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U. S. Congress. House. Committee on Science and
Astronautics.

National meteorological satellite program.



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*U.S. Congress, House, Committee on Science
and Astronautics*

**NATIONAL METEOROLOGICAL SATELLITE
PROGRAM**

REPORT

OF THE

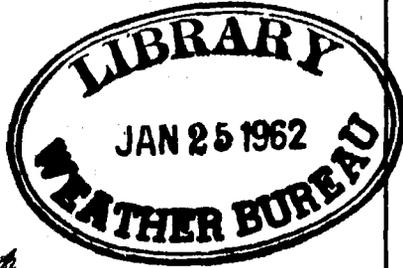
COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SEVENTH CONGRESS

FIRST SESSION

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LETTER OF SUBMITTAL

COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., October 18, 1961.

HON. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the following report for the consideration of the Congress.

GEORGE P. MILLER, *Chairman.*

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., September 25, 1961.

HON. GEORGE P. MILLER,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report, "National Meteorological Satellite Program," based upon hearings held before the committee on July 25, 26, and 27, 1961.

This report deals primarily with the management and funding problems of an operational meteorological satellite program as distinguished from the research and development phase. Even though this report is confined to the weather satellite program, I expect that what is decided in this program may well establish the precedent for management of subsequent space programs where NASA is involved in satisfying the requirements of other civilian agencies.

This report was prepared by Earl G. Peacock.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

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NATIONAL METEOROLOGICAL SATELLITE PROGRAM

OCTOBER 18, 1961.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. GEORGE P. MILLER of California, from the Committee on Science and Astronautics, submitted the following

R E P O R T

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THE NATIONAL METEOROLOGICAL SATELLITE PROGRAM

INTRODUCTION

BACKGROUND

The late Honorable Overton Brooks, former chairman, Committee on Science and Astronautics, held hearings on the national meteorological satellite program July 25, 26, and 27, 1961. These hearings were occasioned as a result of the President's statement to a joint session of Congress on May 25, 1961, that \$53 million would be made available to the U.S. Weather Bureau for a national meteorological satellite system. This action by the administration posed a number of management and funding complications between NASA, which is presently funding and supervising the research and development meteorological satellite system, and the Weather Bureau which will, in the future, fund for the operational meteorological satellite programs.

PURPOSE OF THE HEARINGS

The purpose of the study and hearings was to review and clarify the management and funding structure proposed for the national meteorological satellite program. The major concern of the Committee on Science and Astronautics is not with the meteorological satellite program per se, but the overall management and funding of future operational satellite programs which will contribute to the exploration and utilization of space for peaceful purposes to benefit all mankind.

Satellite programs today, and in the foreseeable future, are started as research and development projects and, if successful, are reoriented as operational programs to meet operational requirements. When this normal process takes place, usually control of any research and development program passes from one agency to another (within Government or to civilian industry). In the past it has been the standard operating procedure for the agency assigned control of a program (R. & D. or operational), to also be assigned all the management and funding responsibilities. An old axiom has been "to properly manage a program one must control all the funds."

In the past this formula may have been true when adding or deleting programs to an agency's budget did not materially affect it; but today when the addition of one program to an agency's budget will increase this budget by 100 percent, it is felt these old axioms or standard operating procedures must be examined very carefully. It is for this reason that the Committee on Science and Astronautics is very much concerned with the national meteorological satellite program, as it is the first in a long series of such satellite programs

on the horizon and will very likely set the pattern of management and funding for future satellite programs.

The major areas of congressional interest were:

1. Interpretation of the Space Act of 1958 as it relates to operational space activities vis-a-vis R. & D. activities of NASA in the case of the meteorological satellite program.
2. Interrelationship between NASA and the Weather Bureau relating to joint vested interests in space activities.
3. Duplication—Will it be necessary for the Weather Bureau to establish internal divisions to carry out "space activities"? (Establishing costly management organizations.)
4. Requirements—Does the proposed operational national meteorological satellite system meet the requirements of all interested agencies?
5. Funding—Should all funding be accomplished under one agency, or should the funding responsibility be split between the two agencies in accordance with its vested interest? NASA would fund for booster, payload, launch and recovery, and the Weather Bureau would fund for the ground data reduction, processing, and dissemination requirements.

WITNESSES HEARD

In order to assess properly the proposed course of action in the light of present and future operational national satellite programs, the late Honorable Overton Brooks of Louisiana conducted public hearings on July 25, 26, and 27, 1961, at which time testimony was received from the following Government officials:

1. Tuesday, July 25, 1961:
 - Dr. Francis W. Reichelderfer, Chief, U.S. Weather Bureau
 - Mr. David S. Johnson, Chief of the Satellite Laboratory, U.S. Weather Bureau
 - Dr. Harry Wexler, Director of Meteorological Research, U.S. Weather Bureau
 - Dr. John Russell, special assistant to Chief of the Weather Bureau
2. Wednesday, July 26, 1961:
 - Mr. John Rubel, Assistant Secretary of Defense, Defense Research and Engineering—Department of Defense
 - Col. Arthur E. Smith, USAF, Office of Special Projects, Defense Research and Engineering—Department of Defense
 - Comdr. Richard W. Sanborn, USN, Office of Naval Weather Service, U.S. Navy
3. Thursday, July 27, 1961:
 - Mr. James E. Webb, Administrator, NASA
 - Dr. Robert C. Seamans, Jr., Associate Administrator, NASA
 - Dr. Morris Tepper, Chief, Meteorological Satellite Program, NASA

Since time was a limiting factor, it was impossible to hear all interested agencies, industrial concerns, and other interested parties in the field, but their suggestions and comments have contributed to the preparation of this report.

NASA RESPONSIBILITIES UNDER THE SPACE ACT FOR OPERATIONAL SATELLITE SYSTEMS

Section 102(b) of the National Aeronautics and Space Act of 1958 states:

The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense; and that determination as to which such agency has responsibility for and direction of any such activity shall be made by the President in conformity with section 201(e).

The civilian agency—National Aeronautics and Space Administration (NASA) will: Section 203(a)(1)—“plan, direct, and conduct aeronautical and space activities;”.

The statutory provision gives NASA very broad authority over everything having to do with this country's civilian space activities. This does not preclude the fact that other civilian Government agencies have interests and responsibilities with respect to specific portions of space programs. For example, the Weather Bureau has a very direct interest in the meteorological satellite program. The Federal Communications Commission (FCC) and the State Department have major interests and responsibilities in connection with the development and operation of communications satellites, as well as all satellites with communications systems tied to space ground support facilities for tracking and data read-out (receipt and translation). In the case of the meteorological satellite system, the satellite would be a “producer” of raw data which in turn would be reduced and processed by the Weather Bureau for distribution in the same manner as raw data received from other sources such as ships at sea, commercial and military aircraft, etc.; NASA would develop and operate the satellite systems based on the Weather Bureau's requirements. This would represent a division of labor consistent with the language of the Space Act.

In the future, other agencies in the Government will look to space programs to assist them in carrying out their assigned missions; this is as it should be. Just as soon as space technology can be put to practical use in providing for everyday requirements, projects and programs must be aggressively pushed by all interested agencies to provide better products, more efficient ways of doing things, swifter and safer transportation, better health, and a longer and more productive life. But the mere fact that such interests and responsibilities exist in other Government agencies does not relieve NASA of its very broad authority and responsibility for planning, directing, and conducting this Nation's peaceful space activities and programs.

When NASA was created as a successor to the National Advisory Committee for Aeronautics, there was a conscious and express intention on the part of the Congress to give this new agency management and operational responsibilities, in addition to its research and development functions. That is why Congress decreed that aeronautical and space activities sponsored by the United States, except for those activities specifically designated as the responsibility of the Department of Defense, should be directed and controlled by NASA. Accordingly, there can be no doubt about NASA's clear responsibility for management of the peaceful space programs of the United States. Conversely NASA has a responsibility to satisfy the requirements of other civilian Government agencies, such as the Weather Bureau, when the utilization of space projects and programs is necessary by these agencies in performing their assigned functions.

The testimony of the hearings supports the committee's interpretation of the Spact Act; i.e., that NASA is responsible for not only the R. & D. satellite systems, other than military, but also the operational satellite programs. Quoting Dr. Seamans, Associate Director of NASA, "the operation responsibility of satellites definitely belongs to the NASA," and "NASA has the responsibility for the satellites, the launch vehicles, the launch operations." This is in keeping with Chief of Weather Bureau Dr. Reichelderfer's testimony, which states the Weather Bureau will not build up great facilities or assemble a large group of scientists and engineers to design and construct satellites but rather pass their requirements to NASA for action. The Weather Bureau would manage ground command and data acquisition stations connected to the meteorological mission, the weather satellite program but would not operate the satellite systems. The tracking and control (space ground-support equipment) would be under the control of NASA.

SIGNIFICANCE OF PEACEFUL SATELLITE PROGRAMS

International cooperation in the exchange of weather observations is of long standing and represents one of the outstanding examples of amicable international relationships. It would be to the advantage of the United States to take the lead in extending such international meteorological cooperation to include satellite data. It should be noted that it becomes no burden for the satellite system to satisfy simultaneously national requirements and many of those of the international meteorological community.

The fully operational system is dependent on at least one command and data acquisition station on foreign soil. In its earliest phase, the reduced and analyzed products of the global observations can be disseminated internationally, and it is contemplated that they will be. Furthermore, any nation that so desires can, at minimum expense, establish stations to obtain, directly, cloud pictures in its immediate vicinity. Later, significant portions of the global data can be transmitted from the satellites directly to cooperative regional weather centrals in other parts of the world. One can foresee a truly international system with the satellites transmitting their observations to a world meteorological center as well as to more specialized regional, national, and local weather centrals.

Today, the extensive weather observing systems are owned and operated by the highly developed nations of the world which acquire

data over approximately 15 percent of the earth's surface. From other portions of the world, especially the underdeveloped areas, such as Africa, Asia, South America, the Polar and Oceanic regions, the weather information is very scanty or nonexistent. Yet, the atmospheric flow is global in nature, the weather will never be completely predictable or understood until the total air mass covering the earth is brought under continual surveillance, and the input and output energy from all sources contributing to its dynamic behavior is measured.

One of the significant immediate benefits of a national meteorological satellite system will be an improved storm-warning system which will save lives and reduce property damage in all areas of the world. Today it is possible for larger storms to develop and reside undetected where observations are scant or nonexistent.

The degree of success or failure in many of man's economic activities is determined by weather. Greater national productivity would result from improved weather forecasts. Meteorological data would provide a significant contribution to the welfare and economic growth of underdeveloped nations. The research and development effort for such a program could lead to an early weather control capability for the United States which would not only provide the United States with a great deterrent to war, but provide us with a system which would enhance the peaceful environment in which we live and make this planet a better place to live for all mankind.

The first phase in the battle for the minds of men is to convince the peoples of the world that the United States is vitally interested in their welfare and is prepared to assist them in providing a better livelihood for themselves. A global weather surveillance and prediction system made possible by the national meteorological satellite program would be an excellent opportunity for the United States to win many friends in many lands.

It is significant that peaceful space programs will provide the United States with many new friends throughout the world. The best evidence of how serious a threat these types of programs are to communism is exemplified by the recent blast from the Soviet Union in which the U.S.S.R. associated the U.S. Tiros III peaceful meteorological satellite with the Midas, Samos, and U-2 "spy in the sky" activities:

Moscow, July 23.¹—The Soviet Union said today that the U.S. launchings of two experimental observation satellites had been acts of espionage and aggression.

