THE ROLE OF THE TECHNICAL WRITER IN THE EARTH RESOURCES SURVEY PROGRAM

By Charles M. Grant, Jr.

INTRODUCTION

One of the most interesting programs currently being developed by NASA and one which perhaps offers the greatest scientific and economic potential to the world is the Earth Resources Survey Program. The technical writer's role in the Program will be comprehensive — from the early planning stage to final data utilization. He will be expected to take what is termed a "systems approach" to his writing. This means that he will not only be familiar with the hardware and the data collected by it but he will also understand the system as an entity and its place in the total program.

A factor of importance to the writer is the large family of documents with which he will work. These documents may include everything from long-range plans through ground-truth survey reports to detailed evaluation reports of a specific location or discipline. Such a diversity of documents will demand the best from a technical writer.

It is anticipated, then, that working in the Earth Resources Survey Program will be both a challenging and rewarding experience for the writer. In addition to his more traditional role of technical writer and editor, he will have an opportunity to act as an observer, a researcher, and an aide to the scientist or engineer.

In the following sections we shall examine the Program itself, the equipment and test sites, the users, and the way in which the technical writer will interface with the Program.

EARTH RESOURCES SURVEY PROGRAM

The earlier space programs have demonstrated that certain earth phenomena can be more easily interpreted when viewed from space. NASA is currently supporting research into remote-sensing equipment and techniques having possibilities for the detection and identification of earth resources.

Earth resources may be defined as such naturally occurring materials as mineral deposits, fish resources, timberstands, crops, land, and cultural resources of value to mankind. The combination of a rapidly expanding population and an increasing use of technology is causing an enormous demand for earth resources of all kinds. In order to step up the surveying and investigation of these resources, NASA has initiated the Earth Resources Survey Program. A comprehensive study of the earth's surface from space is a complex problem requiring the application of many different disciplines and technologies. It is only by adopting a coordinated and integrated approach that the ultimate objectives can be achieved. As we shall see, the technical writer's part in helping achieve the Program's objectives can be significant.

Program Objectives

The objectives of the Earth Resources Survey Program are shown in figure 1:

1. Development of the best combination of instrumentation, procedures, and interpretational methods for gathering resource data and testing these in experimental spacecraft

2. Discovery and delineation of those earth resources from space which will be of economic value to the nation and the world

At the present, five broad areas of earth resources have been identified as potentially suitable for the applications of space technology: agriculture and forestry; geology and minerals; hydrology; geography, cartography, and cultural resources; and oceanography and marine resources. Figure 2 shows some typical earth-resources data applications in each of these five areas.

Major Phases of the Program

The Manned Spacecraft Center at Houston has been designated as the lead NASA Center with respect to the Earth Resources Survey Program. A large number of Federal agencies, universities, and research institutions are also participating. The overall Program, as currently planned, can be divided into three major stages or phases, as shown in figure 3:

1. Feasibility phase. During this phase, aircraft flights over carefully selected and controlled test sites are being flown, employing a number of airborne photographic and electronic remote sensors. Using data obtained from these over-flights, the correlation and relative value of each sensor to the phenomena in question are being studied. Data from current suborbital and orbital flights, such as Nimbus and

Gemini, are also being used to obtain some limited sensor responses. These data are being analyzed and used as a basis for relating aircraft-obtained to spacecraft-obtained signatures or patterns. In addition, several experiments related to the collection of surface earth-resources data by Apollo spacecraft will be initiated during this phase.

2. Spacecraft testing phase. Space flight missions will be made for the primary purpose of acquiring data for extensive studies of the earth's resources. These Apollo Applications Program (AAP) flights will use manned spacecraft and be capable of carrying a large number of remote sensors. On these flights, coverage will be of areas such as the United States where ground controls will be used to verify the conclusions derived during the feasibility phase. A number of earth-based sensors, such as buoys and stream gages placed on or near the earth's surface, for detecting, recording, and transmitting, via spacecraft, may be used to collect a variety of earth-resources data.

Also during the test phase, several unmanned Earth Resource Satellites may be flown. These satellites, with an expected life in orbit of a year, could be an outgrowth of current spacecraft. The Earth Resource Satellites are expected not only to acquire data using sensors in the spacecraft but also to collect and relay data gathered by sensors on the earth's surface.

3. Operation phase. After the testing phase, the scope and magnitude of the Program will depend on the results of the earlier phases. Indications are that it will be multidiscipline in nature, global in extent, and more or less continuous, as many of the important phenomena associated with resources are time variant.

Flight Equipment

In support of the objectives of the Earth Resources Survey, NASA is currently sponsoring an airborne program to define those sensor systems which will be of greatest value for recording earth phenomena. It is recognized that the airborne flights are not the final Program objective, but do serve to calibrate the instruments over known areas. Those instruments and techniques found successful in the airborne flights will later be utilized in the space flight missions.

The experience gained from this airborne program is providing a basis for planning the space flights. The Program calls for the installation, in various airborne vehicles, of appropriate electronic and electro-optical sensors covering selected parts of the electromagnetic spectrum.

The airborne program has been subdivided into three major phases: low altitudes (1500 to 20 000 feet), intermediate altitudes (20 000 to 40 000 feet), and high altitudes (above 40 000 feet). To satisfy the objectives of the low-altitude phase, a Convair 240-A, based at the NASA Manned Spacecraft Center, has been equipped with a number of sensors and data have already been gathered over a number of test sites. Figure 4 shows the instrument locations on the Convair 240-A. Additional work in this phase is being carried out by aircraft assigned to other government agencies.

The intermediate phase will use the Lockheed P3A (also useful in the low-altitude phase) and, perhaps, the NASA/Ames-based Convair 990 over the same test sites. The vehicles proposed for high altitudes may include aircraft, drones, balloons, sounding rockets, and spacecraft. Information on the nature and extent of the high-altitude phase is still in the planning stage.

Remote Sensors and Their Uses

Many types of instruments have been developed for use as remote sensors. Each sensor, including the photographic types, does nothing more than store or record data from some portion of the electromagnetic spectrum. The sensors measure radiated energy emitted from the earth's surface and modified by the atmosphere. The intensities of radiation that are actually measured by the various sensors are compared with theoretically found intensities. Deviations from the theoretical, of course, are of interest.

Of the many types of remote sensors, aerial, panoramic, and multiband cameras seem to have considerable promise. Similarly, the optical-mechanical scanner, side-looking radar, and gamma ray spectrometer appear to have sensing value. Figure 5 shows several of these sensors.

A number of full-time research projects in each instrument area are being carried out by scientists in Government agencies and private organizations. These studies are directed at establishing feasibility and at advancing the "state of the art" in instrument design, data acquisition and data reduction relative to airborne and spaceborne remote sensors as they apply to the various user disciplines.

