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PROJECT ADVENT—MILITARY COMMUNICATIONS SATELLITE PROGRAM

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HEARINGS BEFORE THE SUBCOMMITTEE ON SPACE SCIENCES OF THE COMMITTEE ON SCIENCES AND ASTRONAUTICS U.S. HOUSE OF REPRESENTATIVES EIGHTY-SEVENTH CONGRESS SECOND SESSION

AUGUST 15 AND 17, 1962

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NOTE.—The chairman of the full committee and the ranking minority member, Hon. Joseph W. Martin, Jr., are ex officio members of all subcommittees.



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PROJECT ADVENT

WEDNESDAY, AUGUST 15, 1962

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE SCIENCES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C.

The subcommittee met at 10 a.m., Hon. Joseph E. Karth (chairman) presiding.

Mr. KARTH. The meeting will come to order.

This morning the Subcommittee on Space Sciences opens 2 days of hearings on the Advent program, the Department of Defense Communications satellite program.

This inquiry follows the subcommittee's investigation of the Centaur launch vehicle development program which took place some weeks ago. Advent and Centaur have been closely identified with one another for several years. In fact, the first primary mission assigned to the Centaur launch vehicle was to be the 24-hour equatorial satellite orbit.

The Centaur development program has experienced a series of delays which have caused that program to fall behind its original schedule by almost 2 years. Shortly after the conclusion of the subcommittee's hearings on Centaur, held this session, the Department of Defense announced, early in June, a major reorientation of the Advent program "to bring it into consonance with available boosters."

One of the purposes of the present hearings is to review the Advent program to determine the extent to which the slippage sustained in the Centaur program was responsible for the reorientation of Advent.

Secondly, the subcommittee wishes to determine the present status and DOD's future plans for the Advent program. Since the Committee on Science and Astronautics has jurisdiction over all scientific research and development programs conducted by the various agencies of the Government, this subcommittee has been authorized to review and evaluate the Advent program, particularly in order to determine if the reoriented program involves any unnecessary or undesirable duplication with the three active communications satellite programs of NASA: Telstar, Relay, and Syncom.

Of major interest to the subcommittee are the requirements peculiar to the military vis-a-vis civilian needs, and the extent to which the military requirements may be satisfied by a commercial communications system.

This morning we will hear first from the U.S. Army represented by the Honorable Finn J. Larsen, Assistant Secretary of the Army for Research and Development. He is accompanied by Brig. Gen. Joseph W. Johnston, commanding officer of the U.S. Army Advent Manage-

ment Agency. We will also hear from the U.S. Air Force, represented by Gen. Bernard A. Schriever, commanding officer, U.S. Air Force Systems Command.

On Friday, August 17, our first witness will be the Honorable John H. Rubel, Assistant Secretary of Defense for Research and Development and Deputy Director of Defense Research and Engineering. He will be followed by Dr. Robert Seamans, Associate Administrator of the National Aeronautics and Space Administration.

I see that you have a prepared statement, Dr. Larsen. In the interest of saving time I would like you to submit your statement for the record and take approximately 10 minutes in order to summarize your statement. By following this procedure we will allow the maximum amount of time for discussion.

Dr. Larsen, would you also give us the names and positions of the other people who are with you, and who will participate and assist you in giving your testimony?

Secretary LARSEN. I will be glad to.

In addition to General Johnston, whom you have introduced, I am accompanied by Lt. Gen. Dwight E. Beach, Chief of Research and Development; Mr. J. P. McNaul, U.S. Army Advent Management Agency; Col. L. G. Forbes, U.S. Army Advent Management Agency; Col. R. E. Kimball, U.S. Army Advent Management Agency; Col. K. C. Emerson, Office, Assistant Secretary of the Army, Research and Development; Lt. Col. Nicholson Parker, Office, Chief of Research and Development.

The majority of these gentlemen are members of Advent Management Agency staff.

Mr. KARTH. You may proceed.

STATEMENT OF HON. FINN J. LARSEN, ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH AND DEVELOPMENT

Secretary LARSEN. The Advent program was originally conceived under ARPA, or Advanced Research Projects Agency, and was actually originated and all contracts were let when the Advent program was under the auspices thereof. That began about 1958.

In September of 1960 the Army was given the management responsibility for the Advent program.

Working with and under the Army was the Navy, who had the responsibility for a shipboard terminal, and the Air Force, which was responsible for the spacecraft, booster and upper stage procurement for launch and injection, and for certain phases of control of the spacecraft after injection.

The Army responsibilities included the overall management, program scheduling, systems integration, plans for the testing and evaluation, and so on.

The funding was from the Department of Defense through the Army.

The original plan contemplated that a satellite weighing something over 1,000 pounds would be eventually placed in equatorial orbit at an altitude of 19,300 nautical miles.

Two different boosters were to be used in the program. Atlas-Agena was to be used for the phase I tests, which were at a lower orbit, approximately 5,000 miles.

Mr. KARTH. Doctor, the first several shots of Advent were to be placed in a low orbit, rather than the high-altitude synchronous orbit; is that correct?

Secretary LARSEN. Yes. The first three shots were to be in the low orbit. They were the beginning of the evaluation testing program.

Mr. KARTH. Those first three shots were to be launched over what period of time?

Secretary LARSEN. General Johnston, can you assist me?

They stretched over a span of nearly a year, I believe.

General JOHNSTON. Approximately 3 months apart, Mr. Chairman.

Mr. KARTH. Proceed.

Secretary LARSEN. Phase II consisted of piggyback shots on Atlas-Centaur, in which we had an off-loaded or stripped-down vehicle that would accompany other loads.

In phase III there were five different shots available, in which the final vehicle of the development program could be placed into high orbit.

Obviously, as many of these as necessary to confirm the evaluation and testing program would be fired.

Late in 1961, two things had happened. First, it became increasingly clear that the Centaur upper stage vehicle had major problems, and, second, the satellite vehicle itself which was contracted for with the General Electric Missile and Space Vehicle Department (MSVD) had slipped a considerable period of time.

At about that time, in December of 1961, a Department of Defense team recommended that, as soon as the booster program could be clarified, the scope of the Advent program should be more precisely defined.

They also recommended the management structure be reorganized to place responsibility for the General Electric MSVD contract directly with the Army.

In February of 1962, an Army technical committee made recommendations which were significant to the program. They recommended that phases II and III be terminated and that a lightweight satellite development program which could be used with the Atlas-Agena booster system be substituted.

During February and March we continued our review, with special attention being paid to the problems the satellite vehicle was undergoing at General Electric MSVD.

It became increasingly clear that additional slippage was occurring, and in April of 1962 the Army recommended that the phase I program, which had been continued up to this time, and was for the low-altitude launch of the heavy satellite vehicle, be stopped.

Mr. KARTH. What was the date of that recommendation, sir?

Secretary LARSEN. That the phase I program be stopped?

Mr. KARTH. What was that date?

Secretary LARSEN. That was on April 17.

That decision was made with the realization that continuing on with the original heavier satellite program would make little contributions to the phase II and III program, and that we had already made a recommendation that it be terminated.

Mr. KARTH. To whom were those recommendations made, Doctor?

Secretary LARSEN. Those were in papers addressed to the Director of Defense Research and Engineering and the Secretary of Defense.

Mr. KARTH. What reply did you get to the recommendation?

Secretary LARSEN. We received no immediate replies and, in fact, on May 21 the Secretary of the Army recommended to the Secretary of Defense that decisions be made on the recommendations that the Army had made in February and April. Two days after that, on May 23, the reorientation of the Advent program was effected by the Secretary of Defense.

At that time that reorientation placed responsibility with the Air Force for the space vehicle, payloads, boosters, upper stages, and the injection into orbit. Responsibility for the communications ground equipment remained with the Army.

Mr. KARTH. How much money was spent on the Advent program between February and May 1962?

Secretary LARSEN. February and May 1962?

We had curtailed our rate of spending at General Electric prior to that time, and I think it is also worth making comment that we had not curtailed any expenditures on the ground stations because we expected them to be completely useful with any future program that might be arranged.

Mr. KARTH. You do not know how much money was spent, but there was some spent?

Secretary LARSEN. About \$14 million was spent. [To General Johnston.] That must be on the entire program?

General JOHNSTON. Yes.

Secretary LARSEN. Total program.

Mr. KARTH. How much of that was in ground facilities as opposed to the satellite package?

Secretary LARSEN. I can answer this way: Our monthly rate of spending at General Electric and the expenditure directed toward the flight satellite was about \$4 million per month at that time.

Mr. KARTH. Does that include the Bendix appropriations also?

Secretary LARSEN. The total amount was about \$9 million spent during the period about which you are asking for flight hardware. That would include the Bendix work.

Shall I continue?

Mr. KARTH. Yes, please.

Secretary LARSEN. In addition to the spelling out of the responsibilities of the Air Force and the Army, the Secretary of Defense directed that the Defense Communications Agency, under the guidance of the Director of Defense Research and Engineering, be responsible for the resolution of the interface problems, and for monitoring of the progress of the several components of the system.

At the present time the Army is engaged in completing ground stations at Fort Dix, N.J., and Camp Roberts, Calif., and the Navy is completing the ship terminal.

In general the hardware has been delivered. The equipment has been delivered to the stations and is being installed or is in early stages of test at the present time.

These ground stations are expected to be useful, as I said earlier, in any future defense communications satellite program.

Mr. Chairman, that concludes my statement.

I believe General Johnston is prepared to also summarize his remarks and after that we, of course, stand ready to answer your questions.

(The prepared statement of Secretary Larsen is as follows:)

STATEMENT OF HON. FINN J. LARSEN, ASSISTANT SECRETARY OF THE ARMY
(R. & D.)

Mr. Chairman and members of the committee, in response to your request for information on the Advent communications program, I will present a summary of major events as viewed by the Department of the Army. I will be followed by Brig. Gen. J. Wilson Johnston, commanding general, U.S. Army Advent Management Agency, who will discuss the program as viewed by the project manager.

The Advent program was originally conceived as a development effort under the Advanced Research Project Agency (ARPA) to provide techniques and equipment for synchronous equatorial orbit communications satellites. The project was initiated by ARPA in 1958 and was transferred to the Army for management in September 1960. At the time the program was transferred to the Army, all of the major contracts had been let, and hardware specifications and characteristics of the system had been generally established and approved by ARPA.

The Army was assigned responsibility for the overall project. The Air Force operating as a development agent for the Army was to accomplish certain space portions of the program and the Navy was to develop a ship terminal.

The Air Force was responsible to the Army for the spacecraft, for the booster and upper stage procurement, for launch and injection, and for certain phases of control of the spacecraft after injection. Army responsibilities included general technical management, program scheduling, systems integration, plans for tests and evaluation, et cetera.

General Electric, the contractor for the spacecraft, was selected by the Air Force while the program was under ARPA and this arrangement continued as the program shifted to Army overall supervision. Funding for the program was provided to the Army by the Department of Defense.

It was planned that a satellite weighing slightly more than 1,000 pounds would be placed in equatorial orbit at an altitude of 19,300 nautical miles. Two different booster vehicles were to be used. Phase I tests, low altitude—4,900 nautical miles—would use Atlas-Agena boosters. Phases II and III, high-altitude tests—19,300 nautical miles—would use Atlas-Centaur boosters. Two ground transmitting stations would be utilized while a Navy shipboard terminal would serve as a third station. Phase I testing was scheduled for early 1962 and phase II testing for 1963.

It should be noted that boosters for the program were selected on the basis of performance predicted in 1959 to meet the requirements of placing more than 1,000 pounds in a synchronous equatorial orbit.

The only candidate at that time was the Atlas-Centaur under development by the Air Force and NASA. The Advent vehicle was thus designed for this combination.

After the Army assumed management of the program, during 1961, NASA encountered technical problems in the development of Centaur. Failure of the Centaur upper-stage to provide the required weight lifting capabilities initially predicted was critical to the Advent program.

Further, serious slippages in development of the satellite vehicle by the General Electric Co. were experienced. In general, scheduling difficulties between the availability of satellites and launch vehicles pointed toward the requirement for a reevaluation of the objectives and scope of the program.

In December 1961, a Department of Defense team recommended that: As soon as the booster program could be clarified, the scope of the Advent program should be more precisely defined. A minimum phase I program was recommended by this team.

Also, that concurrently with a decision on phases II and III, overall management structure should be reorganized to place management of the General Electric contract directly under the Army.

On February 20, 1962, the Army forwarded to the Department of Defense the results of an Army technical committee evaluation of the Advent program and recommended that phases II and III be terminated. A lightweight satellite development compatible with available boosters and advances in the state-of-the-art was recommended. It was also recommended that the phase I program be continued to completion. It was estimated that a first launch could take place in October 1962.

During February and March, the Army continued to review the program with special attention on the technical difficulties at General Electric. During this review, it became increasingly clear that a first launch could not be achieved before the fourth quarter of fiscal year 1962.

In view of this conclusion, and the realization that launches in that time frame would consume a large amount of fiscal year 1963 funds, and contribute little to a required lightweight satellite development, on April 17 the Army recommended an immediate phaseout of effort on the planned heavy satellite design and initiation of a lightweight design.

A simplified management structure was suggested. To support and provide a sound basis for implementation of the Army recommendations, on April 26 a development and funding plan for the recommended program was forwarded to the Department of Defense.

On May 21, in order to preclude the unwarranted expenditure of funds for the program, the Secretary of the Army recommended to the Secretary of Defense that a decision be made on the Army's previous recommendations of February and April to reorient the program.

On May 23, reorientation of the Advent program was effected by the Secretary of Defense. The reorientation placed responsibility with the Air Force for the space vehicles, payloads, boosters, upper stages, and injection.

Responsibility for the communications ground environment remained with the Army. The Defense Communications Agency (DCA), under the guidance of the Director of Defense Research and Engineering (D.D.R. & E.), was made responsible for the resolution of interface problems and for the monitoring of progress of the several major components of the system.

On May 26, the Department of Defense requested that the Army phase out the General Electric work on the satellite vehicle.

The Secretary of the Army has designated me to exercise functional supervision of the Army's R. & D. effort in implementing the decision by the Secretary of Defense. I have direct access to Brigadier General Johnston who is the project manager for the Army's portion of this program.

At the present, the Army is engaged in conjunction with the Navy in completing a ship terminal and ground stations at Fort Dix, N.J., and Camp Roberts, Calif.

These facilities will be used in the reoriented DOD communication satellite program and in a cooperative effort with NASA on its Syncom program. The Army is also assisting D.D.R. & E. and DCA in defining details of the future DOD satellite communications program.

Mr. Chairman, that concludes my statement. I will be glad to answer your questions.

Thank you.

Mr. KARTH. General, if you would like to proceed.

STATEMENT OF BRIG. GEN. J. WILSON JOHNSTON, U.S. ARMY ADVENT MANAGEMENT AGENCY

General JOHNSTON. I can summarize very briefly, Mr. Chairman.

I believe on August 9 last year Gen. William M. Thames, then commanding the Army Advent Management Agency, appeared before you and testified as to the technical objectives of the program, so I do not propose to repeat that.

I would like to comment very briefly on the management organization which the Army has and which was directed by OSD at the time of transfer, if you wish me to, and proceed into the schedule for the launches that were visualized in the Advent program as such.

Could I have that first chart, please?

This very complex chart shows the location of the Advent Management Agency here. If I may, we will divide the chart in half.

Going up, you see the agencies to whom we looked for guidance. Coming down, then, you see the agencies that we provided guidance to. Actually, there were three, from the Project Manager's viewpoint, action agencies: U.S. Army Signal Research and Development Laboratory, responsible for the ground communications complex and the airborne communications package; the Space Systems Division of the Air Force, who were responsible for the satellite itself, for the tracking, telemetry and command for the launch vehicle, and for the launch and orbital injection; finally the third action agency to whom we looked, the Bureau of Ships, the U.S. Navy, who had the ship-board terminal.

This then in general terms was the management structure, management arrangement, through which we directed and controlled the program.

There were, of course, difficulties in establishing working relationships, as would be true in a complex organization of this type.

In addition to the perhaps management difficulties, which we pretty well overcame, there were some technical difficulties, which Dr. Larsen has touched upon.

With that general background then, and with your permission, I would prefer to go ahead and describe the schedule of the launches that we had which had originally been set up by ARPA, to show how that schedule was modified.

Mr. KARTH. What I would like to have you do is outline the flight schedule by booster of the Advent program relating to the various periods, and indicate reasons for any changes in the schedule. Is this what you intend to do?

General JOHNSTON. Yes, sir.

Mr. KARTH. If you would.

General JOHNSTON. As Dr. Larsen commented, the overall schedule was broken out into phases.



ADVENT SCHEDULE CHANGES

PHASE	BOOSTER	ARPA			USAAMA		
		11 APR 60	11 AUG 60	10 NOV 60	30 MAR 61	3 JAN 62	APR 62
I	ATLAS-AGENA	SEP 61	MAR 62	MAR 62	MAR 62	JUN 62	OCT 62
		DEC 61	JUN 62	JUN 62	JUN 62	OCT 62	EARLY 63
		MAR 62	SEP 62	SEP 62	SEP 62	JAN 63	LATER 63
		JUN 62					
II	ATLAS-CENTAUR (NASA)	FEB 62	DEC 62	DEC 62	APR 63	SEP 63	DEC 63
		APR 62	FEB 63	FEB 63	JUN 63	JAN 64	
		JUN 62					
		SEP 62	MAR 63	MAR 63	JUL 63	MAY 64	JUN 64
III	ATLAS-CENTAUR (DOD)	NOV 62	MAY 63	MAY 63	SEP 63	JUL 64	AUG 64
		JAN 63	JUL 63	JUL 63	NOV 63	SEP 64	OCT 64
		MAR 63	SEP 63	SEP 63	JAN 64	NOV 64	EARLY 65
		MAY 63	NOV 63	NOV 63	MAR 64	JAN 65	LATER 65
		JUL 63					
		SEP 63					

The first phase visualized utilization of the Atlas-Agena booster. There were three shots planned in this particular phase.

The second phase contemplated the use of the Centaur booster vehicle complex and, as Dr. Larsen mentioned, we were really riding on NASA shots.

These were in the NASA program for the proving out of Centaur.

We were given a boost capability, although we did have to off-load certain of the systems on the satellite vehicle to meet the weight constraints so that NASA might instrument the booster vehicle, nonetheless we did count those launches as being in support of our overall program.

These would have been the first synchronous launches, phase I being a less than synchronous, low orbital launch.

Then we in the Advent program had five program launches in our phase III, where Advent was the sole user of the payload capability.

In general terms, then, that outlines the three phases.

The dates that are shown here (indicating) in the first column are those that were established by ARPA.

The first launch, phase I, was scheduled initially for September 1961, the second for December 1961, and so on.

(The prepared statement of Brig. Gen. J. Wilson Johnston is as follows:)

It is a pleasure for me to be here today to discuss various aspects of the recently terminated Advent communications satellite program and our preliminary plans under the newly reorganized Department of Defense communications satellite program.

My discussion today will, of necessity, be from the point of view of the project manager.

As the person charged with the responsibility for successful prosecution of the program, the project manager must be primarily concerned with those elements of the program which operate below his office.

And yet, by the nature of the Advent program, as a triservice effort but still under Army management, the project manager was made acutely aware of the problems of maintaining effective relationships with various elements of other services and other agencies collateral to him, in the defense structure and of other agencies working along similar lines in the overall Government and commercial organization.

On August 9, 1961, Brig. Gen. William M. Thames, then commanding the U.S. Army Advent Management Agency, testified before you on the objectives of the Advent program.

Therefore, I do not believe it will be necessary for me to go into the technical details of that program.

Throughout this discussion, I think it important to recognize the time period with which we are concerned. We are looking back into the past as a prelude to understanding the present arrangements.

I would like to touch on the program management organization which was directed by the DOD documents which transferred the overall program responsibility to the U.S. Army in September 1960. This organization is shown in this chart. (Chart 1.)

As Dr. Larsen has stated, the hardware specifications and characteristics of the system had been generally established by ARPA and the major R. & D. contracts had been let at the time the program was transferred to the Army.

The transfer documents specified that the Air Force Space Systems Division, then known as the Ballistic Missiles Division, exercise development responsibility and contracting authority for the final stage vehicle; that is, the satellite contract at General Electric Co., as well as the booster vehicle development tracking, telemetry, and command development, and launch responsibility.

They also specified that the Army Signal Research and Development Laboratory be continued as having development responsibility and contracting authority for the communications portion of the program, including ground and spaceborne

communications equipment, and that the Navy continue its participation with the development of a shipborne station.

A separate project office, the U.S. Army Advent Management Agency, was established to provide the technical and fiscal management of the overall program, within the bounds of their directed and legal authority.

I might point out that the Army Ballistic Missile Committee and the Project Advent Coordinating Committee were never called on for any action and, in fact, the Advent Coordinating Committee was never actually established.

At the time of General Thames' testimony, considerable development effort had been completed leading toward an early communications satellite capability.

However, as might be imagined in a program of this complexity, the establishment of smooth working relationships between the various agencies involved and the establishment of firm technical guidelines had not been an easy process.

Very early in the program, after its transfer to the Army, problems had arisen in establishing working relationships to further the development effort.

Not surprisingly, these centered around definitions of areas of responsibility, degrees of management control, and methods of contractual negotiation and supervision as well as areas of technical disagreement.

By early spring of 1961, it was felt by all concerned, that a reasonable basis for program management had been established. Management directives had been issued which delineated guidelines for the overall and detailed management of the program.

Technical information was being exchanged on a regular basis through reports and personal contact between contractor and Government personnel of all agencies and what was felt to be a reasonable reporting system had been established between USAAMA and its action agencies and from USAAMA to higher headquarters.

It had been apparent from the time of transfer to the Army that the program, to accomplish its original objective, had been greatly underfunded, largely because of an underestimation of the magnitude of the technical problems involved.

By June of 1961, it became obvious that the funding estimates for fiscal year 1962, which were submitted in December 1960 shortly after Army assumption of program responsibility, were inadequate to meet the requirements for a March 1962 first launch.

While the technical progress at that time was generally satisfactory with only minor slippage which appeared correctable, it was apparent that substantial cost overruns would occur in the three major contracts; that is, GE for the satellite vehicle, Bendix for the communications gear, and Sylvania for the ground complex less communications equipment.

In terms of absolute dollar amounts and technical difficulties, the GE contract presented the greatest problem. Because of the need to provide the proper control of the GE contract, in May 1961 USAAMA urged the Air Force to undertake a thorough study of the contract, and suggested an approach of using a team of technical and fiscal personnel in residence at GE to provide more responsive contractor supervision.

This team approach of using resident Government personnel in both the technical and fiscal areas, to assure adequate technical progress within the time schedule and within funding limitations, has been successfully used by the Army in the past in many programs.

For example, it was used to great advantage in the Courier program. Because of this recommendation, SSD decided to make a full management survey at GE but did not accept the resident team approach for supervision, stating that this was against Air Force policy.

Therefore, while the need for increased funds in fiscal year 1962 and beyond was recognized, the exact amount and the areas to which it must be applied were not determined until after a thorough analysis by all agencies concerned, continuing over several months, had been completed.

In late August, a first comprehensive estimate of additional fiscal year 1962 funds was forwarded from USAAMA, and in the middle of September an emergency fund request for fiscal year 1962 to raise the planned effort from \$72 to \$123 million was forwarded.

During this same time, continued technical problems had been occurring at GE which raised doubts about the possibility of meeting the first launch in March 1962.

However, by a concentrated effort and by revising certain evaluation and acceptance test schedules, it was felt by USAAMA, SSD, and the contractor that the March launch was still possible. In fact, as late as December 11 it appeared that the March launch was feasible.

However, because of continuing difficulties in certain subsystems of the satellite vehicle it was considered advisable to establish a more realistic program schedule.

Based on new estimates from GE and the Air Force, USAAMA rescheduled the March 1962 launch to June of 1962.

Continued technical difficulties at GE forced further postponment of the first launch to October 1962.

During this period, SSD and USAAMA personnel were continuing to carefully view the progress and plans at GE to try to balance a desirable launch schedule against dollar expenditures.

In April 1962, SSD stated that the first launch of an adequately tested satellite vehicle could not occur before the second quarter of 1963 and additional funds on the order of \$50 million over and above those planned would be required for the first phase of the program.

I agreed with these estimates.

As mentioned by Dr. Larsen, on February 20 and again on April 17 the Army recommended to the Department of Defense a phaseout of effort on the planned satellite design and the initiation of a lightweight design which would be more compatible with the booster systems which would be available in the time frame.

This recommendation came out of a series of continuing system studies by USAAMA. The booster analysis began when development troubles first appeared on a Centaur program in December of 1960.

These problems have been well covered in other testimony before this committee. There has been, of course, a continuing evaluation of the satellite design as part of the project manager's responsibility.

The steady progression of the state of the art since the original satellite design had been detailed permitted the same basic operational functions to be performed in a satellite vehicle weighing approximately one-half of the existing design.

The technical obsolescence of certain portions of the satellite design, the rising costs and delayed schedule at GE, and the lack of a suitable booster led the Army to make these recommendations.

The Army and USAAMA continued to push for a decision on this lightweight program and lacking such, on May 11, USAAMA issued to the industry, through the proper contractual procedures, a request for a proposal on a lightweight satellite design in keeping with its recommendation to OSD.

On May 18, USAAMA was directed to cancel all efforts on this request and recall all material issued.

As you know, on May 23, 1962, the Secretary of Defense reoriented the DOD communication satellite program. As a result of the program reorientation, USAAMA took steps to terminate further effort on the flight hardware at GE and Bendix.

While this summarizes some of the financial and technical problems involved, I would like to go back in time again to discuss some of the management aspects of the program and some of the studies that were made regarding them.

As I mentioned before, the management structure was fairly well defined in the documents transferring program responsibility in September 1960.

The project manager felt it was his responsibility to make the prescribed management relationships work, if at all possible, before any recommendations could be made to the Department of Defense to modify the structure.

With this in mind, every attempt was made to evolve suitable working relationships and, after several initial problems, a relationship which was generally satisfactory was worked out among USAAMA, the U.S. Navy Bureau of Ships, the Army Signal Research and Development Laboratory, and the Air Force Space Systems Division.

From the project manager's point of view this arrangement was less than optimum.

A source for management conflict existed in the split between the Army, having overall project management responsibility concentrated within USAAMA, and the actual contract direction being done by other agencies either within the Army or in other services.

There is an opportunity for conflicts where different philosophies of contractor management, technical approach, and contractual implementation are involved, such as between the Air Force and the Army.

While similar management problems existed between the Army Signal Research and Development Laboratory and USAAMA, these problems were largely alleviated because of the close proximity of the two agencies and because of a common background and philosophy in contractor management procedures.

On April 3, 1961, the offices of the Director of Defense Research and Engineering and Department of Defense General Counsel submitted a report to the Secretary of Defense.

This was rather thorough analysis of the Advent program management structure, and recommended the assignment of complete responsibility for the Advent program to the Army, particularly the satellite contract.

The Secretary of Defense, on May 29, 1961, decided to make no changes in the management structure of Project Advent.

On November 20, 1961, D.D.R. & E. appointed a committee to again survey the Advent program management. This action was precipitated by the request for emergency funding, which was received by OSD in early November, and because of potential schedule slippages.

This OSD committee report, issued on December 12, 1961, made a number of recommendations including that USAAMA should control the Air Force contracts and that resident USAAMA teams should be placed at all contractors' plants.

On January 4, 1962, Department of the Army established a technical committee and assigned as its first task a review of the Advent program.

This committee report, forwarded to OSD on February 20, again recommended the consolidation of all contracts under USAAMA and recommended that work be started on a lightweight satellite design.

As you have been advised on May 23, 1962, the Secretary of Defense reoriented the Department of Defense communications satellite program and placed the overall program coordination under the Defense Communications Agency with technical guidance being provided by D.D.R. & E.

In this reoriented program, the Air Force retains the responsibility for the spaceborne hardware which it essentially had under the Advent program.

In addition, it gained the responsibility for the satellite communication equipment which was previously assigned to the Army.

While the Army lost the project management responsibility, it retained responsibility for the ground complex which it had previously.

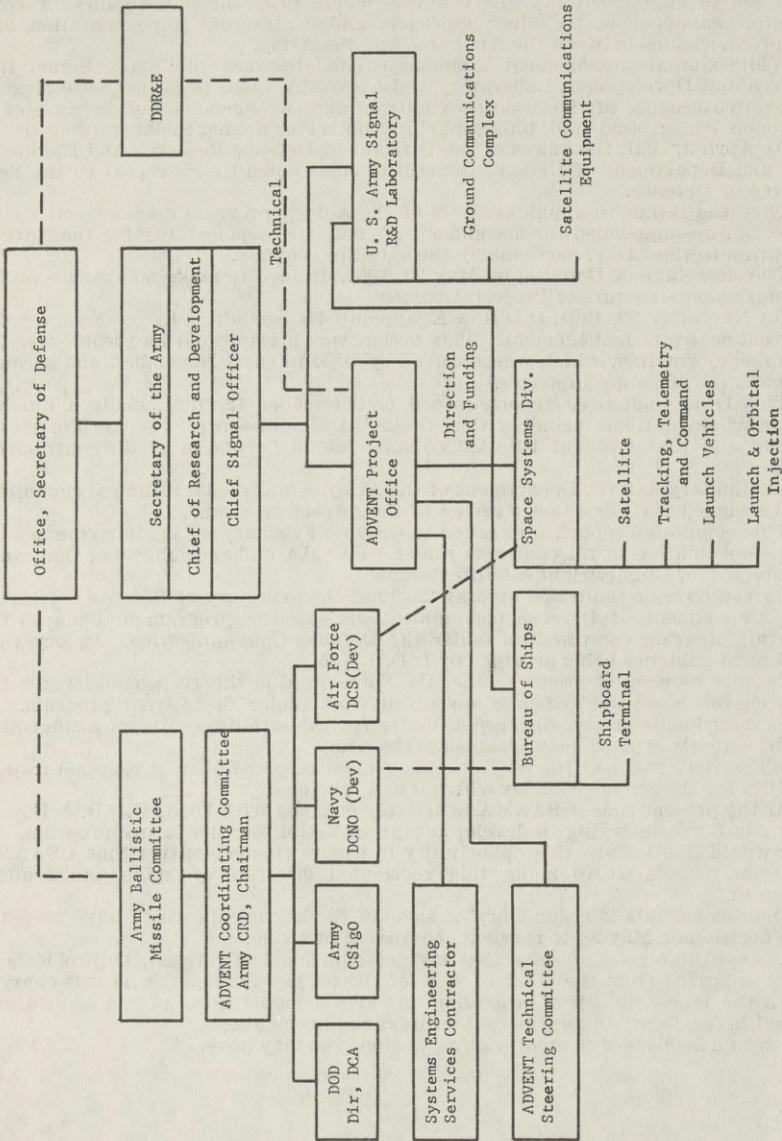
At the present time, USAAMA is actively engaged with DCA, D.D.R. & E., and the Air Force in trying to develop a plan of action for the future program.

I would like to take this opportunity to assure this committee that USAAMA will do its utmost to make this reoriented effort a workable and fruitful program.

Gentlemen, this is a summary of some of the key events which have predated the decision on May 23, to reorient the Advent program.

I would like to emphasize that my presentation has covered the problems as they appeared from the point of view of the project manager, who was charged with the responsibility of providing an early demonstration of communications satellite feasibility to meet urgent military requirements.

I would be pleased to answer any questions you may have.



General JOHNSTON. I would like to ask Colonel Kimball, with your permission, to explain in detail the slippages that actually occurred here as one moves across the chart.

We have tried to put this in tabular form to reflect the slippages and show the final schedule we ended up with just before the reorientation of the program.

Mr. KARTH. Yes, proceed, Colonel Kimball.

Colonel KIMBALL. Mr. Chairman, the chart divides really into two areas, as the general mentioned, the first two columns being associated with schedules that were established by ARPA, the last four columns being associated with schedules associated with the Advent Management Agency.

If you will note, one column is common to both of those classifications, and this [indicating] is the column of the schedule existent at the time of the transfer in September 1960 of the management from ARPA to the Army.

These dates at the top of the columns identify the columns or schedules with published formal documentation of the agencies involved.

The first column, headed April 11, 1960, is the schedule that was established by ARPA when the forerunners of the Advent program were combined into the one military communications program.

Mr. KARTH. That was back in April 1960?

Colonel KIMBALL. Yes. Actually, the schedule was published as an internal directive a few weeks before under date of February 29, 1960, but was reiterated, or confirmed, by ARPA on April 11, 1960.

The schedule at that time had four Atlas-Agena shots and the dates were very close to those which had been in previous ARPA schedules for Tackle shots from the Pacific missile range which were at that time planned to be near polar low orbit shots.

The remaining two phases were to use the Atlas-Centaur. They really derived from the synchronous equatorial portions of the old program Decree.

At that time the phase II had three launches involved. They were to be piggyback on launches on vehicles numbered 4, 5, and 6 of the NASA Centaur development program.

We had, as the general mentioned, a bobtailed capability there because NASA wanted to use some of the payload capability for instrumentation.

Following that, we were to have had—I say “we”—actually ARPA—had planned at that time to have some seven launches in the phase III of the Advent program.

Within the next 3 or 4 months schedule changes took place as the program plans were developed.

Actually they took place in two general steps.

