is available for loading the next basket, to provide agitation in the baskets which are present in the processor. So actually the processor has a potential of 50 prints each three minutes when run by an efficient man.

MR. BOSWORTH (West Palm Beach): Will the agitation of solutions solve the same problem as agitation of the baskets?

MR. KNIBIEHLY: Yes. Since we were interested in designing this processor with the utmost of simplicity, we did not provide any mechanical agitation, such as recirculation of the solutions. The agitation of the prints in the baskets is very simple; it's a lateral motion and at least from performance tests seems to provide adequate agitation. This needs to be done only intermittently.

Proposal for the Miniaturization of Aerial Photography

GOMER T. MCNEIL,
Photogrammetry, Inc.

ABSTRACT: *The proposed system represents an attempt to eliminate the objections of paper prints and to introduce further substantial advantages not offset by corresponding qualitative disadvantages. The proposal does not mean to imply that the days of the paper print are numbered; on the contrary, the use of paper prints will probably increase in certain directions where they will function with undisputed advantage.*

INTRODUCTION

MANY contributions to science and engineering have been developed by men who believed in the concept of fully utilizing the unique combination of existing facts. Technical proposals usually outline an integrated system of elemental components or building blocks. Upon close analysis, it will usually be found that very few, if any, components within a proposal are basically new. The components supporting this proposal for the miniaturization of aerial photography are no exception.

Two of the more salient requirements confronting field officers responsible for aerial photographic intelligence are:

(a) to secure sufficient intelligence of the area under their cognizance, and
(b) once the intelligence is obtained, to effect its widest distribution among the personnel about to engage in an operation.

GOMER T. MCNEIL

THE PROBLEMS OF AERIAL INTELLIGENCE DISSEMINATION

The general dissemination of aerial intelligence is beset with certain obstacles:

(a) the comprehensive installations required for mass production of paper prints,
(b) the inadequacy of the 9×9-inch print as an object to be viewed by many individuals at a time,

(c) the awkwardness of the print as an object to be carried in the field for easy reference, and
(d) the time lag which must elapse between the freezing of a militarily significant event on film, its interpretation as being significant, and the bringing of that fact to the visual cognizance of the men directly concerned.

The routinely accepted method of viewing the paper print must be critically reappraised and subjected to a scutiny devoid of the sentimental attachment habitually bestowed onto practices believed indispensable.

Is The Paper Print A Solution

The commonly practiced method of handling aerial photography consists in merely making a contact print from the original aerial negative. This then not only represents the elementary, but the only medium through which such varied functions as simple viewing, photo interpretation, and metrical analysis are performed. It is the only medium through which mass distribution attempts have been made.

In addition to their relatively high cost, paper prints reveal two major inherent defects: awkward size of the print for handling and low constrast range.

The main road blocks to aerial intelligence dissemination are located at the reproduction end, at the awkward retail handling of the product, and in the qualitative limitations of mass-produced aerial paper positives.

The system under discussion represents an attempt to eliminate these objections and to introduce further substantial advantages not offset by corresponding qualitative disadvantages.

What Is Proposed?

Five basic components are proposed to comprise the system: *reduction printer*, *automatic film processor*, *diazo duplicator*, *viewers*, and *data reduction instrumentation*.

The reduction printer optically reduces the 9×9-inch negative 10 times to a 23 ×23 mm. positive transparency on 35 mm. film. In the event a lesser reduction is required, the 9×9-inch negative is reduced four times to a $2\frac{1}{4}\times 2\frac{1}{4}$-inch positive transparency on 70 mm. film. An aerial 9×9-inch roll of film 200 feet long can be reduced to 20 feet of 35 mm. film and placed in a container $1\frac{1}{2}$ inches in diameter and $1\frac{1}{2}$ inches high. On the basis of 250 frames per container, one million aerial exposures occupy a space equal to a two foot cube or one drawer of a standard file cabinet. Since the material is in positive form, any of this vast amount of information can be viewed instantly, by large groups if necessary.