The present sensor systems are all experimental in nature. Their purpose is to determine the feasibility of applying the space sensors for use in earth studies. Because of some of the complexities involved, the systems are initially being developed for manned flight. However, as problems are solved and experience gained, the various sensor systems may ultimately be developed for unmanned flights as well.

Program Test Sites

Earth Resources Survey Program test sites are of two types: instrument-calibration sites and data-acquisition sites. The instrument-calibration test sites should be areas which have been studied in great detail in one or more of the intended sciences.

At present, the Program policy calls for the establishment of a test-site committee empowered to select and set priorities for the study of test sites. This committee consists of a chairman for each instrument team, a manager of each discipline, a NASA representative, the aircraft project manager, and a representative from the Office of International Affairs.

Data-acquisition test sites should be suitable for the purpose intended; that is, for the field of study in which the data will be used. They should not be larger than necessary or in inaccessible terrain.

To date, 160 test sites of both types have been selected in the continental United States. In addition, approximately 60 sites have been tentatively selected for flights abroad. Figure 6 shows the location of test sites in the United States.

Site descriptions have been prepared for 63 of the U.S. test sites. These descriptions are prepared by investigators supporting the Earth Resources Survey Program and give in considerable detail the facts of the particular site. They are used to verify and correlate the flight data taken over the site. For this reason, the site descriptions form part of what is called "ground-truth" surveys. As the Program progresses, additional sites are expected to be selected, both in the United States and abroad.

POTENTIAL USERS OF THE PROGRAM

The potential users of the wealth of data expected to be acquired during the Program's life may be divided into four categories: other government agencies, private industries, universities, and foreign governments.

The Department of Agriculture, for instance, plans to use remote-sensing equipment to make large area surveys of land use, monitor wildlife migrations, predict future crop yields, warn of insect infestations, locate reclaimable land, and make several other types of surveys. Figure 7 is an excellent illustration of the use of remote sensing to identify soil and crop types.

The Treasury Department has shown considerable interest in determining the spectral signatures of various types of narcotic-producing plants. For instance, if poppy fields could be detected readily, the Department would have an excellent tool for the control of the illicit trade in opium and heroin.

The Forest Service is investigating the use of remote sensors in detecting and locating forest fires. When developed, these devices will enable the Service to provide continuous coverage over the millions of acres of forest lands within the United States.

The U.S. Geological Survey plans to use spaceborne remote sensors to provide advance warning of earthquakes and volcanoes, such as the Kilauea Volcano shown in figure 8.

Orbital data evaluations will be useful to private industries in many ways. For instance, the shipping industry, by even a small improvement in routing techniques, will be able to realize significant dollar savings. These improvements can be expected to be derived from orbital data concerning wave heights, channel shoaling, iceberg location, et cetera. Other uses of commercial value would include the detection of underground rivers, fast and accurate topographic mapping, and the location and delineation of mineral deposits. For example, figure 9 provides a striking illustration of the superiority of multispectral photography to conventional photography in charting the ocean floor.

At present some 31 universities located across the country are cooperating with NASA in the Earth Resources Survey Program. Many of the principal investigators who carry out ground-truth surveys of test sites are from these universities.

As the spaceborne phase becomes a reality, the scope of the program is expected to broaden. Relationships with other nations and their governments on many aspects of the Program will become commonplace. The data obtained will be useful to many nations, yet each will have its own particular problems and priorities regarding utilization of the Program's data.

THE TECHNICAL WRITER AND THE PROGRAM

The technical writer will play a challenging and rewarding part in the Earth Resources Survey Program. His participation will be needed from the planning phase through the final report preparation phase. He will find that the tasks he is called upon to do require a varied background of education and experience. He will need to be versatile and intelligent. His part in contributing to the success of the program will be significant.

Current Role

At present, only a few writers are working in the Earth Resources Survey Program. These few people are engaged in preparing air flight mission summary reports. Approximately 150 of these flights have been completed to date with more planned. Each of the flights is documented with a mission summary report. This report covers the mission objectives, equipment status, and flight-log data. No attempt is made in these reports to discuss the data taken or its evaluation.

Although the total number of technical writers engaged either directly or indirectly in the Earth Resources Survey Program is presently quite small, as the Program advances, the need for technical writers will undoubtedly multiply due to the increasing number of people working in the Program and to the increase in the data flow.

Future Role

Now let us examine the future role of the technical writer in the Program. Currently, nine types of technical documents are being issued under the Program (figs. 10 and 11). You will note that the documents are divided into phases, which we shall discuss later.

Under the planning phase (fig. 10), mission requests which cover the reasons and plans for air or space flights are shown, along with site maps showing the pertinent features of selected test sites.

Within the data collection phase (fig. 10), we have listed both mission reports, which detail flight conditions and instrument performance, and site descriptions of the test areas.

No documentation is carried in the data cataloging phase.

The most important documents are issued by the various investigators and scientists and are seen under the data dissemination and utilization phase (fig. 11). These documents cover detailed reports of sensors and resources and progress reports of various projects being conducted under the Program.

Figures 12 and 13 illustrate the data flow, including several of the documents just discussed. You will note that the flow is divided into four phases.

1. Planning Phase. This section would include short- and long-term plans for both air and space flights, as well as ground-truth surveys of test sites. Technical writers would assist in the preparation of all types of planning documents.

2. Data Collection Phase. In the flight portion of this phase, the technical writer would act as observer and aide on the flight and later help in writing the mission summary report. On the ground portion, the writer would act as observer and aide on the ground-truth survey of the test site. Later he would work on the preparation of the technical report covering the survey. Also during this phase, the writer might be expected to aid in the matching of the ground-truth and flight data. Perhaps he will help in the library research and preliminary interpretation of the data itself.

3. Data Cataloging Phase. This phase will encompass the classification, preliminary evaluation, and cataloging of both the raw data and the reports prepared in the earlier phase. The writer who has the proper background could be expected to help here with the preliminary evaluation.

4. Data Dissemination and Utilization Phase. The final phase concerns the dissemination of the raw data, mission and technical reports, and any preliminary evaluation reports which have been prepared previously. This material will be distributed to a university or to a principal investigator. Again the writer might participate in any or all of these areas, helping with the necessary research and data evaluation for preparation of final reports. These final reports would form the basis for a proposal to explore or develop a specific resource. They would return to the MSC document file for release to other government agencies and private industry users.

Requisites for the Ideal Technical Writer in the Program

What type of technical writer is needed in this Program? We have discussed some of the documentation he would be concerned with and also how he might fit into Program operations. Now let us examine the educational and experience requirements of an ideal technical writer.

To date, the technical writer's education has widely varied from individual to individual. Successful technical writers have entered the field from other professions, and a lesser number have entered the field from other areas of writing. Only a few writers have received formal university training in technical writing as such. Reflecting this general pattern is the background of a typical technical writer engaged in writing for the aerospace industry at MSC. For example, the technical writing group of a single NASA contractor has writers with degrees in 17 different disciplines.