First in the low-level Atlas-Agena area one shot was dropped. I don't know the reasons for this. I have no idea of the reasons for this. This was still back under ARPA days. One shot was dropped. Then later there was a 3-month slippage of the remaining three shots, which brought the December 1961 down to March 1962, with corresponding slippages in the March and June launches.

Mr. KARTH. As far back as August 1960 ARPA revised this schedule so that the first Atlas-Agena Advent shot would be made in March of this year, the second one in June of this year, and the third one in September of this year; is that correct?

Colonel KIMBALL. Yes, sir.

Mr. KARTH. There would be no synchronous orbit shots until December of this year and February of 1963; is that correct?

Colonel KIMBALL. This is correct, sir.

Actually the backup documentation on this phase I slippage indicates this occurred about July 28. It was actually published the 11th of August.

Mr. KARTH. This revision of schedule had nothing to do with Centaur?

Colonel KIMBALL. I have no idea. I presume not.

Mr. KARTH. After the U.S. Army Advent Management Agency was assigned the responsibility, and you reevaluated the schedule—I notice that your schedule is about the same as the last one that was suggested by ARPA?

Colonel KIMBALL. Yes.

Mr. KARTH. Was your evaluation at that time based on Centaur or was it based on the Advent program itself?

Colonel KIMBALL. For these three shots here [indicating], it was not based on Centaur.

Mr. KARTH. It was based on the satellite package?

Colonel KIMBALL. This is correct, sir. You can say generally the changes in the schedules of phase I are related to the Advent satellite. Changes in the schedules of phases II and III are related generally to the booster. There is, you might say, a catalytic action back here; there is a reflection of senses of urgencies, and so forth, intangibles, as to what happens here [indicating], as to how you push satellite development.

But these changes here [indicating], were related to progress on the satellite vehicle, as you say.

Mr. KARTH. Your revision of the schedule where Centaur would be used to put an Advent into synchronous orbit suggests, according to the chart, the first shot would not have been made until April of 1963; is that correct?

Colonel KIMBALL. This was the evaluation in March 1961. Actually there had been a change for the first shot from February of 1962 to December of 1962 back in the ARPA days.

Mr. KARTH. Yes.

Colonel KIMBALL. This was based on considerations of booster reliability. We were riding on shots Nos. 4, 5, and 6 of the R. & D. program of NASA.

The R. & D. program during this period was expanded to some 10 R. & D. vehicles and we were given space on vehicles Nos. 9 and 10 rather than Nos. 4, 5, and 6 for the Advent program.

That accounts for this change here [indicating].

This [indicating] was the ARPA No. 4; this is ARPA vehicle No. 9 [indicating].

We were then given, or scheduled to take, the first five Centaurs after the NASA R. & D. program had finished.

In other words, vehicles Nos. 11 through 15. That represents these phase III shots here [indicating].

This was the situation that existed at the time of the transfer.

Mr. KARTH. Those dates—where you have your pointer—those were ARPA schedule dates?

Colonel KIMBALL. This is correct, sir.

Mr. KARTH. Those immediately to the right in phase III were USAAMA dates of schedule?

Colonel KIMBALL. Yes, sir.

Mr. KARTH. Did those suggested dates have anything to do with the Centaur vehicle, or were they predicated upon how much advancement was being made on the Advent package?

Colonel KIMBALL. These were completely related to Centaur vehicle.

They came about through a change in the Centaur schedule, the NASA schedule. It represents a 4-month change from the November column to the March 30 column.

Actually, these dates first appeared—although there were discussions earlier—formally these first appeared in a NASA document dated around March 8, 1961.

That was released by ARPA on March 21, 1961, to the U.S. Air Force Ballistic Mission Division, now the Space Systems Division, and on that day they dispatched a message to us advising us of the change, the very day they got it from NASA.

Mr. KARTH. The changes in schedule you made on January 3, 1962, which indicated the first Atlas-Agena Advent shot would be made in June of this year, that was not predicated upon Centaur?

Colonel KIMBALL. That is correct, sir. That was predicated upon the satellite vehicle.

Mr. KARTH. You had not planned on making the synchronous shots until after you had made the three Atlas-Agena shots; isn't that correct?

Colonel KIMBALL. That is right; but this change between the March 1961 and the January 1962 columns occurred in two steps: The Centaur, or phases II and III change, occurred during the period of October and November of 1961.

This change was given to the Department of Defense on November 9, as I recall, formally.

Actually, there had been meetings running from around August 28 on. It involved slippage roughly of 9 or 10 months in the Centaur.

Mr. KARTH. Let's get back to the first phase.

Colonel KIMBALL. This was an unrelated action, this change in schedule.

Mr. KARTH. Unrelated action. That is correct.

Colonel KIMBALL. Yes.

Mr. KARTH. Your last of three shots for the Atlas-Agena Advent was scheduled to be January of 1963?

Colonel KIMBALL. Right, sir.

Mr. KARTH. This schedule was predicated upon the Advent package, not upon the Centaur launch vehicle?

Colonel KIMBALL. Right.

Mr. KARTH. And the Advent package was not to be flown on the Centaur launch vehicle until after all the Atlas-Agena Advent shots had been made; is that correct?

Colonel KIMBALL. Yes.

Mr. KARTH. Let's say the Centaur vehicle had been ready at its earliest and most optimistic date. The package would not have been ready to fly on Centaur, is that correct?

Secretary LARSEN. Not at that time, sir. These dates are all ahead of this date.

Mr. KARTH. I recognize that. That is the reason for the question.

I said that if Centaur had been ready, the Army, Air Force, DOD, or whoever had the responsibility for Advent would not have been ready, because they were not ready to make the first shot, which was to be an Atlas-Agena shot, until June of 1962, the second shot, in October of 1962, and the third shot January of 1963. Therefore, whether Centaur had been ready or not, they would not have flown an Advent package until after January of 1963, because of the lateness of the schedule of Advent; is that correct?

Secretary LARSEN. Mr. Karth, I would like to say "Yes" to your question and then make one other, I think, very significant statement.

That is that our decisions, which eventually resulted in recommendations to the Department of Defense to drop phases II and III of the Advent program from the then heavy satellite vehicle configuration, were not based so much on a question of the time slippage on the Centaur program as they were the fact that late last year and early this year it became increasingly obvious that the Centaur did not have the weight-lifting capability.

Our recommendations to drop the phase II and III program related to Centaur were made on that basis.

It could no longer carry the satellite vehicle.

Mr. KARTH. That is right, Doctor, but you were not going into phase II or III until after you had completed phase I; is that correct?

Secretary LARSEN. That is quite correct.

Mr. KARTH. You did not anticipate completing phase I until January of 1963?

Secretary LARSEN. If the Centaur had been available we certainly would have attempted to use it.

Mr. KARTH. Prior to your completing the Atlas-Agena shots?

Secretary LARSEN. Yes, we would have used Centaur for phase I.

Mr. KARTH. You did not need it for phase I?

Secretary LARSEN. We did not require it simply because phase I was planned for low altitude since Atlas-Agena could only take it to an altitude of about 5,000 miles.

Mr. KARTH. Doctor, why did we not fly Advent on Atlas-Agena? Because it was not ready?

Secretary LARSEN. That is quite correct.

Mr. KARTH. Your recommendation to drop phase II and phase III and then ultimately to drop phase I was predicated upon the obsolescence of the spacecraft rather than slippage in time schedule for the Centaur launch vehicle; isn't that correct?

Secretary LARSEN. I cannot accept that, no.

We would, I am sure, not have made the recommendation to drop the satellite vehicle if the Centaur had been capable of carrying it aloft.

But as I stated earlier, it became very definitely—well, as factual as one can conclude about the future—that the Centaur would be incapable of lifting it.

Mr. KARTH. Isn't Advent a rather obsolete piece of communications equipment?

Secretary LARSEN. I think the telephone is an obsolete piece of equipment in one sense, but it is in daily use. It is entirely true that the Advent concept of a space vehicle used older tubes, triodes instead of traveling wave tubes, and for this reason required more power, and, therefore, required more batteries and solar paddles, but nevertheless it is certainly not obsolete in the sense that it could not be used or was impractical to use.

Mr. KARTH. But, Doctor, I am not saying it could not be used and that a certain amount of obsolescence cannot be put up with; I am not saying that, because I know this is not true; almost every piece of hardware, by the time it is ready to fly, I suppose to a certain extent, is obsolete; but as far as the Advent program is concerned, some people in the Department of Defense say that it would not have been worth the additional costs to hoist the obsolete Advent package; do you agree with that or don't you?

Secretary LARSEN. I do not.

Mr. KARTH. It seems to me that Dr. Brown is the one who made the statement before another subcommittee.

Mr. Downing?

Mr. DOWNING. Briefly, Doctor, what was the mission of Advent?

Secretary LARSEN. The mission of the Advent system was to place in an equatorial orbit at high altitude and, therefore, relatively stationary over a spot on the earth, a satellite vehicle that would be used for the testing and evaluation and, therefore, as a development prototype of an operational communication system which could cover the entire world.

Mr. DOWNING. Isn't that now overshadowed by Telstar?

Secretary LARSEN. I believe not.

Mr. DOWNING. What advantage would Advent have over Telstar?

Secretary LARSEN. I think perhaps a better way of answering that is that there are military—if you don't mind, sir—that there are military requirements which a Telstar communications satellite cannot give one.

There are military requirements which are unique to a military communications satellite and which cannot be achieved through a commercial communications satellite.

Mr. DOWNING. But the principle has already been obtained in Telstar.

Secretary LARSEN. I am sorry. The principle, I think, was demonstrated by the Army long before that. Score and Courier were successful programs.

Mr. DOWNING. Have you now decided to wash out Advent?

Secretary LARSEN. Well, it depends on what you mean by "Advent." We continue to feel that a military satellite for worldwide communications is vital to the United States.

Mr. DOWNING. Not necessarily with Advent.

Secretary LARSEN. If Advent is the name of the heavy satellite that we were proposing under this program, then you are quite correct, we have recommended a lightweight satellite—a lightweight synchronous satellite.

Mr. DOWNING. That is all.

Mr. KARTH. Dr. Larsen, Dr. Brown did testify that launching the Advent satellite would not justify the cost of the launch at this point.

Secretary LARSEN. I don't doubt that. I don't know how that is qualified, but I believe that I agree with the statement that it was no longer worth launching, the present, or the then-contemplated Advent satellite, because of the booster limitations, because of the fact that it could not be continued into a synchronous orbit.

Mr. KARTH. I can't find it at the moment, Doctor. We will look at it later.

It is true, however, that using more modern technology today, applying it to a synchronous satellite system, the weight can be reduced from over 1,300 to about 500 pounds, is that correct?

Secretary LARSEN. That is correct.

Mr. KARTH. This is primarily because the power required to do the job for the old Advent—which was some 80 watts, was it?

Secretary LARSEN. Yes, 80 or 85 watts.

Mr. KARTH. It can now be reduced to about 30 watts to achieve the same capabilities, using more modern components?

Secretary LARSEN. That is correct.

Mr. KARTH. This means fewer batteries, fewer solar cells, and so forth and therefore significantly less weight for the entire spacecraft, just as a result of this reduced power requirement?

Secretary LARSEN. That is entirely correct, Mr. Karth.

Mr. KARTH. Doctor, in February you recommended phases II and III be terminated because an oncoming lightweight system could be developed, and in view of your recommendation on April 17 of this year that phase I also be eliminated. Why were those recommendations not accepted at an earlier date, which in itself would have saved \$9 million?

Secretary LARSEN. This was an action that took place outside of the Army.

Mr. KARTH. Can you give any reason?

Secretary LARSEN. I cannot give any opinion.

Mr. KARTH. The committee becomes disturbed about some of these recommendations that are made for termination of, let me say, for lack of a better word, obsolete programs, programs at least that are not designed to meet the original objective, that they continue on after some responsible person or party or organization, recommends termination.

In this one instance I understand \$9 million additional was spent after this recommendation had been made by the Army.

This is correct, is it not?

Secretary LARSEN. We did make the recommendations at that time, Mr. Karth.

Mr. KARTH. Did you ever make any recommendations that you have some kind of survey team at the General Electric plant?

Secretary LARSEN. Rather than a survey team, I think you are talking about Army representatives at the General Electric plant.

Survey teams did go in, a number of them, both from the Department of Defense and the Army level.

We also requested that the Air Force, allow us to send in Army representatives to get information more readily on a continuing basis.

Mr. KARTH. Was this the result of what your survey teams had found out?

Secretary LARSEN. Indirectly. The survey teams had recommended direct control of the General Electric contract by the Army rather than

through the Air Force, and this was an attempt to get better, faster, more direct communication.

Mr. KARTH. What happened to this recommendation?

Secretary LARSEN. It was resisted at first, and I overrode the objections and in December of 1961, under my orders Army representatives did go into the General Electric plant.

Mr. KARTH. December?

Secretary LARSEN. Of 1961.

Mr. KARTH. What happened on that date?

Secretary LARSEN. Resident Army teams went into the General Electric plant.

Mr. KARTH. Is it because of the resident Army team that the recommendation was made in February and April that you discontinued phases I, II, and III?

Secretary LARSEN. I think not. No. The resident Army men simply gave us a better, more rapid flow of information, but the basic information on which those conclusions were made would, I believe, have come forth regardless.

Mr. KARTH. What was the purpose of the team?

Secretary LARSEN. General Johnston will be glad to answer.

General JOHNSTON. Sir, from the viewpoint of the project manager the teams performed a very desirable function in that they made available to him earlier, on a more timely basis, if you will, situations that conceivably were developing, both technical difficulties and funding difficulties.

In the history of the program in the past the project manager had been confronted with serious problems on almost after-the-fact basis.

Mr. KARTH. The team covered the purpose that I suggested then; that is, to better advise the Army as to the worthiness of the program at an earlier date. Isn't that correct?

General JOHNSTON. In an accumulative sense; yes, sir.

The information developed from the team was certainly a valuable input. We relied very heavily, naturally, upon the recommendations of the action agencies which I described.

Mr. KARTH. Prior to December 1961, when someone finally agreed your team should go in, who resisted the recommendation?

General JOHNSTON. There was an exchange of correspondence between the project manager and the Air Force. I believe the resistance is understandable and quite natural, from the Air Force viewpoint. They had the contract with General Electric, not the Army.

There are legal technicalities, if you wish to call them that, where the Air Force was concerned, that by the introduction of a third person the contractor in essence would be looking to two sources for his direction of implementation of the contract.

Mr. KARTH. Who was paying the bill, General?

General JOHNSTON. Directly the Air Force, but in a budget which was approved and handed to the Army by the Department of Defense, so that the Army was the program or project manager.

Mr. KARTH. It is rather confusing. May I ask this question: Who was responsible for the management of the Advent satellite?

General JOHNSTON. The Army had overall project management, sir, and looked to, as I outlined earlier, three action agencies through whom to execute this responsibility.

The Air Force in their Space Systems Division had the responsibility for the satellite vehicle with the exception of the communications package, but they were under the management, overall management responsibility and direction, of the U.S. Army Advent Management Agency.

Mr. KARTH. Do you think that the assignment of this team is one of the reasons that on April 17 and February of 1962, this year, you recommended termination of the program?

General JOHNSTON. Yes, sir; I would say that they did contribute information, certainly, which led to this ultimate determination and decision.

Mr. KARTH. Is it possible if the team had been in there sooner they might have sooner recommended this program be abandoned?

General JOHNSTON. I think not, sir, because there was parallel with these actions reflected to us the difficulties experienced in the Centaur program.

By "difficulties" I mean the reduction in the boost capability of that booster vehicle.

Mr. KARTH. Eighteen months after you had begun work on Advent it became known considerable progress was being made in spacecraft technology that was not being utilized by Advent.

Why wasn't something done about it at that time?

General JOHNSTON. I am not quite sure, sir, if I understand this. By "spacecraft technology," if you mean the development of the reliable traveling wave tube which—

Mr. KARTH. I assume that is one of the things Mr. Rubel was talking about; he said 18 months.

General JOHNSTON. Yes, sir. I believe I can—

Mr. KARTH. Work had been done on Advent. It was found considerable progress was being made on spacecraft technology and communications equipment.

General JOHNSTON. Yes, sir. I believe I can speak to that point.

Early in the development of the Advent project, and its objectives, the question of reliability came up.

It is essential that any satellite vehicle employ the most reliable components and systems that it is possible to produce, because you cannot maintain it once it is launched.

At that time a determination was made we would use triodes as opposed to the then in early development, traveling wave tubes (TWT). The TWT had not proven its reliability.

Later on, as the reliability of the traveling wave tube was more clearly demonstrated, we did give serious thought and consideration to procuring traveling wave tubes and employing them in the Advent program.

Mr. KARTH. When was that, General? Could you give us a date?

General JOHNSTON. As I recall, it was approximately June of 1961 that there was a discussion entered into with a developer for the purpose of coming up with just this, a reliable traveling wave tube. We do have a contract at the present time, which started July 1, 1961, the award was made June 29, 1961.

Secretary LARSEN. I might add, Mr. Karth, in your question you referred to John Rubel's statement that 18 months after—I am not quite sure "after what".

What was that, after the time the Army took over the program?

Mr. KARTH. It is after work had begun on Advent.

Secretary LARSEN. I am sorry.

Mr. KARTH. I am not sure.

Secretary LARSEN. If it is 18 months after the Army took over the program, that would be February of 1962, and that is about the time frame.

Mr. KARTH. Eighteen months after work had started on Advent. That would bring it into the middle of 1961.

General JOHNSTON. As a point of reference, I don't think we can identify Advent as such until some place in October, December 1958.

I believe late 1958. The first meetings that led to the technical development plan that became Advent were in October of 1958.

Mr. KARTH. Is Advent ready to fly now? Was it ready the day it was canceled?

General JOHNSTON. In our judgment, no, sir.

Mr. KARTH. What had to be done on the Advent satellite at the time it was canceled out, General, how many additional months of work would have been required?

General JOHNSTON. It was our estimate that we could have made a first flight in the first quarter of 1963. April—I am sorry—of 1963.

Mr. KARTH. So, if Centaur had been ready, Advent wouldn't have been ready, would it?

General JOHNSTON. Yes, sir. I believe Advent would have been ready. The question here gets back to the Centaur capability, sir.

The Advent vehicle weighed about 1,300 pounds. We were told Centaur cannot inject 1,300 pounds in the synchronous equatorial orbit.

Mr. KARTH. But at the time you canceled out the Advent program, it was a long way from being completed, was it not?

General JOHNSTON. As far as being fully tested, yes, sir. We could have made a flight at one time we were talking—

Mr. KARTH. If you would have worked for another 8 or 9 months, how much additional money would you have spent on Advent, General, to bring it to a successful conclusion?

General JOHNSTON. The level of effort discussed, sir, at the General Electric Corp., just on the satellite vehicle itself was approximately \$4 million a month, as Dr. Larsen has mentioned.

Another 6 months, \$24 million.

Mr. KARTH. You would have spent another \$24 or \$25 million?

General JOHNSTON. Yes, sir. This was a fact.

Mr. KARTH. On an obsolete piece of equipment, to finish its construction?

General JOHNSTON. No, sir. We would not have. This was one of the factors that led to the Army's recommendation.

Mr. KARTH. Even if Centaur had met its original schedule and capabilities?

General JOHNSTON. In that sense, we would have recommended carrying through the completion, yes, sir.

Mr. KARTH. So, you would have been ready to fly it in April of 1963?

General JOHNSTON. Yes, sir.

Mr. KARTH. I want to make sure I get this straight for the record. If Centaur had progressed as originally planned, you would have continued on the Advent program; you would not have recommended that you terminate phases I, II, and III, and you would have spent an additional \$25 million on it, so that it would have been finished in April 1963, and at that time, apparently, flown on Centaur, is that correct?

General JOHNSTON. Yes, sir.

Mr. KARTH. Can you tell me what the Army would have gained by pursuing this course?

General JOHNSTON. We certainly would have achieved, I believe, sir, had the total test been successful, a demonstration of the feasibility of a synchronous satellite to provide communications to the Army and to the Department of Defense, a satellite that would have a far greater communications capability than anything that we know of, a satellite space vehicle which might have application to other programs, but certainly if we could have carried the communications package that we have referred to as being obsolete, then we would have had a growth potential that would greatly exceed anything we know about today.

Mr. KARTH. At the same time you would have recommended you continue on with the lighter weight 500-pound synchronous satellite package, is that correct?

General JOHNSTON. I can't say that, no, sir.

Mr. KARTH. Would you have held this more modern package back just to complete the heavier weight?

General JOHNSTON. Not at all, sir. I believe that we would have improved our capability.

Mr. KARTH. You would have had to do them in parallel?

General JOHNSTON. Only the communications package, sir, not the spacecraft itself. I believe it is obvious that if we could fly a heavy spacecraft, certainly there are many utilizations that could be made of that weight capability to provide even more communications capability.

Mr. KARTH. Either the Advent that was terminated was a good vehicle or it wasn't. It was either obsolescent or it wasn't. It was either going to do a good job or it wasn't.

In your opinion, which one of those alternatives is correct?

General, was it obsolete or wasn't it?

General JOHNSTON. It is obsolete in the sense, sir, that from the standpoint of the communications package it is possible, using today's technology, to achieve the same or substantially the same communications capability using less weight, or involving far less weight, than in the Advent design.

This design was determined and it was frozen some years ago.

I cannot say that the other systems, those of the attitude stabilization, the solar paddles, the concept of injection into orbit, the concept of positioning the satellite, all of which are Air Force responsibilities and which in our opinion were progressing, I cannot say those techniques and technologies are obsolete.

Secretary LARSEN. Advent was obsolete only in weight.

In function, the older, heavier design would have done everything that a new, lighter system could.

Mr. KARTH. Let's say you had gone ahead and produced some of the heavy satellites so that you could fly them in April of 1963.

Wouldn't you have also gone ahead, or recommended that you go ahead, with a lighter weight vehicle, that would do about the same kind of a job?

Secretary LARSEN. We very probably would. However, it might have been a modification of the existing Advent satellite.

In other words, to replace the communications aspects of it.

We are talking about probable actions and cannot be certain about the exact technical details of these—I think it is quite possible that instead we would have modified the Advent vehicle to put the lighter weight communications package aboard and thus have a vehicle that was somewhere in between the 500 and the 1,300 pounds, or we might have been able to launch more than one satellite with the Atlas-Centaur.

Mr. KARTH. When do you expect the lighter weight vehicle to be ready, Doctor?

Secretary LARSEN. This is outside of the province of the Army. It has been removed from our jurisdiction. I prefer you ask the responsible people, Mr. Karth.

Mr. KARTH. Do you have any educated guess about when it would be ready?

Secretary LARSEN. I think it would be dangerous to make an educated guess, sir.

Mr. KARTH. Do you think the procedure that has now been decided upon and the assignment of responsibility is a good decision, on the part of the Department of Defense?

Secretary LARSEN. Unfortunately, I think neither the Department of Defense nor I could make an ideal recommendation—a really clean one here.

I think it is a workable answer.

It will have interface problems.

Mr. KARTH. Do you think it is better or worse than the one canceled out?

Secretary LARSEN. In my personal opinion, I think it is a better one.

Mr. KARTH. How about you, General Johnston?

You do not have to agree with the boss here.

Secretary LARSEN. He does not have to agree with me.

General JOHNSTON. Sir, when I became an Army officer some years ago I realized I was expendable. I have not changed my mind at all.

Mr. KARTH. You are doing pretty well, sir.

General JOHNSTON. I recognize, from my level—that is, the project manager's level—certain improvements in this relationship.

I believe sincerely that the Army, in implementing its responsibilities within the reoriented program, has a clear-cut mission, clear-cut responsibility, and much clarified directive authority to do its portion of the program.

As Dr. Larsen has pointed out, there are these interface problems I think that we may have some difficulty on.

The question in my mind is who is the project manager.

I really do not know, the way it is realined. Our relationships with the Air Force SSD, we have already initiated a program with them where we are interchanging information concerning the future program.

I think that in many, many cases we can work out the technical interfaces, but my concern is in those instances which may arise, as Dr. Larsen points out, where we cannot, where a detailed technical specification, against which both the Air Force on the one hand and we on the other, can work.

I just do not know who is going to do this.

Mr. KARTH. Weren't there some two or three different reports or studies that recommended the Army be given clear-cut management responsibility in this program?

General JOHNSTON. Yes, sir.

Mr. KARTH. Why weren't they carried out?

These were technical recommendations, were they not?

General JOHNSTON. No, sir. They dealt with management in large measure—management arrangements.

Mr. KARTH. But the recommendations were made by technically competent people, I suppose I should have said.

General JOHNSTON. Yes, sir.

Mr. KARTH. You do know why these recommendations were not followed out?

General JOHNSTON. I do not know, Mr. Chairman. I do not.

Mr. KARTH. Just to cap off the question I asked a few minutes ago: it is my understanding that the Army is satisfied with the new directive and the reassignment of responsibility in follow-on Advent program, is that correct?

General JOHNSTON. I would like to qualify my response to that by saying, if I may, we are satisfied in the sense that for our assigned role we probably have a clearer picture. I do not think we are satisfied in the sense we no longer have responsibility for the airborne communications package. It is a little difficult to design a communications system when you are responsible for one terminal and that is all. A cleaner interface would give the Army the total satellite responsibility as had been recommended.

Mr. KARTH. Do you think the management recommendations that have now been made will help or hinder the program?

General JOHNSTON. I think they can be made to work, as Dr. Larsen has said, sir.

Mr. KARTH. You do not think they will help, do you, General?

General JOHNSTON. I am afraid not.

Mr. KARTH. You really, personally think they will hinder; don't you?

General JOHNSTON. I cannot say they will hinder, sir.

I think it makes it even more difficult than it has been in the past.

Mr. KARTH. It is not as good, in your opinion?

General JOHNSTON. I felt that, because of the effort on the part of a lot of people, we were just about achieving a workable arrangement within the Advent program.

I feel it was unfortunate, purely from a management standpoint, that all of these efforts to achieve understanding and a management relationship that was workable were overtaken by events on the

technical side and that it was decided to make a major reorientation in the management relationships because of our inability to perform on the technical side.

Mr. KARTH. General, let's get down to specifics.

The DCA doesn't have this capability to properly manage the interface, do they?

General JOHNSTON. To the best of my knowledge and belief they do not. They are in the process of trying to establish it now.

Mr. KARTH. How long do you think it will take to acquire it?

General JOHNSTON. I would estimate 6 months at the earliest and this I base on the Army Advent Management Agency experience. It took 6 months approximately.

Mr. KARTH. A 6-month delay then will be reflected in further delay in the program, will it not?

General JOHNSTON. I don't see—

Mr. KARTH. Maybe not the full 6 months, but it will cause some delay, will it not?

General JOHNSTON. In my personal opinion, it will, sir. It will contribute to that.

We had a reorientation directive May 23, I believe, and are still waiting for program definition. It is now the 15th of August.

Mr. KARTH. We have some five communications satellite programs going in NASA and the Department of Defense now.

Is it necessary, General, to have that many programs going in parallel with each other, at tremendous cost, in the R. & D. phase, when probably one or two of these programs would serve the purpose?

General JOHNSTON. I feel, sir, that it is essential that we have a military communications satellite system.

The only superficial overlap that I am aware of is between the Advent and the Syncom programs, both of which were aimed at a synchronous satellite.

In the case of Syncom, which is a NASA program, the Department of Defense is participating in preparing the ground complex and in planning and conducting the communications test.

In the case of Syncom the satellite is employing a spin stabilization technique.

Mr. KARTH. That is NASA's program.

General JOHNSTON. Yes, sir, it is, which is quite different from the stabilization technique that was visualized in the Advent program, which is a three-axis stabilization effort.

I am led to believe by the scientific community that both of these approaches should be pursued before one can make a finite determination as to whether spin stabilization is better than three-axis stabilization.

The others are low orbit or are passive, and here again superficial duplication occurs between Telstar, which is a commercial development, A.T. & T., and Relay, which is NASA.

These were in essence conceived in the same frame and pursued on a parallel course.

Mr. KARTH. Assuming, General, that the military does need a separate system for their own use, do you think it is necessary that we have so many research and development dollars being spent on this kind of a program by two different agencies of the Government?

General JOHNSTON. In my opinion, sir, there has been a free interchange of technical information between the Department of Defense and NASA.

I have spoken to the one duplication of which I am aware. I say this is superficial. As one analyzes the technical parameters of the two systems, these are quite different. They are both attempting to come up with a synchronous orbit communications satellite. One uses a spin stabilization technique.

Mr. KARTH. How far down the road do we have to go on these two programs to find out which one is better, General?

General JOHNSTON. I can't answer that positively, sir. I believe it would be after the feasibility demonstration and after the actual test results have been achieved and can be analyzed.

Mr. KARTH. What is the estimate of cost of the DOD synchronous satellite system at this point.

General JOHNSTON. In the reoriented program, sir?

Mr. KARTH. Yes.

General JOHNSTON. I have no knowledge. I do not know, sir.

Mr. KARTH. Do you have any judgments on it, on the cost of it?

General JOHNSTON. Sir, we were talking in terms of approximately \$400 million for the Advent program.

It is my personal opinion that the DOD communications satellite program, the synchronous system, could not be achieved for less than that.

I do not know precisely what their thinking is.

Mr. KARTH. Over \$170 million has been spent already, has it not?

General JOHNSTON. Yes, sir.

Mr. KARTH. How much of that \$170 million can be used in the re-oriented lighter weight Advent program?

General JOHNSTON. We estimate, sir, that in the booster vehicle area—and here again this is purely and simply the project manager's estimate, this is not the Air Force estimate—the assets were two Atlas-Agena vehicles which were substantially complete. We had expended \$15.4 million. We estimate \$12.9 million is a usable asset and could be applied to any future program.

In the case of the tracking, telemetry and command system, which is a four-station system and is now being completed, \$12.5 million had been expended.

We feel that approximately \$12 million is certainly a usable asset that can be applied to future programs.

As a matter of fact, one station is presently in operation and is supporting existing space programs.

On the communications side, which includes the ground terminals, at Fort Dix and Camp Roberts and the shipborne terminal, as well as the airborne communications package, which we feel is in large measure not a usable asset. We certainly can test it, continue to test in the thermal vacuum environment and derive scientific information. For a total of \$54.1 million expended we feel \$40.3 is a usable asset, and essentially this is in the ground or the surface terminals.

On the satellite vehicle, here again, simply the project manager's estimate, of the total of \$74.8 million expended, we feel something on the order of \$15 million is a usable asset.

Some of this includes facilities—thermal-vacuum test chambers, et cetera.

Now, again, we are unable to put a price tag on the scientific data that will be derived from a testing of the systems—the sensor packages that were designed to be aboard the satellite, and from the exhaustive tests, that can be performed on these component subsystems.

Mr. KARTH. So approximately \$78 million of this first Advent experiment is lost, is that correct?

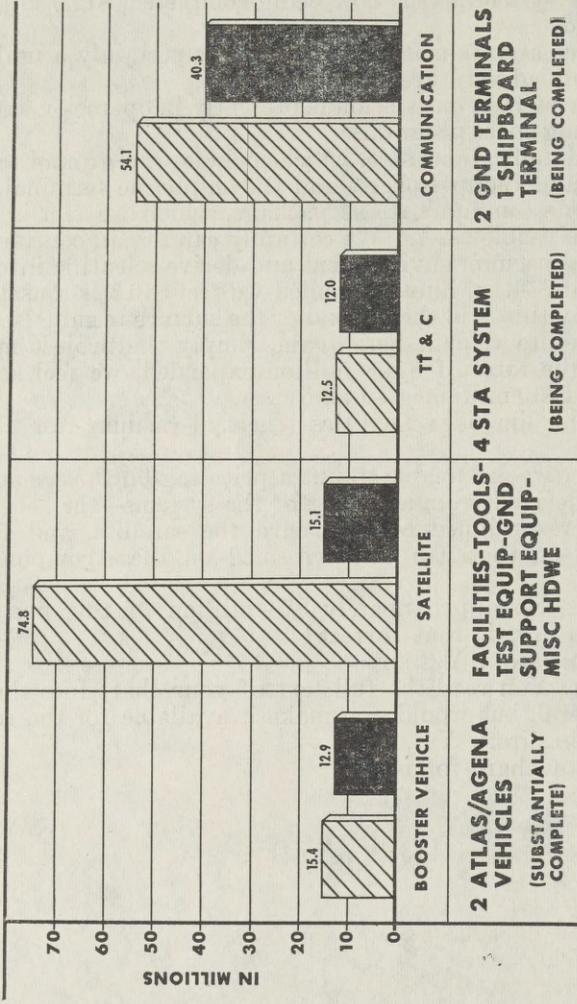
General JOHNSTON. Yes, sir.

Mr. KARTH. You read the full text of your chart into the record, I think, General, but would you make it available for the record?

General JOHNSTON. Yes, sir.

(The text of chart follows:)

ADVENT ASSETS



**TOTAL FUNDING
FY - 59 THRU FY - 62**
Does not include \$15.4 million operating costs and supporting research

VALUE OF ASSETS

Mr. KARTH. What about the low-orbit systems that research and development dollars are being spent on today by two different agencies of the Government and by private industry? How do we justify the expenditures of these funds on programs in parallel?

General JOHNSTON. The only low-orbit systems that I am aware of, sir, are the passive type, Echo and Rebound, both of which are NASA programs. Relay, I mentioned, was an active type. This is a further NASA program.