With the volume reduction just illustrated by means of an arbitrary figure, it can be seen that intelligence for a whole theater of operation can be mass produced for the briefing of all participants in the operation and of small enough bulk to permit distribution by combat type aircraft or helicopter. The cost factor, on the basis of the material alone, is reduced by 90%. This figure does not contain the savings on plant overhead and personnel needed for an equivalent paper print offensive.

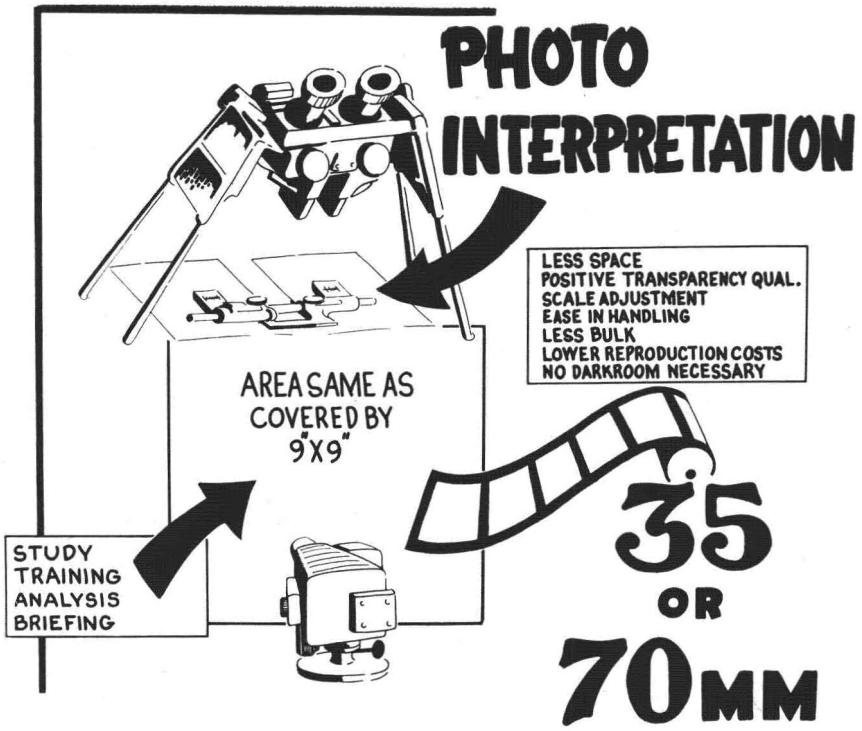
The superiority of the transmittance photograph, or the positive transparency, over the reflectance photograph, or paper print, is well established. A transparency is capable of rendering a range of tones of approximately 1 to 500, whereas the paper print is confined to a range of 1 to 50. The principle is known in a graphic manner by everyone who has had the opportunity to compare the brilliance of a color transparency with the comparative muddiness of the best color prints. The principle applies to black and white as well.

The automatic film processor requires a minimum of water supply and no darkroom or laboratory facilities. The processor can be operated by general photolab personnel.

The diazo duplicator reproduces duplicate rolls of positive transparencies without water or a darkroom, for rapid and mass dissemination to supporting field activities.

There are *three methods of viewing* positive transparencies:

(a) *Direct viewing.* The positive transparency is placed between the light source and the observer. An eyelens is usually inserted between the observer and the transparency for the purpose of magnification. This is the most efficient method of viewing. Fidelity of color rendition and tonal range are more completely ex-



ploited. Viewing is independent of the light intensity of the room. However, direct viewing is usually confined to observation by one person.

(b) *Rear-projection-viewing.* The positive transparency is projected onto the rear of a translucent screen in an area where the light falling on the front of the screen is not appreciably greater than the intensity of the projected light falling on the rear of the screen.

(c) *Projection-reflection viewing.* The positive transparency is projected onto a reflection screen in a darkened area. This is the method used in theaters for the projection of motion pictures.