Although almost any discipline might be represented by a writer in the Program, figure 14 illustrates an optimum educational background for the more successful technical writers entering the field. Such a background would include a degree in an earth science or engineering with courses in physics or chemistry. Graduate work in science or technical communications would be helpful.

As in the case of educational backgrounds, writers have come to the Manned Spacecraft Center with widely varying backgrounds of experience. They have come from other industries, from the aerospace industry at other locations, and from universities and schools. Length and type of experience seem to follow no common pattern. Yet most of the people have found aerospace fascinating and have contributed significantly to technical writing in this field.

Again, as with the educational background, it does not appear that a particular kind of experience in a restricted area is necessary. We have observed, however, that industry experience per se is important, either as a professional technical writer or as a practicing professional in a scientific area. Service with some type of government survey would also be of invaluable help to a technical writer working in the Program.

Figure 15 is an example of the complexity and interrelationships of the disciplines involved in just one possible use of the Program. We have indicated here five major disciplines: geology, physics, chemistry, engineering, and economics. We have also shown the secondary disciplines arising from the blending of the primary disciplines. All of these sciences are necessary for the proper exploration and development of a single type resource — in this example, a mineral deposit.

CONCLUSIONS

We believe, basically, we can make four conclusions concerning the Earth Resources Program and the technical writer's role in that Program.

1. The Program results to date have shown that the rate of data collection has accelerated tremendously compared to earlier efforts. Similarly, the types of data being collected have multiplied. The

aerial camera has been replaced by more and better types of photographic and electronic sensors. There is simply more data being collected.

2. As a result, the time required by the Program engineers and scientists in planning, interpretation, and evaluation has been increased many-fold. Also, the correlation and coordination of the wealth of data acquired is more exacting and time-consuming.

3. Of necessity, with the increase in the workload imposed upon the engineers and scientists, it will fall upon the technical writer to relieve them of the burden of preparing the data and seeing that it is disseminated to the scientific community and to the ultimate users.

4. Although in the past, the writer's task has often ceased when a document was published, we envision a much broader role for him in the Program. Not only will he relieve the scientist of the burden of data preparation and dissemination, but he will also help the cataloger in providing identification keys for each document. Finally, as the mass of data grows, the writer will be required to interface with data storage and retrieval systems.

OBJECTIVES

- DEVELOPMENT OF THE BEST COMBINATION OF INSTRUMENTATION, PROCEDURES AND INTERPRETATIONAL METHODS FOR GATHERING RESOURCE DATA AND TESTING THESE WITH EXPERIMENTAL SPACECRAFT

- DISCOVERY AND DELINEATION FROM SPACE OF THOSE EARTH RESOURCES WHICH WILL BE OF ECONOMIC VALUE TO THE NATION AND THE WORLD

Figure 1.- Objectives of the Earth Resources Program.

SOME POSSIBLE APPLICATIONS BY AREA

- AGRICULTURE AND FORESTRY PRODUCTION

  GATHERING OF DATA ON PLANT VIGOR AND DISEASE FOR INCREASING PLANT PRODUCTION
- GEOLOGY AND MINERAL RESOURCES

  GATHERING OF DATA TO AID IN DISCOVERY AND DEVELOPMENT OF MINERAL RESOURCES
- HYDROLOGY AND WATER RESOURCES

  GATHERING OF DATA TO AID IN LOCATION AND UTILIZATION OF WATER
- GEOGRAPHY, CARTOGRAPHY, AND CULTURAL RESOURCES

  GATHERING OF DATA TO PERMIT BETTER USE OF RURAL AND METROPOLITAN LAND AREAS
- OCEANOGRAPHY AND MARINE RESOURCES

  GATHERING OF DATA TO AID IN OCEAN TRANSPORTATION AND UTILIZATION OF FISHERIES

Figure 2.- Some applications of the Earth Resources Survey Program.

PROGRAM PHASES

- FEASIBILITY PHASE - EXPERIMENTATION FROM AIRCRAFT TO ACQUIRE SIGNATURES OF EARTH RESOURCES PHENOMENA AND HOW TO INTERPRET THEM
- SPACECRAFT TESTING PHASE - FROM 1970 TO 1980, SPACE FLIGHT MISSIONS WILL BE MADE, FOR THE PRIMARY PURPOSE OF ACQUIRING DATA FOR EXTENSIVE STUDIES OF THE EARTH'S RESOURCES
- OPERATIONAL PHASE - BEYOND 1980, THE SCOPE AND MAGNITUDE OF THE PROGRAM WILL DEPEND ON THE RESULTS OF THE EARLIER PHASES. INDICATIONS ARE THAT IT WILL BE MULTIDISCIPLINE IN NATURE, GLOBAL IN EXTENT AND MORE OR LESS CONTINOUS

Figure 3.- Program phases.