Krasnaya Zvezda, newspaper of the Soviet Armed Forces, compared the orbiting of the Tiros III weather-reporting satellite and the Midas III rocket-detection satellite with flights over the Soviet Union by the U.S. U-2 reconnaissance plane.

Both satellites, launched July 12, pass over the Soviet Union. "A spy is a spy no matter at what height it flies," the official newspaper declared.²

It is a curious fact that the U.S.S.R. did not object to the first "spy in the sky" satellites but concentrated on the Midas III tying it to Tiros III. This indicates that the U.S.S.R. has a real fear for what the peaceful satellite programs will do to further the U.S. inter-

¹ The New York Times.

² See appendix II.

ests in world affairs by assisting the underdeveloped nations of the world to help themselves, in the case of Tiros III, provide weather information. By so doing the United States provides the free world with one of the greatest peaceful weapons against communism. In essence, our peaceful satellite programs, such as the meteorological satellite, communications satellite, and a mapping satellite, could become the greatest system for peace this country could produce. The Soviet response to Tiros III in tying it to the "spy in the sky" satellite systems is a baseless charge so long as the United States adheres to its declared national policy of peaceful exploration and utilization of space for the benefit of all mankind. This has been true of all NASA programs of applied space technology.

INTERRELATIONSHIP BETWEEN NASA, WEATHER BUREAU, AND DOD

(Panel on Operational Meteorological Satellites (POMS) report)

GENERAL

On October 10, 1960, top officials [of the National Aeronautics and Space Administration, the Department of Commerce, the Federal Aviation Agency, and the Department of Defense, met and decided that the time had come to lay plans for a national operational meteorological satellite system. As a consequence, the Panel on Operational Meteorological Satellites (POMS) was established as an interagency working group under the auspices of the National Coordinating Committee for Aviation Meteorology (NACCAM). POMS was instructed to develop a plan for the operational system; this report presents such a plan.

The panel agreed at the outset that an operational system should—

OBJECTIVES

1. Constitute a major contribution toward the satisfaction of the meteorological requirements of all the users.
2. Phase into operation at the earliest date consistent with sound development practices and reasonable costs.
3. Capitalize on the continuing research and development program by—
 - (a) Making use of the best available technology in the fields of instrumentation, spacecraft and launch vehicles.
 - (b) Having growth potential to profit from experience and new technology as they become available.
4. Be manageable.
5. Serve primarily the national interests of the United States; but simultaneously—
 - (a) Provide where reasonably possible for the requirements of the international meteorological community.
 - (b) Be capable of ultimate integration into a worldwide meteorological service.

In submitting this plan, the Panel believes that the above criteria have been met.

The Panel feels that the proposed system can be undertaken at once with every confidence of success. It recommends that funds be made available in fiscal year 1962 to begin the implementation of the national operational meteorological satellite system. Furthermore, it suggests supplementary fiscal year 1961 funding to extend the Tiros program and thus provide some measure of continuous operational capability during fiscal year 1962.

CONCLUSIONS

1. Continuous worldwide meteorological coverage is now within the grasp of any nation, or group of nations, possessing the necessary interest, skills, and resources to develop an operational meteorological satellite system.

2. Based on the solid accomplishments of its research and development program, the United States could now undertake the establishment of an operational meteorological satellite system with every confidence of success. The system could become fully operational before the middle of this decade, evolving from the flight hardware developed by the NASA R. & D. program.

3. An operational meteorological satellite system would constitute an extremely powerful complement to the present observational networks. It would provide coverage of important geographic areas not now adequately observed. Furthermore, it would make available new types of meteorological observations which would improve our understanding of meteorological events.

4. Weather exerts a tremendous influence on all mankind. From its careful observation and study can come untold benefits, including improved weather analyses and forecasts over the entire earth. The potential savings in life, property, produce, natural resources, and even in personal convenience are difficult to assess. That a meteorological satellite system can make a major contribution is beyond doubt.

5. It is both possible, and clearly in the national interest, to satisfy the requirements of all the U.S. weather services for meteorological satellite observations with a single, national system. This same system could provide major services to the international community of nations.

RECOMMENDATIONS

1. That the United States undertake to develop a national operational meteorological satellite system at the earliest possible date.

2. That this document be accepted as the basis for initial planning and implementation of such a system.

3. That funds be made available in early fiscal year 1962 to begin implementation of the system.

4. That assignment of management responsibility for the national operational meteorological satellite system be made

at the earliest possible date, and that this responsibility be placed with the U.S. Weather Bureau of the Department of Commerce. That appropriate legislative changes be made to permit the Department of Commerce to effectively carry out this responsibility.

5. That the U.S. Weather Bureau create a new organizational segment to manage the operational satellite system.

6. That the Department of Commerce contract with the National Aeronautics and Space Administration to develop and/or procure for the U.S. Weather Bureau the spacecraft, launch vehicles, and ground-support equipment and to accomplish the launchings. Further, that the NASA shall participate in such postlaunch activities as command and data acquisition, as required by the interrelationship of ground equipment and spacecraft.

These recommendations are designed to support a national policy which centralizes certain types of space flight activities within the NASA and the USAF without precluding operational use of satellite observations by other organizations.

7. That the satellite data users participate in the staffing of the operational system organization through assignment of appropriate personnel.

8. That the operational system evolve from the NASA R. & D. program, initially making use of the Nimbus satellite now under development, and continue to draw on new developments resulting from the R. & D. program. That the Aeros satellite be supported for eventual incorporation into the operational system.

9. That the Tiros program be extended to provide some measure of operational capability prior to the first Nimbus launch.

10. That consideration be given to the eventual replacement of ground communications by satellite data relay.

11. That immediate engineering attention be directed to the following long-range problem areas:

(a) Possible replacements for the Thor-Agena B launch vehicle if it is to be made unavailable by early Thor phase-out.

(b) Optimum number and location of command and data acquisition stations.

12. That foreign countries be phased into the program at an early enough date to allow them adequate time to develop their roles.

AGREEMENT (INFORMAL)

The agreement between the Department of Commerce, Weather Bureau, and the National Aeronautics and Space Administration is based on the plan for a national operational meteorological satellite system. (The POMS report.) During phase I of the plan, which is a transition period, the technical responsibilities of the two agencies will continue to be the same as in the present research and development program as follows:

A. Technical responsibilities of the Weather Bureau

1. Determination of the overall meteorological requirements.
2. Specification of quantities to be measured by the instruments in the meteorological satellites.
3. Participation in the experiment design, calibration, and testing to the extent required to assure that the resulting observations can be used in meteorology and integrated into new and advanced meteorological operations.
4. Participation in launch scheduling and spacecraft programming from point of view of meteorological objectives.
5. Meteorological processing of satellite data at the command and data acquisition stations.
6. Processing of meteorological satellite data at centers such as the National Meteorological Center and the Meteorological Satellite Laboratory.
7. Integration of satellite data into weather analyses.
8. Use of satellite data in weather analysis and forecasting.
9. Dissemination of resulting meteorological data, analyses and forecasts.
10. Archives including processing, storage, and retrieval.
11. Use of the satellite data in meteorological research and climatology.
12. Conducting system studies required to meet the above responsibilities.

B. Technical responsibilities of NASA

1. Engineering design, fabrication, and test of the spacecraft.
2. Procurement of launch vehicles.
3. Maintenance of launch sites.
4. Construction of command and data acquisition stations.
5. Prelaunch preparation of spacecraft and vehicles.
6. Conducting launch operations including scheduling arrangements.
7. Tracking and orbit determination.
8. Engineering aspects of spacecraft programming and control in orbit.
9. Engineering aspects of data recovery at command and data acquisition stations.
10. Communication of data from command and data acquisition stations to central processing point such as the National Meteorological Center.

It is agreed that the DOC-WB will fund for those portions of phase I which are in addition to NASA's research and development program and which are required for the operational program.

Following phase I when the system is operational, it is our understanding that NASA will continue to have technical responsibility for—

1. Procurement of spacecraft to Weather Bureau specifications.
2. Procurement of launch vehicles.

3. Maintenance of launch sites.
4. Prelaunch preparation of spacecraft and vehicles.
5. Conducting launch operations.
6. Providing engineering council and assistance in spacecraft operations.

Although formal agreement has not been reached, it is believed that the following areas should be the responsibility of the Weather Bureau in the operational system after phase I, in addition to the responsibilities listed in A above.

1. Operation of command and data acquisition stations.
2. Spacecraft programming and control (within the policies established by NASA and other cognizant groups). This assumes also participation in launch scheduling to satisfy meteorological requirements.
3. Communication of data from command and data acquisition stations to central processing point such as the National Meteorological Center.

Decision on these items can best be reached after operating experience is gained during phase I.

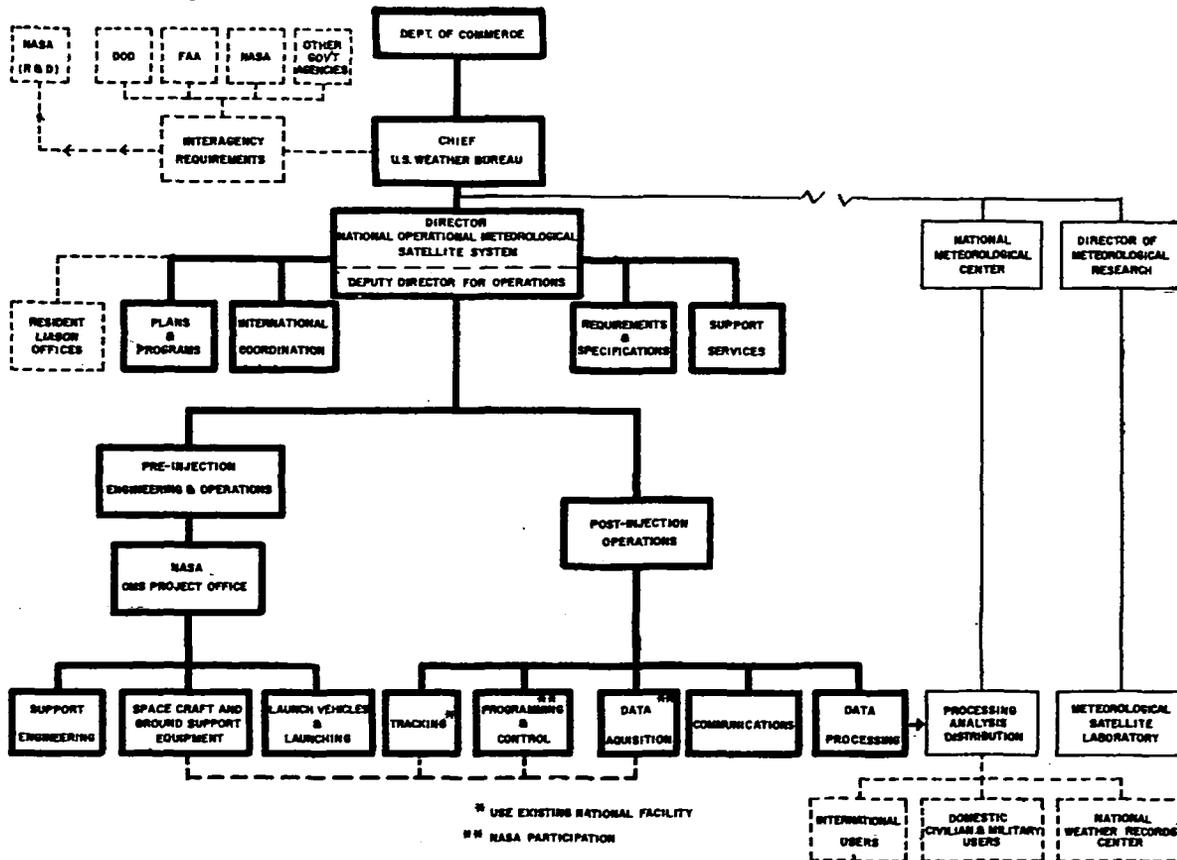


FIGURE 1.—ORGANIZATIONAL CHART, NATIONAL OPERATIONAL METEOROLOGICAL SATELLITE SYSTEM

An illustrative organization chart depicting the management structure of the operational meteorological satellite system is shown in figure 1. This plan proposes that the Weather Bureau, as the existing National Meteorological Service, be assigned the overall management responsibility for the national operational meteorological satellite system. The system office would be a self-contained newly created team within the Weather Bureau. Because of its projected experience and capability in the development and launching of the Nimbus and Aeros spacecraft, the National Aeronautics and Space Administration will carry out these portions of the operational meteorological satellite program under contract to the Department of Commerce and will participate in spacecraft control and programming, and tracking and data acquisition.