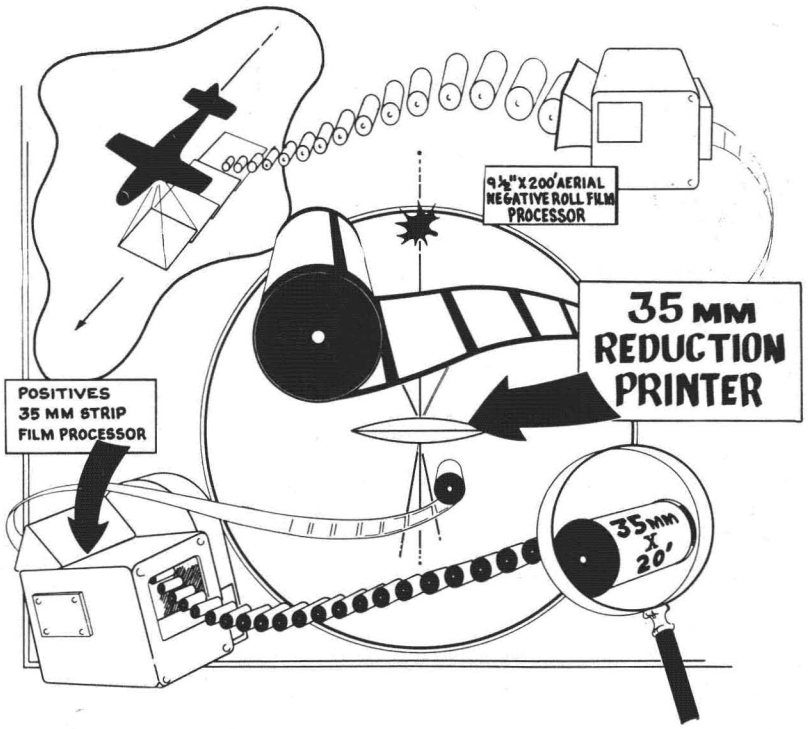
The three methods of viewing may be designed for *monocular or stereoscopic perception.* It is proposed that direct stereoscopic viewing of the miniaturized positive transparencies, with variable magnification, be utilized for detailed photo interpretation and that rear-projection viewing be employed for general photo interpretation and briefing.

The data reduction instrumentation is designed to provide the means for the extraction of metrical intelligence or size language from the miniaturized positive transparencies.

Solving the Problems of Aerial Color Film Duplication

Special study projects require the use of 9×9-inch color film. Once this expensive material is exposed and processed, those who must make use of the material have several ways to get at the data: a) secure *the original* and subject it to damage and wear, b) have a *contact transparency* made, or c) have a *color print* made.

For obvious reasons, it appears undesirable to subject an original to the wear and tear of routine examinations. Copy transparencies of entire 9×9-inch rolls are expensive to make, and single transparencies pose production problems which are the greater with the intermittency of duplication services required. Positive color prints, in addition to the above production problems, offer a dulling of color rendition coupled with the compression of contrast range inherent of all reflection photographs. In addition, none of the



above can be shown to audiences by projection. The *miniaturization of 9×9-inch color positives provides an answer* to these objections. The following advantages may be cited:

a. *Duplication* is carried out with inexpensive 35 mm. film.
b. *Processing* can be effected in small batches, fully automatic in a daylight processor.
c. The product can be *enlarged* through projection for viewing by groups.
d. *Color control* as thorough as that practiced by the motion picture industry can be exercised during the miniaturization stage.
e. *Shipment and handling* of the product is simplified.
f. Deliberate *color distortion* may be introduced at the camera exposure stage to permit exploitation of the full color potential of the printing color stock.

Conclusion

The proposed methods are not intended to imply that the days of the paper print are numbered. On the contrary, the use of paper prints will probably increase in certain directions where it will function with undisputed advantage. *It is implied*, however, that the shortcomings of the paper print are substantial enough to preclude their adoption in universal fulfillment of all aerial intelligence requirements.