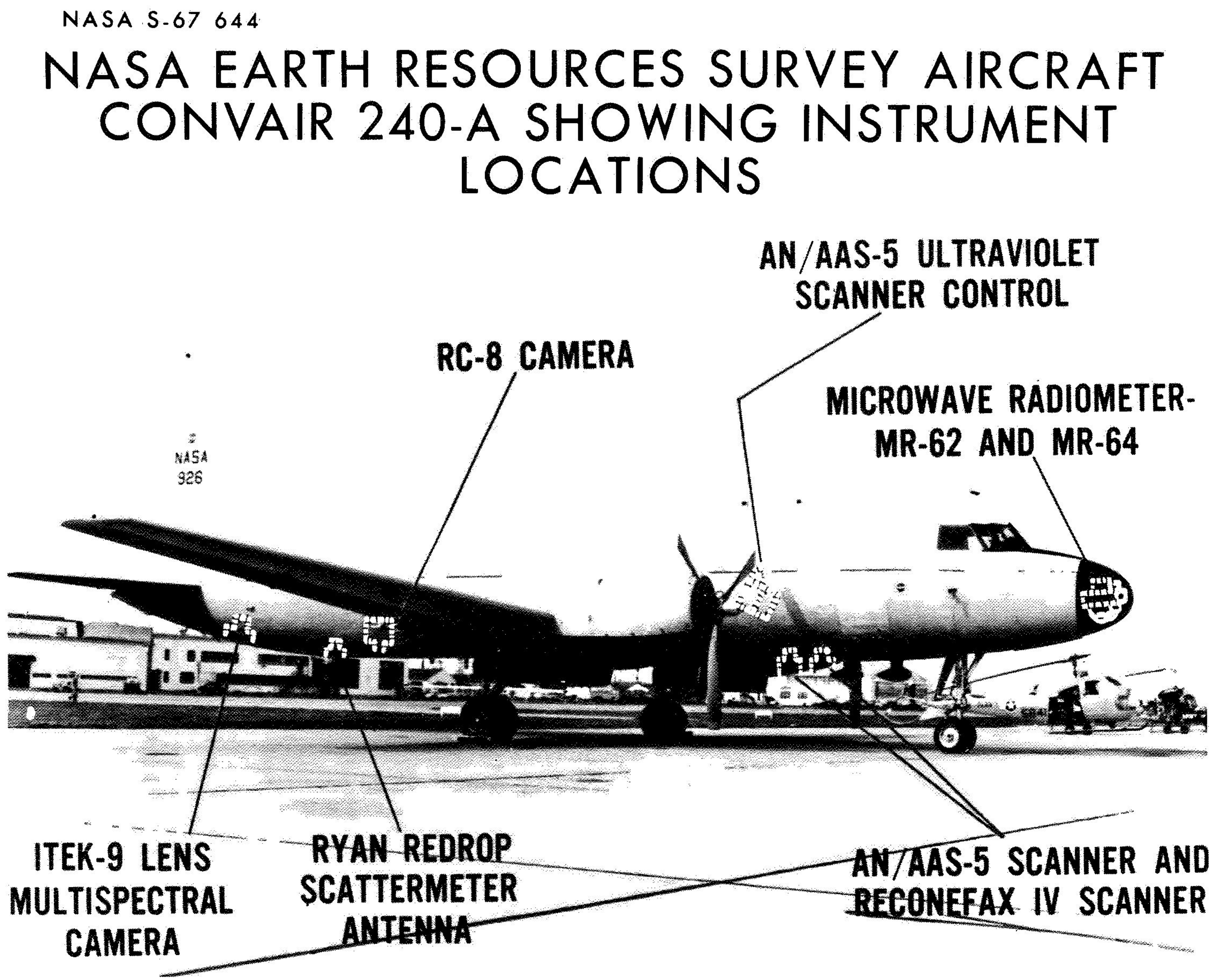


Figure 4.- Instrument locations on aircraft.

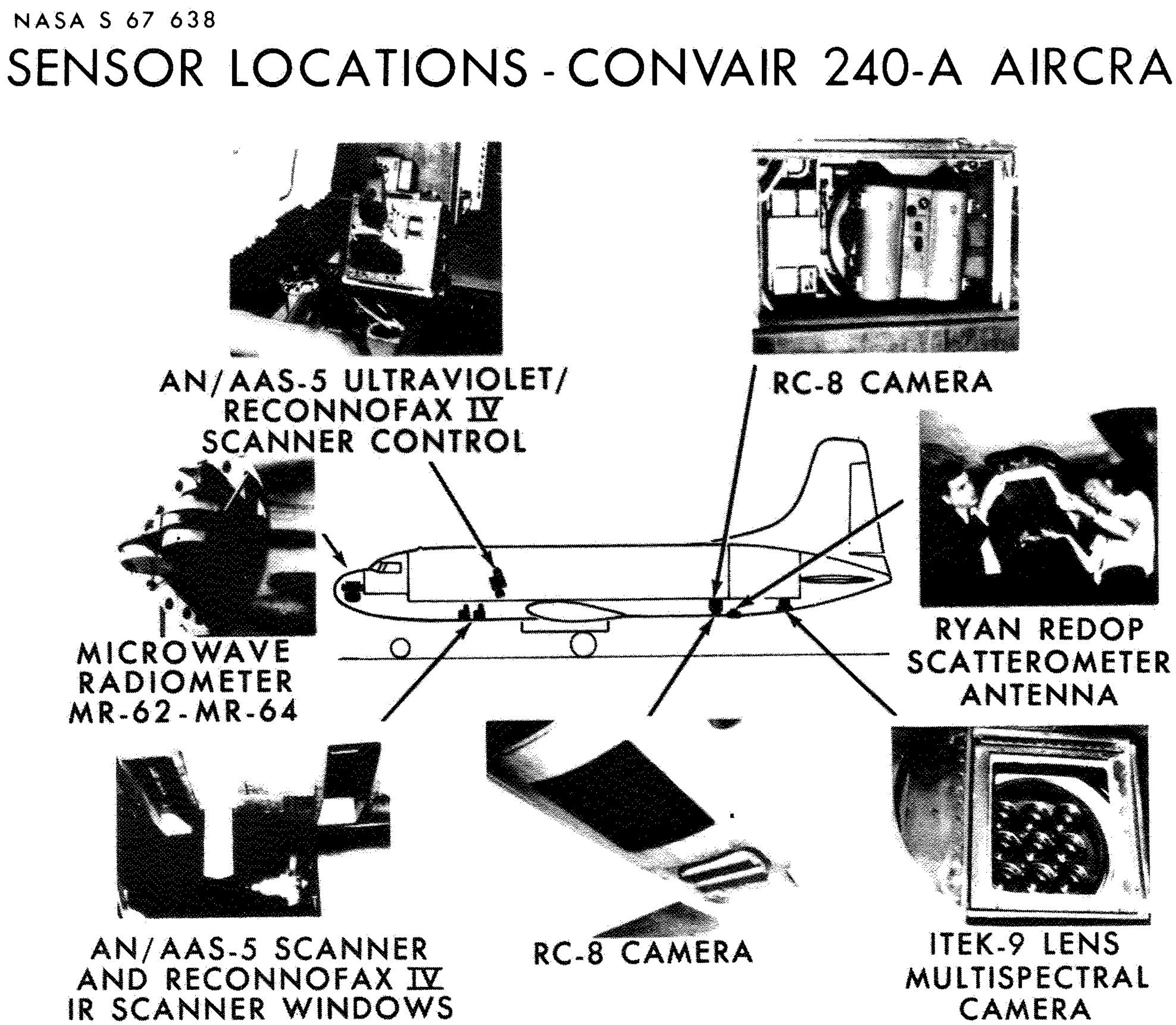


Figure 5.- Sensor locations.

