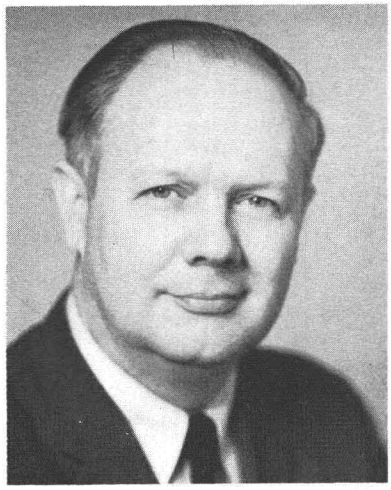
*Improving the Big Picture**

ROBERT E. FROST,
Chief, Photographic Interpretation Research Div.‡

THE selection of a title for a paper or a discussion is often difficult. It has been said that a title must convey a thought on what is to follow; it must infer purposes, pose a problem, report a solution to a problem, reflect a procedure—or even pose a thought deeply rooted in controversy. Dr. Abrams did this very nicely in his recent paper published in this Journal with the title "Aerial Photographs Are Obsolete."** Those seeing this title were undoubtedly disturbed by the horrible thought that the ordinary photograph has served its useful purpose and that something new will take its place. Whatever the thought was, it is probable that the title motivated many to read the paper.

Undoubtedly, those concerned with aerial photography found the ideas expressed in the Abrams paper stimulating and thought provoking. Whether or not the common silver-halide impregnated emulsion will give way to charged particles on a tape or the analyst will bow down before a computer-oriented stereoscope is of no concern at the moment; that is not the purpose of referencing the aforementioned paper. Dr. Abrams is to be congratulated and thanked, for calling attention to a problem—a BIG PROBLEM—one which affects all concerned with aerial imagery. After careful thought and consideration it is doubtful that anyone is ready to say that one system or device will replace another, or that the computer will replace the intellectual judgment of man. It is believed, however, that many are ready to admit that a problem does exist and that its successful solution requires looking intelligently at all aspects of the BIG PICTURE.

Specifically, the problem is to improve the capability to extract information—to obtain knowledge—about an area by use of various airborne systems. The problem is a complex one and is based on the interests and efforts of an interrelated group of researchers, manufacturers, users and teachers.



ROBERT E. FROST

The physical scientists are concerned with the basic relations between matter, energy and image creation. In conducting research, the scientist makes contribution to the general fund of knowledge; the results find their way into the technical literature. The makers of cameras, films and electronic equipment are concerned with the aerial systems or aerial sensing packages—cameras, mechanisms, optical systems and emulsions. The aircraft manufacturer is interested in providing a platform or a carrier for whatever system or package is to be used. Those who make plotters, optical instruments and other devices for extracting information or for making measurements are likewise eager to build a better product. The user has much concern—perhaps the most. The many disciplines of engineering and the earth sciences have found great application for the various systems to suit specific professional and industrial needs. Space-oriented people are interested because what they do and how they do it on extra-

** Vol. XXVII, No. 5, page 691, Dec. 1961.

* Presented at the 28th Annual Meeting of the Society, The Shoreham Hotel, Washington, D. C., March 14–17, 1962. The Abstract for this paper is on page 349 of the 1962 Yearbook.

‡ U.S.A. Cold Regions Research and Engineering Laboratory, Corps of Engineers, Hanover, New Hampshire.

terrestrial surfaces will be based on intelligent analysis of images of such surfaces. The military services are vitally concerned with the use of any and/or all of the various sensor systems on specific military problems. Finally, the teacher—one of the most important of all—maintains interest so that the student can learn of the technical advances and the methods of use through classroom instruction.

Problem Areas

The successful solution to the problem of IMPROVING THE BIG PICTURE and the ability to obtain information is contingent on gathering and analyzing data pertinent to (a) review of past accomplishments, (b) the current state of the art, (c) needs and (d) interdependency between the various areas of interest. The purpose of this paper, therefore, is to call attention to the areas of the problem, how they influence each area of interest and to suggest how the Society can assist in bettering the situation. The following discussion is offered, not as a total analysis of the problem, but to present thoughts on the above for the purposes of stimulating interest, provoking thought, and inviting suggestions and discussions with the hope that those interested can and will participate in developing a method of IMPROVING THE BIG PICTURE.