Then the newly reoriented Department of Defense communications satellite program does contemplate a low-orbit system.

So it would be that one as opposed to the other three.

Mr. KARTH. How do we justify these programs?

General JOHNSTON. I am not familiar with Relay in great detail, sir. It is essentially similar to Telstar, however. The military communications satellite system that is envisioned will have a greater capacity than is contemplated in Relay, as I understand it.

Also it must meet operational considerations that do not exist in the other system.

Mr. KARTH. But those operational capabilities could be built into a commercial system, could they not, General?

General JOHNSTON. From a technical standpoint they could be. If this were contemplated early enough in the design stage to take these things into account; yes, sir.

The ground complex, I would have to say "No."

Mr. KARTH. No. I think I agree with you on that. I am talking about the satellite itself.

General JOHNSTON. Yes, sir.

The satellite vehicle; yes, sir.

Mr. KARTH. The reason I am a little confused—today we have one communications system in this country which takes care of all requirements, whether military, DOD, and so on.

I am just wondering why this cannot be done for a communications satellite system.

If we can do it with a ground system why can't we do it with the satellite system?

Why don't we move in this direction? Why don't we request these people who are talking about and doing research and development on commercial systems to build in the particular capability that the military needs and some of the other requirements of the military? Why don't we do this and save our research and development dollars, or a substantial portion? That \$400 million is a lot of money, General.

General JOHNSTON. Yes, sir.

Mr. KARTH. I doubt if it will stop there.

Why don't we do this?

General JOHNSTON. As I said, sir—

Mr. KARTH. Why not try to have these capabilities built into a commercial system?

General JOHNSTON. From the standpoint of the satellite vehicle I believe it is technically feasible.

I am sure you are aware there are different frequencies we operate on, different modulation techniques that are necessary.

Mr. KARTH. Yes, sir. You could use two wavebands in the same frequency range.

General JOHNSTON. Yes. If this is brought out early enough in the design phase I know of no technical reason this could not be done.

With respect to the ground terminals, this is a totally different problem.

Mr. KARTH. I understand that.

General JOHNSTON. Yes, sir.

Mr. KARTH. Has there been any negotiation, or any meetings, or any suppositions along this line made by the Department of Defense to the Telstar people or to NASA, to your knowledge?

General JOHNSTON. Yes, sir. Recently in the case of Telstar the Air Force proposed the leasing of two ground terminals so that the Department of Defense might derive some operational experience and benefit of working against that satellite.

This is under active discussion at the present time with the Defense Communication Agency, ourselves, and the Air Force.

I am not aware at the moment of the exact stage of these discussions and negotiations, but I do know they are taking place.

Mr. KARTH. While this is going on there is no thought in the mind of the Department of the Defense to, shall we say, curb their own program, for which we are spending many research and development dollars, is there?

General JOHNSTON. No, sir; not that I know of.

Mr. KARTH. There are no negotiations going on at this time which might lead to an arrangement to utilize a commercial system to the full extent possible, which would negate the need for a separate military system?

General JOHNSTON. No discussions of which I am aware, sir. I am a project manager and just look at one project.

Mr. KARTH. How about you, Doctor?

Secretary LARSEN. I am not aware of any either.

I would like to simply state, however, that in fair considerations of whether or not a commercial system could also be used as a military system, I think we have to consider the total traffic, or the total volume of messages that any satellite might carry.

I presume that the Telstar and commercial satellites that will follow it will be designed to handle the amount of traffic that is expected during their own lifetime, and to add a military capability to it would make it appreciably larger.

I do know that the capability, the number of channels—there were four channels contemplated in the Advent program—were considered as being required for peak military loads.

So all that I am saying here is that I think there is an additional consideration, and that a study might reveal that it is no more costly to place two into orbit than it might be to place one considerably larger one.

Mr. KARTH. The military needs would be characterized by relatively low capacity, very few voice channels; isn't that correct, sir?

Secretary LARSEN. That is substantially correct.

Mr. KARTH. Would not the rental of a few channels on the commercial system be much cheaper?

Secretary LARSEN. If a few channels were rented, as we have already alluded to, they would have to be protected against jamming; they would also have to be protected against saturation.

In other words, if they could be used by anyone within sight of the satellite they might be subject simply to being garbled by sending noise or other messages through those same channels.

Mr. KARTH. It looks today as if project West Ford, or one of its type, is about the only jamproof system that has been developed, isn't it?

General JOHNSTON. Certainly we are following the West Ford approach with a great deal of interest, Mr. Chairman.

It does offer many technical advantages. I do not feel that we can go into an exhaustive discussion of this subject at an open session.

Mr. KARTH. I don't want us to get into any classified information in open session, you use your own good judgment, you are the expert on that. My point in asking the question, general, is this: I am not aware of any method presently developed which would make an active satellite system of the type that we are spending research and development dollars on jam proof.

General JOHNSTON. I think I must agree with that statement in general, sir. No system is jam proof. Some would be more resistant than others through the application of certain techniques such as have been developed under the Advent program.

Mr. KARTH. I am trying awfully hard not to get into this area of classified information, General.

General JOHNSTON. Yes, sir.

Mr. KARTH. Certainly this added resistance that may be built into a system could be built into a commercial system, could it not?

General JOHNSTON. From the technical standpoint, yes, sir.

This is a possible determination that could greatly increase the cost.

It might greatly increase the cost. There is the question of control, that Dr. Larsen has alluded to. There are all these other parameters that I believe would have to be examined to make such a determination, sir.

Mr. KARTH. Mr. Downing?

Mr. DOWNING. General, was your office aware of the stage by stage progress of Telstar?

General JOHNSTON. We had a general awareness of this, sir.

Stage by stage, if you mean in detail, I think not. We visited the developers on different occasions, we had technical discussions on different subsystem areas.

In that sense we had a general awareness of the development progress, yes, sir.

Mr. DOWNING. Does the same thing hold true with Relay?

General JOHNSTON. Yes, sir.

Mr. DOWNING. In your management chart I don't see any liaison with NASA. Is there such liaison?

General JOHNSTON. Yes, sir. We had a liaison with NASA but through a separate committee, which did not show on that chart.

Mr. DOWNING. How good actually is this liaison?

Is it just a body with a name that does nothing or do they actually get into the meat of the situation?

Can they make decisions?

General JOHNSTON. The greatest exposure I have had with NASA has been in one particular project, which is in Syncom.

In that area they can and do make decisions. They are considered the project manager and we respond to them.

In the case of the Centaur coordinating committee, to us as a project manager, this committee was a source of information. They kept us generally apprised of the development status of the Centaur vehicle.

So we looked to it purely as a source of information as distinct from a decision making body affecting us.

Mr. DOWNING. It seems to me that you have various agencies trying to accomplish basically the same goal with not too much liaison between these agencies as to the progress?

General JOHNSTON. We have a technical Committee on Communications Satellites, sir, which is under the chairmanship of a member of the Advent Management Agency.

Certainly this provided a desirable coordination. We have had NASA participation, as I mentioned in the Syncom program. We certainly have kept them apprised of our status in the Advent program.

Mr. KARTH. Will the gentleman yield?

Mr. DOWNING. Yes.

Mr. KARTH. Is NASA building into their Syncom program any of the military requirements that you have spoken about moments ago?

General JOHNSTON. Not at the present time, no, sir. Not in this stage of development.

Mr. KARTH. Have you asked NASA to do that?

General JOHNSTON. We have the responsibility for the ground terminals, sir.

We initially looked forward simply to the communications demonstration itself. As an outgrowth, if you will, of the Advent program, we are covering the other features—such as antijam capabilities—which could be added to the Syncom ground terminals.

So in that sense we are aware and are continuing a parallel basis. We have not asked NASA to do this for us.

Mr. KARTH. Have you thought about it?

General JOHNSTON. The exact employment of the future Syncom capability I do not know about, sir.

This is an operational employment. We are concerned here with a R. & D. demonstration of technical feasibility. We are just beginning now discussions with the Defense Communications Agency which has the operating responsibility.

We are pointing out to them the capabilities and limitations of these systems so that they in turn can begin a consideration of operational employment.

Mr. DOWNING. In the Advent program did you come up with the satellite itself?

Do you physically have the satellite?

General JOHNSTON. The Army Advent Management Agency, sir, was responsible for the total program. In that sense the Army Advent management program agencies were responsible for the satellite.

As I pointed out, sir, we had three action agencies. We looked to the Space Systems Division of the Air Force as being the satellite developer.

They held the contract, they were the developer, they were in essence the project manager under ARPA before the program was transferred to the Army.

Mr. DOWNING. We do not have a physical satellite as a result of your program—the hardware?

General JOHNSTON. I am sorry, I misunderstood the question, sir. Yes, we have the orbital test vehicle and an engineering test model.

Mr. DOWNING. Are they ready to fly?

General JOHNSTON. No, sir; not at this point in time. Still undergoing tests. One vehicle is assembled. This is undergoing continuing systems or subsystems tests.

Mr. DOWNING. Are you going to continue work on this hardware?

General JOHNSTON. Only in the sense, sir, that we wish to complete a certain limited testing program so that we may button this up and derive the maximum benefit from the funds that have been expended on the satellite development.

Mr. DOWNING. Is it your plan to eventually hoist that vehicle?

General JOHNSTON. No, sir, it will not fly.

Mr. DOWNING. General, this is a broad question:

What, in your opinion, would be the best management system for future communications satellites?

General JOHNSTON. I think, sir, that—

Mr. DOWNING. Where would you place the interface?

I don't mean to back off of my first question. I realize it is a difficult question to answer.

General JOHNSTON. Right, sir. In my opinion—and I would like to qualify it as just my own opinion—this should be undertaken by a joint agency.

I think it should be under the Department of Defense. I feel that all three services of the Department of Defense stand to benefit greatly from the early attainment of this operational capability.

I think in that respect in the realignment of the program it is probably correct to put it under a Department of Defense agency.

Mr. DOWNING. Why do you say DOD rather than NASA?

General JOHNSTON. Well, I happen to be in the Department of Defense, sir. With all due respect to NASA, I feel that there are many implications, many requirements, that we have that are understood pretty well, and we would have an educational process, I believe, were it the other way.

Likewise, you get into the question of budgetary controls, funding, programing, a thousand and one normal procedures that we must follow.

So I believe that the benefit is to keep it where it is, within the Department of Defense.

I do not wish to be misunderstood. I said earlier and I say again, the management relationships we had hammered out over the months that the Advent Management Agency was in being in my opinion were just beginning to show fruit when we ran into these serious technical difficulties which led to the major reorientation.

Mr. DOWNING. The record would indicate that some reorientation was necessary because nothing had been accomplished in this 4 years?

General JOHNSTON. Yes, sir.

Mr. DOWNING. I don't say that critically. I know these things are hazardous.

Mr. KARTH. General, if I may interrupt, you are a project manager. Will you give for the record what you think would be the best man-

agement system in the communication satellite field, in your opinion?

General JOHNSTON. I feel that, as I mentioned, sir, the best management arrangement would be to give someone in the Department of Defense a total capability.

Not only responsibility but also the authority, with a project staff, and have him run this program. When I say run it, I mean just that.

I feel that it would be necessary for him to have a direct contractual relationship with the contractors who participated in the program as opposed to dealing through action agencies.

Mr. KARTH. Do you think that someone in the Department of Defense should be the Army?

General JOHNSTON. Well, I am a little prejudiced, of course. I think that the Army certainly has had experience in this area.

I am sure the Air Force and Navy have as well. I don't think this is important. It must be a truly joint project office.

Mr. KARTH. Where would you put the interface?

General JOHNSTON. The interface I felt was not properly placed before, sir, where the communications satellite was an Air Force responsibility. They have, I think, demonstrated proficiency in the launch, the placing in orbit, of the satellite vehicle itself.

The communications satellite I feel is a different story. This thing must work with the ground terminals.

I believe that it is logical to have both under the development of the same organization. In the earlier efforts in Score we did not have an interface problem because the Air Force provided the vehicle and launched and the Army made the communications package and put it abroad.

Mr. KARTH. You think that is the best system?

General JOHNSTON. Yes, sir, I do. Such as in the case of Courier, where the Army developed not only the communications package but the satellite vehicle as well.

But in my own judgment it is important that the developer of the ground complex develop the communications satellite.

That is my only personal unhappiness with the new arrangement.

Mr. DOWNING. Then if it is placed under DOD under a specified command you would have coordination between the various military agencies—Army, Navy, and Air Force—would you not?

General JOHNSTON. Yes, sir.

Mr. DOWNING. But you would not necessarily have the same liaison with NASA and with outside independent research?

General JOHNSTON. I don't view this as a limitation, sir.

I believe that we would have the same access to outside research and to NASA through the established subcommittees or through special working groups that could be set up that we have now. We have the same opportunity at least to do this.

Mr. DOWNING. Somehow I don't believe it is being used effectively today. It may be set up.

General JOHNSTON. Again, sir, in my own experience, I must qualify it to that degree, the only direct contact that we have had with NASA, the most direct contact, rather, has been in the Syncom program. We have a close relationship. We have a monthly working meeting with them.

In the case of the other committee here, the Centaur coordinating committee, this is simply information, as I mentioned, to us. I believe machinery does exist and to my knowledge it is being used.

Mr. DOWNING. It seems to me, General, although my knowledge is limited, that if you ran into a problem on your satellite, why would you not feel free to go to NASA and say, "Boys, can you give me a little help on this problem," and they have highly skilled technically trained people over there who could probably help you, and you could go back to your garage and start work again.

General JOHNSTON. Right, sir.

Mr. KARTH. What would be wrong, General, with your having several monthly meetings or, even daily meetings, with NASA, that is between NASA and some of your technically qualified people in the communications satellite field and give all of the responsibility for research and development to NASA?

Wouldn't that provide us with better cooperation, coordination, better liaison? The two agencies of Government going somewhat in the same direction and having monthly meetings on what each one has found out in the last 30 days or so could be mutually helpful.

Why can't we have an integrated team of Department of Defense and NASA people?

I do not care if they come from the Army, Air Force or Navy, but people who are expert in this area, working with the NASA team in research and development on the active communications satellite program? Would not this be better?

General JOHNSTON. I cannot say that it would be better, no, sir. I believe that it could be done. Certainly this gets back in my opinion to a question of roles and missions.

NASA is predominantly on the civil or civilian side, and in the development area, if you will, and certainly we meet with them in many, many technical areas.

Some of these are formalized meetings, which is what I was speaking to earlier, many are not, they are simply working relationships, where one of our people goes to the NASA headquarters and discusses with them on an informal basis.

Mr. KARTH. Mr. Downing's point is we should have a better working relationship in this area than we now have.

Let's integrate it more fully and more completely so that we can have a cooperative effort rather than a duplicative effort.

General JOHNSTON. I certainly cannot argue with that objective, sir.

Again I must explain that I am not aware in complete breadth of the current relationship, only in the area where I have had responsibility have I had the chance to observe it, and I would say in that area our working relationship with NASA has been very good and has been very close.

Mr. KARTH. This could be made to work, could it not, General?

General JOHNSTON. I think it could be made to work.

I am sure that any of these arrangements that we have, bringing together the different agencies, different capabilities, can be improved.

Geography gets in the way sometimes. It has turned out to be a difficulty in our Advent programs, where the Space Systems Division is on the west coast, while we were in Fort Monmouth.

It meant our people or theirs were constantly traveling to achieve these meetings that we felt were so essential.

Mr. DOWNING. Thank you, General. I think you have made a valuable contribution.

Mr. KARTH. General, in your opinion, would the best solution to this whole interface problem be to have the interface between the booster and the satellite package?

General JOHNSTON. Yes, sir.

Mr. KARTH. Mr. Hammill?

Mr. HAMMILL. One question which the chairman asked, and I would like to follow up, General, is the question of the justification of the second Advent program under the reoriented program—that is to say, the medium altitude satellite program.

How do you distinguish this proposed program from Relay and Telstar?

Is this designed to fill a military requirement?

General JOHNSTON. As I understand it, the objective of the program is to continue R. & D., leading to an early operational capability. That is, developing a capability for an operational prototype early.

The proponents of the medium altitude system claim it offers promise of being achievable in an earlier time frame than is the synchronous system.

Mr. HAMMILL. Will it fill a military need?

We understand that the military is shooting for a worldwide system. A medium altitude system would require some 30, 40, perhaps 50 satellites and very complex ground stations all over the world to get this kind of coverage.

General JOHNSTON. This is correct.

Mr. HAMMILL. Now, why would the military be interested in having something like that, and how do you distinguish it from the two development programs that NASA has undertaken some time ago and which are in a fairly advanced state?

General JOHNSTON. I think I can answer the first part of the question and not the second.

The military does require this operational capability as soon as we can achieve it, recognizing that we will not have an ultimate system the first attempt. We must work toward the total worldwide system. Certainly some critical key areas would have to be served in the initial system.

As to why the Department of Defense is pressing forward with this particular concept, a medium altitude system, I do not know. This was not proposed by the Army.

Secretary LARSEN. Advocates of the multiple-satellite medium altitude system feel that there would be multiple communication paths. In other words, if one or several satellites are out, or if one or several satellites are jammed, there is a specific advantage to the fact that the remainder of the system can work. In fact, it may be possible to communicate from one point, point A to point B on an alternate route. I think these are the most significant reasons given by the advocates of the system.

Mr. HAMMILL. Does the Department of Defense contemplate going into the development of an operational medium altitude system that would involve some 40 or 50 satellites and all of the very complex ground stations dispersed around the world?

Secretary LARSEN. I am sure that—now I am speaking for the Department of Defense, and cannot officially do so, of course—but I feel quite confident that the Department of Defense level would want to test and evaluate a system thoroughly before it would aim toward an operational system and before it would plan such a system.

Mr. HAMMILL. I am just wondering whether or not the research and development problems involved in this kind of system won't be solved by the Relay and Telstar efforts which, after all, are research and development programs themselves in this same general area?

Secretary LARSEN. I am sure each of these will contribute some knowledge, some additional information, to an entire system.

I do not think it likely Telstar would give one a thorough evaluation of a low-altitude multiple-satellite capability.

Mr. KARTH. I would like to announce that we will recess at 12 o'clock and that we will reconvene at 1:30 p.m.

General Schriever would find it a great convenience if he could be heard this afternoon at 1:30. So the committee will accommodate General Schriever in that regard.

Mr. HAMMILL. Dr. Larsen, if it is true that the military requirements can be built into a commercial system, from a technical standpoint, and if it is not yet known whether any such suggestions have been made, or whether the Department of Defense has looked into it at all, I wonder whether the committee might be informed as to the possibility of this; that is, if the Department intends to pursue this possibility and what the problems involved are?

Secretary LARSEN. I am sure that the Department of Defense will be very glad to inform this committee and undoubtedly will be willing to make a study which would thoroughly explore the point and be very happy to inform you of the results.

I might add—and I don't do this from an argumentative sense—but the additions to a commercial satellite which would be required for military employment essentially would mean that the result would be a military satellite.

Mr. HAMMILL. It may be that in time of war the Department of Defense might feel obliged to preempt a satellite system for its exclusive use, just as it might some other communications facility.

Secretary LARSEN. I see. You are thinking of dual use.

Mr. HAMMILL. That is right.

Secretary LARSEN. Right. There is a difference in frequency, of course. There are different frequency allocations for military and civil use, as you know.

Mr. HAMMILL. This could be built in, though?

Secretary LARSEN. It could be one channel for military, for example, and one for civilian use.

Mr. KARTH. Is it the intention of the Department of Defense to have a separate satellite system in operation?

Secretary LARSEN. That has been the intent.

Mr. KARTH. I can see some sense to doing research and development work so as to answer the problems that the military see in a satellite communications system and to build those answers into a communications system, but I was not aware of the fact that the Department of Defense anticipated building their own 365-days-a-year communications satellite system.

Secretary LARSEN. That has been the expected goal of the research and development program. No funds have been committed, no final decisions have been made, but in general we would not begin a research and development program unless it did answer a military requirement.

Mr. KARTH. Yes, but to build this requirement into a commercial system rather than to spend large amounts of dollars into a separate system?

Secretary LARSEN. Well, as I answered Mr. Hammill, I am sure the Department of Defense will be very pleased to look into the technical possibilities of it.

Mr. KARTH. I understand that the Department of Defense has adopted a policy on this. If I could read, just very briefly, it seems to me that this question has been answered, and that is why I am somewhat amazed to find out that you were thinking in terms of two separate satellite systems.

In the first place, I understand that you have to use this system rather frequently or it becomes inoperable, and as Mr. Hammill has suggested, in times of peace, when you do not have the requirements for extensive usage for it, we may find this thing is just a bunch of hardware and really is not serving the purpose for which it is intended.

The Department of Defense policy uses this language:

By furnishing private enterprise technical specifications and prospective circuit requirements necessary to meet long line military needs. In general, to apply the same policies to satellite communications as to other long line communications.

This pretty much seems to wrap up the answer to my previous questions and the question of Mr. Hammill?

Secretary LARSEN. I don't believe it is quite that conclusive. It is the policy of the military departments to use commercial long lines and commercial radio and telephone systems.

They do use them a great deal.

In addition to that, we presently have militarily controlled world-wide communications systems. They are required in the event of an enemy attack.

They must be ready all of the time to make sure, for example, that our Strategic Air Command can be given the word to go.

And the same concept is behind a satellite system, that it would replace the military communications system which does exist.

Now, it supplements the normal utilization of the military departments of the commercial communications system.

Mr. KARTH. We are not in disagreement on the need, Dr. Larsen.

Secretary LARSEN. I am sorry.

Mr. KARTH. I agree that the Department of Defense has a military requirement in the field of satellite communications. I think probably what we are attempting to explore today, and maybe even voice our opinion on, is whether or not there should be two separate systems, a commercial system and a military system, both with orbiting satellites, on a continuous basis.

Secretary LARSEN. I understand.

Mr. KARTH. As I understand the policy, and it may be that the policy has been changed since the NASA authorization hearings.

Secretary LARSEN. I am sure there is no change in the policy.

Mr. KARTH. I understood you to say that the Department of Defense is pursuing the course to establish a separate communications satellite system.

Secretary LARSEN. I said that had been the intent of the Advent program.

Mr. KARTH. The policy says "No decision to establish a particular operational system has been made by the DOD."

Secretary LARSEN. That is correct.

Mr. KARTH. This is why I was somewhat thrown for a loss when I thought you indicated this decision had been made.

Secretary LARSEN. No. I am sorry. I should not—in fact, I thought that I did say that a decision had not been made to build an operational system.

I simply said it was a normal outcome of a research and development program.

Mr. KARTH. But the intentions are there?

Secretary LARSEN. I believe it had been the intent, yes.

Mr. KARTH. Mr. Boone?

Mr. BOONE. I don't believe, Mr. Chairman, that the uniqueness of the military system requirements have been fully explained, that would preclude the use of a commercial satellite for military use. It seems there is something particular about the military requirement that would preclude the use of a commercial satellite, other than, say, frequency authorizations, and with the traveling wave tube, or the other system that you suggest—certainly you can change frequency in the satellite.

Maybe you would like to explain.

General JOHNSTON. I assume we are talking only of the satellite and not the ground stations.

Mr. BOONE. The military ground complex would be required regardless of which system is ultimately used.

General JOHNSTON. Yes.

Mr. BOONE. They would be identical, or essentially so?

General JOHNSTON. Yes. Here again we get into the question of control, if I may use that word, of overall systems. Often the commercial system would have U.S. terminations but oversea termination belonging to some foreign nation.

If we had another Lebanon we would like to be able to deploy a transportable satellite station to tie Lebanon to worldwide communications.

We must control both terminations.

Mr. BOONE. In the case of the synchronous satellite the transmitted information is available to anyone who has a receiver?

General JOHNSTON. Yes, sir. But because of techniques employed in the ground stations, this would not be understandable.

We have dealt with the ground station.

Now I think we can go up to the satellite.

Mr. BOONE. This means a duplicate ground station in some foreign country could still receive the information and use it with or without the knowledge of the foreign country?

General JOHNSTON. No, sir; this is not right.

They could get a signal from the satellite, but not the information.

Mr. BOONE. So you do not really have to have foreign countries' concurrence, do you?

General JOHNSTON. On the contrary, the way we have visualized control of a system I feel we would have to control the ground terminal.

You get into the question of security—I mean physical security—foreign nationals are involved in the civil network.

I think from the standpoint of the security of the traffic we would have to have these operated by U.S. nationals and preferably military.

With respect to the satellite, sir, I believe it depends here in large measure upon whether we are discussing a synchronous system or a low altitude system.

For example, from a military standpoint, to use Telstar—and I don't mean to be critical of Telstar—at the present time, with only one satellite in orbit, this provides a very limited capability to any military commander, either here or overseas.

He would have to schedule his emergencies to meet the availability of the satellite.

If one expands this into a complete system you have a more reliable dependable available capability.

We would have to have that. This must be instantaneous. It must give from the command and control standpoint an instantaneous capability. The synchronous system is there, assuming that we had the three or five synchronous satellites that we feel would be necessary. This is there, as you point out, and I believe would satisfy this criteria of constant availability.

But one does have to consider the other criteria, reliability, the responsiveness to military control.

I think the chairman touched upon that when he said that some of these facilities could be provided exclusively for civil use, others exclusively for military use.

I think all of these things would have to be examined, as Dr. Larsen suggested.

Mr. BOONE. From your previous testimony, General, don't you really think the synchronous satellite is the one you would like to go to?

General JOHNSTON. Yes, sir.

Mr. BOONE. And the optimum system?

General JOHNSTON. Yes, sir. There are many, many benefits to be derived there. I think there are also many problems that must be overcome before we get there.

But this I believe, and a substantial number of people share this opinion, does offer the greater promise.

Mr. HAMMILL. From what you have said about the necessity for controlling the ground stations, the terminals at either end, does not this render a medium altitude system unworkable from a military standpoint, because it would mean constructing some very expensive and complex movable antennas all over the world.

General JOHNSTON. This is certainly right, Mr. Hammill, in these areas that you wish to provide this service you would have to have a transportable ground terminal that you could move in there at will.

Secretary LARSEN. He asked if it is impossible.

General JOHNSTON. No, I would not say it was impossible. It depends on the magnitude of the system.

If you are going to provide an initial capability utilizing—well, the example I gave earlier of Lebanon, a remote area—it would be entirely

possible to have a terminal which would be deployed to that area and which could provide a communications capability.

Mr. HAMMILL. These ground stations for medium altitude systems are extremely complex. They must have the capability to track the satellites.

The Telstar horn in Maine gives us some indication of how complex they are. This is not the sort of thing you put on a truck and move around to Lebanon.

General JOHNSTON. You are correct. We would not visualize anything as complex as the Telstar horn.

Our thinking is on a much more modest scale.

Certainly the stations that we have created at Fort Dix and Camp Roberts we consider R. & D. tools. They are much more precise than would be required—in their tracking capability—than would be required in the antenna design for an operational system.

Nonetheless it is a very complex thing, I certainly agree with you, and in the medium altitude or intermediate altitude system one requires more than one antenna.

Mr. HAMMILL. Yes. We might require as many as three antennas at each ground station to track and pick up satellites as they come up over the horizon and then move out of sight over the other horizon.

General JOHNSTON. Yes.

Mr. HAMMILL. So it seems to me that it is a little difficult for the military to justify this aspect of the reoriented Advent program, frankly.

General JOHNSTON. I believe, as I mentioned, Mr. Hammill, the proponents state the early achievability of a communications capability, using the intermediate altitude technique, is what makes this attractive. The satellite itself is much less complex. The complexity is on the ground.

Mr. KARTH. Mr. Boone?

Mr. BOONE. Aren't you in effect starting a new satellite program? Although I think you said you could utilize \$15 million of the old Advent program. This is ground equipment.

General JOHNSTON. The figure was much more than that for the usable assets in ground equipment.

Mr. BOONE. It was \$15 million for the bird?

General JOHNSTON. Yes. For the satellite.

Mr. BOONE. Yes.

General JOHNSTON. Essentially correct. We would hope to build upon what we have learned.

By "learned" I mean in the proving out of reliability of parts, some of the subsystems, sensors, things of this nature. But essentially it is the initiation of a new communications satellite program.

Mr. BOONE. It could be fraught with the same interface problems as Advent has had up to this point?

General JOHNSTON. Yes. If you mean in the technical areas, I think here with each successive program we have learned something, certainly we have learned from Telstar; we expect to learn from Syncom; we expect to learn from our past Advent exposure.

Many of these things have not been resolved. That is why we are in R. & D.

Mr. KARTH. Any further questions?

If not, Dr. Larsen and General Johnston, I want to thank you very much for coming.

Unfortunately, we always run out of time too quickly. I sometimes have a feeling you do not have the opportunity to fully express your opinions, and we do not have the opportunity to ask you all of the questions we would like to ask you.

But I do want to thank you for appearing here this morning and giving us the benefit of your knowledge and views.

If there is anything you would like to add, for the purpose of completing the record later on, anything that might amplify some of the answers you have given, or some of the statements you have made, please feel free to do so.

Secretary LARSEN. Thank you, Mr. Chairman. We appreciate the courtesies you have given us.

Mr. KARTH. We may also have a question or two that we would like to submit to you, Doctor.

Secretary LARSEN. We will be glad to respond, of course.
(The following was submitted for the record:)

ADDITIONAL INFORMATION ON ADVENT

The Advent program was conceived as a development effort, with a direct application to operational systems, to provide techniques and equipment for a synchronous equatorial orbit communications system. The Telstar program is an experimental program to test a medium orbit satellite as a part of an experimental communications system. The Telstar satellite, operating at intermediate altitudes and radiating energy in a circular pattern, will demonstrate communications for limited periods of time. To be operationally useful, a Telstar communications system would require a large number of satellites (25 to 50) and an extensive ground environment.

The Advent program envisioned three to five satellites operating in a high altitude synchronous equatorial orbit and included the minimum ground environment to permit demonstration of an experimental communications system which could be expanded for worldwide use. It is noted that synchronous satellites, to provide a wide band capability with an increased communication capacity, will include antennas which radiate energy directly to the earth. The directional radiation of energy will require continuous orientation of the attitude of the satellites with respect to the ground. Periodic orbital adjustments of the satellite position in space in relation to geographical positions on the earth will be required. It is interesting to note that the NASA Syncom program will require the solution of similar orientation and adjustment problems.

The achievement of obtaining a synchronous equatorial orbit of satellites at high altitudes with proper attitudes is by no means an easy task. To place and maintain the satellites in correct positions, with proper speed, and orbiting in a precise designated direction is a task of significant magnitude. The problems encountered may easily be considered equal to or greater than those of the NASA Surveyor program which has as an objective the effective landing of a payload on the moon.

Mr. KARTH. Thank you very much.

The meeting is adjourned until 1:30.

(Whereupon, at 12:15 p.m., the committee was recessed, to reconvene at 1:30 p.m., of the same day.)

AFTERNOON SESSION

Mr. KARTH. The committee will come to order.

General, I want to thank you for appearing here this afternoon.

I am sorry that we did not have an opportunity to get to you this morning, as we originally planned to do.

We apologize for the inconvenience we might have caused you, by rescheduling your appearance for the afternoon.

I am very happy that you could appear before the committee. I assume you have a prepared statement.

General SCHRIEVER. Yes, sir.

Mr. KARTH. I wonder, General, if you could summarize, in 5 or 10 minutes, your prepared statement, and we can put it in the record.

General SCHRIEVER. Actually, it is a very short statement.

Mr. KARTH. All right.

General SCHRIEVER. I think I can read it in less than 10 minutes.

Mr. KARTH. All right, sir, if you will proceed.

STATEMENT OF GEN. B. A. SCHRIEVER, COMMANDER, AIR FORCE SYSTEMS COMMAND

General SCHRIEVER. Mr. Chairman, and members of the subcommittee, the subject of your current hearings is of great significance to this country, and of vital importance to our national security.

I am therefore happy to appear before your subcommittee today as you review our communications satellite programs.

Our military command and control capability, which is a direct function of communications effectiveness, has been correctly referred to as a potential Achilles heel of our strategic strength.

In his statement in March 1961, President Kennedy referred to our requirements in the following terms:

These recommendations are only the beginning of a major, but absolutely vital, effort to achieve a truly unified, nationwide, indestructible system to assure high-level command, communication, and control and a properly authorized response under any conditions.

Air Force recognition of the great potential communications improvements which are inherent in the use of satellites dates back to the midfifties.

For some years the Air Force has been the largest U.S. military user of long-distance communications. Our needs for rapid, reliable, continuous, and secure communications are particularly critical today with respect to the Strategic Air Command's airborne forces, which operate over ranges up to 5,000 miles from Omaha.

Requirements of SAC's ICBM forces, of the Air Defense Command, and of globally dispersible elements of the Tactical Air Command can be equally critical to national and free world security.

There actually is no operational element of the military services which will not benefit from the great improvement in communications effectiveness which will be derived from satellite capabilities.

Since before the world's first communications satellite, Project Score was boosted into orbit by an Atlas ICBM only a little over a year after the first sputnik, the Air Force has actively supported and participated in almost all the numerous other communications satellite research and development efforts which have since resulted in so notable an advance in this field of technology.

Before going into the current status and future plans for military communications satellites, I believe it would be useful for me to review what I consider to be the salient characteristics or requirements of military communications.