Advice to the Chief of the Weather Bureau concerning the requirements of other agencies will be provided through an interagency coordinating group.

The project management structure and field operational offices will be staffed primarily by personnel supplied by the managing agency. User participation is, however, considered to be highly desirable. This can be accomplished by the assignment of personnel from the interested agencies to tours of duty in staff and operating positions of the satellite system, as is done now in the Federal Aviation Agency, NASA, and the Weather Bureau. The assignment of such personnel will aid in effective working level liaison and coordination between the agencies concerned, as well as contributing directly to the accomplishment of the work objectives. In those instances where significant portions of the operation are being conducted by contractors, full-time resident representatives of the contractor will be stationed with the management agency. All staff assigned to the organization for a tour of duty will be administratively as well as technically responsible to the Director.

DUPLICATION OF EFFORT

From the following extract of Dr. Reichelderfer's statement before the Committee on Science and Astronautics it appears that no undesirable duplication of effort has existed to date or is anticipated in the future:

Heretofore the Weather Bureau has not had direct appropriations for meteorological satellites. The Meteorological Satellite Laboratory of the Bureau which carries on the research and development in processing and weather services uses of data from satellites has been funded by NASA. Consequently, it might at first notice be thought that the estimates for funds for the Bureau represent a new entry in this field and that this may lead to unnecessary expenditures. Although the lack of direct funding may have led to oversight of this Bureau's role and participation in R. & D. in meteorological satellites the fact is that our research scientists and technical staffs have been among the foremost

in this field right from the start. The possibility that this may have some bearing on discussion of the readiness of the Bureau to proceed with satellite operations and also on questions of wasteful duplication leads me to review the development briefly.

In no case does the DOC-WB propose to duplicate the sources of booster and vehicle procurement, launching facilities, and R. & D. capabilities that are now available in this field. The proposed plan will make full use of what is already available in NASA and other space equipment producers. The proposal is to enable the Bureau to carry on effectively the new functions and activities that come with operational meteorological satellites. Some agency must have staff and facilities to carry on the new operational program and it is most logical and should be most satisfactory with respect to management and coordination if these new activities are placed in the responsible user agency—the Department of Commerce-Weather Bureau and its National Meteorological Service.

In studying the several possible ways, the very real problems of unforeseeable "overruns" in costs and disproportionate increases in budgets of the Weather Bureau were considered but these problems are not insurmountable and they do not appear to be as serious as loss of the advantages stated in the preceding paragraph. Tiros launchings have been remarkably successful and with advent of the operational phases, reliability and durability of meteorological satellites should increase. Overruns should be infrequent. Booster procurement and launching services would be sought through the same facilities as if funded by another agency, that is, by transfer of funds to or contract with NASA or DOD sources. The Bureau would not duplicate these facilities.

As regards staffs for planning, design, and management there seems to be little advantage in costs either way. In any case new offices would have to be established to take on the additional work and the user agency, the DOC-WB, should be able to do this as economically as any and with closer coordination with its other meteorological functions.

REQUIREMENTS AND BENEFITS

The requirements and benefits were very amply stated by Dr. Reichelderfer and agreed to by the committee in the hearings. It was the consensus of opinion that the estimated dollar value used by Dr. Reichelderfer in his following statement is low:

Your committee has already taken cognizance of the international value of weather satellites. The known uses of weather information in human activities and welfare are legion and the undeveloped and unknown future possibilities are certainly very great. In fact, man's present knowledge of the innumerable ways in which atmospheric conditions affect his welfare directly or indirectly is probably very

elementary. Even the direct influence of weather on man's health, food supply, occupation, and happiness are imperfectly understood at present and the effects of climate on the evolution of living creatures can only be guessed from available fragmentary knowledge. This remark is not intended to imply that knowledge from weather satellites will answer all of the questions implied in these comments but certainly the wealth of information about the atmosphere and its changes that can now be observed or measured by satellites will greatly increase man's understanding of meteorology and the weather. Tiros has demonstrated its facility for early discovery of storms at sea before they become threats to populous coasts. Preliminary studies give some promise of detection of conditions that lead to violent storms like tornadoes. Early location of the places where storms are being generated is a first step to experimentation in the possibilities of man's modification or control of the threat before it attains a force and violence beyond control. The continuous surveillance of the atmosphere everywhere which now for the first time appears within reach is essential to early detection of storms and application of whatever measures of control can be developed. These remarks give only the briefest glimpse of the many benefits from information available through weather satellites. Published technical papers give many more possibilities within practical achievement.

In view of the cost of spacecraft it would be helpful to have some estimate of the benefits for comparison. There are many benefits that cannot be evaluated in terms of cost. Scientific improvements in warnings of hurricanes have reduced the average annual loss of life from these storms in the coastal regions of this country to less than one-fiftieth the losses two decades ago. Property losses have also been greatly reduced by advanced preparations made possible by earlier warnings. In most parts of the world these methods of storm detection and warning are not yet available. In the United States much more will be gained through protection based on further advances in forecasting other weather anomalies and disturbances. Satellite observations will contribute much to advances in weather forecasting techniques. Eventual benefits will also depend in part on the extent to which weather modification may be found possible. Although no sound estimates of cost-benefit ratio can be given now for meteorological satellites, surveys of the many uses of weather reports and forecasts in this country show that reduction in losses from storm and bad weather damage by virtue of preparedness based on forecasts exceeds a billion dollars annually in addition to saving of human life, and it is reported that more definite forecasts longer in advance would yield double the benefits or greater. These figures refer to this country. The total would be many times greater if technical advances were applied to meteorological services all over the world which would gain from satellite observations. It seems that the cost-benefit ratio work would be very high on the benefits side.

The international aspects of meteorological satellites have been stated by President Kennedy and others responsible for international relationships. The significance of these matters with respect to human welfare and national prestige is incalculable but it may be very large. In a word, the international aspects alone may be worth more than the cost of the weather satellite programs.

The requirements for weather observations from satellites are reemphasized when we recall that our jigsaw puzzle is not complete in a picture for one level in the atmosphere. Usually the elements are significantly different at different altitudes and separate pictures are necessary for each level from the ground or sea surface up to 40,000 feet at 1,000-foot intervals. Actually, higher altitudes are now required. Usually separate maps are needed for each level for the various physical characteristics—atmospheric pressure, temperature, humidity, and winds, and sometimes other “elements.” In short, the advanced technology of modern times and the intensification and diversification of human interests have given new significance to practically all of the weather elements everywhere, all of the time. Although the task of observing, reporting, analyzing, and predicting everything in the atmosphere is beyond practical achievement at least for the present, it is necessary to come as close to the ideal as possible. This is approached by pooling the information from all sources channeled through the National Meteorological Center where the large-scale features can be analyzed and their significance in forecasting quickly utilized.

MANAGEMENT AND FUNDING

GENERAL

The lack of a formal agreement between NASA and the Weather Bureau regarding the division of management responsibilities indicates that there are a few areas of indecision or disagreement. This is supported by the testimony, especially in the area of the operation of the data acquisition, tracking, and read-out facilities. It appears the informal agreement furnished by the Weather Bureau subsequent to the hearings could be extended to give detailed coverage for all areas of operation, and formalized. The Weather Bureau seems willing to do this as soon as possible, but NASA is not particularly anxious to follow this course of action until after the \$53 million is made available to the Weather Bureau for the program.

From the testimony furnished during the hearings, it may appear to some people, because NASA controls the R. & D. program and the Weather Bureau will control the operational program, that separate systems or programs are being or should be established to meet R. & D. objectives vis-a-vis operational objectives. Nothing could be further from the truth, especially in the fields of space technology and space exploration. It is a well-known fact that all our space projects today are R. & D. programs, but in many cases these projects are contributing to an operational mission. For example, the Vanguard satellite launched in March 1958 (3¼-pound “grapefruit”)

is providing geodetic information or assistance in more precisely locating many of the islands in the Pacific Ocean. This program, known as Project Betty, is under the Army Map Service. This is an excellent example of an operational program that was a "fallout" of an R. & D. program. To those who insist on classifying programs and projects, as either R. & D. or operational, may be asked when does an R. & D. program become operational? As yet, no one has been able to answer this question in relation to existing or future space activities.

The first management problem is program supervision and appears where two agencies have a vested interest in a space program. A joint management agreement should be worked out whereby the developer and operator agree with the user as to where the administrative and technical interfaces should be established. This would allow each agency through the normal budget process to make the maximum contribution in the most efficient and economical way to accomplish the task at hand. By following this procedure one eliminates the establishment of an unrealistic interface between R. & D. and operations which are difficult to identify.

If the United States is to capitalize on the extensive lead this country now enjoys in the field of meteorological satellites, one point appears to be paramount—NASA must retain management control of the booster and payload development program until the system has been completely tested and a reliability established which will provide a cost-benefit ratio that substantiates the continued expenditure of funds for operational purposes.

It is the consensus of opinion that the Weather Bureau must retain control over the detailed specifications of the components in the payload so that they will be responsive to their ground data reduction and processing system, in addition to the R. & D. for a ground data reduction, processing and dissemination system. Control of the operational system by the Weather Bureau should be exercised through a joint agreement with NASA under which the Weather Bureau would prescribe the program (schedule and coverage and frequency), provide NASA with the detailed specifications for the payload components that would be responsive to the Weather Bureau's designed and operated ground data reduction, processing and dissemination system.

The second major management problem is funding for a program as large as the national meteorological satellite program. There will be, based on past experience, overruns (unforeseen additional costs) of sizable amounts which will require a management agency with a large enough budget to provide flexibility to absorb these overruns. This is only one example where funding difficulties make it mandatory that large programs be managed by agencies with large budgets which provide flexibility without large contingency funds. NASA is one of the few civilian agencies capable of doing this within the next few years. If such a requirement is imposed on an agency with a relatively stable and limited budget such as that of the Weather Bureau, this could completely unbalance their entire program.