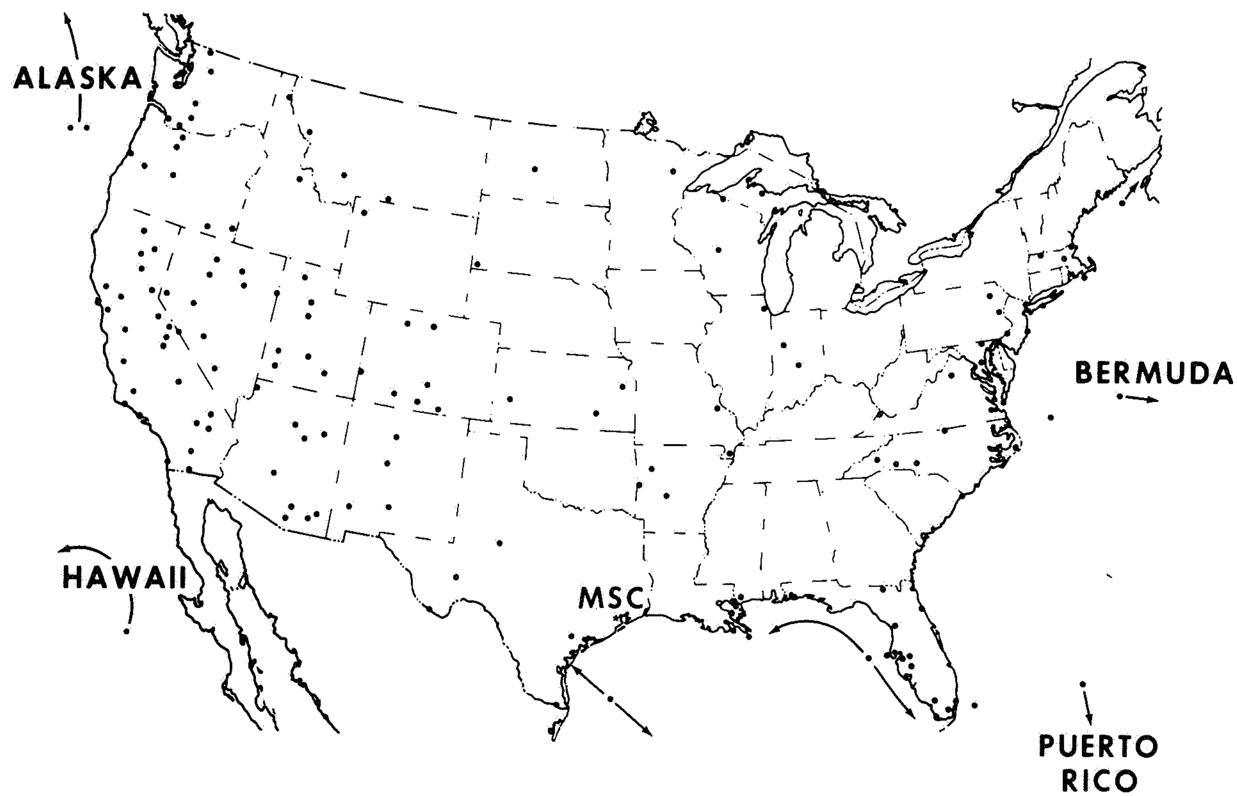
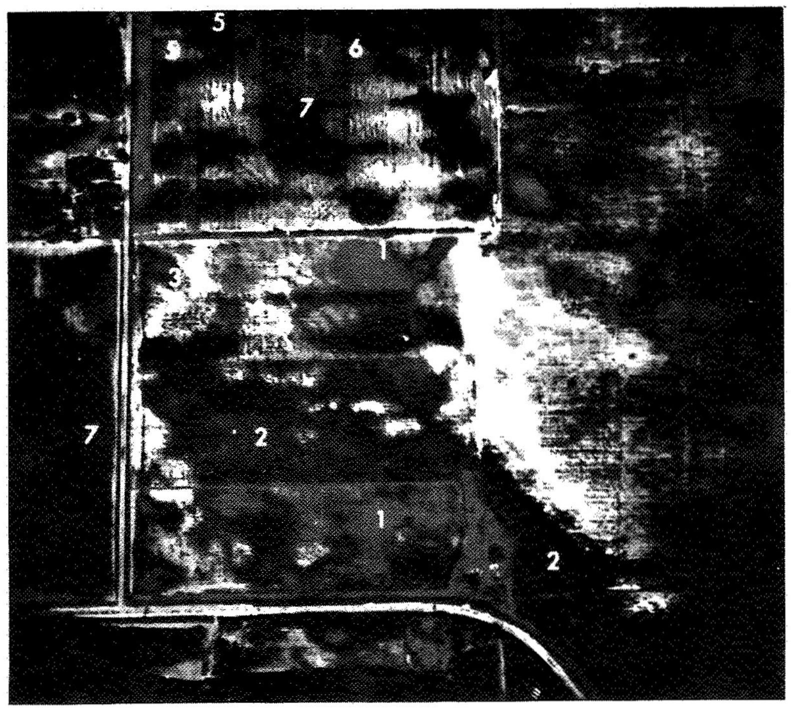


Figure 6.- U.S. Test Site Map.

NASA S 67 648

IDENTIFICATION OF SOIL AND CROP TYPES BY DIAGNOSTIC COLOR SIGNATURES USING AERIAL EKTACHROME FILM (VISIBLE INFRARED)



PHOTOGRAPHY TAKEN IN SEVERAL WAVELENGTH BANDS SIMULTANEOUSLY YIELDS SIGNATURES WHICH WHEN COMBINED WILL PROVIDE POSITIVE IDENTIFICATIONS

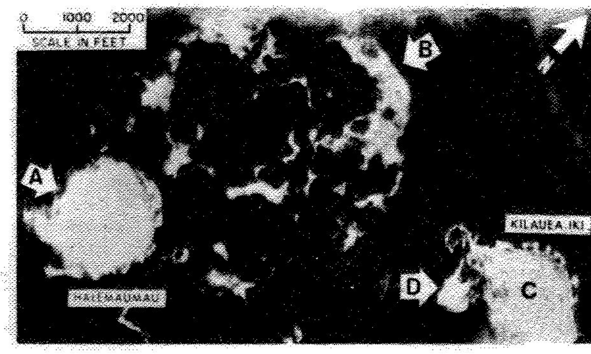
LEGEND

1. HEALTHY COTTON
   48 HIGH
   SALINITY 1 MMHO/CM
2. UNHEALTHY COTTON
   12 16 HIGH
   SALINITY: 7 10 MMHOS/CM
3. BARE SOIL
   SALINITY: > 12 MMHOS/CM
4. PIG WEEDS IN WET AREA, MINOR SORGHUM
5. PIG WEEDS ABOVE SHORT SORGHUM
6. DRY TOPSOIL BETWEEN ROWS OF SORGHUM
7. BARE SOIL BETWEEN ROWS OF SORGHUM
   HIGH MOISTURE CONTENT

Figure 7.- Identification of soil and crop types.