In certain respects they differ from those of civilian or commercial practice, and to a certain extent they can be met by civilian communications satellites.

First, we must recognize that there are three primary phases of large-scale military operations whose requirements must be satisfied: the prehostility phase, the transattack phase, and the postattack phase.

The first of these, the normal status of our Armed Forces, is characterized by large quantities of what we might refer to as "readiness" message traffic.

The second phase, transattack, is actually first in terms of criticality and priority. It is expected to be of short duration and to involve a low volume of communications which will, however, relate to absolutely vital warning and counterstrike functions.

The final phase, postattack, will see an increasing amount of traffic, but message security and reliability will be only slightly less essential than during the transattack phase.

There have been suggestions that civilian or commercial communications satellites can meet military requirements. Such suggestions are valid, to the extent that they are limited to the bulk of routine message traffic during the prehostility phase, and to the extent that such service is more economical than other means which may be available and satisfactory.

As a matter of fact, we would plan to leave commercial satellite circuits for this type traffic just as we have leased commercial land-line and submarine cable communications for many years.

The use of commercial satellites for the Nation's military command and control, however, clearly would be extremely difficult in some cases, and impossible in others.

This is due to basic incompatibilities between the characteristics of proposed commercial communications satellites and certain requirements of military command and control systems, particularly during transattack and postattack phases of potential military operations.

The requirements most important to our first-priority military needs are: (1) survivability under physical or electronic attack, and (2) mobile terminals.

In contrast, commercial systems lay great stress on high capacity and on terminals conveniently located to concentrations of population.

To be more specific, examples of the incompatibilities or differences to which I have referred are:

First, for reasons of economy, commercial satellites are designed for hundreds of standard voice channels or for one or two TV channels operated primarily on a trunk basis.

In contrast, the essential military command and control systems require relatively few channels, whether for voice, teletype, or digital data.

Second, commercial satellite operations will primarily be conducted between large, elaborate, and fixed terminals. Some terminals will undoubtedly be foreign owned.

In contrast, military communications operations are required between far more numerous terminals, some of which are quite remote from probable civilian terminals, and some of whose locations are yet to be determined by future international events.

Certain types of military communications cannot be processed by foreign handling, of course.

Third, commercial communications satellites are planned to operate under international agreement, and in a cooperative electronic and physical environment.

In contrast, military communications will require complete anti-jamming capabilities as well as protection from the physical destruction of any key element.

In addition, protection against possible electronic attack will require higher military transmitter power and a much greater ratio of frequency bandwidth to information bandwidth than would be normal with commercial usage.

Perhaps the most salient military requirement is that of urgency, particularly in view of anticipated disruption of much of the present civil-military worldwide radio networks due to the low sunspot cycle reached during 1964 and 1965.

We must have the most effective possible means for command and control of our globally deployed retaliatory forces, whether airborne, at sea, or in the jungles.

In summary, we must recognize that we can afford no compromises between the diverging characteristics of civil and military practice which could possibly jeopardize national security communications just when we need them most.

Military communications satellite development efforts have consistently aimed at the military characteristics and requirements which I have mentioned.

You are aware of the fact that in effect we may be considered to have overreached our capabilities in the urgency with which the Advent program was implemented.

The Advent effort has nevertheless made significant contribution to technological progress in this field. I can state positively that military and civilian programs are closely correlated through the Unmanned Spacecraft Panel of the Aeronautics and Astronautics Coordinating Board and through the DOD-NASA Technical Committee on Communications Satellites.

The recently authorized Defense communications satellite system program can satisfy the military requirements which I have outlined and is definitely within the technological state of the art.

I see no reason why it cannot be successful on the time scale that is planned. Our immediate objective is a minimum-essential satellite system to be initially operational in late 1964.

It will consist of a series of ultrasimple, high-reliability microwave repeater satellites in medium-altitude—5,000 miles—circular polar orbits.

Satellites will be lightweight and well within the boost capabilities of Atlas-Agena available "off the shelf." The number of ground stations is not yet determined.

Planning for the ground stations includes protection and flexibility through transportability, mobility, and dispersal.

The nature of the medium altitude communications satellite program will depend to some extent upon progress in the synchronous, 22,000-mile "stationary orbit" satellite system which is proceeding concurrently.

Toward that ultimate communications objective we will be working closely with NASA and its Syncom program. Such a communications satellite system will give us many times the capacity of the medium altitude repeater system and will provide greatly improved military usefulness.

The closing thought I would like to leave with you is the extreme national security urgency which attaches to military communications satellites as an essential means of improving our command and control effectiveness.

This operational requirement cannot be overemphasized in this era of rapid and devastating strike capabilities. We believe that we have a sound program, that we can implement it with complete success, and that the national interest dictates that we do so.

That completes my statement, sir.

Mr. KARTH. Thank you very much, General Schriever.

I wonder if we could begin the question and answer period just by going back a little bit.

This morning, the Army witnesses who appeared testified that if Centaur were available in 1963, that with the additional expenditure of some \$25 millions, Advent would have been ready to fly, and that they would have proceeded on that basis and actually have flown it.

Do you agree with that?

General SCHRIEVER. Well, I think this is a matter of judgment.

The big problem in the synchronous orbit satellite is to get the spacecraft to function properly in this environment.

It is the most difficult task that we have undertaken yet in the satellite area. To have been able to get the spacecraft to function—in other words, to get it into that orbit and to keep it there, and control it by orbitkeeping—to operate it with the ground network, both the tracking and acquisition and control stations and the communications stations that the Army had, or will have, I think would have been very useful.

The payload certainly could have been altered, in time. I don't know whether they were planning to alter the payload in that particular spacecraft. I think it is a matter of judgment as to how much we would have gotten out of the program had we continued. I would say that it would have been well worth the additional expenditure to have done so.

Mr. KARTH. What was the anticipated life of Advent, General Schriever?

General SCHRIEVER. We were shooting for a life capability of around a year. One of the greatest problems that we had to contend with, was the reliability of the system, that is the components in the system, as well as the attitude control system.

I don't think we would have approached a year in the early flights, but this was the objective.

Mr. KARTH. To the best of your knowledge, what would the lifetime capability of Advent have been, under the program that was canceled out here recently?

Would you say it would be 3 months or 6 months, possibly?

General SCHRIEVER. I think it would have been something less than 3 months. Something between a month and 3 months, perhaps, is about the best that we could have expected.

Mr. KARTH. General, we had considerable discussion this morning about the management responsibility for Project Advent. There seemed to be considerable disagreement or confusion as to what the best management program would be; and why, and in what areas the management setup that was used might have contributed to some of the Advent program delays, and, for that matter, to some of the Advent satellite's obsolescence.

Would you care to address yourself to the program management of the Advent project, and how you think it could have been improved, why it didn't work too well, and where those improvements should have been made?

General SCHRIEVER. To begin with, the Advent project of course, went through several different management arrangements, starting with ARPA before it was called Advent.

Mr. KARTH. Well, let me ask you to do this: Confine your remarks to after the Advent program was taken over by the Army and certain responsibilities of it were assigned to the Air Force.

General SCHRIEVER. Well, first of all, let me say that in the communications field, particularly as it relates to the Department of Defense, there are a number of agencies that are vitally interested in the communications product—all of the military services and all of the joint and specified commands.

Therefore, there is a need for having close supervision and direction from the DOD level.

This is fundamental to any Department of Defense communications satellite program.

Secondly, where there is more than one service involved in the operating management responsibility of the program, there naturally is always an interface problem. This would be true irrespective of what the joint project may be. It is true when we deal with NASA and we have numerous programs with NASA where this interface exists.

We in the Air Force felt that it would be better for us to have had responsibility for the communications package as well as the spacecraft; however, it is fair to say that this was a matter of opinion and judgment on our part.

I listened to the Army's testimony this morning, and I agree with them that we were, in every way, attempting to work closely together.

There were problems, as there naturally always are in these areas.

However, it can be said that we were at the point where we had overcome most of the problems of a procedural nature.

I do not believe that one can ascribe too much of the troubles with the Advent to the management problems. At least it would be difficult for me to do so.

I think that our major problem stemmed from the technical problems that we encountered—the problems associated with the spacecraft, and certain funding problems as we went along. These were, in my opinion, the major contributing factors to the Advent difficulties, and I would put management problems in a considerably lesser category of importance. I don't believe that if we would have had an ideal management arrangement that we could have been able to do much better than was done in this particular program.

Mr. KARTH. Well, General, where was the chief problem, then, with Advent?

Would you say it was communications space technology, in addition to a little problem with management?

If the problem did lie in communications space technology, precisely what were the problems?

General SCHRIEVER. I think that the problems stemmed largely from a high degree of urgency associated with the program, which stimulated a certain amount of optimism with respect to the technical problems associated with the spacecraft itself—that is, all the elements of the spacecraft.

The problem of injecting the spacecraft into the 22,300 mile position, and providing orbitkeeping, and so forth, together with the reliability of components—which incidentally is another problem that in this ballistic missile and space age has been a very, very difficult problem to which we have devoted a great deal of energy.

We made great strides in this respect. But I think as far as Advent is concerned we were overoptimistic in assessing our ability to solve the technical problems—plus the reliability problems—in the time period and for the amount of money that we indicated.

This in my opinion was our major problem.

The Centaur problem of course was associated with it from the standpoint of the overall phase II and III of the Advent operation. It had nothing to do really, though, with phase I of the operation.

Mr. KARTH. Centaur really wasn't responsible for the cancellation of Project Advent, was it, General?

General SCHRIEVER. I would say that it was a contributing factor, but not the primary reason.

Mr. KARTH. Wouldn't you call it a minimal contributing factor, if it was a contributing factor?

General SCHRIEVER. Well, of course, I can't speak for the Army, who had the management responsibility for the Advent project.

The Centaur could not lift the payload which evolved. Apparently as the performance of the Centaur dropped off the payload of the Advent went up. I don't know the exact details.

Mr. KARTH. About 300 to 400 pounds, wasn't it?

General SCHRIEVER. The increased payload weights are available, but I don't have them here with me. To continue, I would say the sliding Centaur program was a contributing factor, but probably if it had been available right on time perhaps there would have been some effort made—or a greater effort made—to shave off the poundage and get some useful shots out of it. However, this is purely conjecture on my part.

Mr. KARTH. Now, with respect to some of these optimistic analyses on spacecraft technology, communications package changes, and so forth, which took place during the development of Advent; wasn't it possible to determine at an earlier date, General, that this thing wasn't going in the direction in which we wanted to move, that we should have decided much sooner and a great savings to the taxpayer that Advent wasn't the kind of communications satellite we wanted, and that the program therefore should have been stopped at an earlier date?

General SCHRIEVER. Well, let me say this.

The schedules and the objectives of the program were laid down through a combined effort of the Air Force, the Army, and ARPA, with a lot of scientific advice.

So that you can't pin any one particular group as having been over-optimistic. This was a combined effort, and there was a considerable amount of thought that went into it. In my opinion this was just an honest misjudgment on the part of the people involved.

Now specifically in answer to your question: Although it was the Army's responsibility for the Advent as a communications system, there was certain thinking on the part of Air Force people—which did not represent an official Air Force position—that we should go to a simpler satellite system in a lower orbit.

This really was the original Steer program, which was the start of the overall communications planning effort back in 1958 and 1959.

Mr. KARTH. Well, as we were proceeding with Project Advent, General, and you had your technical teams making surveys, or inspections, call them what you want, couldn't we have noticed that there was quite a substantial amount of obsolescence being built into this thing, as we became aware of advances in technology?

And were there any recommendations to this effect that changes should be made by the Air Force? Did the Air Force ever recommend that the project be discontinued, or anything like that?

General SCHRIEVER. I am not sure whether any recommendations came from the Air Force level or not.

As to obsolescence, I think the only thing that we can say perhaps is that some of the communications components were being overtaken by technology.

Certainly, there was no obsolescence in the objective of actually achieving a synchronous orbit with a communications satellite.

I made several recommendations with respect to reorienting the program to achieve an earlier communications capability, and this was a recommendation that I made as commander of AFSC. Because it related to getting an earlier operational capability, it was not associated with any thought on my part of obsolescence on the part of Advent.

It really dated back to getting a capability with a low orbit system. I think the Army made similar recommendations earlier this year, as Dr. Larsen indicated this morning.

I had submitted a recommendation along those lines early this year myself.

Mr. KARTH. What time of the year was that, General?

General SCHRIEVER. In January. However, this went only to the Air Force. As far as I know, it did not go to the Department of Defense.

Mr. KARTH. There were three documents that made certain recommendations regarding management of the Advent communications satellite program.

I wonder if you would tell us what those recommendations were, and what the Air Force's attitude to those recommendations might have been? I am speaking about the Vance study, the Bridges report, and the Clark white paper.

General SCHRIEVER. The Bridges report is the only one that I have a detailed knowledge of.

I don't recall the Ralph Clark paper. It must have been an internal document in DOD. It did not come down to us, nor did the Cy Vance paper.

I am aware of them, but I do not remember what the recommendations were, nor do I remember the dates of the papers.

Mr. KARTH. Well, tell us about the one with which you are familiar.

General SCHRIEVER. It was the Bridges report.

Mr. KARTH. What recommendations were made in that report insofar as management of the program was concerned, and what was the Air Force's attitude on it?

General SCHRIEVER. Because there was a lot of internal activity in this whole management area at the time, I don't remember exactly what documents some of these recommendations came from. However, one recommendation made about that time was to give the Army complete responsibility for the spacecraft, in addition to the communications package in it.

We in the Air Force had always taken the strong position that the relationship between the spacecraft, the booster, the launch complex, the tracking and acquisition stations, the collection of ephemeris data, to include orbit keeping, were relationships that overrode this recommendation. These tasks were much more difficult to achieve and required a higher degree of integration than the spacecraft and the communications package per se.

Therefore, since we were responsible for the things that I have just mentioned, we strongly took the position that we should have the responsibility for the spacecraft.

Our position has remained firm on that particular point.

One other recommendation I recall had to do with having resident representatives from the Army in the General Electric plant.

Mr. KARTH. General, may I interrupt you here? This recommendation that you disagreed with having to do with the interface problems that you mentioned before and constitutes—

General SCHRIEVER. Well, you would have an interface problem. But the interface would be at a different point in the overall system at a point where I think it would be almost impossible for us to operate.

In other words, you are going to have an interface somewhere whenever you have two services involved.

Mr. KARTH. Yes.

General SCHRIEVER. Our position was that the Air Force and Army interface was much better the way it was between the payload and the spacecraft than to move it down between the booster and the spacecraft, for the reasons that I mentioned—the relationship of the spacecraft to all of the other things that needed to be done, which was the responsibility of the Air Force.

Mr. KARTH. So, it was a matter of almost total disagreement, then, between the Air Force and the people who made up the Bridges committee report, as to where the interface should be?

General SCHRIEVER. On this particular recommendation.

But we were not officially asked to comment on that.

Actually, the DOD themselves did not go along with that recommendation, and stated that we would continue under the existing management arrangement.

Mr. KARTH. I assume you unofficially commented on it, General?

General SCHRIEVER. Yes, we did. [Laughter.]

Mr. KARTH. To the Department of Defense.

General SCHRIEVER. We discussed it with the Department of Defense, but there is a difference between discussions and official action with appropriate memorandums. They were aware of my position on the matter.

Mr. KARTH. I understand that the Air Force was the recipient of a copy of the Clark white paper but you apparently are not familiar with it.

General SCHRIEVER. I only know of its existence. I believe it is an early paper, if I am not mistaken. However, I cannot recall the date.

Mr. KARTH. May 22, 1962.

General SCHRIEVER. Oh yes, this was in connection with the recent activities.

Mr. KARTH. Yes, sir.

General SCHRIEVER. No, I have not seen that paper.

Mr. KARTH. All of the services had representation on the Bridges committee, did they not?

General SCHRIEVER. Yes, I had an officer on this committee. I don't know whether they all had representation, but I know the Air Force did because I had an officer from my command on the committee.

Mr. KARTH. What about the change that has been made in the assignment of responsibility by the DOD, General, as it relates to the DCA?

In your opinion, how long will it take the DCA to develop the kind of technical capability that is necessary to determine these interface problems?

General SCHRIEVER. I think this depends entirely on the degree of detail that DCA intends to get into it.

Now, I have had some discussions, informally, with people on the third floor, including Dr. Brown and Dr. Fubini. They have indicated to me that it is not the intent of DCA to get into detailed projecting, but that they would focus their attention on the interface between the Army and the Air Force in their interface area—which incidentally I think we can well work out—and also the interface of the satellite communications system with other means of communications systems.

In other words, the DCA having the operating responsibility for Defense communications, needs to integrate any capability that we have from an operational standpoint on satellite communications with other means of communications.

This would be their area of responsibility. I think they need to have this capability.

Now, if they do this in a broad supervisory sense and without a detailed, technical supervision or projecting point of view, I don't think it would take them long to build up this staff—maybe as much as a couple of months.

If they want to get into it in detailed projecting, then it could take 6 months, as the Army witnesses indicated this morning. I believe this would be a mistake.

Mr. KARTH. The assignment itself would almost indicate that they have to go into considerable detail on this thing, doesn't it, General?

General SCHRIEVER. Well, they need to be able to review the programs, or the program that is submitted to them, by the Army and the Air Force.

Of course, we will be working together and certainly I would hope, and I think it is possible, that we would be in agreement with the over-all program that is submitted.

I think, also, that the DCA is contemplating perhaps contracting with some company to provide them with assistance in this technical interface area; in other words, to do a certain amount of this evaluation from a technical point of view through a contracting arrangement rather than build up a staff to do that in the Pentagon.

Mr. KARTH. Mr. Downing.

Mr. DOWNING. General, if I understand you correctly, in the Advent program, the Air Force had the responsibility for the spacecraft, the booster, the launch site and the tracking and acquisition stations, is that correct?

General SCHRIEVER. Well, the tracking and acquisition relates to all of the orbit control and requires a rather substantial computer capability, which is all tied in with the tracking and acquisition and control arrangements that are necessary.

I think you get some sense of this in the NASA-Mercury control and all of the equipments that they need to conduct their Mercury operation.

This is analogous to the kind of control that is necessary in the Defense Communications Satellite system.

Mr. DOWNING. What did the Air Force accomplish in the assigned responsibilities?

General SCHRIEVER. Well, the tracking and acquisition facilities are essentially complete.

We have considerably built up our control capability, which is located at Sunnyvale and Vandenberg.

Which also has, I might mention, an application to other satellite programs. It is not just uniquely tailored to the communications satellite program.

Mr. DOWNING. And then you were planning, too, on the high-altitude-orbit program alone, weren't you?

General SCHRIEVER. Well, we of course had to have the tracking and acquisition capability associated with the low-orbit shots, which were the first three shots scheduled in phase I of the Advent program.

Mr. DOWNING. Wouldn't that mean many tracking stations around the world?

General SCHRIEVER. No, sir. We have adequate tracking stations for that type of operation. I can't remember all of them, but we have tracking stations, of course, in Cape Canaveral, South Africa, Singapore, Hawaii, Vandenberg Air Force Base, and finally Sunnyvale.

We have adequate tracking and acquisition stations to handle orbit keeping. I am not talking about the communications part. That is strictly an Army responsibility, and they are in fact putting in the communications terminals.

Mr. DOWNING. The launch sites; did you have responsibility for them?

General SCHRIEVER. Well, we have the launch capability from both Vandenberg, Point Arguello, on the west coast, and from the Atlantic Missile Range.

Mr. DOWNING. Already in existence?

General SCHRIEVER. Yes, sir.

Mr. DOWNING. So that no specific expenditures of funds were involved as far as the Advent program is concerned.

General SCHRIEVER. There was some modification required. I would have to check back on that. We have fired Atlas-Agenas, of course, from both Vandenberg and the Atlantic Missile Range, and it was a matter of allocation of launch facilities for this purpose.

In these instances we have to work very carefully in conjunction with other Defense Department and NASA programs.

I can't identify the exact stands that were modified, but we didn't build a new stand precisely for this purpose. Several new stands were built, or have been built for other programs at the Atlantic Missile Range and also at Pacific Missile Range, to accommodate the total space program.

Advent certainly came in for consideration in terms of the total launch requirements of the Department of Defense and NASA.

So Advent, in a sense contributed to these new pads that were built.

Mr. DOWNING. Well, then, your greatest difficulty came with the booster, did it not?

General SCHRIEVER. No, our greatest difficulty in phase I was largely with the spacecraft technicalities.

Mr. DOWNING. What contractor was handling that?

General SCHRIEVER. General Electric.

Mr. DOWNING. Did you have officers, or inspection teams at General Electric?

General SCHRIEVER. General Electric in the Philadelphia area has done a great deal of work for us in the nose cone area and also in the satellite area.

They have been a contractor in the Discoverer program and their performance has been quite good, particularly in the nose cone area.

We have had resident Air Force personnel at the General Electric plant the whole period of time that we have had any of our programs there.

Mr. KARTH. Would the gentleman yield at this point?

(Mr. Downing nods.)

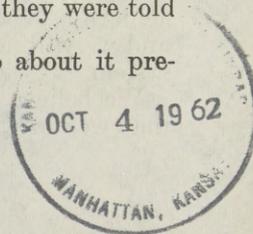
Mr. KARTH. Is General Electric pretty much on their own under the Advent contract, to make the changes that they thought were technically feasible, or were they under the control of the military as to what they should do and how they should do it?

General SCHRIEVER. The military controls changes quite closely. Any change that involves a change in performance, schedule, or dollars, has to be approved by the military. In this case it had to be approved by the Army.

We do, however, allow small engineering changes to be made, that have no effect on scheduled cost or dollars right at the plant, using resident military personnel to approve it. Otherwise, changes must be approved through channels higher than the local resident.

Mr. KARTH. Well, the problem you had then with spacecraft technology was not really the fault of the general contractor, was it? I mean, didn't they do precisely what they were told to do? Didn't they go about it pretty much in the manner in which they were told to go about it?

General SCHRIEVER. We don't tell them how to go about it precisely. That is their responsibility.



Mr. KARTH. You have proposals that are accepted and then they proceed in accordance with the proposals, unless you change those proposals, isn't that correct?

General SCHRIEVER. Well, they develop the detailed specifications and usually, proposals are based on a general performance type specification.

Mr. KARTH. Yes.

General SCHRIEVER. Based on the general performance specifications we then proceed to negotiate a contract. Generally an R. & D. contract of the Advent type, is initiated on a letter contract basis, and following this the first work that is done is the conduct of the detailed design phase. This takes normally anywhere from 3 to 6 months to develop.

The military of course does approve the final design specifications, and also approves the test program and the various development objectives that are established.

Mr. DOWNING. And the contractor was diligent in this work, I suppose.

General SCHRIEVER. I can't complain about the contractor's performance. However, I think he was over optimistic in terms of what he could do in the time period.

He didn't foresee a lot of the problems that developed during fabrication and testing. For instance, we were having considerable difficulty in the stabilization system—putting it in a vacuum chamber and testing it. With items like this you never really know how much trouble to expect, until you actually start environmental testing. Furthermore you don't know how much trouble you might have in getting reliability out of certain specific components.

One of the major payoffs actually in the General Electric program has been a very, very carefully planned reliability program, which has been one of the best that we have come up with in the space business.

In fact, this part of the program is still being carried out now in the termination phase. This is being carried out because all we are able to learn in this reliability phase will have direct application to many other space activities, both in the Advent or any other follow-on satellite program. Reliability is one of the biggest problems we have.

Mr. DOWNING. Well, General, you are convinced that it is a military necessity to have a high altitude communications satellite system for the military alone?

General SCHRIEVER. Yes, I am, for the reasons that I gave in my statement.

Mr. DOWNING. You don't think that the result could be accomplished by the low orbital flights, which Telstar has proven rather successful?

General SCHRIEVER. Well, relative to the Telstar—I am not saying that all we need is a synchronous orbit to perform useful communications for military purposes. What I am saying is that if we can achieve a synchronous orbit, we can have a much greater capability and we will need less satellites in orbit than if we have a low altitude system.

We believe we can achieve a low altitude capability much sooner than we can a synchronous orbit capability.

Therefore, we need to proceed as soon as possible in this area to provide us with our first and earliest operational system.

Mr. DOWNING. Well, let's assume a commercial satellite system were functioning; the military could take that over in the event of hostilities, couldn't they, for their exclusive use?

General SCHRIEVER. No. This would not be possible because the commercial satellite, as I pointed out, would operate on different frequencies than the military.

In addition the present Telstar is purely an experimental vehicle. It would not provide us with any communications capability to speak of for military purposes.

That doesn't mean that the Telstar communications satellite approach is not feasible.

Mr. DOWNING. That is what I am getting at.

General SCHRIEVER. Yes.

Mr. DOWNING. I don't mean this thing that is circling now. I am talking about the system which will follow Telstar.

General SCHRIEVER. As I pointed out, we would propose to use commercial satellites for as much routine communications as possible, just as we now use commercial communications systems for the bulk of our military traffic.

But just as we have military communications systems all over the world that are used strictly for classified military communications traffic, we need a satellite system on the same basis.

Mr. MILLER. Would you yield?

Mr. DOWNING. Yes, indeed.

Mr. MILLER. What you are really saying, General, is that you can't afford to put all your communications facilities in one basket or depend upon one commercial system. The military demands are such that you must have a system that will be functioning even when part of it may be taken out?

General SCHRIEVER. That is true.

We operate, particularly in our secure circuits—on different frequency levels than those frequencies required for commercial traffic. In addition the antijamming problem is an extremely important one for the military system.

We know we have problems in the communications satellite in this area and this is something to which we will have to find the solution. For example, we would operate over a wide bandwidth, and with the ability to shift within bands, the jamming problem may be somewhat lessened.

We want to put more power in the satellite that we put up in order to reduce the size of our ground stations, so that they can be moved around—made either completely mobile or transportable.

Whereas in the commercial satellites normally you would have the minimum of airborne power, because of the large fixed ground stations that would be constructed.

So, what I am saying here is that we would depend largely on commercial communications systems, just like we always have for the bulk of our everyday routine communications traffic—but just as we do today, for our very sensitive, secure communications that is required in an emergency or in very remote places, we must have our own military systems.

Mr. KARTH. You mean your control stations—your transmitting and receiving?

General SCHRIEVER. Transmitting, receiving and—

Mr. KARTH. Yes, I can appreciate that, General.

I think that we pretty much agreed with the Army this morning that to some extent at least there certainly is a need for a very special and peculiar military requirement on the ground.

Now we are talking about the satellite system.

Isn't it true that you could build in several different bandwidths into a commercial system that would serve the purpose for military communications in the event that an emergency did arise?

General SCHRIEVER. You could build in this additional capability but there would be some problems associated with it.

In the first place, the commercial satellites operate in a different frequency band than the military communications—that is, strictly classified military communications and—

Mr. KARTH. Yes, but you could build in another band, couldn't you?

General SCHRIEVER. Yes, you could build in another band.

I don't know whether or not commercial companies would want to do this.

However, there is a greater problem, and that is the international arrangements that will confront us. There isn't going to be any communications in the satellite field commercially that will not be under international agreements. Which means that we would be going through the communication terminals of foreign countries. It is true that we do this now for our unclassified routine message traffic.

Over in NATO countries, we actually go through national communications networks.

Mr. KARTH. And you do so whether it involves routine communications or not, General.

General SCHRIEVER. But we have our own systems for emergency and we would not depend upon those communications systems in the event of war.

Mr. KARTH. Yes.

General SCHRIEVER. We have to go on the assumption that this communications system is just not going to be available to us. And this is likely to be the case.

Mr. KARTH. You mean the satellite, or do you mean the complex ground stations and terminals?

General SCHRIEVER. I am talking of the ground stations.

Mr. KARTH. Yes. But I was talking about the satellite.

General SCHRIEVER. I understand.

Mr. KARTH. Now, regardless of what satellite system you have up, you are going to have to communicate with it. And you are going to have to do it to the best of your ability from whatever location you find you must communicate from.

General SCHRIEVER. True—but I don't believe the commercial companies are going to be very interested in trying to satisfy those uneconomical military requirements that would arise in an emergency. To do so they would have to put in additional power. In addition, they would have to provide for a cryptographic or security capability.

Mr. KARTH. Yes, sir.

General SCHRIEVER. These features would add considerably to what they would have to put into the satellite.

Mr. KARTH. The Government would have to pay for this, General. I don't think there is any question about it.

But on an overall basis, wouldn't this be a lot cheaper than to have a separate and distinct complete communications satellite system for the military?

General SCHRIEVER. We wouldn't be duplicating, actually.

This so-called skinny line system—the military communications satellite—would not be duplicating commercial capabilities.

Mr. KARTH. But a skinny line system like this becomes awfully expensive. We are talking about the low-orbit system?

General SCHRIEVER. Yes.

Mr. KARTH. Such a system becomes awfully expensive just from the standpoint of the type of equipment you need in the terminals, doesn't it?

And while it may be true that the lesser part of your total cost might be in the satellite itself, just by developing a separate capability in this low-orbit area, it becomes tremendously expensive, because of the nature of the low-orbit system, which requires very complex and expensive ground terminals.

General SCHRIEVER. But we are thinking about antennas in the order of even 15-foot antennas, completely mobile.

I think that the military has an urgent need for this kind of communications capability. Furthermore I believe that we can have an operational communications satellite system much sooner than you can have a commercial communications system.

Mr. KARTH. Even if there were cooperation and integration of technical personnel—both civilian and military—and they worked together very closely, you think this is true, General, is that correct?

General SCHRIEVER. Well, you are about to pass a communications satellite bill, which establishes a corporation in this country.

Mr. KARTH. That is right.

General SCHRIEVER. Their motivation will be to create a commercial system that will be able to make profit.

I don't think that they are going to be very receptive to this particular kind of military requirement.

They are not receptive to it in ground communications today, where we have the uneconomic requirements that are necessary under emergency conditions. Furthermore our Government is spending millions of dollars putting in communications systems right today—that has been directed from the highest levels—to give us the kind of command and control that is necessary in an emergency.

Mr. MILLER. Not only the Air Force, but each one of the departments pretty much has its own system, hasn't it?

General SCHRIEVER. Yes.

Mr. MILLER. The Navy has one.

General SCHRIEVER. Yes, but DCA is intending, Mr. Miller, to bring all of this together.

Mr. MILLER. Right now; for the entire military?

General SCHRIEVER. This is true.

Mr. MILLER. But today we have separate operational systems in each of the services.

If I am not mistaken even the Coast Guard has a communications installation not very far away in Virginia that is very powerful.

General SCHRIEVER. That is right.

And, of course, that is one of the points that I made earlier.

The reason for the DCA, and a very good reason, is for integrating not only all communications systems that are existent today that are ground communications systems, but the integration of any satellite communications system that would fit into the total framework of Defense Department communications.

Mr. KARTH. Well, General, let's accept for the moment that there is some validity to the thought that apparently emanates through the Department of Defense to the effect that the military needs a satellite communications system of their own.

At the present time we are talking about a low orbit system, whereby you will probably need 40 or 50 satellites, and numerous complex ground stations.

And this is the area that we want to explore right now.

Why is it necessary to go to this kind of a system when most everyone in the Department of Defense agrees that a synchronous system is the ultimate answer to a military communications satellite requirement?

If we have to spend hundreds of millions of taxpayers' dollars on development of this kind of a capability, why don't we orient our total effort toward the synchronous system and forget about the low altitude system? In this brief period of years when you feel it might be necessary to have it, perhaps our requirements could be taken care of by existing ground facilities together with whatever the commercial communications satellite system might provide.

General SCHRIEVER. Well, in the first place, I think I mentioned that we are going to be running into a very difficult period in 1964 and 1965 because of the sunspot period that will occur at that time.

Mr. KARTH. But this has happened every 11 years since time began, hasn't it?

General SCHRIEVER. Well, that is true, but we haven't been living in a nuclear rocket age, either, until just a few years ago.

So, communications becomes much more vital today than it has ever been.

Our time for decision today is in a matter of minutes, and not in hours or days or weeks, even, that we had before.

Furthermore, the synchronous orbit, or the synchronous orbit-type program, I know is a much more difficult program.

I don't think that we can possibly have an operational capability with such a system until after 1965. I am not ready to predict just exactly when we will have such a system.

I am convinced that we can have a capability in 1964-65 time period with a low orbit—in other words, the 5,000-mile orbit.

Now, in this instance we are thinking about an Atlas-Agena which can lift some five satellites in the same package into orbit. We are thinking about roughly a 100-pound satellite, which an Atlas-Agena, in one launching, can lift five into a random pattern at a 5,000-mile orbit.

We have made some estimates as to the cost of this system. It will run in the neighborhood of probably a couple hundred millions of dollars for development costs.

Depending upon how you want to implement it in terms of deployment would determine the follow-on costs. It may not be desirable to put it into orbit until the situation required that you do.

This very well may develop into a situation where the nature of the operational deployment is not necessarily fixed.

We certainly feel that we should have this capability in 1964-65 time period, for the other reasons that I already mentioned and in this respect there are other significant considerations. If you talk about a military satellite system, you can't just talk about the satellite alone. You have to talk about the satellite and the ground stations in combination.

You have to talk about the capabilities for getting the satellite up and controlling it—further, you have to talk about the logistic support of the system and also the operational environment in which it is likely to operate. Finally, all these factors must be tied in with all of the joint and specified commands, as well as the DOD, and right on up to the White House.

