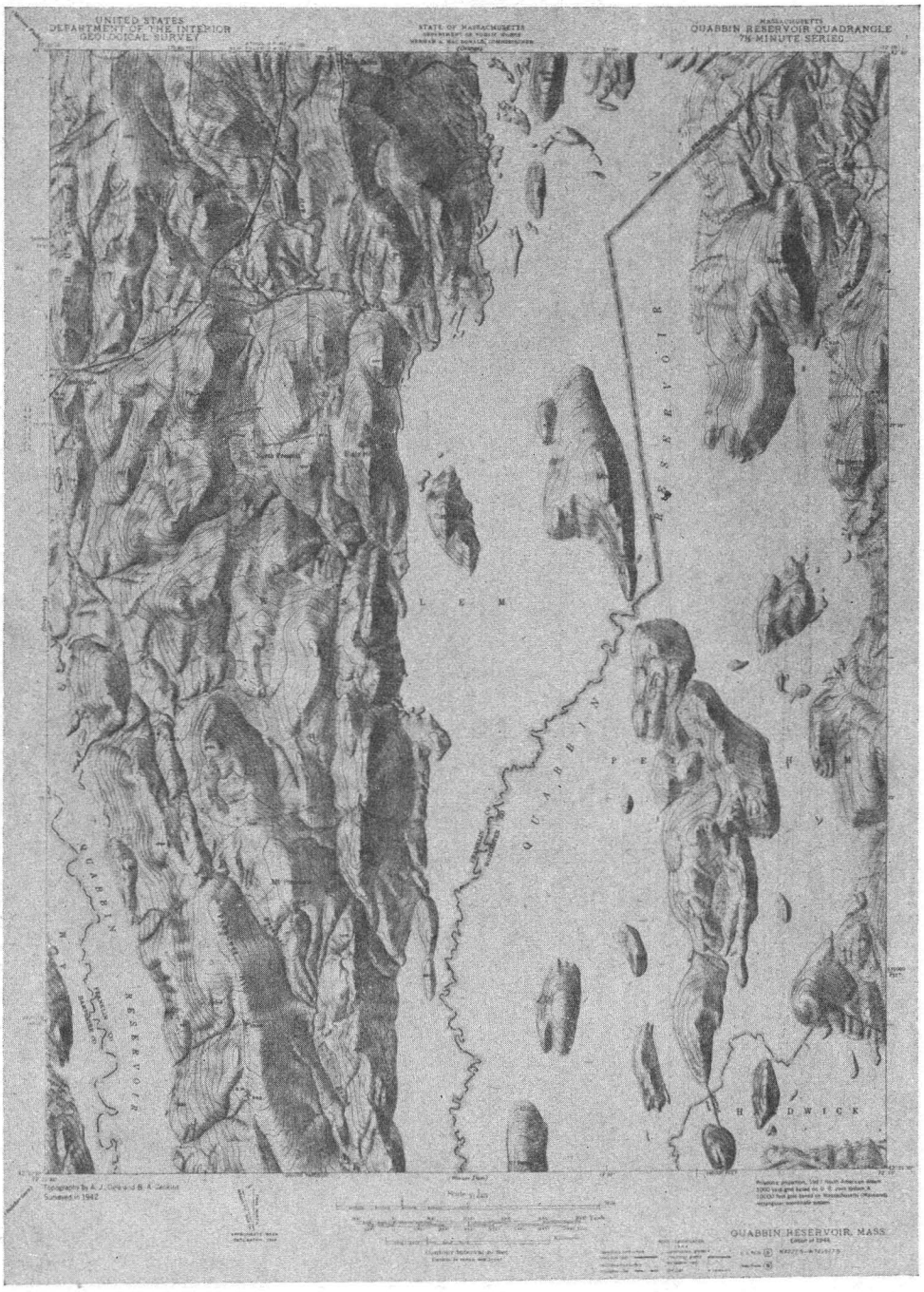


FIG. 3. Standard contour map with shading applied to emphasize shapes.

FIG. 4. Shade plate for arid region topography.