Let us consider a hypothetical example in which the Weather Bureau would provide funding for three boosters to place one payload into orbit. Due to unfortunate circumstances, all the shots are failures. This is not unusual in today's space programs. The Weather Bureau is now faced with the dilemma of having to provide additional funds, not provided for in their normal budget. The magnitude of this

problem is not apparent until we examine the figures involved. The cost of three boosters launched is about \$12 million (Thor-Agena B). Equating this to the Weather Bureau's budget of \$123 million, this is equal to 10 percent of their budget. To provide this amount of additional money would require a trip back to Congress for additional funds. This is not unique with the Weather Bureau, but any Government agency would be faced with the same dilemma if involved in a space program. Conversely, if NASA is required to be responsive to the Weather Bureau's space requirements, including funds, the required flexibility to absorb funding overruns would be a minor problem. A typical example of flexibility is exemplified by two identical, three booster, programs in which the first experiences three failures and the second achieves success on the first shot. From the second program the two backup boosters could be shifted to the first program within the scope of the overall manager's authority and responsibility without requiring additional funds from the user agency. Another consideration from a management funding standpoint: Any agency with a budget of \$1,784,300,000 would be in a better position to absorb an overrun of \$12 million (or less than 1 percent) by a reprogramming action. In the case of the Weather Bureau with a budget of \$123 million, a \$12 million overrun would represent a 10-percent deficit in their budget which would impose serious complications if they were required to absorb an overrun of this magnitude.

The third important management problem is related to program review and analysis in order to take maximum advantage of all scientific "breakthroughs" which in this age of rapid advancement in scientific knowledge, management must know when to make changes in the R. & D. program or operational program to obtain maximum results in the best time frame. Example: Tiros II will carry a magnetic coil to partially control where its cameras look. This magnetic coil was included on the basis of experience with Tiros I. The spin axis of Tiros I was observed to move in a manner other than had been expected (and, fortunately, remained more favorable for observations). It was determined that these motions were due to the interaction of an induced magnetic field in the satellite and the magnetic field of the Earth. The new coil being placed in Tiros II takes advantage of this observation from Tiros I and allows some control of how the satellite is oriented and where its cameras point.

The fourth or future management problem will develop when large boosters are available and many different payloads from numerous agencies with different missions will be consolidated into one vehicle. The economy of effort in manpower and dollars is sufficient justification for one management agency to be responsible, not only through the R. & D. phase, but also for the operation phase.

WEATHER BUREAU'S POSITION

The only dichotomy in policy between the committee and the administration appears to be in the method of funding the operational programs. Dr. Reichelderfer's testimony presents the administration's concept of single user agency funding:

During the past 2 or 3 years the DOC-WB has studied various "packaging" combinations that might be workable

for the national operational meteorological satellite program. While any plan that would provide adequate funds for this program could be made to work through continued whole-hearted cooperation and good understanding among the interested agencies, there are advantages in the old principle that the user should have the funds to procure what is essential to his function. This would make the DOC-WB responsible for funding for the common system of operational meteorological satellites. It is the plan contemplated in the President's request in May, this year, for \$53 million for the Weather Bureau for operational satellites. It is also the plan proposed in the POMS report.

Among the advantages of this plan are that it would facilitate accounting and costing, and would fix the authority and responsibility for decisions in planning, management and operations in the user agency. It is believed to be the most direct way to fund for the program.

The Weather Bureau should certainly not get into the booster business; if funds are given to the Bureau, they should be transferred to the agency that has the booster-operating capability.

It can be foreseen that future developments in communications satellites in which meteorology is vitally interested, and multiple-purpose spacecraft in one launching may call for review of funding and management practices. Spacecraft will be in a state of rapid evolution for some time and reasonable flexibility and responsiveness to change are desirable. But for the present and the next few years the simplest and most direct provisions for funding and management of operational meteorological satellites appear to be to place these in the user agency—the DOC-WB with arrangements for review as circumstances change.

DOD'S POSITION

The administration's position is supported by Mr. Rubel's testimony:

I am not an expert on the subject of what changes, if any, would be required in the statutes in order to permit the Weather Bureau to fund, to be funded and fund, that is, to receive the appropriation and then fund for the accomplishment of the operational meteorological satellite program.

My feeling, as I have expressed it before, is that if an agency has responsibility for a program, that responsibility can best be discharged if they in general have the control of the funds for the program.

As I have also indicated, I believe that it would not be good, it would not be efficient; I believe it probably would be inconsistent with the intent that we have all had in the context of the existing statutes for the Weather Bureau to attempt to establish an independent procurement and launching and operational function with respect to the launch vehicle part of the space operation associated with the operational meteorological satellite.

But on the other hand it would be consistent with good project management, with good administration, and with fortifying the ability of the Weather Bureau to do the job which by statute they are given of furnishing weather services to the Government and to the public, to give them responsibility for the operational program which no other agency can have by statute, and give them the funds that go along with that responsibility, then permitting them to procure the vehicles and their launching, in other words, the space transportation part of the job from NASA or from the Department of Defense, whichever agency appears to be the most appropriate.

It is noted that in both Dr. Reichelderfer's and Mr. Rubel's testimony they indicate that the Weather Bureau "may" utilize an agency other than NASA for booster vehicle procurement and launch activities.

NASA'S POSITION

Dr. Seamans' testimony also supports the administration's position of single agency funding for the operational meteorological satellite program. But, Dr. Seamans makes NASA's position crystal clear regarding the responsibility for furnishing the satellites, the launch vehicles, and the launch operations. NASA is responsible for and will provide the hardware and perform the launching services to any and all civilian Government agencies for all operational satellite systems and programs. Even though some of the launch facilities are owned by DOD and some of the vehicles to be used were developed by DOD, they would be operated or procured under the management and control of NASA and not DOD.

DR. SEAMANS. It has been agreed with the U.S. Weather Bureau of the Department of Commerce, that the Weather Bureau will have the responsibility for the overall management of our national meteorological satellite system when it becomes operational. The Department of Commerce will contract with the NASA for the spacecraft, including the instrumentation payload, for the launch vehicles, for the ground support equipment, and for launch operations.

Further, the NASA will participate in such postlaunch activities as command and data acquisition as required by the interrelationship of ground equipment and spacecraft.

The basis for the agreement is the plan for a national operational meteorological satellite system dated April 1961. According to the plan, the operational system will be implemented in three phases:

Phase I is a transition period between research and development and operations. The full operational system will be implemented during phases II and III.

The functional responsibilities during phase I will be the same as during the present research and development phase and are as follows:

The U.S. Weather Bureau is responsible for the determination of the overall meteorological requirements;

Specification of quantities to be measured by the satellite meteorological instruments;

Meteorological processing at command and data acquisition stations;

Data processing at National Meteorological Center;

Integration of data into weather analyses;

Use of data and analyses for forecasts;

Dissemination of data, analyses, and forecasts;

Archives (processing, storage, retrieval);

Research and climatological use of data.

The responsibility of the National Aeronautics and Space Administration is as follows:

Design, fabrication, and test of the spacecraft;

Procurement of the launch vehicle;

Maintenance of launch sites;

Construction of command and data acquisition stations;

Prelaunch preparation of spacecraft and vehicle;

Launch operations, including scheduling;

Tracking and orbit determination;

Programming and command to satellite;

Data recovery at command and data acquisition stations;

Communication of data to National Meteorological Center.

The maintenance of launch sites and the launch operations will be conducted by NASA with the support of the Department of Defense in the same manner as all launches that utilize the national ranges.

In conclusion, weather exerts a tremendous influence on all mankind. From its careful observation and study can come untold benefits, including improved weather analyses and forecasts over the entire earth. The potential savings in life, property, produce, natural resources, and even in personal convenience are difficult to assess. That a meteorological satellite system can make a major contribution is beyond doubt.

It is both possible and clearly in the national interest to satisfy the requirements of all the U.S. weather services for meteorological satellite observations with a single, national system.

As I have already stated, this is the responsibility of the U.S. Weather Bureau, Department of Commerce.

The CHAIRMAN. You say that is the responsibility. You mean it is the responsibility of both; don't you? You refer partially to the responsibility of NASA—

Dr. SEAMANS. The overall responsibility for the operational meteorological system is the responsibility of the Weather Bureau.

The CHAIRMAN. When does the system become operational?

Dr. SEAMANS. Well, I indicated in this plan, which I believe has been made available to your committee, that there are three phases.

The first phase is this transition between research and development, on the one hand, and the final operational on the other, and the projected dates for this are from mid-1962

through 1963. But as time goes on it may take slightly longer than this to get through this transition period.

The CHAIRMAN. Through the transition period NASA will have control over the operation?

Dr. SEAMANS. Yes; just the same as we have during the research and development.

The CHAIRMAN. After that, what happens?

Dr. SEAMANS. At the termination of the transition period, the Weather Bureau will have the overall responsibility and may at that time take on certain responsibilities which we are now exercising, as, for example, the operation of the data acquisition stations.

The CHAIRMAN. You construct the stations, though?

Dr. SEAMANS. Yes.

The CHAIRMAN. You construct the satellites; you launch the satellites; is that correct?

Dr. SEAMANS. That is correct, Mr. Chairman.

The CHAIRMAN. You put them through a trial period, and then you think at the end of 1963 you will be through, and you turn them over then to the Weather Bureau; is that correct?

Dr. SEAMANS. That is essentially correct.

The CHAIRMAN. Following that, in case there are problems with the satellite, who handles those problems?

Dr. SEAMANS. Even when we get into the operational phases, if there are problems with the satellites, that will be the responsibility of the NASA to make whatever redesigns are necessary.

The CHAIRMAN. No one has the impression that NASA does not have operational authority; do they?

Dr. SEAMANS. The operational responsibility of the satellites definitely belongs to the NASA.

The CHAIRMAN. No agency has the idea that NASA does not have operational responsibility and authority; do they?

Dr. SEAMANS. NASA has the responsibility for the satellites, the launch vehicles, the launch operations.

However, the overall responsibility for weather forecasting is obviously the responsibility of the Weather Bureau.

The CHAIRMAN. I am talking about the authority to operate a system of satellites in space. No one questions the authority of NASA; do they?

Dr. SEAMANS. I have heard nobody question that.

The CHAIRMAN. Do you have a formal agreement with the Weather Bureau?

Dr. SEAMANS. We have this plan for a national operational meteorological satellite system—

The CHAIRMAN. I think we have seen that.

You don't have a signed agreement or formal agreement.

Dr. SEAMANS. We have a letter from the Department of Commerce, asking us if we agree with the contents of this plan. This letter was signed by Mr. Gudeman. There is also a letter from Mr. Webb to Mr. Gudeman, stating that NASA endorses in principle a program leading to the establishment of a national operational meteorological satellite

system; that NASA accepts the plan as outlined in this report, as providing a basis for proceeding with such a program.

The CHAIRMAN. Following 1963, the transitional period, what portion, if any, of that program will NASA budget for?

Dr. SEAMANS. We would not budget for any of the operational program. The Department of Commerce would budget for the full amount. We would, of course, budget for whatever research and development is required, which includes follow-on Nimbus work as well as the Aeros program.

The CHAIRMAN. In a multiple-purpose booster or satellite, how would you work that program out?

Dr. SEAMANS. Is the question that there might be a multiple-purpose launch vehicle that would have both an operational spacecraft as well as an R. & D. spacecraft?

The CHAIRMAN. You might do it or have two operational purposes or two R. & D. purposes.

Dr. SEAMANS. If the purposes were operational, and both for weather forecasting, this would clearly be the responsibility of the Weather Bureau. If it is a mixture between two operational systems, then it would have to involve the two agencies responsible.

I would doubt that a mixture of R. & D. and operational spacecraft would happen very often, because in an operational system the emphasis is on a single design to be used on a continuing basis, whereas the R. & D. vehicles have to be more flexible and be adaptable to design changes almost up to the time of firing.

The CHAIRMAN. You would have to have an ad hoc committee on that?

Dr. SEAMANS. I would very much doubt this would happen. However, if it did, we would have in NASA the responsibility for firing both the operational and the research and development spacecraft, so that we would be the ones to run the program. The only concern then would be the funding, as to how the funding would be shared.