This takes a great deal of planning and a lot of programing and integration of many elements.

I don't visualize NASA participation—in the first place NASA does not have this responsibility. They do not have responsibility for developing operational systems.

We are talking about an operational system.

However, we will take full benefit of all of the technology that comes out of the NASA programs.

Furthermore, I feel certain that the commercial satellites will not be utilized to any great extent until they are competitive on a dollar basis with other means of communications.

Therefore, we just can't wait for all of these things to fall into place right in getting on with a military communications satellite program, in view of the vital necessity for command and control in the age in which we live.

Mr. KARTH. Now, getting back to this research and development, General Schriever, NASA has two or three research and development programs in the field of communications satellites.

One is Syncom, which is the synchronous orbit satellite system.

The Department of Defense has one or two programs going, involving both high and low communications satellites.

This subcommittee would like to ascertain whether or not we are engaging in an overly ambitious program insofar as basic and applied research, and the research dollars are concerned.

Now, I understand from the Army this morning that there is a certain amount of cooperation between NASA and the Department of Defense on what is going on in each one of the agencies with regard to the research in the communications satellite field, and that meetings do in fact take place about once a month or so.

This is once every 30 days.

We were wondering whether it would not be more practical and certainly much more cheaper to put this responsibility under NASA, an agency which does have research and development responsibility, and have a Department of Defense team of scientists or technicians or experts working with them not just once every month, but 30 days out of every month. We think this might prevent a lot of duplication.

Furthermore, we could be more optimistic about an early date for an operational system than we are where two R. & D. programs are going in parallel and one probably duplicates for 29 days of the month that which the other one has done.

General SCHRIEVER. Well, I think I have attempted to point out that we are talking about developing an operational system, which is quite different from just carrying on a R. & D. program.

Mr. KARTH. Yes, but R. & D. has to come first.

General SCHRIEVER. Well, these and other things go along hand in hand. You have to get people trained and you have to get your ground terminals as well as your satellite capabilities and you have to plan for the operational environment in which all of this will operate.

I just happen to have some specifics with me on the NASA program—the relay medium altitude program, for example, and what we are thinking about in terms of the military medium orbit satellite.

There is a very, very great difference between them.

In the first place, in the NASA program, the objective on the relay is to demonstrate technical feasibility of wide-band commercial communications satellites, and for the DOD our objective is to configure a low capacity military communications satellite system with global 24-hour-per-day coverage.

The orbit of the NASA satellite is 5,000-mile apogee, and 300-mile perigee. Ours is a 5,000-mile circular orbit.

Theirs is a 50° inclination, and it is launched from the Atlantic Missile Range; and ours is polar, launched from the Pacific Missile Range.

Theirs is a Thor-Delta vehicle, and ours is an Atlas-Agena.

Their weight is 168 pounds, and our plan calls for five satellites on one Atlas-Agena, of 100 pounds each.

Theirs is spin stabilized, and ours is tumbling.

They are talking about 600 voice channels and we are talking about 2 voice channels.

So, you can see that the performance characteristics are very much different.

Consequently, this leads into a very much different type of satellite system, both in space and the terminal facilities on the ground.

Mr. KARTH. Yes, where each one is geared to accomplish a specific objective, I think you are correct; there is no question about it, General.

The thought this committee was trying to develop, is the possibility of an agreement whereby we could correlate all of the activities and all of the objectives of the Department of Defense with the activities and the objectives of NASA into one program, rather than having two separate programs, each one probably costing hundreds of millions of dollars. Frankly, I think you will probably get into the billions after a while.

We cannot just talk about development of the satellite, but you have to talk about all of the equipment that goes along with the system including the ground stations and terminals.

I recognize that if everyone sticks to his hard objectives, and takes a hard-nosed attitude, then what we might suggest is not possible.

But, believe me, it is getting to be a very costly program.

General SCHRIEVER. I think your suggestion to combine all the objectives of the Department of Defense and NASA into one communications satellite program is unworkable.

I think the requirements are unique for military command and control purposes. Just like an airplane is unique for a military purpose. I do not think we would want commercial interests to develop our military aircraft for us.

There is just as much of an analogy between a Defense Department communications system for emergency needs—the difference there and the need is so different from the normal commercial need—as there is between a military airplane and a commercial airliner.

Mr. KARTH. Well, how long do you think we would be using this proposed medium orbit military communications satellite system before we had a synchronous system, General?

What are we talking about—2 years, 3 years?

General SCHRIEVER. We would hope to be able to use a synchronous system as rapidly as we could develop it.

All I can give you is my opinion here.

Mr. KARTH. Yes, sir.

General SCHRIEVER. I would think 2 or 3 years, probably, would be about the best time that we could move from a low altitude system to a synchronous system.

There are other operational reasons why you might want to use a low altitude system for specific purposes even after you had a synchronous capability, which I do not want to get into in detail because it touches on security. Moreover, I am not so sure that we might not be using both systems, or at least have both systems available for use for a considerably longer period of time.

Mr. KARTH. How much do you think this low altitude system would cost, General, including all of the components that must go together to make up an operational system?

General SCHRIEVER. Well, I dislike to quote any cost figures because they always get set in concrete. We really have not had the opportunity to thoroughly examine the program. As a very rough estimate based on past experience, the R. & D. cost for a low-orbit system would probably run in the neighborhood of approximately \$150 million, for the type of system I described.

Mr. KARTH. And what about the operational system?

General SCHRIEVER. Well, of course the operational program depends on many things.

It would depend on whether you wanted to maintain this system in orbit at all times.

You would probably have to put up somewhere between 24 to 36 satellites, roughly, to maintain 24-hour-a-day coverage.

It depends a great deal also on the reliability of your system.

If we had say 90-percent reliability on our Atlas-Agena, and a year's operating life in the meantime before failure, the system would be relatively inexpensive.

If you crank in reliability factors that are less than that, then the program could get very expensive.

So I would rather not quote a figure on this.

I personally feel, however, that the Atlas-Agena will have a very high reliability in this time period—it has been extremely reliable over the past year.

Mr. KARTH. Well, in terms of the kind of research and development effort \$150 million would buy, which indicates the kind of system you are going to use, how much would that kind of an operational system cost?

General SCHRIEVER. Well, the R. & D. costs really involve having a number of shots that would test out the system in terms of whether or not it functions properly, and also to determine its reliability characterization.

You could simply cost the thing out directly on how much it costs per launch after that.

Now I can provide the committee with this.

We hope and expect the launch costs for say an Atlas-Agena to go down considerably in the time period 1964-65.

We see no reason why we cannot launch them with a military capability.

The cost of the units will go down with further learning.

Further, the cost of putting 24 or 36 satellites into orbit depends entirely on what reliability you want to assign and support.

Mr. KARTH. Why don't you think about it, General?

I understand that this is difficult for you to evaluate on the spur of the moment.

General SCHRIEVER. We have taken various different reliability numbers and applied them to utilization of similar systems and costed them out.

I would be glad to furnish the committee with some of these.

Mr. KARTH. If you would.

General SCHRIEVER. I think we could do this without—

Mr. KARTH. Including the ground station complex that you need. Because as I say, it is more than 24 satellites, or 36, or whatever it is going to be.

It involves the whole spectrum of things that make the system operational.

(The following information was supplied for the record:)

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE SECRETARY,
Washington, September 12, 1962.

Mr. FRANK R. HAMMILL, Jr.,
Counsel, Subcommittee on Investigations,
Committee on Science and Astronautics,
House of Representatives.

DEAR MR. HAMMILL: Reference is made to Gen. B. A. Schriever's testimony before Subcommittee No. 3 on August 15 (Project Advent), and subsequent conversations with Lt. Col. William B. Arnold of my office.

On page 152 of the transcript of the August 15 hearings, Mr. Karth asked General Schriever how much would an interim operational military communications satellite system cost. In subsequent testimony, General Schriever stated that he would supply the subcommittee that information.

At this time, the program is still under study and the parameters are not completely known. Consequently, no meaningful cost estimate can be given. As soon as the program has been clearly defined, we will be pleased to give you the cost estimates of the program. It is expected that this information will be available by mid-October.

I hope this delay will not inconvenience you.

Sincerely,

DONALD W. PAFFEL,
Colonel, U.S. Air Force,
Chief, Congressional Investigations Division,
Office of Legislative Liaison.

Mr. KARTH. Mr. Downing?

Mr. DOWNING. Just one final question, General.

In your feasibility studies, do you consider the vulnerability factor of these satellites—the fact that an enemy could intercept them and destroy them?

General SCHRIEVER. We have not considered that in the studies of our communications satellite areas.

The 5,000 mile orbit satellite, synchronous satellite, would be pretty difficult to destroy—the higher the orbit the more difficult the interception.

We have not considered this as part of our studies on the communications satellites to date.

We have in the overall satellite area of course looked at satellite vulnerability as far as the future goes.

We have a number of studies in this area, of what can be done to reduce satellite vulnerability in the event someone wishes to interfere with it.

Mr. DOWNING. Thank you very much. I have no further questions.

Mr. KARTH. Mr. Chairman?

Mr. MILLER. No; I have no questions right now.

Mr. KARTH. Mr. Van Pelt?

Mr. VAN PELT. No questions.

Mr. KARTH. General, just following on briefly with one other question.

NASA is involved in doing research and development work on a synchronous satellite system.

General SCHRIEVER. I am aware of their effect.

Mr. KARTH. Now the DOD is also interested in developing a synchronous satellite system.

I wonder if you could just briefly address yourself to the different requirements here, or the different objectives which would be reflected by different research and development efforts. Why it is necessary to have two Government agencies going in the same direction on a synchronous satellite system.

General SCHRIEVER. Well, here again the objectives are different as far as the communications capability is concerned although the objectives are the same with respect to achieving a synchronous orbit.

Both of them are aimed at achieving a synchronous orbit at 22,300 miles.

We of course have, from the communications standpoint, the objective to develop a very modest capability from the standpoint of channels, but must attempt in every way possible, to get antijamming devices into our system.

Whereas the NASA objective—the first part of their program, Syncom I, is aimed at primarily getting the synchronous orbit.

They have a very small satellite as a matter of fact, in the Syncom I.

Now Syncom 2, which has not been defined yet, but which I know is in the planning stage—and I do not know when they will firm up their plans—will have approximately the same weight as we are thinking about in our synchronous satellite.

Mr. KARTH. A 55 pound satellite, General?

General SCHRIEVER. No; we are both thinking roughly in the order of 500 pounds.

Mr. KARTH. 500 pounds?

General SCHRIEVER. Yes.

But their needs are, again, aimed at rather broad channelization.

They are also thinking about a TV capability, perhaps two or three channels.

Although this is just planning this is generally the direction they are taking. Whereas our objective from a communications standpoint is quite different.

The technical approach that NASA seems to favor at the moment is spin stabilized. We are thinking more in terms of attitude stabilization.

Now, it could well be that the spin stabilized approach may turn out to be superior to the attitude stabilization method.

However, we should actually proceed along both of these lines, so either agency can take advantage of the system of stabilization which proves to be the best.

I do not know what they are planning to use as a booster on their Syncom 2. Probably an Atlas-Agena. As I have said this program has not been firmed up. It is just in the planning stage.

Mr. MILLER. Mr. Chairman?

Mr. KARTH. Yes, sir, Mr. Chairman.

Mr. MILLER. Just for my own information, General, is my conclusion correct that you, as a representative of the Department of Defense, are telling us that it is not compatible to have a public communications system such as will be put together under the bill that is presently pending tied in with a military system? That the peculiarities and the requirements of the military system are such that these cannot be merged or should not be merged; that we should have two separate systems; is that correct?

General SCHRIEVER. That is correct. The defense communications satellite system is needed to satisfy the unique military emergency requirements.

Mr. MILLER. The emergency requirements?

General SCHRIEVER. Yes.

Mr. MILLER. That requires a separate system?

The DOD will take advantage of all of the NASA developments which advance the state of the art?

General SCHRIEVER. That is certainly correct. As a matter of fact, in that connection, I, myself, have been involved in several conferences in the last several weeks with Bell Telephone Laboratory people discussing certain aspects of the Telstar.

I have discussed the commercial versus the Defense Department communications requirements with a large number of people in the industry, both on the communications side and on the industry side.

I believe you will find unanimity on their part in saying that you need a military communications satellite system in addition to a commercial communications satellite system.

Mr. MILLER. I may say there is no question in my mind. I just wanted to make sure that when we are asked why we do not have just one system, that we can say that you, as a representative of the DOD have told us this.

I can understand why we need the two systems. But you realize that these are all expensive programs?

General SCHRIEVER. Yes, sir.

Mr. MILLER. We have got to defend these programs before the Congress and before the world.

General SCHRIEVER. That is right.

Mr. MILLER. We want to make sure the reasons are substantial; this is the reason that we are holding these hearings.

General SCHRIEVER. Yes, sir.

Mr. MILLER. We are going into the whole program, to make sure that there is not duplication that can be avoided. In your own considered opinion, there is not any undesirable duplication.

General SCHRIEVER. That is correct, yes, sir.

Mr. KARTH. Mr. Peacock.

Mr. PEACOCK. General, if industry were willing to accept the requirements laid down by the military and build this capability into the system, providing that the military furnished the additional funding required, do you see any objections on the part of the military to allowing the civilian communications organization to design, construct and operate the system?

General SCHRIEVER. You mean if they established this capability as a commercial capability?

Mr. PEACOCK. Well—

General SCHRIEVER. To get military requirements?

Mr. PEACOCK. Yes, built in would be the joint civilian military capability within one system, where the additional cost would be paid for by the military, but the military portion of the system would be responsive completely to your detailed design specification. Would you pose any objection?

General SCHRIEVER. As a matter of fact, that is essentially what is going to happen. Industry will in fact build the system that is required for the military. The only thing I am not clear on with respect to your question is who operates this system. In an emergency, it has to be under military operational control.

Mr. PEACOCK. Well, I think in a case of any emergency we all accept the fact that military would take over all communications facilities and utilize them to a maximum.

But the point I wanted to make is this: In the field of research and development and the field of operations under peacetime conditions, short of hot war, this capability, based on a military specification would be provided by industry. Would the military be willing to allow a civilian organization to do this—carry out all the research and make the operational system responsive to military specification, with the understanding that in case of an emergency the military would take over, and the system would have to be capable of immediate response to meet, say SAC's requirements, TAC's requirements, the strike command's requirements, or the Navy's requirements, in case of an emergency?

Would you people be willing to accept this, if industry gave you the necessary assurance that they could and would do the job?

General SCHRIEVER. Well, I can only speak for myself, because I have not really had a chance to analyze and evaluate what you are asking.

However, I think the question is academic, because I don't believe the commercial interests would consider a combined effort.

I will be willing to venture any amount of money they would not do it. If they would, I certainly would accept, with the one proviso,

which is that I would want to look very, very carefully at how the military would take over in an emergency.

You cannot just take over unless you have the people that are trained and really can do the job—it is not just a matter of moving military personnel in on some equipment. In furthering my remarks I am thinking in terms of having mobile equipment that you might move from one place to another, to any place in the world, in the event of an emergency—whether in case of a brush fire war or other dire needs that may confront us. I just do not know how you would satisfy such military requirements with a commercially operated system.

Mr. PEACOCK. I realize that problem exists. But I think the committee finds itself in the position that until they have explored this possibility they cannot take a chance of not considering the commercial system to meet both military and civilian requirements. Based on the terrific costs that may be involved, due to duplicating research and development, and even duplicating operational facilities, the committee must make certain that our tax dollars are utilized to a maximum.

That is why the committee is interested in determining if these conditions can be met, and exploring whether the military would pose any objection to trying to go down this road.

General SCHRIEVER. Let me make it clear: I am interested in having the Defense communications satellite capability and having it under the Defense Department control when it is needed.

Mr. PEACOCK. You say when it is needed.

You mean in an emergency, ready to go?

General SCHRIEVER. I mean we need it to be responsive at all times—actually there are certain communication nets today that are operated only by the military because of the nature of the communications nets.

This would certainly apply to all the elements of a communications satellite system as well. Therefore you will have to take a look at how these systems are to be operated which would include all of the ramifications of the international agreements that exist in communications systems and so forth.

I honestly believe your premise is academic. But I certainly would explore it with industry and see what conclusions can be obtained.

Mr. PEACOCK. One other point along that line. Wouldn't it be of great advantage to you if this could be done?

This system would be utilized on a continual basis, so that you knew it would have a positive response when you wanted to take it over to meet a military need on a moment's notice. This would cut down the time required to heat the system up and actually put it in operation.

General SCHRIEVER. Well, all I can say is there are problems there from an operating standpoint because of security considerations, of how you phase from say a normal situation into an emergency situation and so forth.

I just cannot visualize all of these situations coming about.

Mr. PEACOCK. Do you think it is worth exploring?

General SCHRIEVER. Well, I think if you ask the commercial interests what they would do, I think the answer would be they are not interested. I think that is about as far as you would need to explore it.

Mr. PEACOCK. I would like to ask one more question, Mr. Chairman, from the management aspect.

(Mr. Karth nods.)

Mr. PEACOCK. We all share your great concern on the urgency of putting an operational system into being as soon as possible.

One question I would like to ask you, General: Due to the reorientation of the Advent system, do you feel that the management that has been set up now will give you the maximum capability to develop as soon as possible a system to meet your requirements? Do you feel there is a better management system that could be established to actually give you this capability in a shorter period of time and with a more efficient and effective system?

General SCHRIEVER. I think that the present management arrangement can work. I think it is absolutely essential that the Department of Defense have a control such as they are proposing to put into effect.

I think one question which I raised a moment ago, as to what degree of detail will they get into this—

(Mr. Peacock nods.)

General SCHRIEVER. It is my opinion that if they carry out their management responsibilities along the lines that I have indicated and along the lines that I have heard certain people in positions of responsibility express, I think it will work.

As for the situation between the Army and the Air Force, there isn't any question in my mind but that the arrangement will work. I think it is a matter of attitude on the part of the parties on both sides and I can assure you that from where I sit we are going to make it work.

Listening to the Army people testify this morning, I think they will make it work.

Mr. PEACOCK. When the Army and the Air Force come to an impasse under this new system, who is going to decide—D.D.R. & E. or DCA?

General SCHRIEVER. Well, if it is a technical question at the interface between the ground and the spacecraft, and DCA cannot resolve it, D.D.R. & E. will be the court of last resort.

Mr. PEACOCK. Weren't they the court of last appeal under the last management arrangement?

General SCHRIEVER. Yes, I would presume that you could say they were, yes.

Mr. PEACOCK. What has happened that will change their ability to make wiser decisions for more rapid response under the new management arrangement?

General SCHRIEVER. Nothing is changed.

Mr. PEACOCK. So you still feel you have a management problem there that could create a headache for both agencies and problems may not be resolved, because you would have to go back to the same court of appeals?

General SCHRIEVER. This is not an easy problem.

Mr. PEACOCK. I realize that.

General SCHRIEVER. Mostly because of the many agencies that are involved. And you just cannot say "Well, leave the DOD out—give me the job and I will run with the ball."

I would like to be able to say that. That is the best way to do it.

Mr. PEACOCK. What type of management arrangement would you like to have, if you had to do the job yourself?

General SCHRIEVER. If I did not have to consider anybody else, I would say give me the ball and I will go with it. A single manager is the best way to manage anything.

In this particular system, I don't believe this is possible because the Army, the Navy, the Air Force, the joint and specified commands, the DOD and the President's office, are all involved.

Consequently one just cannot say "Well, give me the ball and I will go with it," in all fairness to the many other requirements that have to be considered.

Mr. PEACOCK. If the Secretary of Defense gave you the ball and you had to do the job, exactly what would you do with the existing management structure you have right now?

General SCHRIEVER. I would prefer to give the current particular management arrangement a real try because command and control is so vital, the Secretary of Defense and the Joint Chiefs have to have their needs met as well as the DCA.

I believe we can make the present management system work.

It is not like building a weapons system which only one service is going to use. The defense communications satellite is a system that everybody connected with defense is going to use. Therefore you just have got to live with rather complicated arrangements.

In the final analysis, it is people that make things work anyway—and I think we can make this work.

Mr. PEACOCK. If you had the job would you put all the funding under one agency?

I understand now you have split funding responsibilities. You must fund for your responsibility, the Army must fund for their responsibility, and if DCA needs any technical advice they have to fund for their needs.

General SCHRIEVER. Well, in looking at the overall program, it has got to be reviewed on the basis of the total fund requirements.

This review will of course occur at the Department of Defense level, which would include the total fund requirements involving a wholly integrated program between the Army, the Air Force and the Navy.

Now once, though, the program and funding level is approved, then I believe, very, very strongly, that the funds should go to the agency who has the responsibility for carrying out that part of the job.

Mr. PEACOCK. Well, I was referring to the step before that, when you have to place requirements in the program and get them under a budget ceiling within a particular service. The service is fighting to budget for competing programs even before you go to DOD.

It appears to me that if the funds are not in one package so that they can be defended as a unit, you may finish up with your spacecraft communications package, and you may not have any ground data operating system which would be responsive to your needs.

General SCHRIEVER. I agree that that could be the case.

But certainly if I were sitting at the DOD level, I would insist on the Army and the Air Force coming in with an integrated program which is integrated in the sense of schedules and dollar requirements, and make them defend their part of it in terms of being able to meet their particular performance schedule and within the dollars indicated.

There must of course tie in—the activity of one service has to be phased in with what the other service is doing.

Mr. PEACOCK. Hasn't D.D.R. & E. had a very difficult time doing this in the past?

General SCHRIEVER. No, as a matter of fact.

The Army had the responsibility for coming in with a complete program.

Mr. PEACOCK. Wasn't that one of the problems, the Army was unable to come up with adequate funds to meet some of the Air Force overrun requirements because of the restrictions that were placed on them?

General SCHRIEVER. The estimates on the fund requirements were not good in the Advent program.

There is no point in trying to say they were. Once this was evident—and this was evident as early as last year—there has been a constant struggle to get additional funds for the program. This has added to the program difficulties, because these funds have not always been forthcoming.

The combination of spoon feeding and inadequate dollars, has had a serious effect on that program.

In other areas, insofar as coming up with the necessary inputs to the Army from the Space Systems Division, no significant problems were encountered.

Initially we had some detail problems, but you will remember that prior to the time that ARPA transferred the responsibility to the Army, the Air Force had the responsibility for coming in with a complete program and giving it to ARPA and this procedure had to be altered. Following these initial changes we had no difficulty.

I believe we can work satisfactorily at the service level if we are not directed too much—in too much minute detail from top levels.

The services have worked together before, and I see no reason why we would have any more difficulty in continuing to work with the Army than in working with NASA.

Mr. KARTH. Mr. Van Pelt?

Mr. VAN PELT. No questions.

Mr. KARTH. Mr. Fulton, would you care to participate in our subcommittee hearings?

Mr. FULTON. I have a statement to make, and then if I may ask a question?

Mr. KARTH. Go right ahead.

Mr. FULTON. There is much to be done in the field of the satellite communications system.

And I believe there is room enough for all of us to work. That means both the civilian and the military, as well as the various departments under the Department of Defense.

I would agree with you that the requirements of the military and the civilian for operational systems are entirely different, and based on entirely different concepts.

For example, on the civilian system, there will be a proprietary conference in 1963, on the international telecommunications union, and then a conference in 1965 to settle by negotiation the frequencies.

That will be a joint action and will be dependent on other countries' agreement, in the allocation of frequencies.

On the military side, we will have much less need for the wide bands, and we will want to have use of the frequencies that are the best for the security of the United States which assures security decisions.

Under these circumstances I agree with you that operationally they should be separate.

And that is your conclusion, isn't it?

General SCHRIEVER. That is correct.

Mr. FULTON. Do you feel that for operational purposes the various services could even have separate requirements and therefore separate operational research and development facilities?

General SCHRIEVER. No, sir.

Mr. FULTON. I had hoped you would say "Yes."

Go ahead, sir.

General SCHRIEVER. No.

The communications systems are primarily being put into service by the operational forces, which are the joint and specified commands, and going right into the JCS, the Secretary of Defense and as required, to the President.

Mr. FULTON. For example, in the communications satellite system for the Navy, for ships at sea, the Air Force would not be particularly interested, although you might be interested in the coverage in geographical areas—across Africa and the area—that the Navy is not interested in.

General SCHRIEVER. Well, that is possible.

Although I have not seen any requirements that have come up from Army, Navy, or Air Force sources, that are so different as to require the services to have their own satellite communications system.

In other words, the low altitude communications satellite system that we are talking about could service all the forces.

Mr. FULTON. So you would then have multipurpose satellites, with payloads from each of the departments, for example, the Army, Air Force, and the Navy, the Coast Guard, and the Marine Corps?

General SCHRIEVER. Probably not.

Because it would be the DCA's responsibility to integrate the communications capability of the communications satellite with the communications system for the DOD as a whole.

Mr. FULTON. So that your recommendation is that the military approach on satellite communications would be at the DOD level for all U.S. armed services?

General SCHRIEVER. Certainly as it relates to the integration of the requirements.

Now, if a service came up with a unique requirement which could not be met by a system, a single system, and the unique requirement were tied to an important national security need, then naturally I think we would be justified in having a separate system for that need. But so far as I know, there is none at the moment.

Mr. FULTON. You would not recommend that the peacetime uses of communications satellites be carried forward through military satellite communications systems?

General SCHRIEVER. I am not—

Mr. FULTON. You would not combine the two, would you?

You would not combine so that when military is not using the full load of the satellite it might have, that then it would be used for peacetime purposes?

General SCHRIEVER. Well, actually the military satellites would be operating strictly in the military frequency band widths.

Mr. FULTON. I agree. But you have no interconnection, then—

General SCHRIEVER. No.

Mr. FULTON. To peacetime ground stations or to areas those facilities that are in being for military and security purposes when they could be used for peacetime purposes. I am asking really how separate would you keep the military and the peacetime communications systems on satellites?

General SCHRIEVER. I think they would be essentially completely separate. That is, the military satellites from the commercial satellites.

Now we would be using the commercial satellites for the bulk of our traffic—that is, administrative traffic and so forth, in normal peacetime circumstances just as we use the commercial lines today for most of our unclassified military traffic.

Mr. FULTON. If that is the case and your philosophy, then I can see that for funding for different purposes on separate systems, that there should be a difference in approach. You should have separate funding and separate systems and separate operational characteristics. Don't you agree with that?

General SCHRIEVER. Yes, if you put it in the broad sense of Department of Defense funding.

Mr. FULTON. Yes, sir.

General SCHRIEVER. Yes.

Mr. FULTON. I am really putting it in context of or in apposition to the peacetime uses, separating the military from the peacetime uses in communications satellite systems.

General SCHRIEVER. That is right. There would still be the necessity for the Defense Department to take full advantage of any technological advances made by the commercial and NASA programs.

Mr. FULTON. And a full distribution of information helps everybody.

General SCHRIEVER. Yes.

Mr. KARTH. Would the gentleman yield?

I understand General Schriever to be saying that the military will utilize the commercial system on a day-to-day basis, but that they would like to have their own system for the emergency type situation.

Is this essentially correct, General?

General SCHRIEVER. Yes, sir.

Mr. KARTH. Thank you.

Mr. FULTON. And in the converse, that the military system, while not in full use, should not be open to peacetime uses for communications, because they want to keep the military system entire and separate.

You see, you want to use the commercial system for ordinary messages, but you say that even though you have the capacity, you do not want to operate the military system for commercial usage.

General SCHRIEVER. Well, this is true and there are two reasons for this.

In the first place, I do not visualize that we would ever have very many channels in the military type of operation; therefore it would not be very useful in a commercial sense.

Mr. FULTON. I agree.

General SCHRIEVER. Also, because of security and antijamming and other aspects, there will be certain important security characteristics with respect to our communications systems which we certainly will attempt to maintain to the highest degree possible.

I don't see where this type of a system would fit into a peacetime operation or as a normal backup, you might say, to peacetime communications.

Mr. FULTON. The military satellite communications system has the power to jam and the power then not to be jammed by any adverse force?

General SCHRIEVER. One of the objectives of course is to develop an antijamming capability. It would not be used for jamming purposes.

Mr. FULTON. So that you do not have within this program a jamming purpose?

General SCHRIEVER. No, sir.

Mr. FULTON. On line of sight, using narrow bands, and with relay stations among satellites, could it not well be possible that we could avoid any jamming because it will be so difficult in a millisecond for an interloper to pick up a message on what you are sending?

General SCHRIEVER. This is one of the advantages of the low-orbit satellite.

Mr. FULTON. So that your purposes in the military are relative to restricted use and your approach is different than the peacetime uses of satellites?

General SCHRIEVER. That is right.

Mr. FULTON. Likewise, the military would be covering many areas and have ground stations at points where there could be no possible peacetime traffic that would in any way sustain the system for commercial purposes?

General SCHRIEVER. Well, this is true. And, of course, we would hope to develop highly transportable, mobile stations, so that you could move them about as required.

I want to give you one example of my own experience during World War II. I was stationed in the Southwest Pacific toward the end of the war on Leyte when the U.S. forces were moving into Manila. I was the first commander of Nichols Field in Manila, and I moved in there while the Battle of Manila was still going on.

The first thing I moved in there besides myself and a jeep was my communications capability. You were absolutely helpless without communications.

So the same thing would apply in any limited or brush war that might come up. The first thing that you have got to have in order to be effective is communications. So—

Mr. FULTON. We in the U.S. Navy who were there at the time were glad to help you move your communications supplies in. [Laughter.]

General SCHRIEVER. I flew them in.

Mr. FULTON. Well, we were there to see that you were not going to get shot down by a submarine. [Further laughter.]

General SCHRIEVER. I was glad to have the Navy around, you can be sure.

Mr. FULTON. I was on the bridge of one of those small U.S. Navy carriers that you people in the U.S. Air Force defended.

Mr. KARTH. General, when do you expect the DOD to make the decision as to whether they will have a separate communications satellite system?

General SCHRIEVER. I think they have already made the decision.

The DCA is in the process of working out their definition phase. We are already working with the Army, as the Army witness pointed out this morning. I cannot give you a timetable as to when a program from the standpoint of actually having it under contract would be underway.

As far as my understanding goes, the DOD has decided to proceed with a military satellite program, along the lines that I have outlined, with the low altitude system being the first priority in terms of getting an operational capability, and the synchronous system coming on behind for an improved capability as soon as possible.

Mr. KARTH. Then the Defense Department policy that states: "No decision to establish a particular operational system has been made by the DOD" is rather misleading—misleading because I suppose it puts emphasis on the word "particular," as they have not decided which system, but they had at the time this was released decided there should be a system?

General SCHRIEVER. Well, what is the date of that statement?

Mr. KARTH. This was given to a subcommittee of this committee that considered the NASA authorization bill.

This was given, I think, by Mr. Rubel. I assume in May.

General SCHRIEVER. That may have been true in May.

Mr. KARTH. These hearings were held from March 5 to April 10. I assume the statement was made the first part of April.

General SCHRIEVER. I am almost positive that was true in that time period. Because we came in with our proposal either in late May or June. The Secretary of Defense has issued two directives, both of them dated in June, I am quite sure.

Mr. KARTH. Yes.

General SCHRIEVER. Which I think spells out pretty clearly what the Defense Department's policy and intent is with respect to carrying on such a program.

Mr. FULTON. On July 14, 1961, Mr. Edward Murrow appeared before the Science and Astronautics Committee, as Director of the U.S. Information Agency. He pointed up the basis of the philosophy of the administration peacetime and commercial satellites, which is different than the military.

General Schriever, on page 3 of your statement, you have said: "Certain types of military communications cannot be processed by foreign handling, of course."

Now, Mr. Murrow, in contrast, on page 585 of the hearings, said, about the peacetime space communications satellite program:

We [the United States] must make our policy not in a vacuum but in concert with others.

And it is axiomatic that we must examine with other countries the best role that can be played by the United Nations and the International Telecommunications Union.

The world should, and will, be reminded that this is a system fostered and founded by this Nation, but it is a system that we freely choose to dedicate to more than our own national interest.

Under those circumstances, it becomes apparent that we would need a separate military system, wouldn't we?

General SCHRIEVER. Under those circumstances?

Mr. FULTON. Yes. With the peacetime concept of Mr. Murrow, the United States would need a system that is dedicated to the security and the national interest of the United States.

General SCHRIEVER. I would think so; yes, sir.

Mr. FULTON. That would be my judgment, as well.

As a matter of fact, I have disagreed, and, of course, continue to disagree, with Mr. Murrow's official administration approach to our peacetime satellite system. He says, on page 586:

Second, this is to be a global system. That means no less than global participation.

We can best satisfy the national interests of other lands by bringing them into a partnership regarding the system.

But the national policy as iterated by the President is that advances that we make we offer to the world. The satellite system cannot be made to work without world cooperation.

Fourth, the principle of "access" must be paramount. Every nation must be guaranteed this right of access to the system. Smaller countries must be assured that while the system is within the technological control of the United States, we will not turn the system on or off at will, limit or bar them from its use, or operate it in any way for capricious national advantage.

I might add parenthetically that that removes our national interest completely from the operation of the system, even though the United States has technological control of the peacetime satellite communications system.

Mr. KARTH. You are talking about the commercial system.

I called these hearings to get the opinions of the witness that appears before us, on what their particular desires are and what their opinions are.