1. Basic phenomena—the relation between matter, energy and image creation

Much has been done by the research scientist and many technical papers have been published on some of the findings. However, much of this has been from a pure scientific standpoint in which the scientist was undoubtedly motivated by the thirst for knowledge—not knowing or particularly caring about a specific end point or application. This picture has changed markedly during the past few years and much scientific research has been and is being done based on problem—oriented motivation as a problem specifically relates to aerial sensing. There exists, however, a great need to bring the results of some of this work to the meetings and to the publications of the Society. A few papers have been given and have appeared in Photogrammetric Engineering, but only a few. Thus, the scope of information presented has been limited.

Why is this important? To put it bluntly, it certainly should be sound thinking to subscribe to the philosophy that it would be ideal to design equipment and then to use it to suit specific needs in instances where consideration for the design and use reflects knowledge of basic matter—energy relationships and further with respect to the type and amount of information desired. For example, in order to record earth-surface features utilizing visible light, why not use the conventional camera, a suitable film/filter/optical system and utilize weather conditions desired to give the best image characteristics? There is no known equipment which will surpass this to date. The fact that there is now a variety of systems which go on beyond the visible portion of the spectrum, does not make the camera obsolete. This merely adds to the package of sensors available to give information. Therefore, there is need for determining when and under what conditions these other systems can be used. The aerial camera has been used so long that there has been developed an intuitive know-how on its proper use. Thought must now be given to the extent of use to the newer and more sophisticated systems.

To record differences in energy which are thermally engendered and are either reflected, radiated or emitted beyond the visible, it is necessary to select a sensor package designed to work in certain energy bands, but with all due consideration for the fundamentals involved and the atmospheric conditions through which the energy must travel. When used improperly, such devices vary from worthless to merely providing a novel way to take conventional pictures at a great cost. More serious, however, is the fact that often it is not that there is no information, but that a case of untruths has been built up around error and misleading information. The same can be said of long-wave radio pictures. Success is based on cognizance of design features, limitations, natural and instrumental parameters and intelligent use.

The future looks bright as much is being done in utilization of all energy forms for aerial sensing. Why not make more of it available to the followers of the Society?

2. Sensor systems and their carriers and factors limiting their use

This is a very difficult subject to cover. First, everything related to this aspect is costly. One question which is logically raised is "Do needs exist to marry aerial sensing equipment and the carrier?" In the past this has not been a major item for conventional photography. However, as new systems have become available and the desire to use multiple imagery devices has come into being, it

seems that the problems have become quite complex and costly resulting in confusion and disappointment reigning supreme. Modification of an aircraft is very costly—particularly if a system is heavy, bulky, has unusual power requirements, requires extra ports, or requires a complex crew and operating procedure. Likewise, much of the sensing equipment is notoriously complex and is often tempermental thereby causing costs to soar "spaceward." Certainly, this area needs thorough exploitation by manufacturers of aircraft and the components of aerial sensor systems with full knowledge of basic fundamentals and end use.

3. METHODS AND EQUIPMENT FOR OBTAINING INFORMATION FROM IMAGES

It is in this category that much progress has been made. Perhaps this is because purchase of the final print is easy and does not represent a high cost. Just because the final print is inexpensive does not mean that extracting information is easily accomplished. Here is an area suffering from personal and professional problems. It really does not matter whether the study of photos is called an art, a science, photoreading, photo analysis, photo interpretation, remote sensing, multiband sensing, terranology. Each user is after information. What title is given to the pursuit is pretty much a function of the method, the approach, and the intellectual ability of the analyst and how he uses his intellectual ability. There is much merit in all approaches and methods; however, in this as there is in the other component parts of the BIG PICTURE more research needs to be done. Why not really exploit some of the methods and determine what degree of dependency might exist between several in order that more useful and more reliable information can be obtained from the various types.

Another important and timely aspect of the problem pertains to automatic data processing, scanning retrieving, storage and computer oriented study. Often, the excessive number of pictures obtained for study is so great that a disproportionate amount of effort must be expended for information gained. Along with this is the ever-present need to establish and to maintain collections of images of natural and cultural objects or surface features, particularly the type showing how an object or situation looks throughout the spectrum. Above all, the efficient and intelligent use of man and machine must be based upon the job requirements, limitations of man, limitations of machine and the degree to which one may or may not supplement the activity of the other.