The CHAIRMAN. One more question.

As I understand it, after the first year when the Weather Bureau budget is \$53 million, the NASA budget will then be around \$60 million. Any construction or repair, or anything of that sort to be done for launching, under an R. & D. or operational program, will be done by NASA. Is that right?

Dr. SEAMANS. We would have the responsibility for implementing whatever space effort has to be done. However, the Department of Commerce will fund the program.

The CHAIRMAN. And that is from now on? That does not cease in 1963?

Dr. SEAMANS. That does not cease in 1963.

The CHAIRMAN. Dr. Reichelderfer yesterday, or who was it, the Secretary yesterday felt that the operation itself would be handled by the Weather Bureau.

That is not correct, as I understand it from you?

Dr. SEAMANS. The actual operation, the control of the satellite, we feel is the responsibility of the NASA, and I believe that is understood by the Weather Bureau.

The CHAIRMAN. I think that is very important because that is one of the points that I really seriously disagreed with.

Mr. FULTON. One other question. On this matter of procurement of the satellite boosters and equipment, under your contract there is no particular provision that requires the Weather Bureau to procure from the National Aeronautics and Space Administration, so we just take this case:

The Department of Defense has some boosters. They have been lying around and they want to get rid of them. You have some boosters, and with a little bit of advance we find that Luxembourg has some extra boosters. And the Weather Bureau says: "We would rather have these from Luxembourg or the Air Force, and we are not going to take NASA boosters."

Dr. SEAMANS. I think that would be a mistake, and I think it is inconsistent with our agreement.

Mr. FULTON. Who makes the decision? You have the right under your agreement to be for the U.S. Government for peacetime purposes—I am speaking of the NASA agency—the procuring agency, the research and development agency, test, engineering, launch, right straight through, don't you?

Dr. SEAMANS. That is correct.

Mr. FULTON. It is your sole jurisdiction, isn't it?

Dr. SEAMANS. That is my understanding.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. Bell.

Mr. BELL. Dr. Seamans, it was my understanding a few minutes ago, and I just want to get this straightened out for the record, you said after 1963 NASA will have none of the operational program but that the Weather Bureau will, and that NASA will only be concerned with R. & D. Is that correct, or did I hear wrong?

Dr. SEAMANS. Mr. Bell, the funds appropriated directly to the NASA will be for research and development. But the funds for the operational system will be appropriated for the Weather Bureau, who will transfer portions of that funding to the NASA for the items that I have just mentioned, namely, the spacecraft, the launch vehicle, the launch operation, the data acquisition stations and the control of the vehicle in space.

COMMITTEE'S POSITION

The committee's position vis-a-vis that of the administration's position is in support of a dual funding responsibility whereby two agencies each fund in accordance with their responsibilities or vested interests, i.e., NASA for the spacecraft, the launch vehicle, the launch and control operations; the Weather Bureau for the ground data reduction, processing, and dissemination requirements. The committee's position in support of a dual funding policy as stated by the chairman is summarized in the following statement by Mr. Fulton:

The question comes whether our space policy recommended by the National Space Council to the President

indicates that NASA shall have the general jurisdiction of space. I realize that when you have a railroad, maybe you would have a service that is operating on the railroad, the railroad isn't going to be interested in how the railway mail service, for example, handles its mail. But the railroad nevertheless runs the railroad, the tracks and cars, and has overall supervision.

That brings up the question when you have said that it will be the responsibility of NASA to provide the boosters, the pads, the launch sites, the personnel, the relay communication stations, whether on ground or in space, and the many services that would go with a satellite system, be it weather or communications, that whether you by not having the control of the money on handling the overall system—because in NASA you will be handling this probably, and many other systems, that all are intercorrelated—whether you have the power to do the things you say, when you don't have the money.

I can see on the specific payload when the Weather Bureau wants to send it out for storms and other systems, you are not interested in running the messages.

I would certainly doubt whether it would be advisable to set up in the Weather Bureau a separate institution for research and development, other than the one they now have that NASA supplies, meteorological satellite laboratory for weather, and which you fund.

If we do this in one department, then there is the old Socrates question: Is it good for everybody, if it is good for one?

I could see then you would get R. & D. facilities in the Department of Commerce and the Weather Bureau, the Department of Commerce under the revision having to do with FCC.

The other side of the coin is, are the statutes that now set up NASA, giving NASA wide policy direction and control on space activities, wise, or shall we change them.

I brought that up to Mr. Webb. On page 8 of the statement of Mr. F. W. Reichelderfer, Chief of the U.S. Weather Bureau, on July 25, 1961, before this committee, he said this:

"While any plan that would provide adequate funds for this program" and he was referring basically to the national operational meteorological satellite program "could be made to work through continued wholehearted cooperation and good understanding among the interested agencies, there are advantages in the old principle that the user should have the funds to procure what is essential to his function."

That seems to say to me that with proper cooperation, wholehearted and good understanding under the interested agencies as you have now, it could work out very well.

"This would make the Department of Commerce, Weather Bureau, responsible for funding for the common system of operational meteorological satellites. It is the plan contemplated in the President's request in May, this year, for \$53 million for the Weather Bureau for operational satellites. It is also the plan proposed in the POMS report."

That says to me that the funding, the authorization, and the appropriation have all moved out to compartments in the various departmental budgets and agency budgets, and become a minor part of an overall budget.

So that it is very difficult to get a policy direction in space when the budget of the whole agency is in question, and this is just one part of it, for example, with the Weather Bureau. They spend around \$50 million now, and this would add more on to the budget.

What is your position in NASA? How do we approach that policy? Was Congress wrong in 1958 when we on the select committee, Mr. Brooks was on it, I was on it, recommended to the country and the Congress that the NASA Act be set up for a national space agency?

Is that wrong, and should we now change, and go in the direction which I believe the Chief of the Weather Bureau is pointing out to us, and that is have the user determine, have the user fund, have the user justify to Congress and to the Budget Bureau, and use you just as a procurement agency, when they need you?

And originally when he spoke here first, Mr. Chairman, the Chief of the Weather Bureau was going to even do the boosters and do the payload. But he had originally granted that you should have the ground stations and originally the communication of relay satellites.

That poses a real problem. It is a problem that I think NASA must face.

I would like to hear your comments shortly if I haven't overdone the lily.

Dr. SEAMANS. Mr. Fulton, as Mr. Webb indicated, we feel that those who planned the NASA, of which you are one, planned very wisely. We think it does make sense for the total civilian space program to be managed by a single agency.

This is the intent of this agreement that we have reached with the Weather Bureau, that we would have the full responsibility for all phases of the satellite design, procurement, testing, launching, and operation in space.

The committee's position is further supported by the following letter from Lt. Gen. Donald N. Yates, USAF (retired).

LUSBY, MD., August 4, 1961.

HON. OVERTON BROOKS,
*Chairman, Committee on Science and Astronautics,
House of Representatives, Washington, D.C.*

DEAR MR. CHAIRMAN: Thank you for your kind invitation to comment on the management organization and funding procedures for the national meteorological satellite program. I personally feel that this program is one of, if not the most important space program presently planned by the United States. Its potential value to the welfare of the peoples of the entire world is tremendous. It should form the basis for extensive international cooperation in the peaceful exploitation of our newly gained space capabilities in a field of science which vitally effects the daily lives of every individual on earth.

The U.S. Weather Bureau has for years worked closely with the other nations of the world in advancing the science and technology of weather. Through the Joint Meteorological Board of the Joint Chiefs of Staff, it is kept currently aware of our military meteorological needs. It is logical to assume continuation of this agency's responsibilities in all aspects of the meteorological program including the planned acquisition of meteorological observations from space. To insure that the most effective use be made of this new tool, I would urge that management and control of the operational meteorological satellite program be placed firmly with the U.S. Weather Bureau. By this, I do not mean to infer that the capabilities and the responsibilities of the National Aeronautics and Space Administration should be in the least neglected, compromised, or duplicated. On the contrary, a management agreement could well be attained between the Bureau and NASA whereby the capabilities and facilities of NASA would be fully utilized in a manner responsive to the needs established by the Weather Bureau and under the latter's technical control as regards the meteorological aspects of the program.

To insure adequate control one might logically assign to the Weather Bureau the responsibility for funding the total program. This would include not only the operating satellite and its associated ground control, data collection, and processing equipment but also the booster vehicles, ground-supporting equipment, launch-support cost, and range-operating costs. It might even extend to include NASA or Department of Defense tracking costs if common tracking is used. Without question the Weather Bureau must fund for the payload development and procurement, the development and procurement of unique control and readout equipment as well as its ground communications and data-processing equipment. This I consider to be the meteorological segment of the program.

Since the Weather Bureau's primary interest is to have its payloads placed in orbit when needed and that they perform as required, NASA might well find economy in utilizing boosters capable of handling multiple payloads, thus providing a "free ride" for someone's experiment. Flexibility in use of boosters as the state of the art progresses will certainly be an asset. Ground-support equipment is not unique to the meteorological satellite system. It will continue to support multiple programs as will the national ranges which presently provide service without reimbursement to all Government agencies. In my judgment the most practical solution would then be to assign total funding responsibility for the meteorological system segment of the program as indicated above, to the Weather Bureau and to require NASA to fund for the booster development and procurement, the launch operation and range and ground support as required to meet the needs established by the Weather Bureau in the ultimate operational system. The possibility of utilizing surplus Department of Defense boosters later should not be overlooked.

I would suggest that the Weather Bureau utilize the capabilities of NASA to develop and procure its payload and its ground control and readout equipment. This could be accomplished by transfer of funds along with technical requirements and specifications. The Weather Bureau should contract directly for its data processing and reduction system. To the extent that the equipment in the system is unique to the meteorological program its operation should be by the Weather

Bureau funds and/or personnel. Where common NASA or the Department of Defense-owned equipment is utilized, this service should be provided by the operating agency on a nonreimbursible basis.

The above comments reflect my personal judgment in response to your inquiry and do not necessarily reflect the Department of Defense or Air Force view. I have been out of contact with this business since my retirement 4 months ago but trust this will be of some assistance to you in your consideration of this very urgent problem. I have no objection to your publication of these remarks as part of your printed hearings. Kindest personal regards.

Sincerely,

DONALD N. YATES.

CONCLUSIONS

1. The Space Act of 1958 charges NASA with operational responsibility, as well as research and development responsibility for space activities. This responsibility not only encompasses the operational meteorological satellite system, but all nonmilitary satellite programs.

2. The U.S.S.R. charge, that the Tiros III meteorological satellite is a "spy in the sky," is unfounded and without proof. It appears the Soviets' greatest concern is not with Tiros III as a "spy in the sky" but as a peaceful producer of weather information which is beyond their control. Therefore, it appears the U.S.S.R. is trying to discredit the U.S. meteorological satellite program by giving it the undesirable "tag" as a "spy in the sky."

This action by the Soviets should not inhibit the United States from moving forward with utmost speed in the fields of space exploration and utilization especially in areas where the United States is definitely ahead of the Soviets such as meteorology and communications. If successful systems are developed and placed into operation before the U.S.S.R., the United States would reinforce its image of being a world leader in the fields of science and technology.

One of the U.S. national objectives should be to achieve and maintain world leadership in the peaceful exploration of space and astronomical sciences but insure that the military applications are available and ready for use in the interest of national security.