NASA-S-67-651

KILAUEA VOLCANO, HAWAII



INFRARED IMAGE

TONAL VARIATION SHOWS DISTRIBUTION OF RADIANT HEAT; THE BRIGHTER THE TONE THE WARMER THE SURFACE

USGS INFRARED SCANNER AT 4.5—5.5 MICRONS

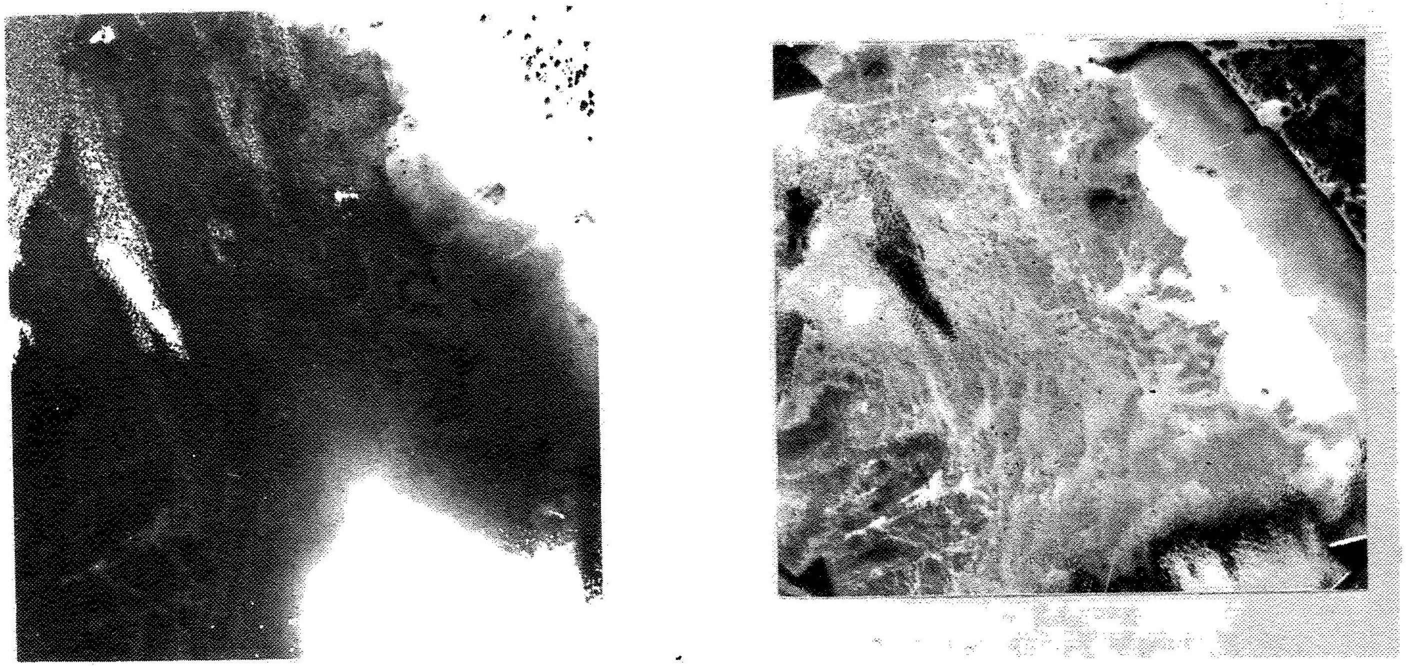
JANUARY 28, 1962 - 7:02 A M

AERIAL PHOTOGRAPH

LARGE VENT AT LEFT AND SMALL VENT AT RIGHT ARE WITHIN LARGE CRATER (CALDERA)

AT-11 MAPPING CAMERA

Figure 8.- Kilauea Volcano.



CONVENTIONAL COLOR PHOTOGRAPHY
SCALE 450 FT/IN.

MULTISPECTRAL PHOTOGRAPHY PROVIDES BETTER VISIBILITY AND PRESENTS THE POSSIBILITY OF CHARTING NEAR SHORE BOTTOM TOPOGRAPHY AT DEPTHS OF 30 FEET OR MORE

Figure 9.- Water depth penetration by photography.

- PLANNING PHASE
  - MISSION REQUESTS - REQUESTS FOR AIR OR SPACE FLIGHTS
  - SITE MAPS - MAPS OF TEST SITES SHOWING FEATURES
- DATA COLLECTION PHASE
  - MISSION REPORTS - REPORTS OF FLIGHT CONDITIONS & INSTRUMENT PERFORMANCE
  - SITE DESCRIPTIONS - OF TEST AREA DESCRIPTION
- DATA CATALOGING PHASE
  - NO DOCUMENTATION

Figure 10.- ERSP documents.

- DATA DISSEMINATION & UTILIZATION PHASE
  - TECHNICAL LETTER REPORTS - PAPERS BY USGS ON SENSORS & GROUND STUDIES
  - TECHNICAL REPORTS - EVALUATIONS OF RESOURCE SITES & SENSOR USE
  - MISCELLANEOUS DOCUMENTS - PAPERS ON A VARIETY OF ERSP SUBJECTS
  - PROGRESS REPORTS - REPORTS ON ERSP PROJECTS BY USGS & UNIVERSITIES
  - SUMMARY REPORTS - REPORTS ON EARTH RESOURCES SPACECRAFT

Figure 11.- ERSP documents, continued.