Recommendation

The complete exploitation and utilization of positive transparencies by responsible intelligence officers will come to pass eventually—so why not now!

Acknowledgment

This paper and the illustrations are the results of much deliberate thought and constructive effort by the Photographic Department, Photogrammetry, Inc.

Discussion of Mr. McNeil's Paper

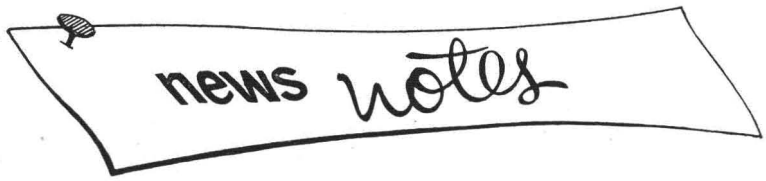
MR. HARMAN: We have a few minutes for questions.

MR. MCNEIL: The display in front of the table shows the capabilities of the system, including a ten-time enlargement of that ground resolution target on standard bromide paper. You can see the original negative and the consequent results of reduction and enlargement.

MR. VICTOR ELLIS: There are many applications of microfilm that are being overlooked. I raise one question. From the standpoint of photographic quality, is it not rather bold to attempt to make still pictures on strips of movie film?

MR. MCNEIL: I don't fully understand your question. One of the big problems is the miniaturization for space in handling problems. There will be a compromise most likely along the line, but not to the point of losing the intelligence material. There will be a slight degradation. But the other advantages will possibly far outweigh some of the disadvantages.

MR. HARMAN: It's growing close to the end of the scheduled time. I'm sure that any of these gentlemen will be glad to meet any of you later and answer further questions. I express my deep personal appreciation for the time and effort that these men have given and I congratulate them on the excellent papers that they have presented.



World's Largest Mining Survey, Library and Test Laboratory

The world's most extensive mining library and geophysical model test laboratory in Toronto are but two of the many far-reaching results seen of the new gigantic cooperative geological study of some 357,000 square miles of aerial photography of the rich mining areas of the Precambrian Shield in Canada and the United States.

Already the leading North American mining companies which started the project co-operatively are planning 400,000 square mile extensions which will extend its scope to Labrador and far beyond the Manitoba border. Multi-million dollar geological and geophysical field work will follow the over-all study. A listing of the possible locations of the economic minerals in the area will be compiled, especially the lesser known minerals.

The experts from The Photographic Survey Corporation, of Toronto, who worked on the complete natural resources inventories of Pakistan and Ceylon and of Alberta have been assigned to this project. As well as geologists, these experts number among their ranks soils engineers, foresters, hydrologists, civil engineers and experts from other fields related to mineral search. "Operation Overthrust" as it is called, is the largest survey of its type in the world. Under the study, all known existing and available geological and geophysical data will be correlated with a structural and mineral evaluation by stereo-interpretation of aerial photographs.

Type T301 Mk 2 Gamble Stereo Plotter

This is the production version of the earlier engineering model. Developed and produced by PSC Applied Research Limited, it applies in practical form a principle patented by Mr. S. G. Gamble, Chief Topographic Engineer, Department of Mines and Technical Surveys, Ottawa. The production version of this principle incorporates either the Bausch and Lomb Multiplex or the ER55 Balplex projector system. Williamson Multiplex projectors can be used by substituting a special projector bar and rack for the standard type.

The plotter makes use of a 10″ diameter projected pattern of dots which forms a reference plane on the surface of a 38″×38″ tracing table. The dot projector, which is a small self-contained unit, may be placed in any desired position on the table surface. By means of an electrical drive and finger tip control adjustable to any convenient position over the working surface, the projector system can be raised or lowered through a distance of 250 mm. in the vertical direction, causing the stereo model to rise or fall through the reference plane of the projected dots. This adjustment can be made within the accuracy of 0.1 mm.