3. No formal agreement exists between NASA and the Weather Bureau delineating the division of responsibilities for the national meteorological satellite program. There are a number of informal understandings which could be used as a basis for a formal agreement. To accomplish the stated national goal for the meteorological satellite program, a formal agreement between NASA and the Weather Bureau should be consummated as soon as possible.

4. Requirements of all interested Government agencies have been incorporated in the Panel on Operational Meteorological Satellites report. This unified plan for a national meteorological satellite system is a highly objective plan which should be implemented without delay.

5. There appears to be no undesirable duplication of effort in the present research and development meteorological satellite program. If present plans materialize without change, no undesirable duplication of effort or facilities should develop in the operational program except in the field of management and funding.

6. Management and funding—In the case of a single user agency, the funding policy as proposed by the administration whereby the Weather Bureau and other user agencies would fund for all aspects of the operational satellite system, but procure vehicle booster hardware and launching services from NASA on a pay-as-you-go basis, large contingency funds would be established in each user agency's budget to cover possible launch failures. Initially, this is not significant when one considers only the meteorological satellite system, but when a large number of user agencies enter the operational satellite field, each with their own funding requirement, and when multipurpose boosters are developed that carry a number of payloads as did the Navy's recent Transit IV-A satellite, this policy of single user agency funding will create a number of management problems and an unnecessary increased burden on the American taxpayer. By initiating a dual agency funding policy whereby the user agencies fund for those responsibilities which they perform (Weather Bureau would fund for the development, procurement, and operation of the payload components which must be responsive to the ground data reduction system, in addition to funding for the ground data read-out, processing, reduction, and dissemination system and NASA would fund for the vehicle procurement, launching, and tracking operation), would eliminate the necessity of the Weather Bureau and other user agencies from establishing large contingency funds to cover launch failures. Instead, NASA would provide one contingency fund to cover booster vehicle requirements for all user agencies. In addition, when multipurpose booster vehicles are used for operational satellite systems, NASA would fund for these boosters, and thereby eliminate the management problem of determining equitable charges to each of the using agencies. It is agreed, as a short-term solution, single agency funding for one or two operational programs would present no major problems, but as a long-term solution this policy would not be in the best interests of the American taxpayer.

An alternate interim solution for one or two operational satellite programs may be to follow a policy whereby each user agency would provide, in a separate budget, all funding covering their space program, similar to the "oceanography" budget. This would identify space activities within each agency to make sure there is close coordination between all interested parties. By this course of action, one could insure that the interests of the American taxpayer would be protected and still follow the single agency funding concept.

RECOMMENDATIONS

The Committee recommends that—

NASA and the Weather Bureau sign a formal agreement delineating the responsibilities of each agency for the national meteorological satellite program, keeping in mind that this agreement may be used as the pattern for all future agreements covering civilian operational satellite programs. The agreement should include but not be limited to—

(a) the Weather Bureau fund for the development, procurement, and operation of the meteorological satellite payload, ground command control, and data readout facilities unique to the meteorological satellite program on data re-

duction, processing equipment, facilities, and for necessary ground communications links.

(b) NASA fund for and provide as required, launch vehicles, launch and recovery services to the extent its common type facilities are available and required.

(c) the Weather Bureau, by transfer of funds, utilize the capabilities of NASA for the development of payload and unique ground command, control and readout equipment. Such work by NASA would be in accordance with Weather Bureau detailed specifications and requirements. The development and procurement of ground data processing and reduction system, along with its associated communications, should be accomplished by direct Weather Bureau contracts.

APPENDIX I

Following is some of the most recent weather information received from the Tiros III meteorological satellite system.

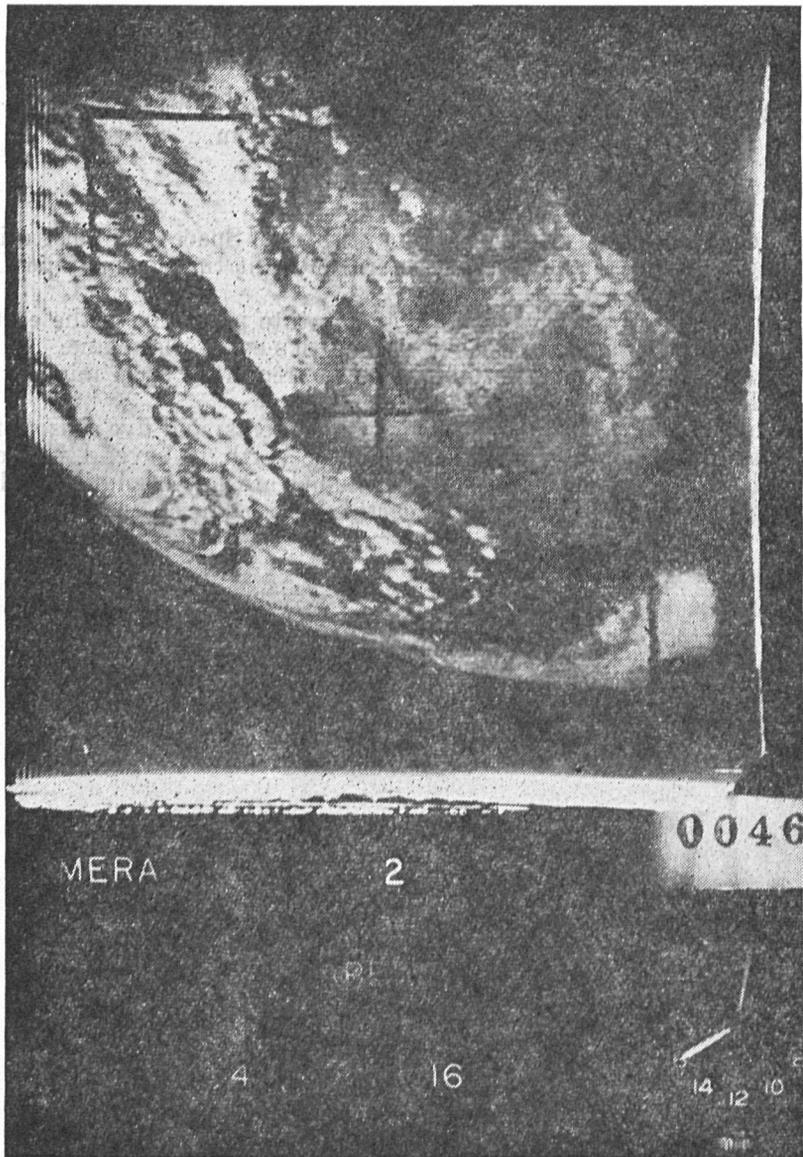
TIROS III

Launched by the National Aeronautics and Space Administration July 12, 1961, at 0625 a.m. eastern daylight time from Cape Canaveral, Fla.

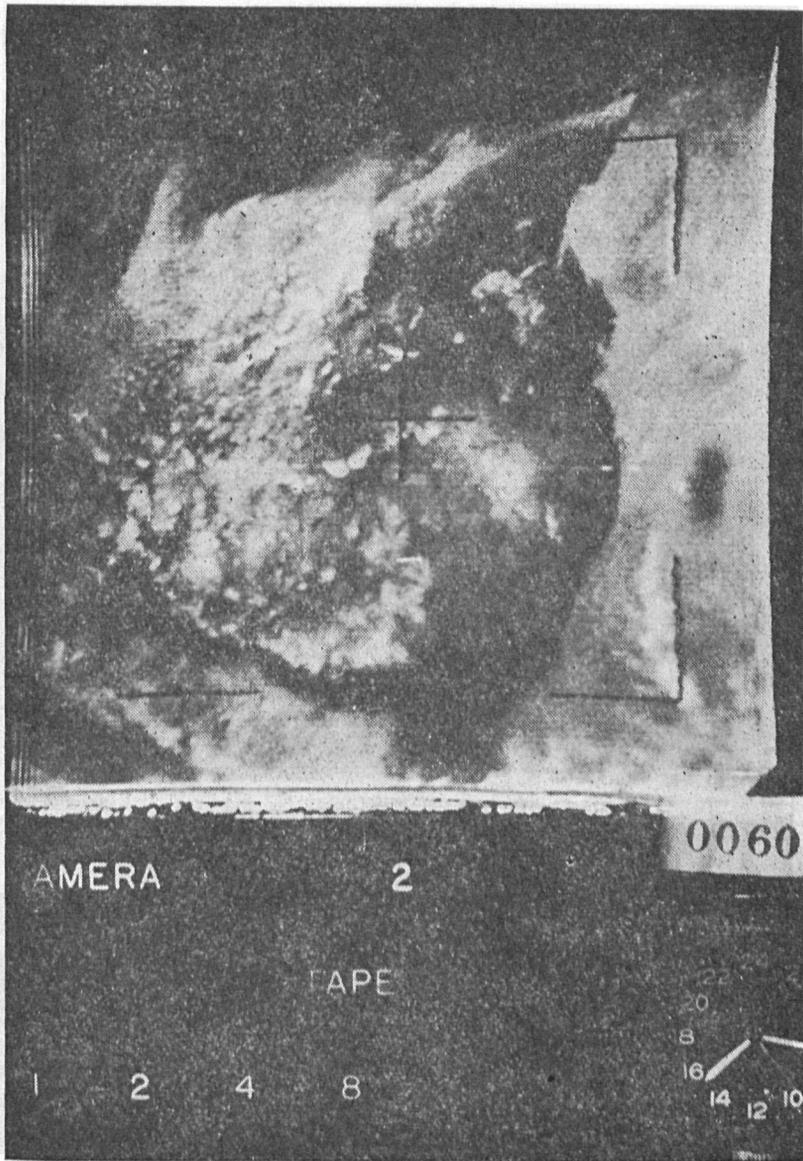
Orbit: Nearly circular, averaging 483 statute miles above the earth, inclined at an angle of 47.9° to the earth's equatorial plane.

Velocity: Averages 16,695 miles per hour, requiring 100.4 minutes to make a complete pass around the earth.

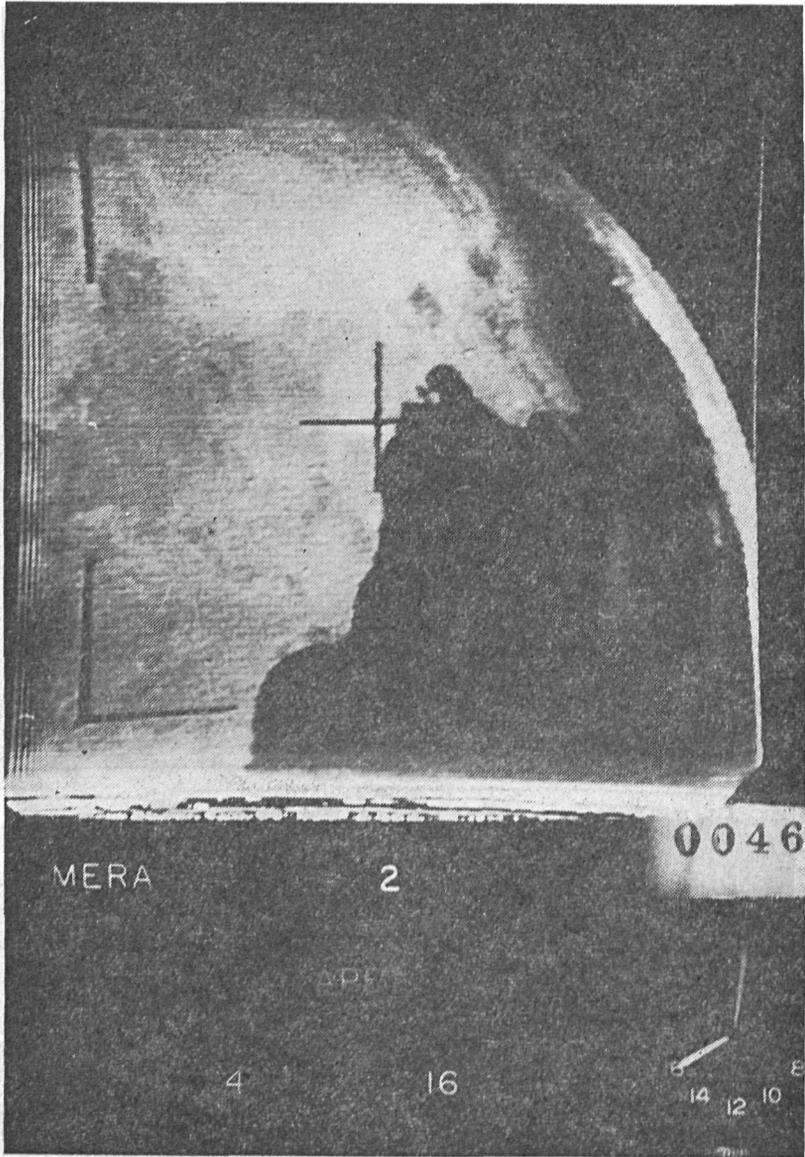
Instruments: Two wide-angle television cameras, and five sensors for measuring outgoing radiation from the earth in several infrared and visible wavelengths. Also included are low-resolution radiation sensors for measuring the earth's heat balance.