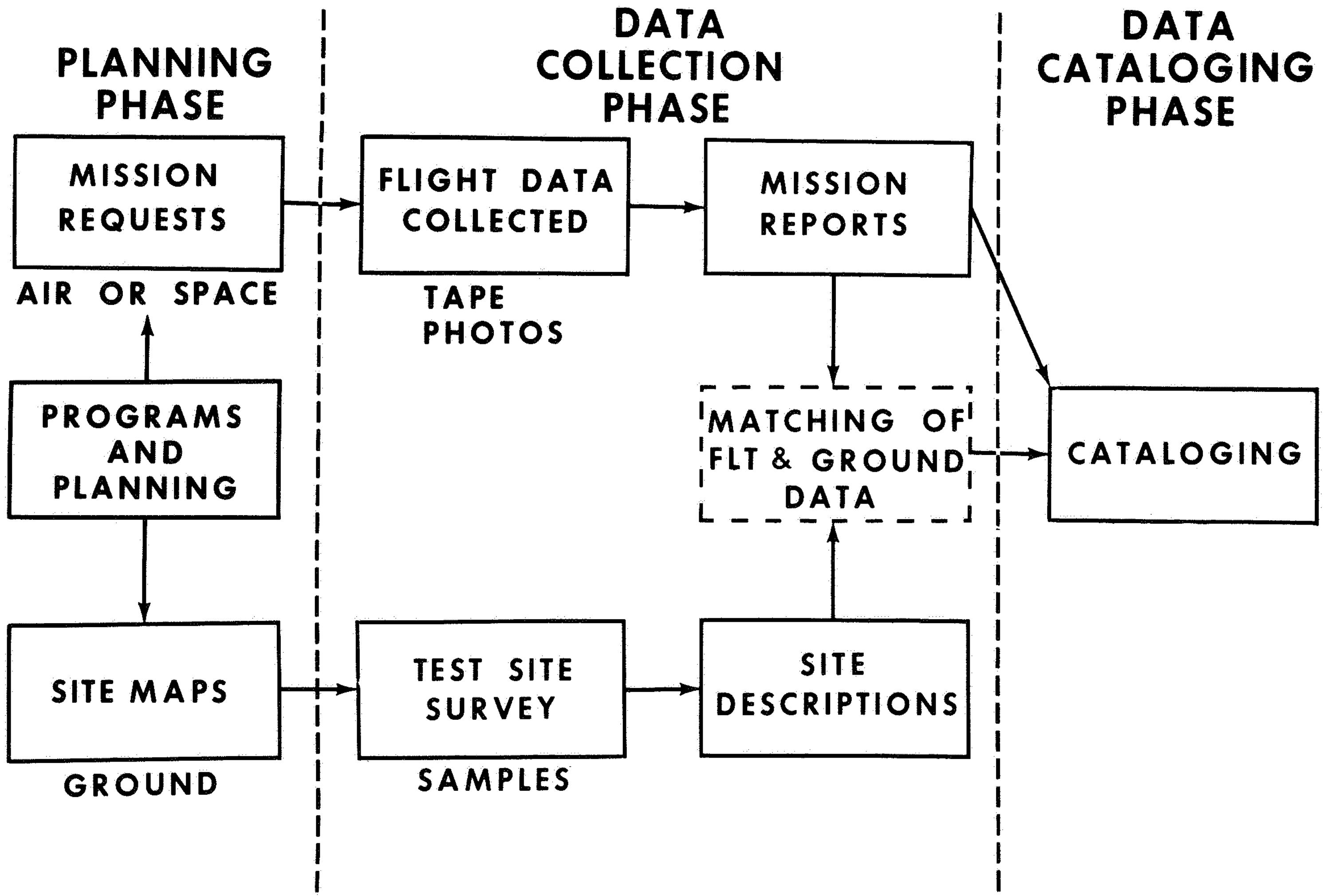


Figure 12.- ERSP data flow.

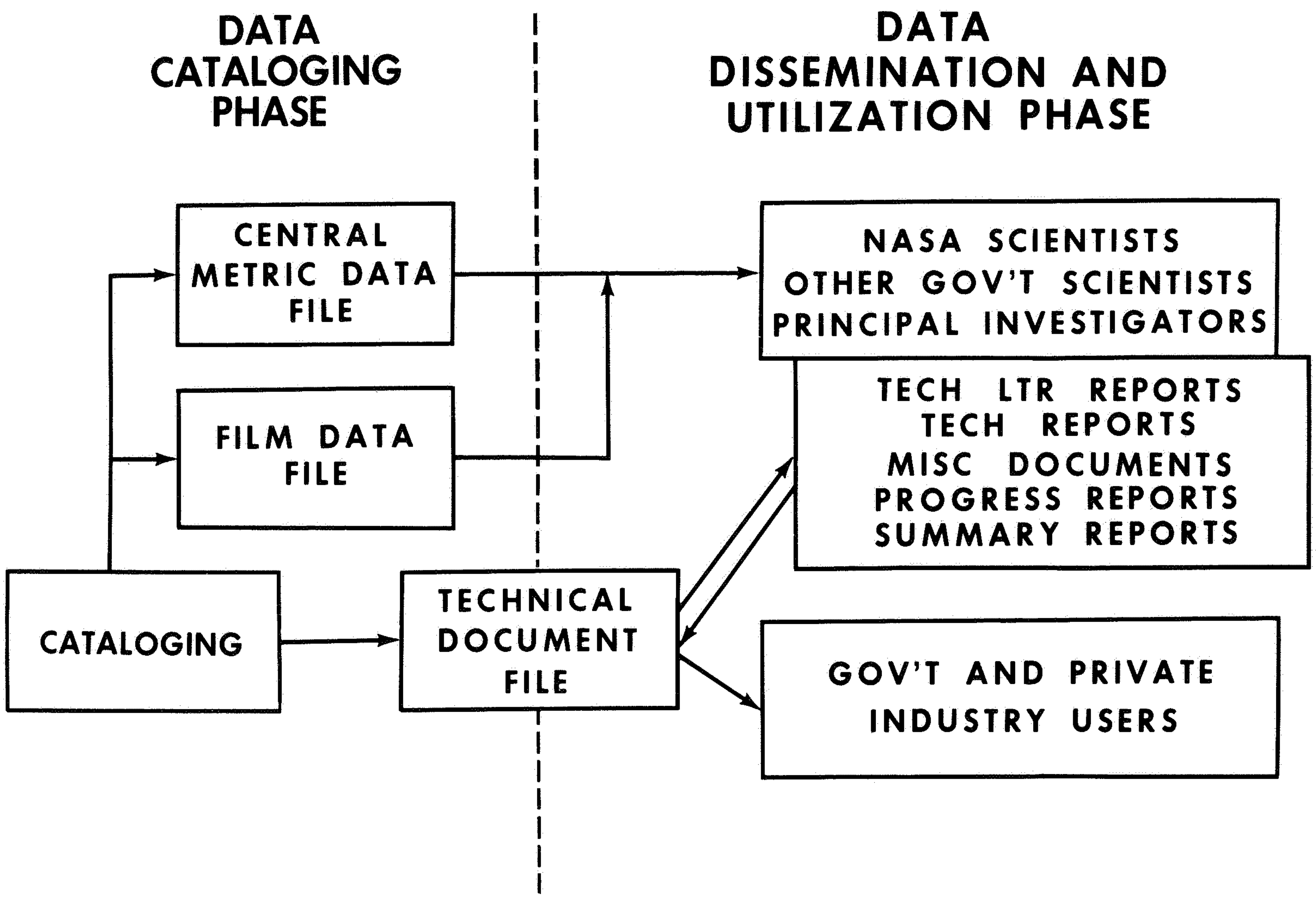


Figure 13.- ERSP data flow, continued.

