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*New Requirements in Photo Interpretation**

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ABSTRACT: *In this discussion some of the major factors which will place new and demanding requirements upon the photo interpreters of today are described. These requirements primarily result from an expansion of the conventional areas of application into the sphere of extraterrestrial investigations where these new requirements may prevail. No attempt has been made to establish how these new requirements will be satisfied as the principal effort has been directed towards a definition of the sources of these new requirements. New basic requirements for the interpreter will fall into five major classes, which are:*

1. *Need for a broader technical background in order to remain competent in the field of image interpretation.*
2. *Utilization of a technique for defining the image quality needed for specific tasks and the ability to evaluate specific systems in terms of useful image output.*
3. *Preparedness for interpretation of various sensor records and the need for a greater understanding of integrated sensor systems.*
4. *Utilization of non-stereoscopic photography of scales smaller than that used for most interpretation tasks of today which will direct the emphasis of the interpretation procedures to shift from image identification to the processes of imagery associations.*
5. *Ability to utilize highly sophisticated systems for the necessary data extraction and recording tasks.*

NEW requirements which will affect the photo interpreters of today are primarily results of advances in new fields of scientific investigations where the interpreters' talents may be required. One of the most important of these areas is in the field of extraterrestrial investigations. This is becoming very important to everyone at the present time.

As scientific knowledge and capabilities are expanded into these new fields, it becomes

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obvious that the classic term "photo interpreter" is less characteristic of the job performed. Various forms of image recording media will be adapted for the best possible information acquisition under the demanding environmental conditions of space investigations. It is, therefore, important that the interpretation capability of the traditional "PI" be broadened and that the limitation implied by the term "photo" be replaced by a more general term. The title of "image interpreter" has been suggested by several people and perhaps now is the time to give more serious consideration to this idea. It is quite probable that photographic means of image recording will be prominent for many years to come; however, other image recording methods are in use now, and in the future the interpreter will be required to handle various other information recording media.

Conventional applications of photography for investigations of terrestrial problems will be continued and will become more important in the years to come. The fields of geology, agriculture, and geography, to name only a few, have benefited greatly from applications of photo interpretation and there is every reason to expect these applications will be continued.

Photography of the earth taken from within the earth's atmosphere during peacetime conditions imposes very few really new requirements upon the photo intrepreter. Airplanes can now go faster and higher than ever before and the components of the photographic system have been improved. But the methods of aerial photography remain basically unchanged. It is true that improvements can be noted in the photography and that greater accomplishments are obtained. But this is not really the result of new procedures as much as improvement of the old techniques. The utilization of some new aids in photo interpretation and the more abundant applications of other aids—such as multiband spectral reconnaissance—will undoubtedly increase the scope of current earth-oriented interpretation capabilities.

New requirements will arise from the relatively new image recording means which will be utilized in extraterrrestrial investigations. These requirements will most probably occur as a more imperative need for prerequisites of a more technical nature along with the scientific backgrounds presently considered as the foundations for a skilled interpreter. No longer is a knowledge of the relatively simple process of conventional photography the only technical background which will be needed by an image interpreter for accomplishing his task. The evidence of this is quite apparent in the present applications of unconventional photographic methods, such as infrared and radar, for use in forestry and military photo interpretation.

With the advent of orbital vehicles and the highly complex systems for the procurement of various forms of imagery, the problem for the interpreter becomes more complicated. Knowledge of the basic fundamentals of the recording and sensing systems will be required if the interpreter is to obtain the maximum information possible from the data. Just as current photo interpreters make use of specific items of a flight plan, such as flying altitude and camera focal-lengths, so will the interpreters in the future need a working knowledge of subjects which directly affect obtaining and recording imagery in other systems. In such systems, it is necessary that the interpreters be able to distinguish target imagery from background noise which may be inherent to the image recording or transmission systems. Without some insight into the system environment and operating conditions valuable information may be lost.