Spain and the Straits of Gibraltar. The circular cloud pattern of a cyclonic storm shows prominently in the North Atlantic to the northwest. July 15, 1961.



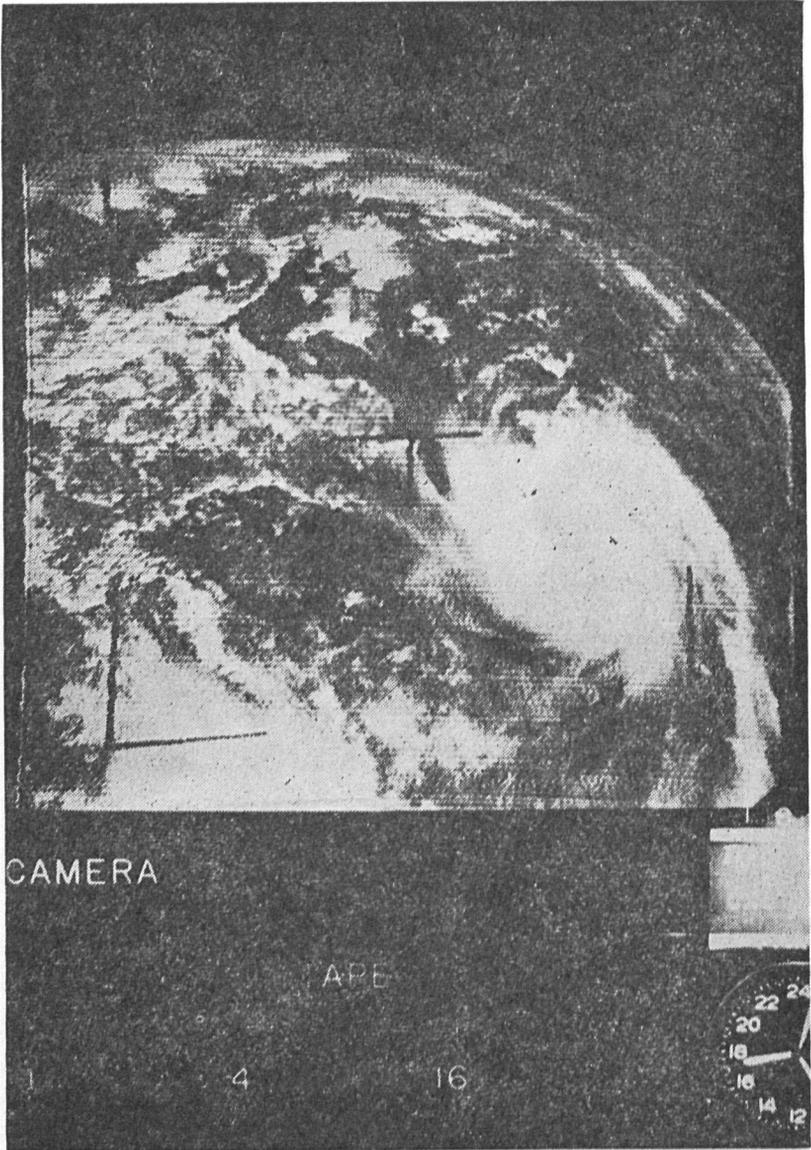
West African coastline from Cape Blanc at the north to Dakar at the south, with a cellular cloud formation lying to the west. July 16, 1961.



Mediterranean coastline of Tunisia and Libya, with Sicily and Italy at the upper right. July 15, 1961.



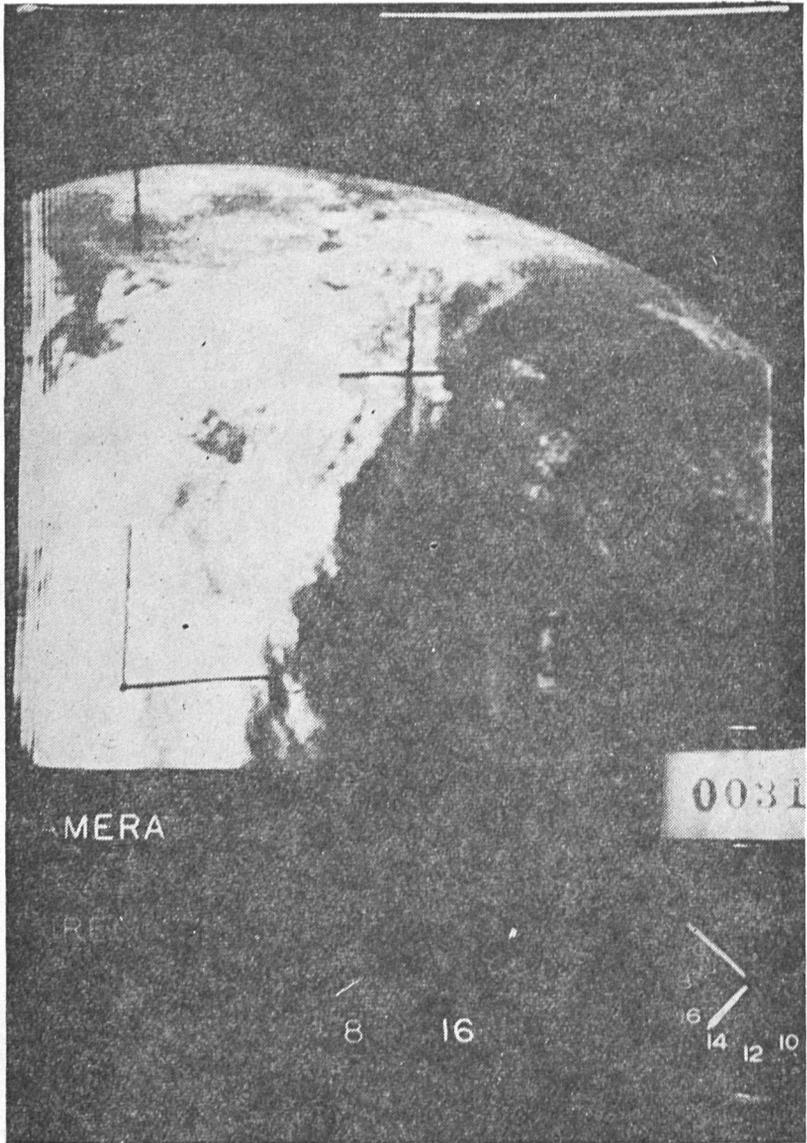
Mediterranean coastline of Libya, north Africa. The dark area at lower right is a mountainous rocky outcropping in the desert, of special significance to geologists. July 15, 1961.



Hurricane Anna located about 125 miles off the Colombian coast, at 14° N. 72° W.
 July 21, 1961.



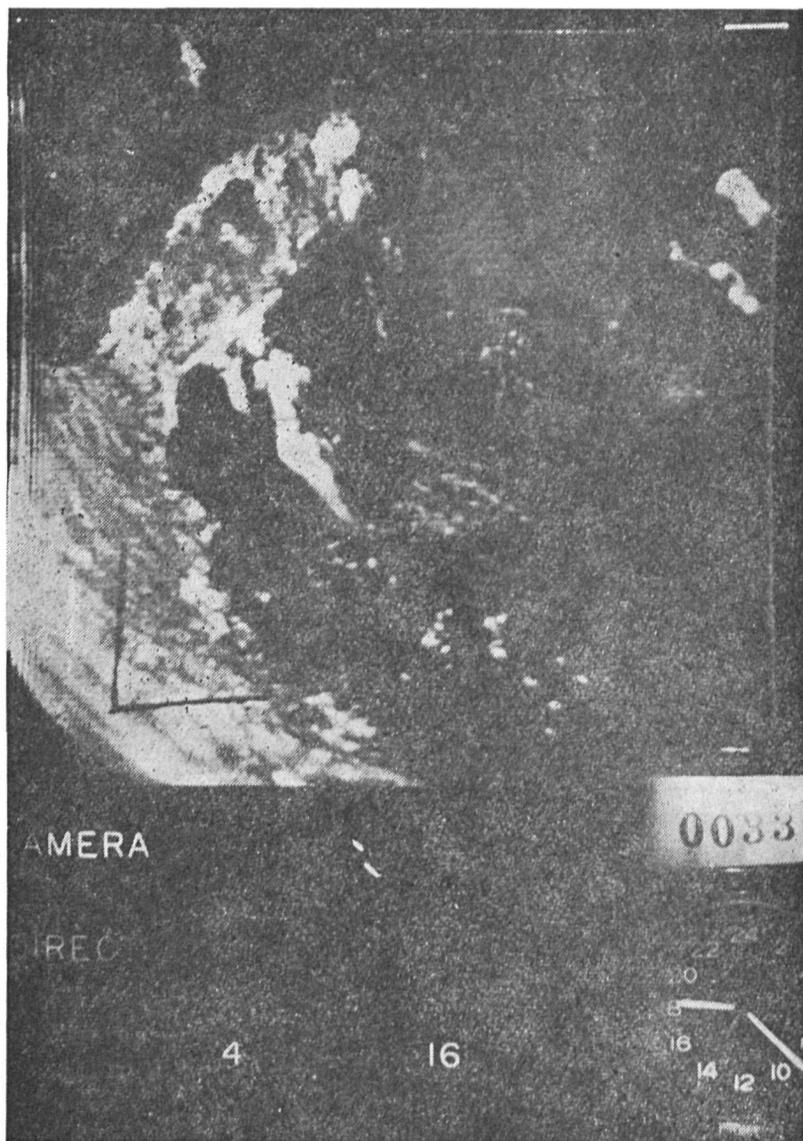
Tropical storm Liza in an area of no weather reports west of Baja California. Its position could only be estimated until these Tiros pictures located its center at 25° N. 123° W. July 19, 1961.



Wide band of dense clouds extends across New England and into the Atlantic Ocean. The Gulf of St. Lawrence, Nova Scotia, and the Bay of Fundy show prominently. July 14, 1961.



Cloud pattern over northeastern United States. July 15, 1961.



Gulf of Mexico, Florida, and a portion of the Bahamas, with well-developed convective cumulus clouds over the land areas. July 14, 1961.

