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*Diapositives for Today's Photogrammetry**

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(*Abstract is on following page*)

BECAUSE diapositive requirements vary with altitude, terrain, and type of stereoplotter, discussion in this paper will be limited first, to projection-type stereoplotters, and second, to low-altitude, large-scale photography.

As changes are made from medium to low-altitude photography, the photogrammetrist is faced with several problems which previously were of only minor concern. These are:

1. An increase in the brightness ratio of the photographic situation. This tends to produce unusually contrasty negatives.
2. Contour intervals sufficiently small to be affected by normal ground cover.
3. Compilation scales large enough to require that several contours be placed within a single shadow or highlight area.
4. An increase in the number of contours concealed by "hidden ground."

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These problems, along with those created by the diverse magnifications and different optical systems of the projection type plotters, suggest that there be made at this time a re-evaluation of diapositive function, of methods of production and of concepts of quality control.

A diapositive functions as the translating medium between the aerial camera and the stereoplotter. The information contained on the diapositive must fulfill two sets of conditions—those imposed by the optical and mechanical requirements of the plotter, and those imposed by the psychological requirements of the operator. The first set of requirements are adequately filled by present instrumentation and are of not much concern in connection with this paper. Fulfillment of the second set is dependent on the ability, judgement and technique of the diapositive processor. His understanding, whether learned or intuitive, of the psychological and optical mechanisms that create a stereomodel, contributes as much to the quality of his diapositives as does his understanding of developer characteristics.

ABSTRACT: *Opinion as to what characteristics are most desirable in diapositives is almost as varied as the subject matter of aerial photography itself. This paper presents, first, a subjective method of diapositive evaluation, and second, a description of the newer methods of high quality diapositive production. The role of the projection type LogEtronic Printers and Calva High Resolution Developers in low altitude, large-scale photogrammetry are described in detail. The paper concludes with a survey of the photogrammetric process and the relationship of diapositive quality to the over-all photogrammetric system.*

Perception of the stereomodel is somewhat more complex than the mechanical or "spatial model" concept used in many descriptions of stereoplotter operation. Although projection-type stereoplotters approximately reconstruct the geometric situation of stereoscopic vision, they also require a non-natural function of vision, the psychological mixing of red and green images into a black-and-white stereomodel. In addition, the scale of the perceived model is distorted and the operator is forced to move through vectors proportionate, but nontheless different, from those he observes. Many plotters are worked from both sides of the table and the operator sometimes works against a pseudo-stereoscopic effect.

He must fuse two images into a stereoscopic model whose perspective is the opposite to that of either image viewed monoscopically. A 10 per cent cross transmission in the viewing filters aids his orientation in space, and helps the intellectual combination of these sometimes conflicting stimuli into a stereoscopic whole. But this cross transmission must be mentally suppressed and not permitted to become part of the visual consciousness. Failure to resolve the various visual stimuli into a coordinated whole results in uncertainty, hesitation and doubt in the act of seeing, in other words, a "soft model."

The characteristics and quality of a diapositive contribute to or depreciate from each factor of stereoscopic vision. Most of the present concepts of diapositive quality are based on medium- or high-altitude photography. When a large area is observed at small-scale, the earth's surface becomes a series of definite, almost geometrical surfaces. Accurate stereoscopic definition of these surfaces requires that they be marked at optimum density by small, contrasty detail. Vertical resolution of the detail itself is unimportant. In large-scale mapping, the surface to be defined is more obscured than it is defined by small-detail mapping. Here, the three-dimensional shape of the small detail becomes important as do textures and the subtle aspects of shading. The basic stereoscopic unit, instead of being a sharp edge as it is in high-altitude photography, is the smallest possible object with three-dimensional shading and shadow.

The problem of maintaining shading of the small detail within the large areas of highlight and shadow of a contrasty, low altitude negative is a large one. At Mark Hurd, this problem has been approached from two directions —electronic dodging and special developers.

Electric dodging systems are capable of bringing both the light and dark areas of a negative to a useful exposure level. Through the cooperation of Bausch and Lomb and LogEtronics Inc., there has been installed an efficient electronic dodging system in our Balplex Printer as well as our contact-scale printers.

The developers in use are the result of several years joint research with the Calva Cor-

poration. The diapositives developer is extremely fine-grained and shows little deterioration of image-quality when magnified to 15 diameters.

Consistency in both density and contrast is extremely important to diapositive quality. When small objects contain shading, that is when their brightness varies in a non-linear form across their image, the reproduction of this gradient in both views of the object must be very close to that of nature. Faulty reproduction might easily create the situation known to psychologists as "Fechner's Paradox." The paradox refers to the tendency of the mind to perceive an average brilliance when the eyes are stimulated unequally, but to perceive an additive brilliance when the eyes are stimulated equally. In situations where the diapositives have failed to reproduce the situation of nature, the apparent bright point of certain small objects might be shifted from its true position. In other objects, this would not be the case. The conflict in perceiving parts of the same stereo situation would produce an uncertainity of vision, a "softness" of the model and the tendency of certain objects to distort or to float from their true position. Termination of exposure by exact measurement of the light transmitted through the negative and the controlled contrast of special developers will minimize the frequency of this effect.

Methods of evaluating diapositives differ and usually reflect the history of the individual or organization. Experience has isolated trouble spots and characteristics indicative of these spots are used as a basis of evaluation. The correlation between quality and characteristic may or may not be valid for all diapositives because few, if any, organizations have experienced the entire range of terrain, photographic, and plotter requirements. For example, tone is sometimes a basic consideration. Tone is a valid indication of how some developers are working; for others it is meaningless.

The diapositive should be viewed by transmitted light. In the darkroom of this company has been installed a dimly lit translucent screen with racks to hold several wet or dry diapositives in viewing position. The racks are at eye level and each diapositive is viewed through a magnifier whose power and field approximates that of the plotter for which the diapositive is intended. An auxiliary higher power magnifier would be useful if grain were a problem, but with the developers now in use, grain size is not normally observed. An installation of this sort provides the darkroom operator with controlled viewing conditions for comparing and evaluating diapositives.

The true test of a diapositive, however, is the stereoplotter, and frequent checks are made by setting up test models. Evaluating a test model requires discipline. A quick overall view of the model may or may not indicate its quality. Reading spot elevations and contouring parts of its various areas will provide a better evaluation, but even this can be improved. An operator's reaction to a test model is a personal condition colored by his own habits and experience. The evaluations of several operators of different experience levels and viewing habits can usually be combined into a meaningful evaluation, especially if several sets of diapositives of a single exposure pair are set up and compared.

So far, there has been discussion of diapositive making from the aspects of process and product. Quality and characteristics of the aerial negative contribute a great deal to diapositive quality. Exposure of the aerial negative is, by necessity, less carefully metered and controlled than diapositive exposure. The best negatives for electronically dodged diapositives are not necessarily the best negatives for ordinary diapositive printing, prints and enlargements. Electric dodging systems can pull detail out of very dense areas of the negative, but such dodging fails to find detail in those areas of the negative that are too thin to contain any. For this reason, low-altitude mapping negatives are given a slightly heavier exposure and are developed to a greater density than the normal run of aerial negatives.

Electronic dodging and the new developers bring a new precision to diapositive processing. But precision itself is not enough. Just as in the machine shop, in science, or in engineering, precision must be accompanied by meaningful methods of measurement. The stereomodel is a psychological phenomenon. To understand it, our concept of the human must be extended into the machine rather than our concept of machine into the human.