B. THOMAS HOPKINS*
U. S. Geological Survey
Arlington, Va. 22210

Human Problems in Stereocompilation

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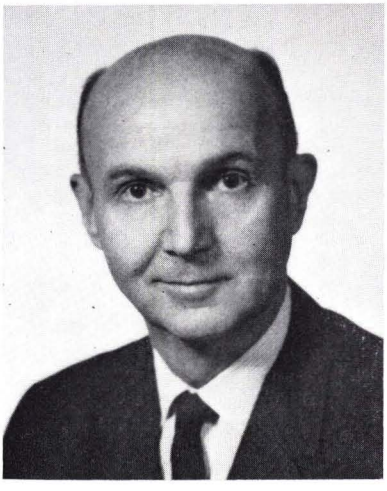
OVER A PERIOD OF many years much attention has been given to developing rigorous solutions to the technical problems of photogrammetry. Precision aerial cameras, stable film bases for the aerial negative, geometrically faithful projection systems, and complex mechanical-optical trains have all contributed to highly accurate viewing and measuring devices in which the stereoscopic model is created. Much effort has been devoted to the design and development of integrated photogrammetric systems in which the major components are coordinated in an effort to achieve maximum instrumental efficiency. Refinement of existing systems is still an important goal of the photogrammetric engineer. However, all developmental efforts have stopped at a vital juncture—the point where the human being is introduced into the system to collect desired data from the stereoscopic model.

It is probably a sad commentary on the wisdom of much of the photogrammetric community that the application of human engineering to the problems of the stereocompiler as a data-reduction device has been largely ignored until automated systems have appeared on the horizon. There is a good probability that, had the automated devices appeared on the photogrammetric scene before the human operator, the introduction of the latter with his ability to apply reason and judgment to data reduction would have been hailed as a major breakthrough. In view of the many advantages of the human in the collection and reduction of data (e.g., he is freely mobile, does not require a power supply, is tolerant of environment, requires a minimum of programing, and is self-reproducing at small cost on the worker's own time) we should be giving careful consideration to means by which we can utilize this remarkable mechanism at optimum efficiency.

WHAT ARE THE HUMAN problems in stereocompilation? Basically they fall in two categories: physical and psychological. The physical problems are primarily associated with visual ability, although deficiencies in manual dexterity and muscular coordination as well as poorly designed instruments that ignore the comfort of the compiler can all be inhibiting factors in a stereocompiler's performance. Efficient stereocompilation de-



B. THOMAS HOPKINS

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mands a high level of visual ability and the maintenance of that ability throughout the compiler's career. Over the years, selection of candidates for stereocompilation positions has been based on a variety of optometric tests for which minimum visual profiles have been established.

Once employed, however, the compiler was on his own in obtaining visual aids to maintain his level of visual ability. Usually his only available solution was the general optometric aids prescribed without consideration or knowledge of the unique visual task faced by the stereocompiler. In 1959, however, the Rocky Mountain Region of the U.S. Geological Survey, with the professional assistance of Wendell E. Bryan, O.D., initiated research into the visual requirements of stereocompilation with the aim of determining and furnishing the optimum necessary optometric assistance to the compiler. The results have been published in PHOTOGRAMMETRIC ENGINEERING.*

ABSTRACT: *A vital part of photogrammetric systems—the human operator—has been largely ignored in the efforts to improve these systems. Because the operator's reasoning and judgment capabilities have advantages in the photogrammetric data-reduction task over the automated digitizing systems, greater efforts should be made to increase his efficiency. The human problems are primarily physical and psychological. Specialized optometric prescriptions can ease the visual task of the compiler and help solve the physical problems. Improved environmental conditions coupled with greater appreciation of the creative challenge in stereocompilation are solutions to the psychological problems. Managers must utilize an optimum mix of these beneficial factors to reduce human problems.*

In brief, the research demonstrated that with proper consideration of the various unique factors of the stereocompiler's viewing task, appropriate optometric prescriptions can be formulated for visual aids which will prolong the compiler's visual ability and extend his career much longer than had previously been thought possible.

Effective visual-aid programs are now current in both the Atlantic Region and the Rocky Mountain Region of the U. S. Geological Survey, with plans to extend these programs to the other two Regions. Through these programs, the human eye (the last element in the photogrammetric system) is getting attention and being made an efficient part of that system.