Mr. FULTON. I want to show the philosophy is different on a commercial system, and that our U.S. military shouldn't use it when the present administration at U.S. taxpayers' expense makes the U.S. commercial and peacetime satellite communications system open for use by Castro, Red China, and the Communist nations.

Mr. KARTH. Well, read it in the record after we get through because I don't want to impose on the general's time. He is a very busy man.

Mr. FULTON. All right.

But my point is: Under the present administration philosophy, the commercial or peacetime system would be open for propaganda purposes, without any priority for our U.S. military agencies or for our own U.S. Information Agency, to Communist China, Russia, and where even Castro could put in an 8-hour speech.

That is why I think there is the necessity for two systems. So, I compliment you on your position. That is all.

Mr. KARTH. Mr. Chairman.

Mr. MILLER. I just want to say, General, getting back to the question of duplication—one of the things that we are concerned with, and I share my colleague's concern with the philosophy of this, but I don't think you are the one to discuss the philosophy of the systems. Wasn't there a little trouble in Advent where the Air Force had some contracts with Aerospace?

General SCHRIEVER. I wouldn't say we had any trouble.

Aerospace was beginning to get a capability at about the time that the Army was given the responsibility for the satellite program, which was in August or September of 1960.

One of the tasks given Aerospace following its formation was providing us with technical support in the communications satellite program.

Now, I think from a trouble standpoint you might have reference to the fact that the time that Aerospace was forming and building up to strength was the same time that there was a question as to what the decision would be as to who was going to have management responsibility for the satellite program.

Mr. MILLER. And didn't the Army then go to Space Technology Laboratories?

General SCHRIEVER. They went to Space Technology Laboratories.

Mr. MILLER. Was this good, to have the different services dealing with two different technical support agencies? Wasn't this a place where duplication could have been avoided?

General SCHRIEVER. Well, of course, I felt that this was not the best arrangement.

Mr. MILLER. Well, I am not going to press it.

General SCHRIEVER. Yes.

Mr. MILLER. I will just say that I hope in the future that we won't have to see this thing taking place again. I think you agree.

General SCHRIEVER. I agree. There was a lot of confusion.

Mr. MILLER. A lot of confusion. And that is the thing we want to eliminate.

General SCHRIEVER. Yes, sir.

Mr. MILLER. And those are the things that make for misunderstandings, sometimes.

General SCHRIEVER. Yes, sir.

Mr. MILLER. And I hope we can avoid them.

That is all, Mr. Chairman.

Mr. KARTH. General, I would agree with the chairman, that these are probably small things, but sometimes these build up to a large festering sore.

General SCHRIEVER. That is right.

Mr. KARTH. Which cause a great deal of unnecessary concern and probably some of the reasons why you and other very busy people are called to the Hill on occasion when there really isn't as much need for it as appears to be at the time that the hearings are called.

Mr. MILLER. Are you going to adjourn now?

Mr. KARTH. Yes, sir; but I understand that Mr. Hammill has one question.

Mr. HAMMILL. Just one question.

Following something that the chairman brought up earlier in the hearing, we understand that the Advent satellite was conceived in 1958, and that in June of 1962 the program was virtually canceled and replaced with two brandnew proposed satellite programs.

Now, this reorientation took place after over \$170 million was spent on the Advent program, and much of it has been reported as an unrecoverable loss.

We have heard from various people in Defense, in NASA, and elsewhere, that one of the worst features of Government R. & D. programs

is that decisions don't seem to be made in a timely fashion to cancel undesirable programs.

What I am suggesting is that 4 years went by during which the program was under development. Then in a letter to Chairman Miller, Dr. Brown stated that as of June 1962, the date of cancellation, the Advent satellite was considered obsolete—not just obsolescent, but obsolete.

I wonder if you could tell us whether you have any theory as to why the decision to cancel the program wasn't made sooner. Weren't the problems obvious long before June of 1962?

General SCHRIEVER. Well, there were a lot of problems obvious in the Advent program before June of 1962 in terms of schedules and dollar requirements.

I think it is an oversimplification to interpret Dr. Brown's statement that it was obsolete to apply to all aspects of the Advent program. And there were many reasons, which I stated earlier in my testimony, why even as late as the middle of this year that there would have been justification based on judgment to continue in order to achieve this synchronous capability, even though the payload had been largely overtaken by events from a technological standpoint.

As far as how much of the total dollars were essentially down the drain as compared to what is recoverable, I am not prepared to say at the moment.

You received a rundown on that from the Army people. I would be glad to furnish our own estimate on this if you wish.

Now, I feel that not nearly as much is down the drain as one might suppose. Because the thing that you can't measure, particularly in the spacecraft, is how much we got out of the project in terms of design, reliability development, environmental testing, and in test facilities.

It is difficult to put a precise dollar value on what was accomplished or what remains since a greater portion of the effort was more of an intangible nature.

Some of the other things that the Army witnesses pointed out this morning, like the tracking and acquisition stations and the Atlas-Agena boosters—those things are all essentially available at full value for a continuation of the reoriented program.

So, I don't believe that the loss is perhaps as great as it might appear, even if you take the broadest possible interpretation of Dr. Brown's comment that it is obsolete.

There is much of it that is a long way from being obsolete. We just haven't gotten there yet.

Mr. HAMMILL. Well, maybe I should narrow the question slightly. And I don't want to misinterpret Dr. Brown's statement—

Mr. KARTH. I think Dr. Brown meant that as a package it was obsolete.

General SCHRIEVER. I think as a package he meant it was obsolete.

Mr. KARTH. There are some components that undoubtedly are not obsolete and that you will be using in the future.

General SCHRIEVER. However, I think it is also fair to say that if we had been able to achieve the capability of putting a payload of this size, volume and weight into a synchronous orbit, that a new payload need not have been developed by the Army which would have been more responsive to today's state of the art.

After all, what we were struggling for, was the increased payload capability. It became necessary to lower the payload, in order to conform to the booster capability.

It could have been reoriented around another payload.

I think in essence that is what we are doing now, except introducing the low-altitude orbit into the total program to achieve an earlier capability.

You must remember, also, that the Advent program was not aimed specifically at an operational system. It was aimed at a demonstration of a capability.

We are now talking about an operational system, when we talk about the low-altitude orbit system.

Mr. KARTH. Would you say that Centaur is pretty much in that same unique position?

General SCHRIEVER. On Centaur—that is right.

Mr. KARTH. This was a research and development project more than anything else.

General SCHRIEVER. The whole thing started out strictly as an R. & D. project.

Mr. KARTH. It just so happened that as time went on they assigned to the vehicle the launching of the synchronous satellite system as one of its chores.

General SCHRIEVER. No. The Advent was strictly a R. & D. program. It did not have an operational system as its objective.

The main objective of Advent was to prove out certain capabilities.

Mr. KARTH. That was phase I of the program?

General SCHRIEVER. Phase I of the program and also phase II.

Mr. KARTH. Of course phase I was to be in low orbit range.

General SCHRIEVER. Low orbit. The synchronous requirement did not come until phase II.

Mr. KARTH. Yes, sir.

Mr. FULTON. I am glad to hear you say that both the Advent program as well as the Centaur program were each research and development programs.

The purpose of research is not an operational system.

And, therefore, when it is proved that certain designs and procedures are not feasible, that result in itself is a gain.

That is part of the purpose of research and development, isn't it, to learn that we are not correct on certain proposals or plans? I think we are looking at the problem maybe in the perspective of an operational system, that did not develop.

But to me it was a tremendous gain to go through the research on the phase I and phase II of the Advent system.

And likewise, while I disagreed on the specific missions for Centaur, I nevertheless have looked at Centaur as a good research and development project.

Don't you agree?

General SCHRIEVER. The Centaur is a vital R. & D. element of the total space program.

Whether the Centaur precisely in its present stage is going to be used to a great extent, I don't know. But certainly the development of a hydrogen stage is absolutely essential to our space mission.

The Centaur is the first major development, R. & D. program, in that direction.

Mr. FULTON. My comment on the Advent program is that the Army did a pretty good job of research and development.

But they were not purposely developing an operational system at that stage.

General SCHRIEVER. That is right. That was not the objective of the Advent program.

Mr. KARTH. General, we don't want to impose on your time too much.

Mr. Boone has two short questions. And if you will permit us to go through with those?

General SCHRIEVER. All right, sir.

Mr. KARTH. Then we will conclude the hearings.

Mr. BOONE. General, I was going to ask if you don't have to go through the same R. & D. phases on the programs that DOD has now approved?

General SCHRIEVER. No, we don't think so. First of all, the booster that we are using is essentially off the shelf. We are not even going for a stabilized system in our low altitude system.

The communications equipment contemplated in the new package is also essentially off the shelf, based on what has been done as part of the Advent, as part of Relay, as part of Telstar, and just generally from the advance in the state of the art of electronic componentry that goes into a communications package.

We feel that there is little or no development as such involved in the low altitude system.

Mr. BOONE. The Army suggested this morning that the satellite itself was essentially a new project, and that development of the satellite would have to almost commence anew.

General SCHRIEVER. The fabrication of it, yes. But I think it depends entirely on whether you are fabricating with a great deal of know-how and using essentially existing components, or whether you are going into something that you are moving into for the first time which was essentially the position that we were in when we moved into the Advent program some 3 years or so ago.

Mr. BOONE. The Army also stated that ultimately they would prefer the synchronous satellite. I assume that is certainly true.

General SCHRIEVER. That is right. It would have a greater capability.

Mr. BOONE. Well, from the characteristics that you read out earlier, it would seem to me this is considerably less than that inherent in the old Advent program, and that with a lighter satellite, why by this time you should be able to put it into synchronous orbit.

General SCHRIEVER. Well, the problem of putting it up there is still significant and whether it is lighter makes no great difference.

The injection into orbit, to be followed by the coast period and the orbit-keeping—all of those problems from a technical standpoint are just as difficult as they were for the Advent.

Mr. BOONE. You would prefer not to take the final jump, to check into either orbit, and let the low altitude go.

General SCHRIEVER. Well, we are convinced that the low orbit would give us the earliest operational capability.

Mr. BOONE. One last question, Mr. Chairman.

Do you really think an operational satellite system can be accomplished in a couple of years? This would be a record, would it not for an operational system of the Defense Department?

General SCHRIEVER. Well, I think if we get this one on the track and we are allowed to go, I think we can have an operational capability with this low altitude satellite in the latter part of 1964, or early part of 1965.

We can't wait for 6 months or 9 months to get the program underway.

Mr. BOONE. I am reminded of your statements of optimism and overoptimism of the other day.

Thank you, sir.

General SCHRIEVER. On the other hand, though, I want to make one other statement.

I have appeared before this committee and many other committees on many other programs that have had a very high degree of technical complexity, and generally speaking, we have made our schedules pretty close.

Mr. FULTON. Mr. Chairman, on Mr. Boone's point, you had spoken of the limiting factor of funds.

I would say to you that this committee under our chairman has emphasized that its jurisdiction generally in science research and development, wherever it is—our committee has cognizance of R. & D., even under the military.

This committee so far, I think because of the confidence of the House, has had no trouble getting money on any recommended program.

In fact, our bill this time, under the chairman's leadership, went through 342 to 0, for the scientific programs of this country, of a peaceful nature.

I would recommend that you let us hear when you have research programs that are more basic research than operational, and I am sure the committee would be interested enough to pursue it; is that not right, Mr. Chairman?

Mr. MILLER. Yes, that is right. It is up to us to keep informed.

Mr. FULTON. Yes.

The fact is that this limited amount of money held you back, and if so, how much in the establishment of a communications satellite program for the military?

General SCHRIEVER. As to my comments on money—I am not trying to blame anyone for that.

Mr. FULTON. There is no blame.

I want you to know—

General SCHRIEVER. We came in with budget statements that were just not adequate to carry the program out. So we were caught in midstream without having adequate funds. I don't think that this has had a substantial effect on the Advent program although it has had some effect.

Mr. FULTON. Do you have sufficient funds to get the most efficient and quickest implementation of these programs?

General SCHRIEVER. Well, we have not—

Mr. FULTON. Because if you do not, I wish you would tell us on this committee.

General SCHRIEVER. We have not arrived at the point of actually asking for specific funds.

Mr. FULTON. That is all, Mr. Chairman.

General SCHRIEVER. The funding requirement in fiscal year 1963 is not very great in this program. And I am almost sure that there is more than enough in the DOD budget for it.

The requirement for 1963 is not very high.

Mr. FULTON. Thank you very much, you made an excellent statement.

Mr. KARTH. General, we want to thank you very much for being with us this afternoon.

Again we want to apologize for not having been able to get to you this morning as originally scheduled.

I would like to say that if there were any questions upon which you would like to elaborate, please feel free to do so and submit the material to the committee staff, and we will make sure it is placed in the record in its proper order.

In addition to that, if there are any questions that the committee later feels that they should have asked and did not have the time to ask, we would like to submit them to you in writing for your consideration.

General SCHRIEVER. All right, sir.

Mr. KARTH. Again, thank you very much.

General SCHRIEVER. Yes, sir.

Mr. MILLER. I would like to join you and tell the general we are always happy to see him here.

We always get along with him fine.

General SCHRIEVER. Well, I am always happy to appear before your committee.

Mr. KARTH. We are adjourned. Thank you.

(Whereupon, at 3:56 p.m., the subcommittee was adjourned.)

PROJECT ADVENT

FRIDAY, AUGUST 17, 1962

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE SCIENCES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C.

The subcommittee met at 1:30 p.m., Hon. Joseph E. Karth (chairman) presiding.

Mr. KARTH. The meeting will be in order.

This afternoon the Subcommittee on Space Sciences will hold its second session of the Advent hearings. You will recall last Wednesday the subcommittee heard testimony from the U.S. Army, represented by the Honorable Finn J. Larsen, Assistant Secretary of the Army for Research and Development, and Brig. Gen. Joseph W. Johnson, head of the U.S. Army Advent Management Agency, Fort Monmouth, N.J., followed by testimony of Gen. Bernard A. Schriever, commanding officer of the U.S. Air Force Space Systems Command.

Today, we will hear testimony from the Department of Defense, represented by the Honorable John H. Rubel, Assistant Secretary of Defense and Deputy Director of Defense Research and Engineering.

He will be followed by Dr. Robert Seamans, Associate Administrator of NASA.

First, gentlemen, I want to apologize for not having a full complement of subcommittee members.

As the chairman explained this morning, while both of you were present, Congress late yesterday afternoon decided they should have a 10-day recess, and as a result of this the air transport systems of this country have been overcrowded with people going back home to take a look at what is happening in their respective districts.

I wanted to make that observation so that you would understand that it is not a matter of lack of interest on the part of the subcommittee.

More than that, it is a matter of political expediency, I suppose I can say, that they get back home to take care of some of the things that they feel they have to take care of.

I understand, Mr. Rubel, that Mrs. Rubel and your children are in the room, and I want to take this opportunity to welcome them here. I hope they enjoy the hearings.

You will see your daddy in action, children.

I wonder if there would be any objection on the part of the witnesses to both participating as we go along. If there is no objection on your part, the subcommittee would be pleased to have that arrangement.

I think we may expedite this thing if you would participate in that fashion.

Mr. RUBEL. I think that would be very helpful. We have worked closely together.

Mr. KARTH. Dr. Seamans.

Dr. SEAMANS. I will be happy to appear in that fashion.

Mr. KARTH. I understand, Mr. Rubel, you have a prepared statement. And I would like to ask that, if it is convenient, you submit it for the record and give us a 5- or 10-minute summary.

Dr. Seamans, if you have a prepared statement, would you do the same thing?

Mr. RUBEL. Right.

Dr. SEAMANS. Yes, sir.

STATEMENT OF HON. JOHN H. RUBEL, ASSISTANT SECRETARY OF DEFENSE (DEPUTY DIRECTOR OF DEFENSE, RESEARCH AND ENGINEERING); AND ROBERT C. SEAMANS, JR., ASSOCIATE ADMINISTRATOR, NASA

Mr. RUBEL. I will very briefly summarize the contents of my statement.

I aimed the statement principally at the relationship that has existed between NASA and the Department of Defense and the manner in which our programs have resolved together, because I knew that one of the principal interests of the committee was that relationship, and the question of the proper number of programs, and whether or not there is some unnecessary or unwanted duplication among the programs sponsored by the Department of Defense and NASA.

So that is one of the principal thrusts of my statement.

It also deals with certain problems associated with the Advent project that led to its reorientation and, very briefly, some of our plans for the future.

In the beginning I pointed out that it is NASA's principal responsibility to conduct research and development aimed at the evolution of new techniques and new technologies in space, that this mission differs somewhat from that of the Department of Defense with respect to communications satellites, and, for that matter, other items in the field of development, because the Defense Department has a responsibility for the development of complete systems for operational use.

I then point out that several years ago, in the early part of the year 1958, in fact not long after the NASA was formed, many of the committee members will recall one of the principal subjects of discussion was the distinction between passive communication satellites on the one hand and active communications satellites on the other.

At that time it was much more difficult than it is for us today, although we are far from solving all our problems, to identify clearly and to assess clearly where the principal field of interest lay, and as a result an agreement was made in that period to divide responsibility for communications satellites between the two agencies, with NASA carrying the responsibility for passive communication satellites and the Department of Defense for active communication satellites.

One of the points that I make, or attempt to make, in the prepared statement, has to do with the evolution of technology and the corresponding change in our ideas, and the way in which these changes in

our ideas led to changes in the way in which we worked together, and the way in which we arrived at agreement.

One of the points that I note is, in 1960 it was desired by the Department of Defense to undertake what was then called Project Needles, what is now called the West Ford experiment, the belt of little dipoles of principal interest to the military department, of much less interest from a civilian or commercial view point, and that became the subject of a written agreement between NASA and the Department of Defense, so that here was the first example where a passive communications satellite capability was to be at least experimented with by the Defense Department, even though our principal division of responsibilities was passive for NASA, active for the Department of Defense.

I also point out how during the 1958, 1959, and the early 1960 period we went through a number of changes in our concepts relative to what would make the best and the most effective program for an active communications satellite.

I talk in here about Steer, Tackle, and Decree.

All of these led ultimately to Advent, as we know it, and in the spring of 1960 the management was transferred to the Department of Army.

I also point out, in the fall of 1960, although we had been working on Advent or its predecessor projects, for more than 2 years, new technologies had evolved, new devices had been put together, and NASA began to develop an interest in these, with the result that an agreement was concerted between Dr. Glennan and the then Deputy Secretary of Defense, Mr. Douglas, which ultimately led almost a year later to the Syncom project, which is currently being conducted under NASA's auspices although the Department of Defense, as I believe the committee knows, is furnishing the ground support for that program.

Here then, because of the evolution of new technologies and the desire to seize new opportunities, an agreement was made which gave NASA responsibility for an active communications satellite.

I then point out that there are many ways in which the coordination between our agencies takes place, not only the written agreement between the heads of agencies but also, of course, the many conversations and discussions that led up to those.

I also mention the unmanned spacecraft panel of the AACB and the communications satellite subcommittee that we have established under that unmanned spacecraft panel.

I then point out that, and this also is a subject in which the committee has been interested, the Advent project ran into difficulties which caused us to reorient it.

I would like to read one of the things I have said there because I know it is of particular interest to you and the other committee members, Mr. Chairman.

Propulsion and the problems associated with the Atlas-Centaur are a very important reason but not the only one. If the Advent project had not run into any difficulties at all, we would have still been forced to reorient it because of propulsion limitations and delays. If, on the other hand, the Atlas-Centaur had remained on its original schedules—

Mr. KARTH. You mean because the Advent program grew from an original 1,000 pound concept to 1,325 or thereabout?

Mr. RUBEL. No, sir, that is not the case. Actually, when the project was shifted to the Army in September of 1960, the weight of the satellite was almost exactly 1,250 pounds.

I am quoting from memory. It was very close to 1,250 pounds. There were some estimates made subsequently which indicated that the weight would be greater, but 1 year after the time at which the satellite had been transferred to the Army the weight still was 1,250 pounds. Even though in the meantime it had on paper gone up, it later on went back down again.

Mr. KARTH. Its initial concept was 1,000 pounds, wasn't it?

Mr. RUBEL. The initial concept at the time of the STL-Air Force submittal to ARPA in May 1960, again quoting from memory, was in the neighborhood of 1,250 pounds.

It was not 1,000 pounds. There was a 1,000-pound version that was to go on certain of the Atlas-Centaur launch vehicles, Nos. 9 and 10, I believe. It was the stripped down version that weighed about 1,000 pounds; but the operational version, or the prototype version that was to go in the phase III launches was nominally a 1,250-pound satellite. [Continues reading:]

If, on the other hand, the Atlas-Centaur had remained on its original schedules and had promised to meet its original performance characteristics, we would still have been forced to reorient the project because of problems that had nothing to do with propulsion per se. All of these factors taken together clearly indicated and supported the decision that was made.

Mr. KARTH. If Centaur had been on schedule and, of course, this is very wishful thinking, because the Centaur program started out as a research and development program without any objective in mind at the time it started—but if it had been on schedule, and if it had met its original design capabilities, that would have meant that Centaur would have had to wait for Advent; because I understand if work had been carried on at Advent at the rate at which it was being carried on at the time it was discontinued or scrubbed, then the first Advent would have been ready to fly in April of 1963. So, if Centaur had been ready, and if it had met its original capabilities, would you have continued your work on the present Advent vehicle and flown it in April of 1963?

Mr. RUBEL. My personal opinion is no.

Mr. KARTH. The reason I ask the question is because yesterday, both the Army and Air Force witnesses in answer to the same question suggested that, despite the fact it would have cost an additional \$25 million to make Advent operable in addition to the launching cost—and I have no idea of what this might have been—they would have gone ahead with it.

Now, the question that arises in my mind is, who is the boss of this program and who is going to be the boss of the new program?

Who would have made the decision?

They talked yesterday as if they would have made this decision to go forward with the program if the booster were going to be available.

I would just like to find out who would have made it.

Mr. RUBEL. I think the answer is that they might have made recommendations, but the approval of the necessary expenditures and program changes would have been the responsibility of the Secretary of the Defense on the advice of the Director of the Defense Research and Engineering, and we would have not approved merely going forward with the program to meet a launch date.

Mr. KARTH. So your testimony is to the effect that it would not have justified the cost of the launch?

Mr. RUBEL. No, I don't mean to testify that way, but I do mean to say that I would not, based on my knowledge of the project, say that if we had known for a certainty that we could have launched from the Atlas-Centaur in April 1963 with the full load, having demonstrated the reliability of the launch vehicle through eight launches up to that point, because I think No. 9 was scheduled for about that time, as I remember the then schedule, I am not saying that we would have merely gone along at the same rate we were already going on Advent in the early spring of this year and the latter part of 1961 to meet that launch date. I am not saying we would have reoriented the program in the way we did because our reorientation has been influenced by the fact that we are not able to meet that launch date. Furthermore, the Atlas-Centaur will not be able to accomplish this mission on any kind of a schedule owing to the differences which we now perceive in the calculations for its ultimate performance and capability.

Mr. KARTH. You could have scrapped it, couldn't you?

Mr. RUBEL. I don't think those are the only two alternatives. I think there are many possibilities in between.

Mr. KARTH. I would be interested in those possibilities. If you don't go ahead with the program, and do not scrap it, I would be interested in knowing what the other alternatives might be.

Mr. RUBEL. I cannot lay before you a complete plan, of course, we never worked such a plan out. It is an entirely hypothetical consideration, but there are lots of ways in which to reorient a program without either cancellation or committing yourself to continuing on the course you are.

Mr. KARTH. You certainly would have had to reorient the Advent project.

Mr. RUBEL. Unquestionably, in my opinion.

Mr. KARTH. Therefore, you would not have continued down the road of the present Advent—finished or completed it—whatever you call it, and then launched it in April 1963. This you would not have done?

Mr. RUBEL. This is my opinion.

Mr. KARTH. You may proceed.

Mr. FULTON. In your Project Advent program, you had within it certain parameters that you were then designing for and on components were proceeding with some engineering and tests, so that you did have within it factors of change and levels of development as you proceeded; that is right from the start, and you expected those to continue, didn't you?

Mr. RUBEL. Yes, sir.

Mr. FULTON. And as you progressed with that Advent program, you then found, in the then generation of accomplishing, that it did not meet your design parameters that you had thought it could, so of course technically you must change, for technical reasons within the program, not the target dates but the method of building up the components to what would be called Syncom or Advent; is that what you are trying to say?

Mr. RUBEL. That is part of it, a very important part, Mr. Fulton. We found out as we went down the road on Advent that many of the concepts we had had in the beginning did not hold water to the extent we hoped they would.

Mr. FULTON. That is my point. The target concepts were not of the type that you then with your level of design and engineering could meet with an Advent so that obviously if you were going to meet those targets you would have to change the vehicle, and, of course, change every component. Possibly it might have left you with a name but it certainly was a change in the direction that research told you to go.

You see, I am pointing out that it is a factor of the Advent research that caused you to change, so it is a project of research; therefore, again, wouldn't that be right?

It is better not to go ahead and build a vehicle that will not come up to the standard you want, and in the face of that, of course, you should change it, even though you are left with the name called Advent; wouldn't you agree?

Mr. RUBEL. That is correct; yes.

Mr. KARTH. I might say for the record that, as I understand the reorientation of the Advent program—

Mr. FULTON. You must use simpler words for me.

Mr. KARTH. All right; reorienting means changing of the advent program from what it was designed to be originally to what it is going to be in the future; it is going to be changed to a point where it is going to be an entirely different satellite, and it is not a matter of changing a few component parts, it is not a matter of adding something or deleting something that was in the original configuration, it is a matter, as I understand it, of changing the entire design, the entire concept which will in effect have tremendous changes, or substantial changes, at least, in weight and configuration; isn't that correct?

Mr. RUBEL. This is correct, Mr. Chairman; yes, sir.

Mr. KARTH. As a result of reorientation of the Advent program, you will now have two communications satellite programs—or is it three?

Mr. RUBEL. It is two. That is our present plan.

Mr. KARTH. Project West Ford is another one, is it not?

Mr. RUBEL. It is not one of those though. Project West Ford really is an experiment only.

Mr. KARTH. It is a program.

Mr. RUBEL. You can call it a program. We like to emphasize it is an experiment because of the implications of an operational followup.

Mr. KARTH. I understand, but it is under research and development, isn't it?

Mr. RUBEL. Surely.

Mr. KARTH. Your other two programs are also under research and development?

Mr. RUBEL. Yes.

Mr. KARTH. All three programs are under research and development?

Mr. RUBEL. Yes.

Mr. KARTH. To that extent, they are the same?

Mr. RUBEL. Yes.

Mr. KARTH. They are research and development programs?

Mr. KUBEL. Yes.

Mr. KARTH. In effect we have three programs in the Department of Defense?

Mr. RUBEL. That is right.

Mr. KARTH. We have two in NASA, don't we, Dr. Seamans?

Dr. SEAMANS. We have a passive program, using the large Echo-type balloons—

Mr. KARTH. Then you have three programs also?

Dr. SEAMANS. We also have an intermediate altitude and a synchronous altitude active satellite program.

Mr. KARTH. With the commercial satellite communication system we have seven communication satellite systems in all, isn't that correct?

Mr. RUBEL. That is not correct, because we are not developing seven systems.

Mr. KARTH. We are doing research and development on seven different systems?

Mr. RUBEL. We are doing research and development on seven different technical approaches to satellite-based communication devices, any one of which may find an important part as a component in an overall satellite communication system.

Mr. KARTH. But the fact of the matter is, you expect to put in orbit all three of those that you are now doing research and development on, don't you?

Mr. RUBEL. Yes, we do expect to put them all in orbit, but in the case of West Ford experiment the purpose of doing that is entirely experimental and entirely aimed at determining the performance of a dipole belt, which can only be determined by putting it in orbit and without the experiments associated with it to put it in orbit we would simply be unable to carry forth our calculations and plans in this area, but it doesn't imply a commitment to any kind as to operational deployment.

Mr. KARTH. Is some of the technology that you expect to gain from Project West Ford applicable to either one of the other two systems?

Mr. RUBEL. I would say no. Maybe Dr. Seamans would care to comment. I don't think so, Mr. Chairman.

It is just a totally different kind of approach.

Mr. KARTH. You don't ever expect to have it become an operational system?

Mr. RUBEL. I don't expect it will or it won't, Mr. Chairman, because until we get the data that we can only acquire by doing the experiment we simply aren't able to make any kind of a judgment.

Mr. KARTH. So, it might be that you will have three operational systems?

Mr. RUBEL. It is conceivable, although doubtful—but not inconceivable.

Mr. KARTH. And it might also be, Dr. Seamans, that NASA would have three systems going at the same time?

Dr. SEAMANS. I would like to point out NASA is not developing any operational system.

We are carrying out advance technological development in the three areas I indicated.

Mr. KARTH. Strictly research and development?

Dr. SEAMANS. Yes.

Mr. KARTH. Any portion of the technology may be applicable to Defense Department use or the commercial satellite use?

Dr. SEAMANS. I would trust our program is planned in such a way it will be of use both to the commercial interests as well as to the military.

Mr. KARTH. Have you completed your summary?

Mr. RUBEL. Yes, sir, I have, Mr. Chairman. That is about all that I have.

(The prepared statement of Mr. Rubel follows:)

STATEMENT OF HON. JOHN H. RUBEL, ASSISTANT SECRETARY OF DEFENSE (DEPUTY DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING)

Mr. Chairman, gentlemen, it is a pleasure to appear before you again and to discuss the subject of communication satellites. I understand that the interest of the committee centers on the interrelationship of the roles of the National Aeronautics and Space Administration and the Department of Defense in the development of communications satellite technology and systems, on where we stand today and on what the future holds.

First, I think that we should understand in broad terms the responsibilities of the NASA and the DOD in these fields. NASA's responsibilities include, of course, conducting research and developing new techniques and equipment which will contribute to civilian and scientific uses of space, although they do not bear responsibility for designing or for operating complete communication systems.

The Department of Defense, on the other hand, is interested in and has a responsibility for developing communications satellites having as their immediate purpose an operational communication capability to meet our Defense needs.

With this as a backdrop, then, I would like to briefly review the history of this field.

As early as 1958, the Department of Defense recognized the importance of the role communications satellites could play in improving the communications capability critical to the exercise of the command of forces and the control of weapons.

The early activities of the Department of Defense in the development of communications satellites was carried on under the auspices of the Advanced Research Projects Agency. At that time, we knew much less than we know today of the technologies involved and of the complexities and difficulties to be overcome in developing capabilities in space.

Members of the committee will recall in this connection that much of the early discussion concerned passive communications satellites as opposed to active repeater-type satellites. The major emphasis today and, we now believe, the greatest potential, lies in the active satellite area. This earlier emphasis was, however, reflected in the arrangements made between NASA and the Department of Defense several years ago governing the division of effort between our agencies.

In 1958, not long after NASA was formed, discussions were held between representatives of the ARPA, NASA, and the Bureau of the Budget in order to allocate areas of exploration between NASA and the DOD, to insure that the sum of our efforts avoided unwanted duplication and promoted the national interest in this field. It was agreed that ARPA would continue the work which it had started or initiated on active communications satellites, while NASA would concentrate on the passive type.

Even before ARPA was formed in February 1958, the Department of the Army had begun the development of a communications satellite known as Courier. Like a number of satellite developments that were to be inaugurated later, this one was aimed at specific operational objectives.

The Courier was a repeater-type satellite which incorporated tape recording devices and control mechanisms so that information could be stored on board the satellite as it passed over, say, the United States, for subsequent transmission a few minutes later as the satellite passed over, for example, the European Continent.

Like the other space projects that had already been started by the military departments, Courier was assigned to ARPA when it was established and continued for approximately 1 year before its completion under ARPA supervision.

The Army continued, of course, to retain responsibility for project management and the actual execution of project actions.

During the spring and summer of 1958, ARPA reviewed numerous concepts and proposals and in the fall issued a memorandum which established requirements for what was then called the 24-hour communications satellite.

ARPA's studies had indicated that such a satellite which, as its title indicates, would be placed in an orbit over the Equator and synchronized with the rotation of the earth would best fulfill a very large fraction of the Defense Department requirements that had been identified at that time.

It was recognized, however, that the attainment of this capability would represent a substantial undertaking and would require considerable time for its attainment. ARPA, therefore, specified certain preliminary steps which were somewhat less ambitious but which were intended to develop the technology needed for the 24-hour satellite through a series of experimental stages. Each of these became known by a different term and three projects titled Steer, Tackle, and Decree, comprising these steps, were outlined in considerable detail by the early part of 1959.

While Decree was to have been the 24-hour satellite, Tackle designated an intermediate step which called for placing a satellite using similar communications equipment and similar stabilization equipment in a lower and more readily attainable orbit.

Tackle was to be launched in a polar orbit of an altitude of about 6,000 miles, a mission that could be accomplished using Atlas-Agena launch vehicles.

Decree, the 24-hour satellite, required the use of Atlas-Centaur launch vehicle which would not, of course, have been available as soon as the Atlas-Agena and for this reason, it was thought, would limit the earliest time at which space experiments could be undertaken.

Finally, the Steer portion of the total project, which for a while was designated Notus, was also to be a polar satellite; but was intended to use UHF rather than microwave frequencies.

Steer was vigorously supported by the Air Force and was conceived as an important adjunct to SAC operations.

Launched in a polar orbit the Steer satellites would permit communication between the continental United States and SAC aircraft in many parts of the world, including regions on the other side of the North Pole.