U.S. Weather Bureau
Washington, D.C. 20540
July 14, 1961

APPENDIX II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
OFFICE OF THE ADMINISTRATOR,
Washington, D.C., August 31, 1961.

HON. OVERTON BROOKS,
*Chairman, Committee on Science and Astronautics,
House of Representatives, Washington, D.C.*

DEAR MR. CHAIRMAN: This responds to Colonel Peacock's letter of August 2, 1961, requesting, for the record, comments of Dr. Morris Tepper on the Russian charges that Tiros III is a "spy in the sky."

A paper prepared by Dr. Tepper is enclosed. If we can be of further assistance to you please let us know.

Sincerely yours,

PAUL G. DEMBLING,
*Acting Assistant Administrator
for Congressional Relations.*

COMMENTS BY DR. MORRIS TEPPER ON RUSSIAN CHARGE THAT TIROS III IS A "SPY IN THE SKY"

The report referred to was published in the July 24, 1961, issue of the New York Times under a Moscow dateline of July 23 and was written by Seymour Topping. The newspaper stated that "an article in *Krasnaya Zvezda*, newspaper of the Soviet Armed Forces asserted that the launchings of the Midas and Tiros satellites for reconnaissance of Soviet rocket bases and other objects and reporting of weather conditions over Soviet territory shows that the Pentagon has not given up the plan for spying on the Socialist camp."

It was coincidental that the successful launches of Midas III and Tiros III took place on the very same day. Probably, in order to heighten reader interest, this joint event was reported in our own newspapers as the launch of two spy satellites—one for reconnaissance on human activity and the other on nature's. Apparently the Soviets chose to follow up this idea by condemning both satellites as reconnaissance efforts being perpetrated by "the Pentagon."

The following observations may be made:

1. The Tiros satellites, and the meteorological satellite program as a whole, are part of the U.S. civilian space program being conducted by the National Aeronautics and Space Administration. It is not a "Pentagon" program.

2. The Tiros satellites are purely meteorological in character. They observe natural phenomena—clouds, reflected and emitted radiation. In no sense have they been designed nor have they a capability for reconnaissance on human activities.

3. Since the launch of Tiros I on April 1, 1960, the United States has kept the meteorological community completely informed on the

satellite operation and performance. The entire Tiros data output is available to all, including the Soviets, through the World Data Center in Ashville, N.C.

4. Until July 23, 1961—more than 1 year after the launch of Tiros I—there was no objection on the part of the Soviet to the Tiros program.

5. There have been several articles written by Russians supporting the concept of meteorological satellites. These have included:

(a) "Sputniki i Pogoda" (Sputniks and Weather) by Col. N. Varvarov published in *Sovetskaya Aviatsiya* (Soviet Aviation) February 9, 1960.

After discussing the limitations of existing meteorological observational systems the Soviet article states:

"METEOROLOGICAL STATION IN OUTER SPACE

"Earth's heavy sputniks open great prospects for the solution of long-range weather forecasting problems. From aboard these sputniks, it will be possible to observe the state and the development of meteorological processes taking place on a planetwide scale, at any altitude and for a lengthy period of time in the same way as the automatic meteorological stations set up in arctic, desert, and mountainous regions, and accessible only with the greatest difficulty, observe various meteorological phenomena and transmit the information via radio.

"With the help of television instruments aboard the sputniks it is possible to get a picture of cloud systems location and their movement over the entire globe. There will be seemingly no difficulty, as far as theory is concerned, to obtain parameters determining the air masses' location and the boundaries between them. A system of three or four sputniks will permit to observe earth's atmosphere from above, with practically any [re]solution in space and time—it is thus that Ye. Federov, corresponding member of the Academy of Sciences U.S.S.R. characterized sputniks' significance in weather forecasts.

"Imagine to yourself sputniks, equipped with instruments for observation of processes which take place within our planet's atmosphere, revolving at a certain altitude around the earth. Completing a full revolution in 1½ or 2 hours, the sputniks will record the state of meteorological processes over a large territory.

"Since earth rotates on its axis it will be possible to observe during each successive orbiting of each sputnik a similar picture in new areas. As the new strip under observation borders with one of its edges on the strip already observed, it will be possible to ascertain, for instance, where and with what speed a storm, discovered earlier, has been moving, which cyclones and anticyclones have been dispersing and which have been getting stronger, or in what direction have the warm and cold air masses been retreating.

"With the use of special light, photographic, and kinotelevision technical equipment, it will be possible to determine the meteorological processes which take place in the atmosphere, and not only get a weather picture for a definite moment, but also to detect processes' main tendencies on a planetwide scale.

"From aboard the sputniks, it will be possible to study with sufficient accuracy the shifting of geographical pole, which, as scientists

presume, influences the course of meteorological processes. It is known that in winter, large air masses push toward Siberia and form the so-called Siberian anticyclone. An air mass of about 14 billion tons accumulates there. In the summer it disperses. This, scientists think, brings about the shifting of the geographic pole, which, in turn, exerts an influence upon the character of meteorological processes on an earthwide scale.

"RADIATION ENERGY'S BALANCE

"It has been determined that the earth's mean temperature remains practically unchanged and thus the quantity of heat which is received by the earth has to equal the amount of radiation received from the sun. However, in the Tropics, the amount of the absorbed solar energy exceeds the radiated amount, while in polar regions the case is reversed: the white cover, snow and ice, reflect about 90 percent of solar energy.

"It will be possible to study the equalization processes of this imbalance from aboard the heavy artificial sputniks, flying at a terrific speed from one zone of the globe to another. In order to find an answer to this complicated process it will be necessary to establish precisely the amount of solar energy reflected by earth back to aerospace; this will permit to determine how much solar energy is absorbed and dispersed in earth's atmosphere.

"The sun plays the principal role in the formation of weather and climate on earth. Therefore, the study of the solar radiation's balance has an enormous significance for meteorology. Data on meteorological conditions in the earth's atmosphere, received from aboard the sputniks, will serve as starting material to determine heat exchange in the air. They will be taken into consideration in the general atmospheric circulation theory and may result in considerable improvement in long-range weather forecasts.

"MACHINE WEATHER FORECAST IN THE FUTURE

"An enormous amount of data on meteorological phenomena could be obtained by means of earth's heavy sputniks. Obviously, it will be possible to process this information only with the aid of mathematical machines. Electronic computers will permit to use numerical methods for weather forecasts. It is known that any physical process can be described by mathematical equations. By solving them, it will be possible to get an idea of how these processes will recur in the future.

"At the present time, we are going through an amazingly productive period in the development of meteorology. The inclusion of scientific data, which will be obtained by earth's heavy artificial sputniks, into combined report provided by worldwide network of meteorological services will contribute to a new impetus to the progress of meteorology. Earth's sputniks and computing machines will contribute to a better solution of the problem involving accurate weather forecast."

(b) Moscow Tass radioteletype report in English to Europe on November 14, 1960.

"Moscow.—Prof. Georgy Pokrovskiy believes that a system of artificial earth satellites can provide reliable daily weather forecasts which are impossible to obtain by modern meteorological methods.

The sputniks should move at a definite distance one behind another along a common orbit to form a 'sputnik ring,' as it were. Meteorological sputniks 'flung' up to an altitude of some hundreds of kilometers might carry out systematic observations in the upper layers of the atmosphere. Their orbits should be polar, passing over the earth's poles.

"Much use can be found for a meteorological sputnik carrying a television device for recording cloud formations and atmospheric structure and also instruments recording various components of atmospheric and solar radiation. It could have radio relay contact with neighboring sputniks and terrestrial stations. Such sputniks could also be equipped with small rocket engines for regulating their position in orbit.

"Professor Pokrovskiy points out that the establishment of a 'sputnik ring' through the joint efforts of several states would not only render an invaluable service to meteorology, but would also be a stimulus to progressive cooperation based on a concrete undertaking. It may be expected that even in its first decade the system of meteorological sputniks would produce a saving of several billion rubles by raising the efficiency of agriculture on the earth."

(c) Moscow Tass in English to Europe on May 10, 1961.

"Manned flights to outer space will contribute to the successful solution of weather forecast problems, Prof. F. Davitaya writes in today's Selskaya Zhizn—Rural Life. From outer space, the article says, it will be possible to view great areas of the earth's surface simultaneously and to see how clouds are distributed. On the diurnal side of the earth this will be possible by means of television cameras installed in the spaceship, and on the nocturnal side by means of thermal direction finders which will register the accumulations of clouds by recording longwave radiation.

"Changes in the radiation balance of the earth can be measured from spaceships with more accuracy than is possible by means of actinometric apparatuses, the professor adds.

"The Soviet scientist points out that plans are already afoot for determining the distribution of precipitation and thunderstorm areas by means of radar installed in satellite spaceships. There are also other possibilities of studying the earth's atmosphere and processes occurring in it from spaceships. These possibilities are now the subject of preliminary studies.

"By making utmost use of favorable climatic and weather conditions and by reducing their adverse effects to a minimum it will be possible to make nature serve people and insure an abundance of farm products, Professor Davitaya says in conclusion."

NOTE.—An F. F. Davitaya is one of the Deputy Chiefs of the Hydrometeorological Service U.S.S.R. and Chairman of its Scientific-Technical Council. The same name appears among the meteorological research personnel of Moscow State University.

(d) On May 14, 1961, a talk by Prof. Viktor Antonovich Bugayev, entitled "Weather and Space," was reported by the Moscow Domestic Service as follows:

"An historic event which we had the good fortune to witness a month ago—the triumphal space flight of Yuri Gagarin on the Vostok—is, in my view, of important significance to the science of weather forecasting. As observations have shown, with the aid of

apparatus sent up on the sputniks, a rapid and intensive transformation takes place in the upper layers of the atmosphere hundreds of kilometers from the surface of our planet. The atmosphere breathes, as they say, and only by rising to a colossal height can one carry out research from there on the cloud cover of the planet, taking large expanses at a glance.

"And this is very important. For instance, one cannot see a cyclone from the surface of the earth because its dimensions exceed thousands of kilometers. Only by amassing observations from many meteorological stations and fixing them on a weather chart can we detect the characteristics of the cyclone. From cosmic heights this cyclone can be viewed as a whole. Moving around the earth at a speed of some 8 kilometers per second, it is possible in a comparatively short time to make a review of the weather on a worldwide scale. Included would be the oceans of the southern hemisphere and the sixth continent of the earth, the Antarctic, where the network of observation stations is very sparse.

"It is necessary for us to carefully follow the movement of air masses on a worldwide scale, since only such observations will create the basis for reliable weather forecasts for long periods, like a month or a season. Moreover, only from great heights can one measure the thermal exchange between the earth and the cosmic space surrounding it so as to use these observations in calculating the rules governing atmospheric movements.

"Observations of the behavior of the atmosphere from space will undoubtedly lead to a revolution in many views long held in meteorology and will be reflected in methods of forecasting weather."

NOTE.—V. A. Bugayev is the Director of the Central Institute of Forecasts in Moscow.

6. These reports indicate that Soviet scientists have endorsed the principle of global weather observations by means of satellites. Moreover, as indicated by reference 5c above, they are actively engaged in studies leading to instrumenting satellites with meteorological sensors including TV, radiation detectors, and radar.

7. In view of the interest expressed by the Soviet scientists in meteorological satellites, and the satellite fabrication and launch capabilities already demonstrated by the U.S.S.R., we may conclude that the Soviets have not launched a meteorological satellite to date simply because they have chosen to concentrate on other programs.

AUGUST 30, 1961.