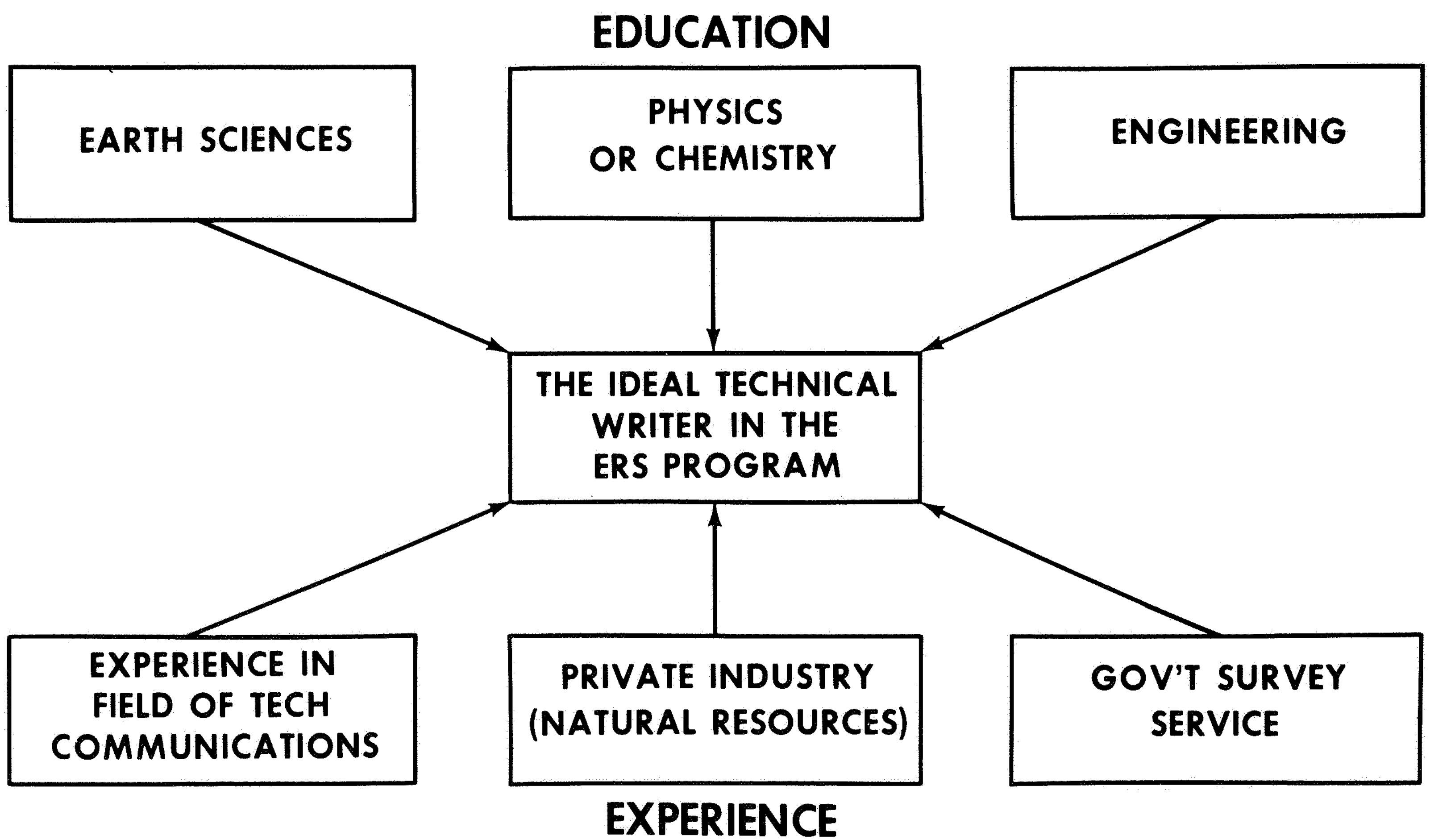


Figure 14.- Requisites for the ideal technical writer in the ERSP.

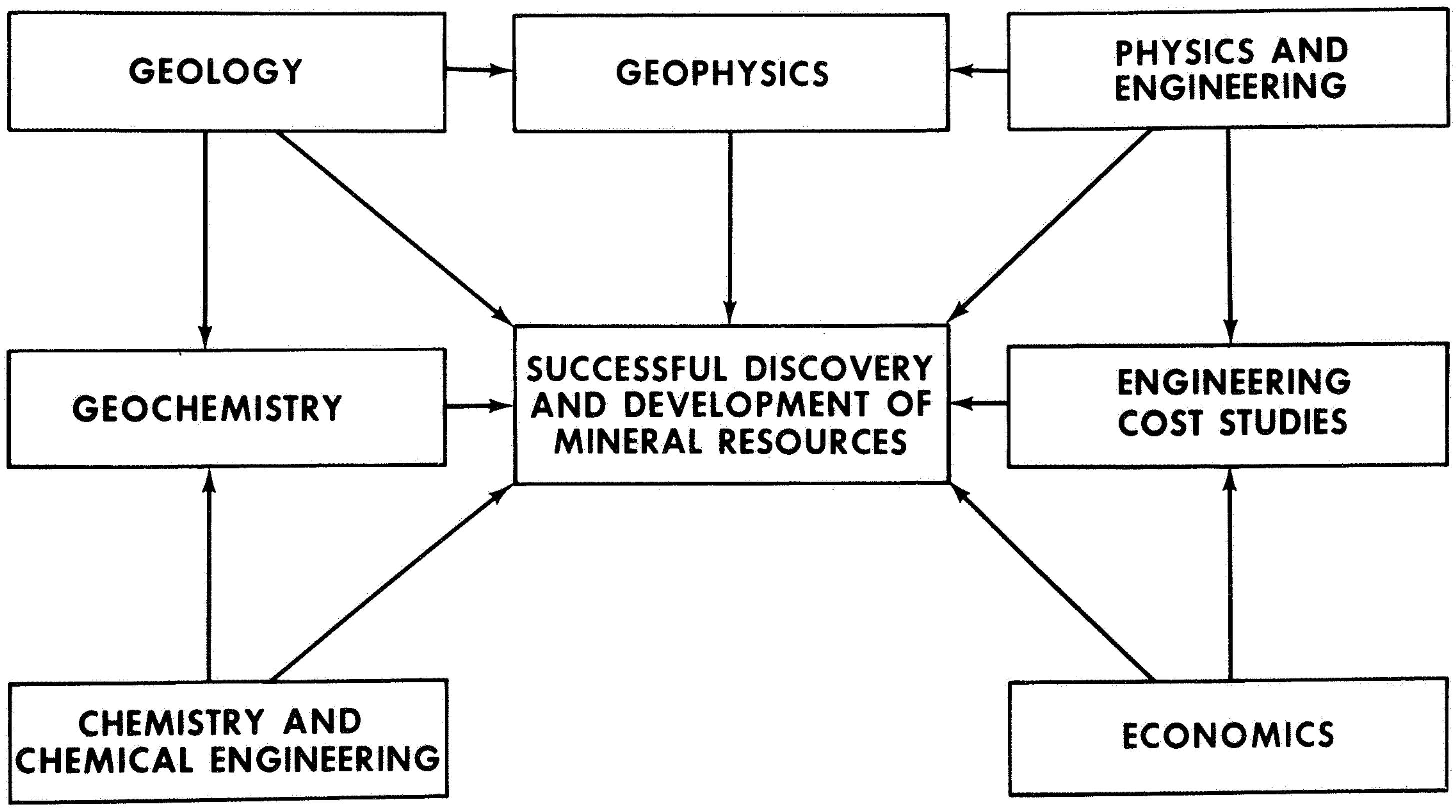


Figure 15.- Typical example of interralationship of four disciplines.