Those who advocated its development were hoping that an early operational capability using Steer type satellites could be created and utilized to improve and extend SAC's operational capabilities.

Contracts covering many phases of these developments were written both by the Air Force and by the Army in response to ARPA directives and by the latter part of 1959 Steer, Tackle, Decree and Courier were all under development. It became evident, however, that each of these projects and hence the aggregate of projects, represented a considerably more difficult and more costly undertaking than had been contemplated at the start. It became apparent, too, that a number of projects, particularly Steer and Tackle were aimed at relatively near term objectives which could probably not be attained on schedule because of the developmental problems that had to be surmounted first.

Moreover, it became increasingly apparent that even if successful development demonstrations were accomplished, economical operations in space could not be accomplished on the schedules proposed principally because of unreliability in components and launch vehicles that was characteristic of that period and which could be predicted for the years that lay directly ahead.

Accordingly, early in 1960 the Notus project was reoriented in order to concentrate on the single most important objective rather than dissipating our efforts unwisely by endeavoring to accomplish too many programs concurrently.

This reorientation included also Project Courier. It was canceled after two launchings during the summer and fall of 1960. The totality of the remaining efforts was renamed Advent and that project was designed as the development of a 24-hour satellite system with responsibilities divided among the Army, the Air Force, and the ARPA with overall project responsibility reposed in ARPA.

During this period, NASA had initiated Project Echo and Echo I was launched in August 1960. Additional developments were taking place within industry and within NASA and the DOD during this period too. Several of these resulted in the inauguration of new programs and the development of new working arrangements and agreements between NASA and the DOD in connection with the development of communications satellites.

One of these new developments was what was then called Project Needles and is now called West Ford. About a year after the initial agreement between NASA and the DOD, to which I have referred earlier, the concept of using an orbital belt of small wire reflectors as a passive communication device was evolved in the Department of Defense. This was a passive system although it did not employ satellites of any kind and for that reason would, under the terms of the earlier understandings to which I have referred, have become the responsibility of the NASA.

This was, however, to be the first of several examples which subsequently arose in which technological advance and the further development of our ideas made it necessary to somewhat modify our organizational and administrative arrangements in order to get on with the job.

West Ford seemed then, as it does now, to be of little or no interest from a purely civil or commercial point of view but of relatively much greater interest from a military point of view. Accordingly, it was agreed that the West Ford experiment would be undertaken by the Department of Defense and a memorandum specifying that division of responsibility was signed both by Richard E. Horner, Associate Administrator of NASA, and Dr. Joseph E. Charyk, Assistant Secretary of the Air Force (R. & D.) in January 1960.

Another new development emerged during the first half of 1960 and led to a still further agreement between NASA and the DOD which altered somewhat more the basic pattern that had been established not more than 2 years before.

That was the development of a new satellite by the Hughes Aircraft Co. during the latter part of 1959 and the balance of 1960. Hughes proposed a simple lightweight spin-stabilized satellite for use in a 24-hour orbit. It differed in many ways from nearly every other satellite design that had been brought to the attention of either NASA or the Department of Defense. It combined lightweight elements, the utilization of spin-stabilization and certain ingenious provisions for control and orientation which seemed interesting and attractive to specialists in this field.

Moreover, the Hughes Co. had, between the fall of 1960 and early 1961, actually constructed laboratory models of such a satellite and had demonstrated many features of its operation on the ground.

NASA felt that it would be desirable to exploit the possibilities inherent in this design, incorporating as it did many advanced techniques that had been evolved only during recent years.

Accordingly, Dr. Glennan, then Administrator of NASA, concluded an agreement with the Deputy Secretary of Defense under the terms of which NASA would exploit the possibilities inherent in this field of active communications satellites, no longer restricting its effort to the passive communications satellite field.

The Defense Department was not only agreeable to this but actually wished to encourage NASA in this work, feeling that this new technology should be explored.

NASA's studies in connection with the synchronous type of satellite led to the inauguration of the Syncom project during the summer of 1961. This, too, was undertaken in accordance with a joint NASA-DOD agreement which authorized a specific project consistent with the broader principle agreed upon earlier.

This agreement specified that NASA would act as project manager and would find the development of the satellite while the Department of Defense would furnish the necessary ground-based terminals needed to operate the satellite and to communicate with it.

NASA and the DOD agreed upon the choice of frequencies and numerous other characteristics that would insure that the Syncom satellite would be compatible with ground equipments that had already been designed to work with the Advent satellite.

As I have noted, the basic policies that have governed communications satellite undertakings both in NASA and the DOD have been the subject of specific written agreements between the heads of these agencies or their alternates on numerous occasions during the past several years.

Needless to say, these matters are thoroughly discussed on many occasions before agreements of this kind are written and signed. The agreements themselves constitute, therefore, a very important but only a partial measure of the extent to which Mr. Webb, Mr. McNamara and their key associates have concerned themselves with specific projects and programs and with the policies which govern them.

In addition, of course, we carry out extensive coordination efforts at lower echelons. The committee is familiar with the Aeronautics and Astronautics Coordinating Board which was set up in the spring of 1960.

The Unmanned Spacecraft Panel of the AACB established a communication satellite subcommittee for the specific purpose of insuring special attention to the coordination of matters which concern communication satellites by the NASA and the DOD.

In the latter part of 1960, we set up an intensive study project under the supervision of the Institute for Defense Analyses specifically aimed at a comprehensive review of all communication satellite proposals, ideas, and projects.

Although this activity was sponsored chiefly by the DOD, we shared all our findings freely with NASA and many of their representatives participated with us frequently in meetings and discussions. In these and other ways, we have succeeded in coordinating not only our efforts but also our approach to development efforts in the field of communication satellites.

I should like to turn now to a further discussion of the Advent project and finish with a brief description of where we stand today. After the elimination of Steer, Tackle, and Decree and the substitution of Advent in the place of all these, responsibility for the Advent project was shifted from ARPA to the Department of the Army. The first moves aimed at accomplishing this shift were begun at about the same time that Steer, Tackle, and Decree were being reoriented and the Advent program plan was being formulated.

By the time the final transfer was made on September 14, 1960, a finalized and approved plan for Project Advent had been formulated by the Air Force and approved by ARPA.

Details of the management arrangements that were made at that time have been given to the committee by earlier witnesses.

Dr. Brown's letter of July 10, 1962 which answered numerous questions that were submitted by the chairman on June 25 details the evolution of the Advent project and changes in the management arrangements for it with which the committee is familiar and which I will not repeat here.

As noted in Dr. Brown's letter, numerous problems arose after the transfer of Advent to Army management. Many of these problems were of a technical character, while others were ascribed to the management arrangements that had been made and the manner in which these were found to be working out in practice.

Accordingly, during the latter part of 1961 and the early months of this year, we conducted an additional, exhaustive examination of the Advent project. This examination led, as you know, to a decision by the Secretary of Defense to alter both the technical approach we were following in certain important ways and to change certain of the management arrangements.

Although you are familiar with these, it may be helpful if I recapitulate briefly certain highlights that will help place them in context. The management changes that were made were aimed at two principal objectives. One was to find a better interface between the Army efforts on the one hand and Air Force efforts on the other.

The new arrangements make the Air Force responsible for the design and development of the spaceborne portions of the system and for the associated launching and control provisions and activities.

We have studied this subject extensively and are convinced that the new arrangement will greatly facilitate the coordination of Army and Air Force efforts toward a common goal.

A second major objective was to insure that all Defense Department communications satellite undertakings would be directed at overall Defense Department needs. The Defense Communications Agency is responsible for the evolution and operation of all long-line communication facilities in the Department of Defense.

Accordingly, under the new arrangement, the Defense Communications Agency is given the job of integrating the efforts of the Army, which is responsible for developing the ground equipment and of the Air Force, which is responsible for developing the space based equipment, to insure that the result will be fully compatible with the needs, with the terminal equipment, and with the other features that characterize the Defense Communications System.

Finally, it was necessary to specify the principal objective toward which our future efforts should be aimed.

Advent had taught us that the attainment of a synchronous system of large capacity was more difficult and was further off in time than we had originally planned and hoped for it to be.

There are many reasons for this statement with which I am sure the committee is familiar. Propulsion and the problems associated with the Atlas-Centaur are a very important reason but not the only one. If the Advent project had not run into any difficulties at all, we would have still been forced to reorient it because of propulsion limitations and delays.

If, on the other hand, the Atlas-Centaur had remained on its original schedules and had promised to meet its original performance characteristics, we would still have been forced to reorient the project because of problems that had nothing to do with propulsion per se. All of these factors taken together clearly indicated and supported the decision that was made.

Our belief in the importance and the value of a 24-hour satellite system has never been diminished. We fully intend to pursue developments in this area and we are laying plans for that at the present time. In addition, however, studies and the developments that have been accomplished in the past few years now indicate that we can attain a more limited but nevertheless a valuable and much earlier capability by developing a simpler satellite system to operate in orbits at intermediate altitudes between 6,000 and 12,000 miles.

The synchronous satellite appears the most attractive for the long haul, partly because it has the simplest ground system and the greatest potential for growth, but it is the most difficult to place in orbit and requires the most complex satellite.

The intermediate altitude system, on the other hand, requires the simplest satellite but it calls for a much more complex aggregation of equipment on the ground. It is likely to be operationally more complex as well. In short, both of these approaches are very interesting but for different reasons. But have advantages and disadvantages. Our efforts during the next few months will be aimed chiefly at defining in much more detail than we ever have before through extensive study and preliminary design efforts, the precise characteristics of the system which we will place in full-scale development.

It will be apparent to the committee, of course, that the DOD interest in a 24-hour system appears in some ways to parallel NASA efforts with Syncom 1. As I pointed out before, that is a cooperative undertaking between NASA and the DOD. We have an understanding with NASA that neither Agency will contract for the development of a new satellite system without ample prior consultation with the other.

As I pointed out, such consultations are carried out all the time and at many levels. I am convinced that even though we are dealing here with a complex subject in a field of growing complexity, our understanding of it is growing too and our arrangements with our colleagues in the NASA insure that our national efforts in this field will be the best we are jointly capable of conceiving and carrying out.

Mr. KARTH. In your statement, Mr. Rubel, you mentioned correspondence between Chairman Miller and Dr. Brown. I would like to insert that correspondence at this point in the record.

(The correspondence referred to is as follows:)

JUNE 25, 1962.

Dr. HAROLD BROWN,
Director of Defense Research and Engineering, Office of the Secretary of Defense, The Pentagon, Washington, D.C.

DEAR DR. BROWN: A review of the research and development efforts in the field of communication satellites is being conducted by this committee to make sure maximum benefit is being derived from this great scientific experiment. Would you be kind enough to furnish answers to the following questions in relation to the Advent communication satellite program.

1. How does the Advent program objectives compare with the Telstar program of the American Telephone & Telegraph Co., the Relay program of NASA (RCA) and the Syncom program of NASA (Hughes Aircraft)? Request this comparison be made (1) with the original Advent program and (2) with the program as reoriented on or about May 23, 1962.

2. What agencies and contractors were responsible for overall program management, technical management, research and development, funding, contractor selection and supervision, systems integration, interfaces, trade-offs, operational

control of ground system and airborne system, and program scheduling? If changes in any of the above responsibilities have been made due to program reorientation by the memorandum from the Secretary of Defense dated May 23, 1962, so indicate and give reasons for the changes.

3. We understand the single manager concept (authority and responsibility assigned to one agency) was not followed in the case of the Army regarding the Advent program as was the case in the assignments of responsibility and authority to the Air Force for the Samos and the Discoverer programs and to the Navy for the Transit program. If this is true, why was an exception made in the case of the Advent program?

4. Reference is made to the following DOD studies:

- (a) May 1961, Office of the General Counsel, Vance study.
- (b) December 1961, D.D.R. & E., the Bridges committee report.
- (c) May 1962, D.D.R. & E., the Ralph Clark white paper.

Is it true that both the Vance study and the Bridges committee report recommended that the Army management of the program be strengthened but no action was taken as the Air Force objected to this? Subsequent to this, did the Clark white paper recommend the entire satellite (including the communication package) be assigned to the Air Force and that on this recommendation D.D.R. & E. and the Secretary of Defense turned over the Advent development satellite program to the Air Force except for the ground stations?

5. List the Advent program changes from the time that ARPA relinquished control of the program, to date, indicating the reasons for changing: Management responsibility, design criteria, program objectives, and agency and contractor authority and responsibilities.

6. How much money has been funded for the Advent program? What was the original estimate as compared to the latest estimate for completing the program? Of the funds expended to date, what portion are considered as an unrecoverable loss due to the reorientation of the program?

7. Is it true that the satellite work (contract with General Electric) under supervision and administration of the Air Force but funded by the Army experienced contract overruns of 100 to 200 percent? Have there been any other contract overruns in the Advent program to date? If so, indicate the amount of money involved and give reasons for the overruns where they have been excessive. Indicate what Government agency was responsible for contract administration and supervision of each such contract.

8. Is it true the General Electric and Bendix satellite contracts have been stopped and that the Air Force is determining whether to reorient these contracts to new objectives or let new contracts?

9. Is the Advent satellite communication package obsolete? If so, why and indicate changes necessary to overcome this deficiency. Is it true that Secretary of the Army (Elvis J. Stahr, Jr.) on May 21, 1962, recommended to the Secretary of Defense, "that phases II and III of Advent program be terminated and that a lightweight satellite development compatible with available boosters and advances in the state of the art be developed," but to date no action has been taken on this recommendation?

10. Is Defense Communication Agency (DCA) responsible to D.D.R. & E. in the chain of command? If not, what operational responsibility does DCA have for R. & D. programs such as the Advent program? Will future R. & D. programs be placed under DOD agencies similar to DCA that report directly to the Joint Chiefs of Staff instead of within the services, under the staff supervision of D.D.R. & E.? Will the Samos and Discoverer programs be placed under Defense Intelligence Agency (DIA) instead of the Air Force, following the same formula used for Advent in the case of DCA?

11. Is DCA building a new operating agency to supervise the Advent program?

12. What factors were used to select boosters for the Advent program and what agency made the booster selection?

13. How many different boosters have been selected for the Advent program and then discarded at a later date? Give reasons for the changes.

14. Was the failure of the Centaur project the reason for revising the management structure in the Advent program as indicated in the press?

15. Is the R. & D. development information being obtained in the Advent program made available to NASA and NASA contractors working in the fields of communications satellites, or is the new DOD secret space directive No. S-5200.13 dated March 23, 1962, preventing this?

16. Has interservice rivalry, as reported in the press, prevented the Advent program from moving forward as originally planned? How does the present schedule compare with the original schedule?

I am sure you agree with me that the impact of a worldwide satellite communications system is of vital importance to the free world. Therefore, I feel the R. & D. effort necessary to make this dream of mankind a reality must not be impeded in any way; on the contrary, the scientific effort must be accelerated. Your cooperation and early reply will be greatly appreciated.

Sincerely,

GEORGE P. MILLER, *Chairman.*

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING,
Washington, D.C., July 10, 1962.

HON. GEORGE P. MILLER,
*Chairman, Committee on Science and Astronautics,
House of Representatives.*

DEAR MR. MILLER: This is with reference to your letter of June 25, 1962, concerning the Defense communications satellite program, including a number of specific questions with respect to Project Advent. The answers to these questions will be dealt with in the following numbered paragraphs which correspond to the paragraph numbering of your letter.

1. The Advent program was conceived as development effort to provide the techniques and equipment for synchronous equatorial orbit communications satellites under the original ARPA Project Decree. With the transfer to the Army from ARPA and the subsequent reorganization, the project acquired an operational slant which subsequent review indicates was somewhat detrimental to systematic, expeditious solution of the complex scientific and technical problems involved. However, it was and will continue to be the intent of DOD communications satellite programs to develop components and techniques which have direct application to operational systems. The Telstar program of A. T. & T. is an experimental program to test a particular medium-orbit satellite as a part of an experimental communications system. The Relay program of NASA also contemplates the development of a medium orbit experimental spacecraft carrying communications and environmental sensing systems to demonstrate capability for long-distance transmission of communications, including one-way television transmission through a satellite. Both Telstar and Relay operating at intermediate altitudes with orbital periods of a few hours will only demonstrate communications for limited periods of time and a communication system derived from these devices would require a large number of satellites and extensive ground environment to be operationally useful. The Syncom program, sponsored by NASA and Hughes Aircraft, is a project to demonstrate the feasibility of a "simple" extremely lightweight vehicle carrying a communications repeater of very minimum performance characteristics in a synchronous orbit. Both the launch and injection procedures and the limitations of the vehicle's carrying capacity makes Syncom a very experimental undertaking which even if successful would not be a prototype for an operational system. None of the projects other than Advent has had the objective of producing either space or ground components that could be considered operationally ready or even operational prototypes. The DOD program that is expected to derive from the reorientation of May 23, 1962, will be even more firmly directed at operationally useful systems, although a more realistic development program will be sponsored to provide the necessary components, technology, and techniques for achieving these objectives.

2. The U.S. Army and within it the Advent Management Agency (USAAMA) at Fort Monmouth, N.J., was responsible for the overall Advent program management. This responsibility included general technical management, specification of all technical characteristics, research and development, plans for test and evaluation, etc. Funding was provided through the Defense budget to the Department of the Army; thence to USAAMA. General Electric, as the contractor for the spacecraft, was selected by the Air Force under the ARPA phase of the program and continued as the program shifted to Army overall supervision. Systems integration, interfaces, trade-offs, operational control of the communications ground environment and program scheduling were responsibilities of the Army. However, in accordance with the original space directive, the Air Force was responsible to the Army for the spacecraft, for booster and upper stage selection and procurement, for launch and injection and then for

certain phases of control of the spacecraft after injection. The program re-orientation affected by the memorandum of the Secretary of Defense, dated May 23, 1962, places clear responsibility for the space portions of future communications satellites systems, including space vehicles with all of their payloads and for boosters, upper stages, injection, etc. with the Air Force. It expands the responsibility for the communications ground environment which stays with the Army. The resolution of the interface problems of the satellite system and the monitoring of progress of the several major components of the system are responsibilities of the Defense Communications Agency under the functional guidance of the Director of Defense Research and Engineering. DCA is also responsible for resolution of the very complex interface between the satellite system and the Defense Communications System. The D.D.R. & E. is the court of last resort for resolving program problems between the three participants.

3. The single manager concept was followed in assigning the Advent program to the Army—the Army had responsibility and authority for the entire project with the Air Force really operating as a contractor to the Army for performing certain of the space portions of the program. The clear instructions from the Secretary of Defense to the Army were that if the program did not proceed as the Army believed desirable, the Army should come back to the Secretary of Defense. Exactly the same arrangement exists for the Navy to manage the Transit program and has been completely successful. Appropriations of all Advent funds were made to the Army which as part of its program management function channeled them to the Air Force and to Army contractors.

4. Various studies of the Advent program have recommended that Army management be strengthened by making the Army responsible directly for the spacecraft development contract. This would shift the management interface with its accompanying technical interface problems from the interface between the spacecraft and its payload, i.e. the communication package to the interface between the spacecraft as a whole and the launch vehicle. At no time was consideration given to the Army's establishing an independent, duplicating space program to launch communications satellites. One such program in the Department (that of the Air Force) is considered adequate. The complexities of the spacecraft and the interaction between the spacecraft and the launch vehicle for a synchronous satellite are such that it was concluded that the Air Force should retain responsibility for the spacecraft development. As a matter of fact, the interface between the spacecraft and its payload, the communications packages, has not proved to be a problem of consequence. The real question was that of Army control over the General Electric contract. Decisions reflected in the May 23 memorandum make the Air Force responsible for all aspects of the space operation and the Army responsible for the ground environment. As indicated in 4 above, the DCA will be responsible for resolving the interface problems, for approval of all specifications and schedules, and for reporting progress to the D.D.R. & E.

5. When the Advent program was relinquished by ARPA, the general characteristics of the system had been established. There was a period of time, however, before specifications were completed and the spacecraft contractor, General Electric, had clear authority to proceed. Subsequent changes were only those necessitated by the improvement in our knowledge of the technical difficulties of the development. From the time the Army assumed responsibility until May 23, 1962, the Army responsibility for the entire project was clear.

6. Total Advent funding (ARPA and Army) from fiscal year 1959, including fiscal year 1962, was about \$159 million. An ARPA-service estimate of February 1960 set the cost of the program at \$139 million, whereas the USAAMA estimate of September 1961 placed the total program cost at \$352 million. Of the funds expended to date, a substantial portion, perhaps 50 percent, of the General Electric expenditure of about \$65 million is unrecoverable because it was addressed to the design, fabrication, and production of a spacecraft which had no booster to lift it to its required orbit.

7. General Electric's initial estimate (when a letter contract was issued) of the cost of the spacecraft portion of the Advent project was \$56.5 million; before contract definitization, the GE estimate had risen to \$77 million. General Electric accepted a contract at \$56.5 million and stated that they would have to request the additional funds as an overrun. Subsequent contract changes which added about \$13 million to the scope of the originally contemplated work raised the estimated cost for completion from \$77 million to about \$90 million. The overrun that would have been incurred had the project been carried through to

completion is entirely a matter of conjecture. General Electric claims now that \$130 million would have been sufficient for completion, Air Force Space System's Division quotes \$144 million. D.D.R. & E. considered opinion is that if the contract had proceeded as planned prior to the redirection of November-December 1961 the total GE cost would have been at least \$180 million. The analysis of contract performance (conducted by the Bridges committee referenced under par. 4 of your letter) based on the situation as of December 1961 indicated an expected overrun of 33 percent on the General Electric-Air Force administered contract (which is certainly low); 45 percent on the Bendix-Army administered contract; and 150 percent on the Sylvania-Army administered contract. A number of change ordered account for some of the Sylvania overrun. Some portion of the Bendix overrun will not be incurred because of curtailment of the program as, of course, is the case with GE; but substantially all of the Sylvania contract, which is concerned with the ground stations, has been completed.

8. The General Electric and Bendix contracts have been reduced in scope to reflect termination of work on the 1,300-pound Advent vehicles and the deferral of flight test in either the 5,600-nautical mile or synchronous altitude orbits. Certain work on reliability and the conduct of specific tests of portions of the fabricated spacecraft will continue at G.E. (Essentially all work required by GE on the ground environment is completed.) The reduction of the Bendix contract involved the elimination of the payload packages for later 1,300-pound spacecraft. D.D.R. & E., with the advice and assistance of DCA, the Army and the Air Force, is reviewing the results of the Advent program to date to determine the characteristics of new system necessary to a sound DOD program. This program will be based on the current state of our science and technology and tailored to boost vehicle performance upon which we can depend. As soon as a program has been designed, in which we can have good confidence of success, new contracts will be let.

9. The Advent satellite communication package is obsolete. It was designed in 1958 with components which were considered reliable at that time with the result that the primary power requirements for each repeater will approximate 85 watts. Today, a comparable repeater with greater expected reliability can be built to require less than 30 watts of primary power. The primary power requirements affect directly and almost linearly the weight of the spacecraft because of the number of solar cells needed to collect the power and the batteries required to store it. It is, therefore, apparent that if a satellite based on carrying four of these packages designed in 1958 would weigh around 1,300 pounds, one designed in 1962 could possibly weigh around 500 pounds. However, other factors that developed during the Advent program have indicated a more cautious approach to the follow-on synchronous orbit system than to proceed forthwith with a vehicle in the image of Advent by using these lighter weight communication packages. We have gone down one road with no boosters at its end and it is desirable not to start down another with the same situation. The answers to previous questions indicate that when we have a sound program defined the new developments will proceed forthwith.

10. The Defense Communications Agency is responsible to the Secretary of Defense through the Joint Chiefs of Staff for a wide range of functions related to the long-haul communications system of the Department. Included is responsibility for review of research and development and recommendation concerning the R. & D. necessary to improvement of the DCS. As a corollary of these chartered responsibilities, the Secretary has assigned specifically to the DCA the resolution of the interface between the elements of the Defense communications satellite system and between the ground environment of that system and the worldwide DCS. In addition, DCA is responsible for monitoring the progress of the communications satellite program as a whole and reporting any situation which may result in program slippages, cost increases, or reductions in technical capability. For this portion of their work (clearly an R. & D. matter), the DCA is functionally responsible to the Director of Defense Research and Engineering. There is no intent at the present time to assign Samos or Discoverer to the Defense Intelligence Agency.

11. DCA has been requested to establish a project office (which will probably be within its Directorate of Research and Development) to discharge its responsibilities with respect to the Defense communications satellite program.

12. Boosters for the Advent program were selected on the basis of the performance predicted as of 1959 to meet the requirements of placing approximately 1,000 pounds in a synchronous equatorial orbit. The Atlas-Centaur was the only

candidate at that time. It was designed to do considerably better than 1,000 pounds and the Advent vehicle was tailored to this booster. This selection was made by ARPA with the advice and the assistance of the Air Force and Advent continued to be dependent upon Centaur for boost into synchronous orbit. A test phase was evolved to use Atlas-Agena boosters to place prototypes of the synchronous spacecraft into approximately 6-hour (5,600-nautical-mile) orbits to test spacecraft functions including power supply, communications repeaters, attitude stabilization, position control, etc.

13. Booster selection was made as described in 12 above; however, a new study is now on to determine what booster system can, with confidence (at least as to weight-lifting capability) put a useful communication payload in a synchronous orbit.

14. The failure of the Centaur upper stage to provide the weight-lifting capabilities initially predicted and to perform the third burn for orbital injection was a factor in the reorientation of the Advent program. Other factors which affected the decision were scheduling difficulties between the availability of satellites and launch vehicles which resulted in excessive costs due to overtime and inefficient construction and fabrication of components for spacecraft which were not adequately developed to justify the cost of launch. At the same time, ground equipment and other supporting systems were rushed to completion to meet these launch dates with resultant increases in cost. In certain respects, the program was overly elaborate in order to prepare for an early operational system which was not justified by the technical progress of the critical space components.

15. Information derived from Defense communications satellite programs is readily made available to NASA. The extent to which NASA makes this available to its contractors is not known.

16. Interservice rivalries in the strict sense are not believed to have been an important factor in the difficulties with the Advent program. The desire of each service to enhance its roles and missions by developing and acquiring new operational systems is considered to be a major factor in producing over-blown development programs which begin to look like operational systems and cost like operational systems long before adequate scientific and technical work has been done on the critical components of these new systems such as spacecraft. Further, the optimism of the services and their supporting contractors is often responsible for greatly underestimating the cost, complexity, and time for completion of these complex new systems. The original optimistic schedules for the Defense communications satellite system predicted experimental operations by 1962. We are now 3 years and a great deal of research wiser than in 1959 and it is clear that, based on much more tightly managed and realistic development programs, we will do well to have a few medium altitude communication satellites in orbit by mid-1964. We may also have one or more synchronous birds of somewhat medium performance and life expectancy in orbit at the same time.

The Department of Defense is keenly aware of the importance to the free world of the development of worldwide satellite communication systems. Although the Department has urgent need for all the communications capabilities which can be derived from this new technology, we believe that our programs can also contribute to the technology which will make a worldwide system for public communications purposes available. Our studies and research on this subject lead us to the conclusion that the medium altitude systems which will require 20 to 50 simple satellites in 5,000- to 7,000-mile orbits and which will require a complex ground environment to provide reasonable continuity of service between terminals spaced the widths of the oceans will have primary utility for defense because it has promise of early availability. The complexity of such a system is on the ground. Many people believe that the ultimate systems to meet most defense requirements and to meet civil communications satellite requirements at a cost which is economically feasible for public common carrier operations will be synchronous altitude systems and probably synchronous equatorial systems. It further appears that for many technical reasons, this ultimate satellite will be fully stabilized so that the antenna remains pointed toward the earth and the solar fields are continuously oriented toward the sun. Advent has been the principal program sponsored by the United States either publicly or privately which is developing the technology to make this type of system possible. The Defense synchronous follow-on program to Advent will probably contemplate the same characteristics. It is going to take

considerably more time and money than people thought in 1959 to develop the components and techniques for economically reliable communications satellite systems, but it is still considered to be well worth the effort.

Sincerely,

JOHN H. RUBEL,
(For Harold Brown).

Mr. FULTON. Could I ask—

Mr. KARTH. Mr. Fulton.

Mr. FULTON. Each have a high level program of communications and you each have a low level program of communications.

Could you give us the distinctions between the NASA programs on those levels and the DOD programs?

Extrapolating on what the chairman has been thinking here, it would seem that many of the components and much of the research in each of those fields would be something that is common to both.

Could you tell us generally how you distinguish between them, between what the Department of Defense is doing and NASA.

Is that right, Mr. Chairman?

Mr. KARTH. Yes.

Mr. RUBEL. Well, perhaps I can start and Dr. Seamans can chime in or add to what I have to say.

The principal program that is active at the present time in the highest orbit, which is the 24-hour synchronous orbit, and I think that is what you had reference to, Mr. Fulton—

Mr. FULTON. Yes.

Mr. RUBEL. Is Syncom.

Since the reorientation of Advent we can't be said to have under active development at the moment in the Department of Defense any satellite program specifically aimed at that objective at the moment.

The Syncom project, I think, is an excellent example of the manner which both NASA and the Department of Defense have tried to make their plans conjoin for maximum benefit.

I believe the committee is familiar with the fact that the Syncom satellite development is sponsored by and funded by the NASA.

We agreed with the NASA ahead of time that the frequencies for which the Syncom would be designed would be fully compatible with the ground environment equipment that had already been installed for the Advent system.

In addition, we agreed with the NASA that we in the Department of Defense would provide certain desirable ground facilities necessary to enable NASA to carry out their experiment, because the Advent facilities by themselves weren't quite enough.

Mr. FULTON. And that you would fund those?

Mr. RUBEL. Yes, this we are doing.

The project manager for the Syncom project is a NASA man.

We have instructed our people in the Department of Defense to consider, in essence, as far as this project is concerned, they are working for him. What he says goes on the project, within the framework of the joint plan that we have agreed upon, and within the framework of the funds that we have allocated for work. I think that arrangement is working out very satisfactorily from both points of view. Dr. Seamans and I have reviewed the progress on this particular project on a number of occasions and worked together to solve problems as they have arisen.

Therefore, the results that will be acquired in the course of accomplishing the Syncom experiment objectives will be of joint value to the Department of Defense and NASA.

It was with that in mind that we undertook it on this basis.

Mr. KARTH. Mr. Rubel, for the record, the Department of Defense then is funding the Syncom research and development program for NASA?

Mr. RUBEL. No, sir. The only part that we are funding is the—

Mr. KARTH. The ground terminals?

Mr. RUBEL. Are the ground terminals.

We are funding certain additions to a ship originally scheduled for Advent project—Navy ship—funding the creation of two ground terminals that are air transportable, which we also agreed with NASA we would fund, and we are funding certain modifications to one of the fixed Advent ground stations that facilitate its operation with Syncom.

These are the additions we have made to our total communication satellite program in agreement with NASA in support of Syncom.

In addition, we are modifying a second of fixed Advent ground stations and funding the addition of a third air transportable station so that we can participate—our Department of Defense people—can participate more actively than would otherwise be possible in the Syncom experiment. That is the extent of our participation.

All the funding for the satellite development itself and all the project scheduling, launch scheduling, determination of what experiment will be done, at what times, are the responsibility of NASA. We defer to their project manager on such matters.

Mr. FULTON. The Department of Defense has a peculiar interest in Syncom.

Could you tell us, for the record, what that interest is?

Mr. RUBEL. At the time that the Syncom project was first conceived—and it wasn't really conceived in its present form originally—but we saw it—perhaps not with so much clarity—at least in its product outlines—at that time we were heavily engaged in Advent.

That was about summer of 1960. The Hughes Co. had developed the technology and some of the hardware that goes into a satellite of this kind and it actually put these elements together and demonstrated, partially at least, the performance of the equipment in the laboratory.

The NASA people became quite interested in that. They thought this was the kind of technology that needed to be pushed along.

Dr. Glennan approached the Defense Department with the suggestion that a joint agreement be concluded, that in this particular case, for this kind of advanced technology, the NASA undertake to give its support, which would move it forward more rapidly than otherwise would be the case. The Defense Department agreed.

We felt at that time it wouldn't make sense for us to follow Advent on the one hand and Syncom on the other, that simultaneously trying to undertake two projects, both of them as parallel as these would have been with respect to the demands on the time and energies of people concerned, didn't make the best sense.

So we welcomed participation from the NASA, and Dr. Glennan and Secretary Douglass concluded an agreement to this effect.

Mr. FULTON. But this is a parallel program, regardless of who does it, isn't it?

Mr. RUBEL. Yes; the parallelism is this, that the fundamental characteristics of Advent then conceived called for a satellite which, as the committee knows, would continue to point at the earth 24 hours a day.

Mr. FULTON. One was spin stabilized and one wasn't.

Mr. RUBEL. Yes. It had gyroscopic devices, and others, to cause it to continually rotate as it went around the earth, so that it would always point at the earth.

The Syncom was self-stabilized and employed ingenious devices to alter its orientation in orbit.

These were, we felt, differences of sufficiently fundamental approach to a similar kind of job, sufficiently different so that both really should be explored.

That was the basis for the agreement, in principle, that NASA would move forward in this direction. NASA spent a number of months thereafter trying to define in more detail what really made sense in terms of a program.