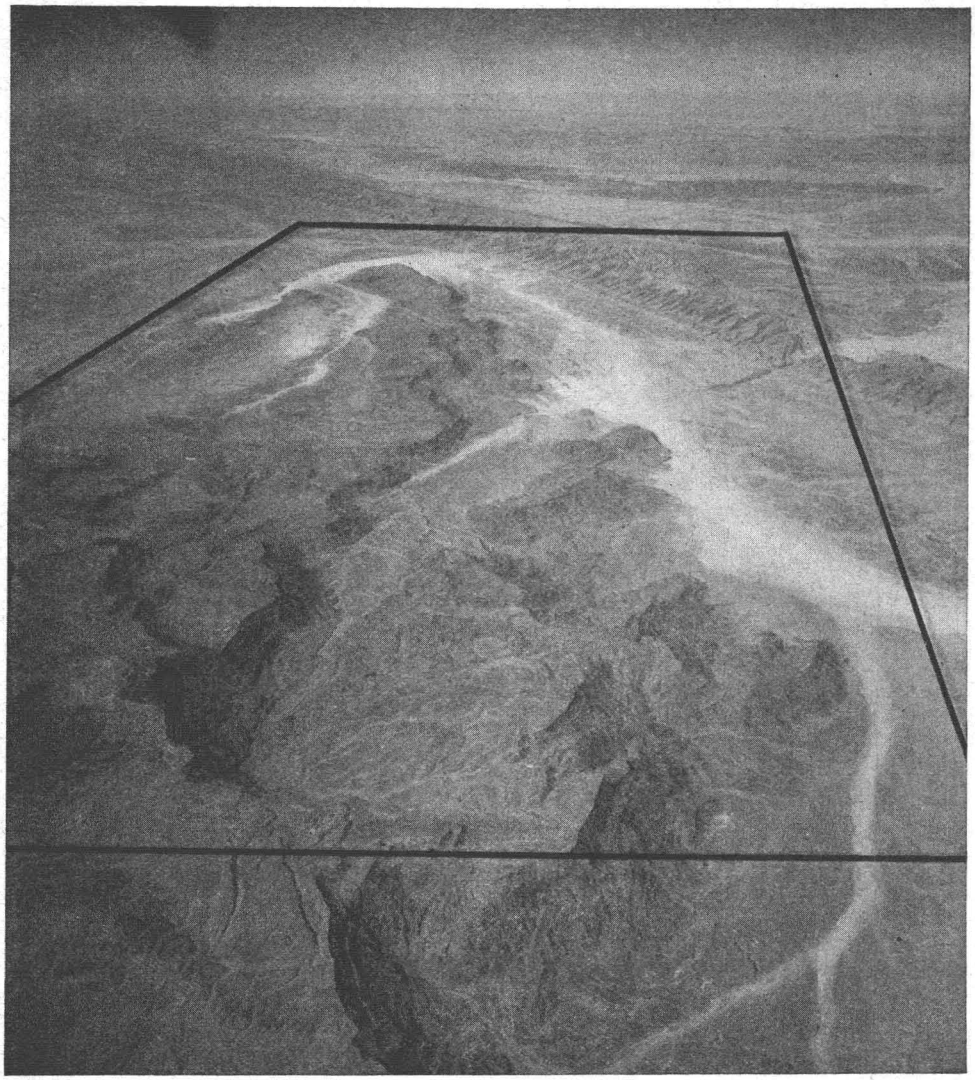

FIG. 5. Photograph used as guide in preparing Figure 4. Black line indicates area sketched.

photograph tends to exhibit its information in an order of importance corresponding to the needs of the navigator. On air navigation charts it is sometimes desirable to show ground features with an order of emphasis quite different from the order that would be used in making maps for use on the ground. For example, an intricate small drainage pattern and a trail through the woods might be of utmost importance to a man on the ground and, at the same time, be practically indiscernible and of no use from the air, while on the other hand a large descriptive pattern of light and dark earth would be a primary landmark to the air navigator and yet of no significance to the ground traveler.

This necessity for a re-evaluation of both feature and symbol in the modern air chart has brought sharply into focus the need for a better graphic representa-

tion of topography. We feel that Visual Topography is a promising step in the right direction.

Preparation of original copy depends, of course, on the method of reproduction to be employed. Halftone lithography requires the preparation of at least three separate color plates in addition to the conventional line plates; projection, drainage, roads, town symbols and names.

These plates can be made by laying a sheet of Dyrite over the prepared base and applying black ink tone with the Paasche airbrush, Model AB. This brush in the hands of a skillful operator is particularly suited to a rapid production of these tonal plates. One plate to be printed in subdued green covers valley areas, a second in earth brown indicates relief, and a third "shadow" plate in red brown, is added to accentuate the higher areas of plate number two.

This gradual transition of color from a cool receding color (green) in the low areas to a warm color (red brown) on the higher slopes is designed to indicate relative elevation only. No attempt is being made to indicate exact ranges of elevation in the manner of a gradient tint.

These fundamental colors can be varied or supplemented as required to accurately describe a particular area and their selection should be made with extreme care.

Because all three color plates are prepared in black, particular care should be taken in coordinating the blending of one plate into another in order that the final color progression is not interrupted.

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## SHADED-RELIEF MAPS IN THE GERMAN AIR FORCE

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DURING the last months of the war it became necessary for the USAAF to portray relief on maps and charts of some areas by a method other than contours because of the lack of vertical information and the urgency for compilation in previously uncharted areas. This resulted in the revival of showing terrain features by shading, using the compilation photographs for source material as discussed in the preceding articles in PHOTOGRAMMETRIC ENGINEERING.

For comparison, the following notes on German practices are published.

An investigation of the mapping and charting operations of the German Luftwaffe reveals an intense interest in shaded-relief maps, even in areas where large scale, accurate contour maps were available. Statements of numerous GAF officers indicated a decided weakness in the ability of both officers and soldiers intelligently to interpret and use maps. This led to the use of relief models and anaglyphs in training programs for operational personnel. Information indicates that the average map user could more readily read and interpret contour maps overprinted with shaded-relief, than plain contour maps. This was said to be particularly true for aeronautical charts as pilots and navigators could readily recognize their position by the likeness of land forms shown by this method on the map.

This requirement led to a unique and scientific method for preparing shaded-relief printing plates for overprinting on maps. The method used also indicates the importance the Germans placed on this type of map and the desirability of having it truly portray the terrain in all respects.