THE PSYCHOLOGICAL PROBLEMS in stereocompilation, being more abstract than the physical problems, are less amenable to solution. To a considerable extent these problems result from environmental factors. With some instruments the compiler may be confined in a dark room and confronted with an eerie montage of red and blue images from which he must derive the data to compile the map. With other instruments he must maintain a rigid position at the eyepiece while "spread-eagled" between handwheels whose rotary motions must be coordinated with that of a footwheel to trace the detail from the stereomodel. The wonder is not that the stereocompiler has psychological problems; the wonder is that he does not have more.

Another psychological problem is that stereoplotting is an individualistic operation requiring introversive self-discipline. Individuals with gregarious tendencies are apt to lack the necessary discipline and become disgruntled in the confined environment with resulting loss of production.

Although mastery of map compilation requires several years of experience, some degree of proficiency in the routine functional operations of stereocompilation is acquired in a short time. After a period of about two years the feeling of challenge may be lost unless it is fostered.

WHAT CAN BE DONE to alleviate the conditions which contribute to these psychological problems? Modern technology has some of the answers; others must be developed. First, StereoImage Alternators (SIA) are now being introduced which will eliminate the complementary-color filters of the double-projection plotters and permit the compiler to work effi-

* Dwyer, R. F., "Visual Factors in Stereoscopic Plotting," PHOTOGRAMMETRY ENGINEERING, Vol. XXVI, No. 4, pp. 557–564, Sept. 1960.

Moore, R. H. and Bryan, W. E., O.D., "The Practical Application of Research on Visual Factors in Stereoplotting," PHOTOGRAMMETRIC ENGINEERING, Vol. XXX, No. 6, pp. 991–999 and 1020, Nov. 1964.

ciently with black-and-white imagery in a relatively high level of ambient light. Second, even before development of the SIA, photogrammetrists had come to realize that the isolated booth in near darkness was not necessary for efficient operation of the anaglyphic plotters. Today, these plotters are often installed in groups of 10 or more in large rooms where the general illumination is only subdued. Compilers freed from the confined environment of the dark booths have the feeling of being part of a team, with a beneficial effect on morale.

Solutions to the fading challenge in stereocompilation as proficiency increases are not easily found. One avenue is through emphasis on the creative aspects of the task of reducing the raw data imaged on the photograph to useful information in the form of a map. Without the creative efforts of the human, the images on the photograph are part of a picture—nothing more. Through his efforts the picture becomes related to a coordinate system on the earth's surface and the photographic images become map symbols, providing useful information for many important activities.

Apart from technological developments, what can be done to reduce the human problems in stereocompilation? These could be reduced to a considerable degree by careful screening of prospective employees. Restriction of employment to only those candidates with good visual ability, introversive self-discipline, dedication to individual performance, an appreciation for the creative challenge of reducing raw data to a useful form, and a willingness to exchange this rather rare combination of abilities for the relatively inadequate salaries paid to compilers would minimize the human problems we now encounter. In today's limited labor market, such screening is virtually impossible.

Since careful selection of candidates with all the desirable attributes is nearly impossible, management is faced with its own creative challenge—that of developing the personnel it is able to recruit into effective, efficient, and motivated employees. To this end the manager must employ the optimum mix of technological developments, aids to vision, and alleviation of undesirable environmental conditions, and then develop in his compilers an appreciation of the creative challenge in stereocompilation in order to reduce the human problems in his work force.

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lights of current stereocompilation practices," items concerning the automated procedures have purposely been omitted, rather than impose on other presentations in this panel. I have also omitted any reference to the related uses of the stereoplotter, such as the determination of profiles or volume studies.

Stereocompilation Practices have chalked-up some definite highlights throughout the years. Those currently being achieved undoubtedly *out-shine* those of 10 to 20 years ago. The primary objective of this paper is to stimulate your interest and participation in the panel discussion to follow. We'll be awaiting your contributions.

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efficiency of the succeeding phase. In photogrammetric procedure, it is imperative that the quality of the aerial photography be high to permit good stereomodels, that the field personnel fulfill their objective in a thorough and accurate manner and that the computations and the plotting of control data likewise be done accurately. If these operations are not done completely and accurately, it will have a detrimental effect on the efficiency of the stereocompilation which often cannot be overcome by the organization of procedures and proper attitudes. Finally, stereocompilers must accomplish their objectives also with the anticipation of what problems they might create for the draftsmen who must be able to interpret the compilation in order to maximize the efficiency of the drafting operation.