4. THE USES OF AERIAL IMAGERY FOR ENGINEERING, SCIENTIFIC AND MILITARY PURPOSES

Perhaps more work has been done in uses or application of aerial imagery than in any of the other categories. For more than 20 years the Society of Photogrammetry has enjoyed the fruits of successful use of air photos as applied to many fields. Some papers have reported on research or on concepts of how information is obtained. A limited few have been of a philosophical nature and some have been on method and on instruction. But, for the most part, the bulk of published matter has been concerned with application to a problem. In so doing the earth sciences, engineering and military aspects have been covered.

During this period of activity the use of airphotos for professional and industrial purposes has "grown like Topsy." Research has been performed on the development of a system or method primarily from an engineering standpoint only to find application to one of the earth science fields. Of course, there have been almost cataclysmic causes for the rebirth or rediscovery of the camera, such as war and the inquisitive nature of the intelligence personnel, the desire to explore other lands for development and rehabilitation, and the Inter-State Highway system.

It is perhaps now necessary to re-evaluate what has been done and to see that all important and worthwhile uses have been publicized, and are in the technical literature for all to use. Does the technical literature really contain a well balanced series of papers reporting on methods and uses for the various major professional and industrial interests? Papers are needed which point out how and in detail just how each of the various sensor systems can find application to a specific field in engineering, one of the earth sciences, the military or as a space probe. Need exists for informative papers describing not only what *can* be done, but *how*. These papers should be informative, well written, and present information based on sound engineering and/or sound scientific principles.

In summarizing uses one aspect of the problem is the shortage of basically informative papers in each of the following and apparent disproportionate balance between the various uses. These uses are:

(a) Engineering purposes.
(b) Scientific purposes.

(c) Military purposes.
(d) Analysis of extra terrestrial surfaces.

Thus, for each of the above, it is necessary to determine what has been done or the extent of progress, what the needs are, and what relationships exist between the various fields of use.

5. TRAINING—VISUAL AIDS, METHODS AND PERSONNEL SELECTION

What about the user? This is a very serious part of the problem. In one sense it is basic since the information obtained is only as good as the user was *able* to produce—not as he *intended* to produce, but as he *accomplished.* Just because the analyst owns a stereoscope or has a precision instrument or a "PI Kit" does not imply a license to analyze images utilizing many portions of the spectrum from the ultraviolet, through the visible, into the infrared, and on out into long-wave radio. It is true that recognition and familiarity with the expression of natural and man-made features plays a most important part in image study and description. Hence, it can be said that man is limited by his background, experience, interest and curiosity.

The above is quite true in the visible part of the spectrum. But, being thermally blind and not sensitive to radio frequency response, man must learn an entirely new set of standards and values if he is to study thermal and/or radio images. This is only a part of the picture. Successful analysis of such exotic pictures is by definition contingent on knowledge of certain basic matter—energy relationships, energy transmission through the atmosphere and image creation. Thus, object recognition may be grossly misleading, and techniques based on such are practically worthless. Just how does one get this message across to all who use aerial imagery?

Another aspect of the problem pertains to formal instruction, the academic classroom, the short course, or the military training program and on-the-job training. The teacher by definition must be informed, he must pursue the literature, he must maintain contact with his collegues, he must keep abreast of the recent developments and uses, and above all he must have or seek the opportunity to "practice what-he-preaches" through professional and/or private contacts. Classroom instruction requires well-made and well-chosen visual aids, good equipment, and a good collection of aerial pictures of all types. The combined classroom/laboratory/field-trip type program has proven to be very successful. The teacher must inspire as well as teach. The rest is up to the student!

Personnel selection is also very important to the problem. Is proper attention really given to the determination of desirable personal traits, background and other characteristics? What type of person is really needed for each level of proficiency in each field? These must be investigated if analysis pursuits are to keep pace with equipment development.

This leads to personnel selection. Here, perhaps the human systems engineering, psycho physics and related fields can be of great assistance after such fields have been made aware of what is to be accomplished and what the tools are.

THESE FIVE MAJOR ITEMS above described, and how they now fit together and how they should fit together and what to do about them, constitute the BIG PROBLEM which faces the BIG PICTURE.