Another major requirement for a more technical background will be the need for the interpreter to be able to converse with and understand electronic engineers, physicists and other technical personnel who are responsible for the development and operation of the sensing systems. The interpreter must have the ability and means to convey to the designers what the system output, his required imagery, must be in order for him to do his job. He must be able to present his requirements for image quality in terms of sensor sensitivities, power requirements, contrast transfer characteristics or modulation transfer functions, and various other normally unfamilar areas. It is doubtful if the designers will adjust their language to that of the interpreter, so the interpreter must expand his professional language to meet these demands.

Until space reconnaissance investigations are more highly developed, records will continue to provide imagery which will be in scales much smaller than that which today's PI desires for the greatest portion of his work. The preliminary systems will most likely be forcing their sensitivities to the limit in order to get some useful information from these records. Under conditions where the record-

ing media are forced to do most of their data acquisition at the extreme limit of their capability, small differences in target contrasts become critical. Consequently the interpreter must be able to anticipate the scope of image acquisition possibilities, and this requirement consequently places him firmly in the system design picture.

It is a major problem to describe imagery before an acquisition system actually exists. A possible solution lies in the application of frequency response techniques which can currently be applied to predict the imaging capability of photographic systems prior to the actual assembly of the components.

This emphasis on realistic and meaningful terms for a description of the imaging capability of any system will be of prime importance to all persons involved in the design, development, and operation of image sensing systems, whether these people are interpreters, optical experts or electronic engineers. In order to keep the interpreter in a capable supporting position, a broader technical background becomes a prime prerequisite.

The first stages of planetary investigations are primarily involving very basic imagery with very little which can compare to the detailed imagery obtained in conventional aerial photographs of the earth. This may result in a shift of the preliminary emphasis of the interpretation tasks from the identification of specific details into the type of interpretation where associations and inferences will be of prime significance to the ultimate data output. Much of the imagery obtained from the various extraterrestrial exploration systems will be viewed for the first time. Almost all images will be analyzed by the interpreters and mentally compared with familiar earth images. This is a natural reaction when the individual interpreter has accumulated prior experience in earth-oriented interpretation problems. Consequently it will be imperative that interpretation personnel have knowledge of the differences existing between planetary and terrestrial environments in order to associate the observed imagery, the various elements of their past interpretation experience, and the conditions relative to the image formation process. The physical conditions in the sphere of the planetary environment in which the images exist should be known or, at the least, what ever is known of these conditions should be considered and evaluated in regard to possible effects on the target imagery.

During these preliminary exploration efforts very little direct image reference material will be available. No items such as the numerous key type references for terrestrial identifications will exist. This will place a greater burden on the interpreter and in turn require a larger dependence upon his background and ability to readily and effectively analyze the imagery through associations and inferences which are guided by his knowledge of the image and its environment.

As the amount of raw data containing imagery for analysis increases, the problems of handling and interpreting the data within a useful time period become critical. Even for photographic interpretation tasks which are occurring today, the problems of data handling and extraction from the large numbers of photographs resulting from normal photo missions are serious. Extensive effort has been expended in the development of automated information handling and data extraction systems. The complexities of conventional photo interpretation procedures and techniques, plus the limitations of human recall or memory ability, have made the problem of automatic photo interpretation extremely difficult.

The development of individual or groups of equipment to assist the interpreter in his task has made some encouraging progress in the past few years. Most of these advances have been made in the area of various image viewing and mensuration devices. Additional development has occurred in the area of automatic and semiautomatic information displays and reference systems.

The need for these types of equipment cannot be overemphasized. Sometime in the future when an efficient and workable system is developed, the interpretation task will benefit greatly. With the anticipated inclusion of such sophisticated equipment, it will be necessary that the operator-interpreter be able to utilize the numerous advantages of the automated system to their fullest extent, and not just continue to use obsolete procedures and techniques of previous methods, thereby relegating a highly complex system to the role of a simple viewing device. This anticipated advancement established the requirement for a period of personnel training, not only in new interpretation procedures, but also in system operations and computer type of organization used for data extraction, handling, storage and display techniques.