IMPROVING THE BIG PICTURE

Improving the BIG PICTURE can be accomplished only after a study of "state of the art" survey data, consideration of current and future needs, and following establishing and maintaining a good balance between all of the component parts—basic fundamentals, the airborne package methods, uses and training.

A method of accomplishing this is to establish a Working Group under sponsorship of the Photo Interpretation Committee composed of sub-committees representing each of the eight categories with a minimum of three in each sub-committee. These eight groups and the composition, as suggested are:

(a) *Basic Fundamentals*—scientists concerned with matter/energy relationships.

(b) *The Aerial Package*—scientists or engineers concerned with aircraft and aerial sensor design and manufacture.

(c) *Methods and Equipment*—scientists or engineers concerned with research in development of analysis methods and techniques and related equipment for study.

(d) *Uses for Engineering*—engineers and/or photogrammetrists concerned with exploitation of the aerial image to suit engineering needs.

(e) *Uses for Scientific Purposes*—scientists representing the earth science disciplines (geography, geology, ecology).

(f) *Uses for Military Purposes*—representatives from key Navy, Army and Air Force users (research, intelligence, operations, etc).

(g) *Uses for Analysis of Extra Terrestrial Surfaces*—representatives in engineering, earth science and astro physics.

(h) *Training and Personnel Selection*—representatives of military training programs, university or college academic programs, and representatives of human systems engineering pursuits.

Each group will solicit ideas from their colleagues representing the various fields of endeavor keeping in mind that items to be covered are *State of the Art*, Statement of *Needs*, and *Relationship* and Inter-Dependency *Between* the *Component Parts*. The data submitted will be screened, analyzed and the best ideas incorporated into a technical expression covering various aspects of the problem. By working in groups of three, the possibility of "Personality Writing" will be minimized and there will be better assurance that all ideas will be considered. Thus, a group of three (or more) will consider ideas, discuss them, select the best and/or the most informative, and develop a report which will find an outlet at the next Annual Meeting of the Society and become a part of the technical literature.

Contributors will be acknowledged and the ideas selected will be identified with the originator either in footnote form or as part of an appended bibliography. The report or paper thus prepared will carry threeway (or more) committee authorship and one of the group will be chosen to make the formal presentation. It must be remembered that many researchers, users, and teachers have developed excellent ideas, but have hesitated to prepare a technical paper; thus, the profession has been denied benefit of such thoughts. It is hoped that the Society acting thusly can assist in bringing out needed information. Obviously, papers which are submitted containing detailed, carefully thought out and expressed ideas, which are well written and which contain much useful information will be referred to the Editor and/or Program Committee for special consideration at the Annual Meeting or for publication in the Journal.

In the above way it is believed that the following will be accomplished:

1. An excellent cross-section of opinions, facts, methods and ideas will be obtained.
2. The technical literature so developed will contain a good appraisal of the situation and will thereby provide a source of information for all to use.
3. Communication between all those working in any or all of the aspects of aerial imagery will be established and encouraged.
4. A basis for the 1963 contribution to photo interpretation will be provided by setting aside one day of the series of eight papers and possibly having sufficient information papers for additional session presentation.
5. The way will be paved for proposing that the committee be formalized and remain active by meeting at least once between Annual Meetings to act as a clearing house for ideas in all or any of the related fields. This will make certain that the best information and new developments are made known for all to use.

SUMMARY

With presentation of this paper comes an appeal. The Society of Photogrammetry has initiated such an undertaking, and it is requested that members and other interested people submit thoughts and ideas on any or all of the above. In doing so it is hoped to perpetuate continued interest in all activities by a free exchange of ideas, concepts, and information. By sponsoring this, the Society automatically becomes a storehouse of information bringing together people, organizations and ideas. Should the above succeed, much will have been done toward betterment of mankind in utilization of his inherited earth.

Administrative Problems in High-Level Photo/A.P.R. in the Canadian Arctic

A. F. SOUTAR,
Hunting Survey Corporation Limited,
Toronto, Can.

IN THE last decade interest has been focussed on developing the large land masses in the Canadian Arctic—a vast area, scarred by ice age glaciers, and the world's least-known rock pile.

It has been said that the whole history of