The experiments with various automated image recognition devices present some insight to the possibilities which the future may hold for a completely automated image interpretation or detection system. However, it will probably be a long time before any such system is operable, and until then the human interpreter will be a very important part of the overall data extraction and evaluation processes. In the preliminary evaluation of image data from space vehicles, it should be anticipated that some type of automated signal recognition device may be utilized to distinguish or to assist in the separation of the actual useful imagery from interference or background data.

Since the early imagery will probably be at relatively small scales, it will be necessary to make some measurements with selected mensuration devices in order to obtain the necessary accuracy for the succeeding interpretation procedures. Application of instruments similar to the microdensitometer will undoubtedly assist in the problem of image definition and determination of various physical measurements. Consideration must be included for the non-photographic image recording media, but this can be done as these new recording methods are refined and brought into the image recording picture.

It is possible that extraterrestrial image acquisition systems will be sensitized in regions other than that of the visible portion of the spectrum. A broader range of operations in both the ultraviolet and infrared portions of the spectrum may prove to be highly profitable and result in additional useful imagery. The potential gains to be obtained from sensors operating in the non-visible portions of the spectrum need not be considered as a substitute for the visible sensors. The greatest information gains will probably be from analysis of some types of integrated sensor records. Sensor integration studies have been under investigation for several years and now, with the coming of the space age, perhaps this is the time for evaluation and consideration of all portions of the spectrum for providing energy for the recording of various imagery from space.

The applications of conventional photography for image recording for extraterrestrial reconnaissance problems should not be overlooked. Photography will probably continue to occupy an important position in many coming space projects. However, it may be anticipated that one of the current PI's primary working tools, stereoscopic coverage, may be missing. This will probably be because of the extreme difficulty of obtaining sufficient base-height ratios, for a useful stereo effect. Several tests have been made attempting to establish the value of stereo viewing to interpretation. In general the results have been debatable, but it seems that most interpreters simply prefer to have stereoscopic coverage. Regardless of the value of stereo to the amount or proficiency of the data extraction, reconnaissance records from space will most likely not consist of stereoscopic coverage. This must be considered in the information extraction processes which will compose the interpretation phase of the program, and the interpreters should be prepared to work without it.

If the photo interpreter desires to advance with the technological accomplishments of the space age, and not remain primarily as an identifier of certain classes of images, it behooves him to acquire the necessary technical background to understand and communicate with the members of the technical fields already established in the space sciences. He must be able to define his needs for quality imagery and comprehend the relevant problems of the people who design and develop these very sophisticated systems. This information coupled with the ability to utilize the advantages of new equipment concepts and additional forms of image recording media will further assist the photo interpreter of today to maintain his position in the technical world of the space age.

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*Aeronautical Chart and Information Center Technical Training Activities**

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ABSTRACT: *The technical training concepts, requirements, and procedures of the USAF Aeronautical Chart & Information Center are presented within the framework of a rapidly advancing technology. The paper emphasizes the importance of comprehensive planning for the initial academic training of the Cartographer and for a continuing up-dating of his skills in order to maximize the advantages offered by technological improvements.*

THE events of the past few years point with certainty to the challenge which faces those of us who support the economic and military strength of the Nation with the cartographic materials essential to progress in these areas. It would be difficult to make accurate statements which compare technological progress of any period of the past with that which can be expected in the next half decade; for each period of time provides its own unique contribution to subsequent progress. However, an objective view can be taken of the individual who has provided the cartographic skills of the recent past, and the question asked, "Can this man provide the skills which are needed for the future?"

PREPAREDNESS FOR THE FUTURE

In answering this question, let us first recognize that the physician, the lawyer, the engineer, and members of other professions which are based on a formal schedule of academic training, enter active practice with a reasonably current knowledge of the state of their art. It is a fact that, with few exceptions, the individual depended upon to fill the needs for cartographic skills has been developed without the advantages of similarly planned academic training, and that he over a period of time gains experience which, more often than not, channels his activity along specialist lines. The advantages of an individual specializing in a portion of a chosen career field are unquestioned; the disadvantages of specializing without first having qualified as a general practitioner should be equally obvious.

The degree to which these disadvantages are considered organizationally as being im-

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