In the summer of 1961 we concluded an agreement in detail to proceed with what is now called Syncom, and is the project I have described, and which flowed really from the original Glennan-Douglass agreement which was accomplished almost a year before.

The concept that we had, rationale, for doing this, was that we wanted to explore the potentialities of this new technology, to see whether it was as simple as it seemed.

We felt if it was it would be something that would open up a very likely and a very promising channel for further development. If it wasn't we would find that out too and perhaps surmount some of the difficulties in the process.

We felt that if the experiment worked it would give us a very interesting interim communication capability—limited but interesting, limited but useful. If it didn't work we might identify certain problems that would again help us move forward in this area.

This was the kind of thinking we had.

Mr. FULTON. Regardless of whether we call it a parallel program or not to say some of the DOD requirements, it is parallel, at least to the extent that it is being paid for by the taxpayers of America, but NASA is paying for it from their budget and DOD is paying for Advent and research and development on the other, isn't that about the only difference, Mr. Rubel?

Mr. RUBEL. Well, I don't—

Mr. FULTON. If you paid for both you would have called it a parallel program, but because you are paying for one and NASA is paying for one you choose to call it this.

Mr. RUBEL. I hope I didn't say—and if I did I would like to change it—that these weren't parallel programs, because they are.

Mr. FULTON. Your explanation led me to believe they were, because of the tremendous possibilities that you saw in Syncom for the Department of Defense.

Mr. RUBEL. Yes, it is precisely, because they are parallel, perhaps, that we decided to undertake them in this particular manner.

Mr. KARTH. Dr. Seamans, we have been kind of unfair to you.

Do you have a prepared statement?

Mr. FULTON. Before you do—

Mr. KARTH. Let Dr. Seamans go ahead and then we will question both.

Mr. FULTON. This was on the point on the funding.

Mr. KARTH. Come back to it later.

Dr. SEAMANS. I do not have a prepared statement, Mr. Chairman.

Mr. Stoller, who is here with me, who is the director of our application program, which includes communications as well as meteorological effort, has prepared material which describes the NASA communications program, which I would like to submit for the record, if I might.

Mr. KARTH. Please do.

(The material referred to is as follows:)

STATEMENT OF MORTON J. STOLLER, DIRECTOR, OFFICE OF APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. Chairman, members of the committee, I appreciate this opportunity to review for you the NASA communication satellite program. I will cover at the end of this review the relation of NASA's Syncom satellite program to the Advent program of the Department of Defense. As I have already entered in the record, during the authorization hearings for the fiscal 1963 NASA budget, an extensive description of NASA's communications program, I will try to be as brief as I can in outlining to you the various aspects of our program. I will pass over passive satellite activities with the remarks that we are continuing our investigations of suitable configurations for such satellites; that we hope to orbit the Echo II, 135-foot sphere, later this year and that we plan to continue to investigate various special materials which are useful for passive satellite structures and will also investigate the possibilities of multiple launches of such satellites in a future project.

I think you are chiefly interested in our active satellite projects. If I can remind you again, there are two altitude regimes of interest for communication satellites. One of these we can characterize as the low or intermediate altitudes and the other the synchronous orbit altitude. As I am sure you understand, if a low or intermediate altitude is used, the necessity for a large number of satellites in order to maintain continuous communication makes a careful consideration of the launching procedures a must. The synchronous orbit altitude will permit the use of as few as three satellites for an operational system, but only if the very difficult technical problem of precision injection into orbit and the operational problem of the maintenance of the satellite on station in a desired location can be met. When we contemplated low or intermediate altitude satellite systems, we do not in general expect to provide these satellites with any special provisions for maintaining their position in orbit. Consequently, we can utilize quite simple satellites. In some cases we contemplate spin stabilized satellites and in others, satellites with simple stabilization devices which may improve performance. In some applications no stabilization at all need be considered. If no provisions for station keeping are made, as many as 19 satellites would be required at the synchronous altitude.

As we have not yet solved the problem of precision injection and station keeping, the development of the synchronous orbit communications satellite system is considered to be an experimental activity which we are undertaking in order to establish the engineering design parameters for future systems. For the low altitude satellite system, where station keeping is not a necessity, the problem reduces to simply injecting the satellite at the desired altitude. There are still questions though as to what degree of stabilization of the satellite is required and as to how to hand over the message traffic from one ground station to another as one satellite after another comes over the horizon. This latter problem has not yet been investigated in practice.

In the NASA program our flight projects include spacecraft designs for both the low to intermediate altitude and the synchronous altitude active satellites. The intermediate altitude satellites are a part of the Relay project. The Radio Corp. of America is the contractor building the satellites under the project direction of our Goddard Space Flight Center. This satellite has many features

which resemble that of the Telstar satellite and yet it has a number of technical details which differ. The upgoing frequency to the satellite from the ground station differs from that of Telstar and the internal configuration of the ground is such that in Telstar there is only one while in Relay there are two transponders. In Relay, we have a much different structural and antenna design which will enable us to make an overall comparison on the advantages to be gained from the various elements of the two designs. As another element of difference we have different designs of high-frequency transmitting tubes and so we are gaining engineering experience with both types of units.

Both Relay and Telstar will fly in approximately the same orbit (about 600 miles perigee altitude and 3,500 miles apogee altitude). This elliptical orbit is not the most desirable one by any means for an operational satellite system. The elliptical orbit is used because we wish to use the most economical available launching vehicle, the Thor-Delta, for these early experiments. I should remind you that Telstar is an experimental satellite. It furnishes a great deal of engineering information on the specific circuits that were used, it carries radiation experiments, which will measure the environmental radiation as it passes through the Van Allen belts, and also includes semiconductor damage experiments, which will measure the actual damage that will take place in sensitive components in the course of the satellite's life.

The Relay satellite which NASA expects to launch later this year carries a similar radiation measurement and damage experiment so that additional information on the problems of flying solar cells and sensitive electronic components through the Van Allen radiation belts can be determined. With these experiments we expect to gain enough information on the basic design for low and intermediate altitude satellites to be able to make many of the final decisions for the design of operational satellites. At the same time, a great deal of information will have been gained at the various ground stations, both here and abroad, on the design of communications antennas, and on receivers for satellite communication systems. This information will be used in the continuing development and improvement of such systems. As I pointed out in the budget hearings, there is much that remains to be done in the design of low and intermediate altitude satellites. We should endeavor to improve the information carrying capacity of such satellites and should provide additional redundancy within the satellite so as to improve the life in orbit.

Economic studies have indicated that a commercial operational communications satellite system may need satellites with lives of some 3 years or more before a profitmaking enterprise can be expected. While we have had excellent success with Telstar up to this point, I will remind you that it has only been in orbit for somewhat over a month and that some time remains until the 2 years for which its designers hope it will survive, will have passed. Our experience to date with satellites of comparable complexity indicates that somewhere in the order of 3 months is when one item or another of the electronic systems starts to have trouble and continuous reliable operation is no longer realized.

I will turn now to our Syncom program. The Syncom program is an experiment in 24-hour synchronous orbital injection and station keeping. The satellite itself was designed to cooperate to the greatest extent possible with the Advent facilities being built by the Department of Defense and in this way NASA was able to take advantage of the DOD systems capabilities and of the previous ground station engineering efforts directed to the development of the Advent ground stations. The satellite itself is small and has the ability to carry only a limited amount of communications traffic at one time. In fact, only a single message channel is available in the normal, conservative, mode of operation. However, the information to be gained on the use of what is known as the "apogee kick" technique and on the rather advanced control and position-keeping mechanisms, which have been designed for the Syncom system by the Hughes Aircraft Co., which is under contract to our Goddard Space Flight Center for this communication project, make the program well worth the support it is getting. This is our first opportunity to investigate in some detail whether or not such techniques are directly adaptable to the communications satellite problem.

If these techniques work out satisfactorily, it becomes possible for us to consider the establishment of synchronous orbit satellite systems with a larger launching vehicle, even one which would generally be considered to have little or no capability for direct injection into the 24-hour orbit.

In Syncom, as I have mentioned before, we have the support of the Army's Advent Management Agency. This Agency is responsible for the development and procurement of a pair of transportable ground stations which will be used

in the tests of the Syncom system. With such stations it becomes possible to change the terminal point for the Syncom system fairly readily, by simply packing up the antenna and communications equipment into their trailers and moving to another location where a suitable emplacement can be made. In an effort to get the Syncom project into flight status at as early a date as possible, it was agreed with the DOD that the ship being prepared by the Navy in support of the Advent project would be made available to NASA for support of Syncom until all the ground equipment has finished construction and test. At the present time, both the spacecraft and the ground station work is proceeding quite satisfactorily and we have every expectation that a launch early in next year will be possible.

We have also undertaken one other step in the development of the 24-hour orbit satellite system. It is obvious that the Syncom project, as it is now conceived, will only demonstrate the techniques of injection and station keeping. A more practical communications satellite will have to be larger, carrying much more communications equipment, and be capable of maintaining position for a much longer period of time. Accordingly, we have initiated with the Hughes Aircraft Co. studies on an advanced synchronous communications satellite. These studies are intended to point up the design difficulties and engineering problems involved in the construction of a satellite weighing some 500 pounds, utilizing essentially the same techniques as are used in Syncom for injection and stationkeeping. The satellite is to have a far greater capability in message handling. A specialized antenna system which is needed to realize this improvement in message carrying capability is one item in the study. We are also investigating in these studies the feasibility of the development of a multiple access technique which will make it possible for more than one ground station to simultaneously use a given communications satellite repeater. Relay and Telstar can do this now for two narrow band telephone channels. The two stations that can simultaneously use either Telstar or Relay just make it possible for a limited number of two-way conversations to be carried. We would like to make it possible for any number of pairs of stations to do this simultaneously. If we wish to carry a number of two-way conversations simultaneously the multiple-access capability must be developed. These active satellite projects which I have just described are very important in building up our understanding of the design problems and the engineering solutions facing the operational communications satellite system. I feel that we have received excellent support from the Department of Defense in the development of the ground stations for the Syncom project, and am happy to take this opportunity to say so.

Thank you.

Dr. SEAMANS. Then I just will make a few comments.

Going back approximately 2 years in time, the Echo balloon was in orbit and some limited communication experiments had been run with it.

However, at that time it was obvious that the communications industry was more interested in an active system than in a passive system.

We felt it desirable to continue with the passive work but felt that because of this interest, and the interest was, I would say, in large part because the passive system puts a greater load on the ground environment than the active, that companies were coming to us with various proposals requesting that a program be initiated that would permit more rapid development of the technology in the active area.

As has been discussed this afternoon, and discussed with your various committees during the authorization hearings, there are a variety of techniques which can be used in the active field.

The intermediate altitude satellites, which are simpler devices than synchronous altitude satellites, put a greater load on the ground environment, but keeping track of the various satellites in such a system is more of a job than is required for a synchronous system.

With a synchronous system there is the difficulty of injecting and maintaining the satellite in a very special orbit.

There is also the problem—what may be a problem, at least—in a commercial system, of the time delay for the passage of signals from the ground to the satellite and back down again.

Consequently, about 2 years ago NASA commenced planning an active program.

This program, as Mr. Rubel has indicated, was jointly approved by NASA and the DOD. This is our practice on all of these projects, to review them with the other agency before proceeding.

The first project that was initiated was Relay. It went out as a standard competition. A contractor, RCA, was selected, and negotiations were carried out and a contract let.

At the completion of the proposal evaluation, A.T. & T., as you know, came in and asked that they be permitted with their own funds to proceed with another experiment.

We felt that this would be highly desirable. Certain elements of the experiment were different than those which were planned for Relay.

This approach gives us a broader base from which to make the ultimate decision as to which operational system will be preferable.

Following that, and in conjunction with the DOD, we commenced negotiations with the Hughes Aircraft Co. for a joint project for Syncom.

All of these efforts, Echo, Relay, Telstar, and Syncom, are giving us very valuable experimental and practical information on which to eventually base the design of whatever operational systems are required.

There are certain elements of these systems that will differ, depending upon whether they are to be used commercially or are to be used militarily.

We feel, as I have said earlier, everything we do will be of maximum assistance to the Department of Defense.

But it is also true they do have certain special requirements, and it is better for them to work on those special requirements if that know-how and skill is going to be required to carry over into the operational phase.

Just to mention a few items in the commercial area, to make the system economically feasible it will be necessary to have very great reliability.

There is no question but what reliability is desired in the military system, but the economics of a commercial system makes a 2- to 3-year life mandatory.

Consequently, in the experimentation which we are doing both on Relay and on Telstar, great emphasis is being placed on measurement of the degradation of the system due to radiation and such effects as may cause the satellite to cease operation at an early date.

There are other commercial-type problems. There is a need for a very large number of channels. There is a need for multiple access; that is, it would be desirable to have a single satellite which can be used for communication between many points on the earth at the same instant of time.

There is the hand-over problem that is required if we go to a low-altitude system.

There is the obvious requirement for very broad band capability for television.

Very briefly, turning to the military, they have a need for a system that gives them considerable flexibility. They need a system that makes use of transportable ground stations which they can set up on very short notice to provide communication between selected points on the earth, whereas the commercial interests know what their traffic patterns are, and will be more interested in large stations that are operating on a continuing basis.

Mr. KARTH. There we are talking about the ground terminal system and not the satellite, isn't that correct?

Dr. SEAMANS. Yes, that is correct, but this does have a bearing on the kind of satellite that is used.

Mr. KARTH. Pardon?

Dr. SEAMANS. This does have a very strong input on the type satellite that is used.

Mr. KARTH. Yes, but yesterday we had testimony to the effect that military requirements could be incorporated into a commercial system.

Dr. SEAMANS. I am sure when a commercial system is ultimately in operation, the military will make use of the system, just the way they now make use of our long line telephones and our transatlantic cables. But they will have in addition special requirements that the commercial system cannot meet.

Just the one last point, is the whole matter of security. They must have secure communications. This gets into special technology that NASA is not prepared for and has no need to become familiar with.

So there are differing requirements between the commercial systems and the military systems.

However, there is a lot in common. If we go ultimately to a synchronous orbit we have got to solve the problem of stabilization as well as orbital injection, as has been discussed, and this is a matter that we are actively working on.

We are working with the spin-stabilized Syncom I. We are also looking, on a study basis, at the possibility of a more advanced Syncom that would still be spin-stabilized but would have improved antenna characteristics by the use of a phased array.

This kind of work is applicable to the military as well as the civilian system.

Mr. KARTH. Dr. Seamans, and Mr. Rubel, I am sure you understand that one of the reasons for this hearing, which in effect is an adjunct to the hearings that have been conducted in full committee, is for the purpose of determining whether or not we can effect any economies. There is some feeling that we are spreading ourselves too thin, going in too many different directions at the same time; doing a lot of work that is in duplication to other work that is being done, and providing too much redundancy in our various systems that we follow as we proceed along this space program path.

Now, obviously, all this research and development on satellite communications systems is costing a lot of money. It is a tremendously expensive project. Yesterday, as you said, we were told that these peculiar military requirements could in fact be built into a commercial system.

Maybe not as quickly as a separate system could be developed with just these peculiarities built into it, but nevertheless it could be done.

Is this, in your opinion, a correct statement or not?

Dr. SEAMANS. I personally think it would be very difficult to build them into a commercial system to be used, say, for transatlantic communications.

Mr. KARTH. I am not talking about the terminals, but just about the satellite itself.

Dr. SEAMANS. I think even a satellite itself will require certain special features: antijam features, and so on, but I would prefer to have Mr. Rubel answer that question in detail.

I have not myself been deeply involved in that special part of the communications-system requirements for the military.

Mr. KARTH. Yes, sir.

Mr. Rubel?

Mr. RUBEL. Mr. Chairman, let me see if I can divide the problem into some definable categories that will make it easier for us to discuss and understand it.

First, let's imagine we are talking about a communications satellite that is in a synchronous orbit and the question that we wish to address ourselves to is, if that is a commercial satellite system, could not the Department of Defense use a part of it; couldn't the same satellite carry aboard, for example, another transformer so that you would use the same pole in essence for two rather than just for one purpose?

Mr. KARTH. Either two wave bands within the same satellite or two satellites?

Mr. RUBEL. Well, let's first suppose we are talking about using that one satellite so all the launching costs are shared, so that all the cost of the vehicle on orbit is shared. So that we are making maximum use of an operation that would have to be conducted anyway for commercial purposes.

The first problem you get into is the frequency allocation problem.

We solve that problem by putting another payload on board that operates on the military frequency. So we surmount that difficulty.

The next problem you concern yourselves with is the ground terminals, but we do not have a ground terminal problem because we will design the power levels and antenna systems and everything on this hypothetical satellite so that it will work with our military ground stations by definition.

This might involve some technical problems. Maybe it is more difficult to put a satellite up with two sets of antennas than one with only one. That would be a requirement because of necessity to use different-frequencies bands.

But suppose we surmount that problem.

A third problem you get into is antijam. If you have got your own receiver and transmitter on board that satellite, it can be designed presumably so it will be as free from jamming through enemy action as if it were on some other satellite vehicle.

That is really independent of whether it is on that satellite or not.

Let's talk finally about control of the satellite in orbit. That satellite not only has to be launched into orbit but if it stops functioning another satellite has to be launched.

Furthermore, while it is on orbit it has to be controlled. It will not just stay there. From time to time signals have to be fed in which give that satellite information so that it will either remain in the right place or go to the right place, remain in the proper orientation or assume the proper orientation.

We have an internal governmental regulation at the present time which says that in order to avoid the danger of interference in satelliteborne communications devices, a capability must be built into these systems which permits us to turn it off.

So you now have three elements of the control problem—getting a replacement satellite into orbit, keeping it on orbit and in the proper orientation, and control of the emanations.

The question from a military point of view is who is responsible for that control. If this is a commercial satellite, does the military have control of those functions?

If it is a commercial satellite and the commercial organization that owns it or controls it has control of those functions, how then in time of emergency can the military be assured of an effective control of their communications system?

Mr. KARTH. Wouldn't you say the answer is about the same way you would have control over communications facilities now in the event of emergency?

Mr. RUBEL. That depends on how we are situated. If we are visualizing a satellite launched from an American launch pad by American crews and it is placed over American territory and controlled by emanations from American soil, the answer to that question might very well turn out to be "Yes."

If we visualize a global communications system in which the satellites, which undoubtedly would be launched from our territory, or most likely would be, would nevertheless have been placed in orbit in other places in the world, and where the control of those satellites must be maintained from bases or from stations or from transmitters located elsewhere than the continental United States, you now get into problems associated with those in control of those stations.

Is it some foreign communications company, some foreign contributor that is employed by our communications company, whoever else owns those satellites, or an American military installation abroad or American military ship at sea?

You can see many of these questions are without answer at the present time.

Mr. KARTH. I do agree. The only observation I make is that many of these questions you raise certainly must be worked out in advance—just as you will have to work them out, I suppose, in order to operate from foreign soil a strictly military satellite communications system.

Mr. RUBEL. Oh, unquestionably.

Mr. KARTH. I assume these things could be worked out through the State Department, whether it is a combination of two, or one or the other.

Mr. RUBEL. I think then the burden of my view would be that it is essential you have a military satellite capability in the sense that you have control of those essential features of communications system that render it as invulnerable as possible against hostile action and that you retain your control over it in time of emergency.

Without that, the principal rationale for having such a system disappears. If this can be worked out in conjunction with the deployment of a suitable commercial system, naturally the military departments will seek to do that in the future, just as they have sought to do that in the past.

The example I have used is a hypothetical one.

Mr. KARTH. Has there been effort made on the part of the Department of Defense to meet with and discuss this problem with the people who will be going into the commercial enterprise?

Mr. RUBEL. I would not say that the answer to the question is "Yes," if by "this problem" you refer to my previous testimony just now, because the example I chose was hypothetical and represents a type of satellite system that the commercial people, at the present time at least, are really not very interested in.

The one that they are really very interested in now is the Telstar type of satellite, of course.

With respect to that the answer is "Yes."

As a matter of fact we signed a contract—or the Air Force has signed a contract—with the I.T. & T. Co. to lease a ground station that will function with the Telstar satellite. It is exactly the same kind of a ground station that the A.T. & T. Co. is also leasing from I.T. & T.

Mr. KARTH. I understand that discussions have gone on with the commercial companies insofar as Telstar is concerned. Telstar is what we might call a first-stage or first generation vehicle. My question is: As long as we are pursuing this whole question of satellite communications, and we are going on down the development road, and as we look to the future, we are obviously going to have to have two independent systems, or else we are going to have to have one that takes care of both requirements, military and civilian.

The longer we go down this road before we have discussions among the interested parties, the more apparent it becomes to me that we are going to have such discussions, if we have them at all, much too late to have any effect.

Mr. RUBEL. I don't know.

Mr. KARTH. Again my question is, have you any intentions at this time of discussing the possibility of a joint or cooperative system with the commercial people so that in building the satellite the military requirements might be built in?

Dr. SEAMANS. Mr. Chairman, as you know, at this time there is no one organization that the Department of Defense can discuss this kind of joint program with.

Mr. KARTH. If the Senate ever quits talking over there I am reasonably assured within a week or so we will have such a law on the President's desk, and that we will have this corporation set up, and I sincerely hope we do.

Mr. RUBEL. To answer your question and carry out further what Dr. Seamans said, we have talked to everybody there is to talk to, I think.

We participated in the administration's effort to formulate the terms of the bill that is presently being debated in the Senate.

We submitted last year—submitted to the record of this committee last year—a policy statement relative to the Department of Defense satellite-based communication interests and communication needs.

We have given many copies of this statement to members of industry, to other departments of Government, as well as submitting it for the inspection of this committee.

Mr. KARTH. Mr. Rubel, for the record, is your answer to my question "Yes" or "No"?

Mr. RUBEL. The answer is "Yes," insofar as possible, Mr. Chairman, but there are no commercial interests that we have been able to identify with whom we can talk about "how can we work with you with respect to your communications satellite system in the future," because that commercial mechanism has not yet been established.

Mr. KARTH. Backing up one step further, Mr. Rubel, if you do not mind: I understand that in February and April of this year the Army did, in fact, recommend to the Department of Defense that some decision should be made on Advent. Before the Department of Defense made any recommendations in line with the recommendations submitted to them by the Army, an additional \$9 million had been spent, and the eventual decision was the decision that the Army was recommending early this year.

Would you care to address yourself to the reason why this rather costly delay took place between the time that the Army made the recommendation and the Department of Defense chose to make a decision?

Mr. RUBEL. Well, Mr. Chairman, this file that I have in front of me here—

Mr. KARTH. It is much too voluminous for me to read.

Mr. RUBEL. Much of it is my own correspondence with regard to precisely that question.

I am not sure you are not interested in that.

As a matter of fact, I think most of us have come to feel that a lot of the history of this particular incident probably is not of much interest any more, anyhow.

May I summarize it perhaps as follows: In the latter part of 1961—in November, to be exact—we were confronted, as you know from earlier testimony, with a request for the Army for \$41.5 million overrun on Advent.

This occurred in the month of November, which was only 4 months into the fiscal year. We had apportioned to the Army all of the \$72 million that was in the fiscal year 1962 budget in the month of August or September, whenever the appropriations bill was passed.

Yet in November we were confronted, with no prior notice, with a \$41.5 million overrun request.

Mr. KARTH. Who was supervising that contract, the Air Force or the Army?

Mr. RUBEL. There were overruns on virtually all phases of the Advent project, and there were substantial overruns on contracts administered by the Army and substantial overruns on contracts administered by the Air Force, and it would be impossible to say: "You and you alone share the blame for this."

Now, it was perfectly apparent that two things had happened. Not only had the estimates of what it was going to cost to accomplish the program of objectives altered but in addition the rate of expenditure on the project up to that point was such that a very substantial overrun had developed in any case.

We discussed this matter with Dr. Larsen, with members of Dr. Larsen's staff, with members of General Trudeau's staff, presently General Beach's staff, we issued numerous documents and we issued directives.

One of the first things we did was to write a memorandum to Dr. Larsen relative to this emergency fund request and say—

Whatever you do to operate the Advent project from this point forward is to stay within the \$72 million funding level that was apportioned in the fall of 1961, and, secondly, give us a plan for how you will either live with or modify the program objectives in consonance with this guidance.

Mr. KARTH. Wasn't that inherent in the recommendation that the Army made in February or April?

Mr. RUBEL. I would like to make another point.

That particular guidance to the Army was put in writing on the 20th of November, although it had been verbally issued even before.

On the 21st of November, the Army, Dr. Larsen's office, said, "We withdraw the proposal that we made to you earlier, that we should move forward with the development of a 500-pound version of Advent; we really do not think that is a proper decision at this time, it is not perfectly apparent that the Centaur vehicle is not going to be satisfactory; yes, we have some problems associated with the program in its present form, but we are ultimately going to need a 1,200-pound satellite anyway, therefore let us continue."

I raise this point only to make it clear that hindsight is so often even easier than foresight.

Mr. KARTH. I thank you very much for raising that point. This is the first time I have heard it. It is very interesting.

Mr. RUBEL. At that time, November 21, 1961, when things really were not very good, as we found out later, did not look like they were so bad to some of the people that were writing us memorandums. I don't say that in a critical sense.

We proceeded, as you know, to appoint a committee to investigate the project. The Army proceeded to appoint another committee also to investigate the project.

We wrote additional memorandums to the Army asking them to come down with their plan. They never did.

As a matter of fact, the Army really never came forward with the plan to reorient the Advent project that I had asked for on the 20th of November.

They did in April come down with a plan which said: "Let's make another project out of this; let's make it a 500-pound satellite."

It is true we did not answer that particular document and, as a matter of fact, I remember why we did not.

I kept asking some of the people on the staff to please get the answer drafted and they said they would, but they did not, and I kept asking them to do it, and by that time we were so deeply immersed in the project that every time they got an answer drafted they were overtaken by events, and there is actually a hiatus in our exchange of correspondence. We should have answered Army's memorandum at that time and did not.

I have in the file a rough draft answer that I had found unsatisfactory and we never got around to making it satisfactory. That is the main reason that we did not answer it. There were plenty of verbal exchanges.

Mr. KARTH. Mr. Rubel, I think we agree that the management structure that had been set up on Advent was a rather cumbersome, unwieldy thing; that it just did not lead to the best results.

Now I do understand—

Mr. FULTON. That is the understatement of the year. [Laughter.]

Mr. KARTH. I do understand that a suggested change in management has been made. I am not sure that the suggested change is the answer to better management.

I am somewhat fearful you will have the same problems because you have to go to the same people—or the parties have to go to the same people—to get the same decisions they had to go to before the change in management was suggested for the new program.

Would you care to address yourself to this, and including the interface and where it should be; what responsibility and capability has the DCA and tell us whether, in your opinion, they can carry them out. If they cannot, even from a funding standpoint, tell us whether your office is willing, able, and ready to make the decisions that have got to be made.

Mr. RUBEL. Right. I would be happy to do that.

May I go back and finish my answer to the first question? Because I did not fully answer why we took so long to cut off the project and therefore money was wasted—

Mr. FULTON. You are on my time now.

Mr. RUBEL (continuing). That we would otherwise have been able to save. We had people who had advocated that, and many of them were on our own staff. I have a staff paper written here sometime, perhaps a month and a half to 2 months before we finished the May 23 memorandum which did reorient the project, which advocated almost exactly what was in there, but not quite exactly what was in the May 23 memorandum.

When I was put under pressure to go along with these recommendations I said "No." I said, "We have got a project that has been going now for 2 years and we had a lot of trouble getting it going the way it is."

We had a lot of trouble getting the management arrangements established even the way they are.

One year before we had made an exhaustive study of the management arrangements on Project Advent, as I believe the committee is aware. One year later we made another investigation of the same thing.

We, in my opinion, should avoid the mistake of fluctuating upward and downward on large projects of this kind, where thousands of people are involved, and my policy was to say "Yes, it does appear that we are in serious trouble on the Advent project and we should hedge our bets and cover our losses to the extent of issuing those directives which will preserve the integrity of the project within the framework of initial guidance."

That is exactly what we did. We issued directives which placed ceilings on expenditure rates, which asked for modified plans in accordance with those guidelines, but what we did not do was cancel the project, or start a new project, or reorient the project, until we thoroughly understood what we were doing—or hopefully thoroughly understood what we were doing. We had our own committee investigate this.

The Army did it, too. Not being satisfied with that, Dr. Fubini and I personally visited the General Electric Co., Army Management Agency, Space Systems Division, in Los Angeles, before we drafted

our final white paper, before we submitted our recommendations to the Secretary of Defense, and it was on the basis of those investigations and those detailed understandings that we made the recommendations we did, and significantly, I might add, the recommendations that finally were adopted in May were not identical to the recommendations made in January, in February, and in March—I think we did a better job.

I do not think we wasted the taxpayers' money. I don't think there was an untoward delay in taking action.

I think that if we had taken actions of the kind being recommended by any one of a number of people that you could identify by reading memorandums in this file, you would have had as many different courses of actions as you had people recommending them at that time, and you would have found, retrospectively, that you could identify here courses of action which would have appeared to have been expensive from a taxpayer's point of view.

Personally I think we took a conservative approach.

Mr. KARTH. Mr. Rubel, back in December of 1961 the Bridges committee report recommended pretty much, as I understand it, what the Army recommended in April. Why didn't you take some action on the Bridges committee report?

Mr. RUBEL. We did take action on the Bridges committee report. There were many recommendations there which were adopted immediately.

Mr. KARTH. But the management recommendation was not, was it?

Mr. RUBEL. Yes, many of the management recommendations were. Among the recommendations—

Mr. KARTH. Interface was not then, was it?

Mr. RUBEL. They recommended, as I recall, that the Army be given control of the final stage vehicle contract for the development of the satellite.

Mr. KARTH. The communications package and the system?

Mr. RUBEL. They had the communications package.

It is the whole satellite development that the GE was responsible for. Action of that kind was not within our power. That is the kind of action that only the Secretary of Defense in fact can really take.

Mr. KARTH. Isn't that true under the new management plan?

Mr. RUBEL. No.

Mr. KARTH. Who will make that decision in the future?

Mr. RUBEL. The decision has now been made but it has been made a different way.

The recommendations in the Bridges report, as I remember the Bridges report, which were adopted, were, among others, that the representatives be actually stationed in the contractor facilities, Army representatives, that representatives from the space systems division be physically stationed at Fort Monmouth, and certain other recommendations along that line, as well as a reorientation of certain technical phases of the project.

To come to the second part of your question—

Mr. FULTON. Before we leave that: It was then in the fall of 1961 that the limits were set on the \$72 million and they were told to live within the budget, wasn't it?

Mr. RUBEL. Well, I don't want to say "Yes" to that, Mr. Fulton, because as a matter of fact, the budget for 1962, fiscal year 1962, had at one juncture in the previous administration been reduced to, I think it was \$57 million for the Advent project, and the Army had gone through the whole first half of, or a good deal of the first half of the calendar year of 1961 thinking that was going to be their budget.

We increased that budget to \$72 million.

So I don't want to accept the implication that—at least the inference that I drew from your remarks, perhaps wrongly, sir—that we were forcing the budget, forcing the Army into a very restricted budget in saying live with this \$72 million, because the situation was quite the opposite, we had increased the budget allocation for the Army in very recent weeks prior to the apportionment of the funds.

Mr. FULTON. Yes, but obviously the program was then in difficulty because of overruns, so you had to fund it, and where the rate of expenditure had far exceeded what you expected, and was in the future looking as though it would exceed again, I would believe I am not too unfair in saying that on the 20th of November 1961 you told the Army: "Look over your requirements, don't get into overruns, and live within your money."

Mr. RUBEL. We did, but we had no intimation, to say nothing of any notification, of an overrun condition before November 3.

Mr. FULTON. When did that first show up, that it was going to run into badly overrun aspects of the program?

Mr. RUBEL. The project management—the then project management of Advent—as I understand it, informed the Army headquarters staff that he was in overrun condition on his project in about the middle part of September—I can't give you the exact dates—but the Army did not transmit any notification of that to the Department of Defense, to my office, until early in the month of November, more than 6 weeks after they had been notified of it.

Nor were any reports of any kind, any memorandums or any conversations, ever held at any time, that I was ever made aware of, prior to the instant that that overrun request reached my desk concerning the fact that there were problems of this character on the Advent program.

There were quarterly progress reports, I have been told, that are issued from time to time.

I am also told in one of those project reports, at least, there were some words to the effect that there might be an overrun.

I just don't read all the project reports on all the projects and I missed that one.

Subsequent quarterly project reports on Advent I am told did not have that same information in them.

So that we simply did not—though maybe we should have—but simply did not know that we were in an overrun condition until notified of it in the month of November.

Mr. FULTON. What appears here is the necessity for some overall management responsibility and control that is centralized.

We have the Defense Communications Agency—DCA—set up to integrate general communications within the armed services.

Now, they have made management recommendations on the handling of the communications satellite program.

When General Johnston was here he was asked will these recommendations of DCA management work.

His answer was, I believe I can say, that he was afraid that they would not.

What do you say?

Mr. RUBEL. I think they will.

Mr. FULTON. What we are up against—

Mr. KARTH. Are you pretty sure of that, Mr. Rubel?

Mr. RUBEL. Yes, I am, Mr. Chairman. I think they will work. I think they will work very well, as a matter of fact.

Mr. FULTON. He was so optimistic I did not want to question it and break it down.

The Advance Research Projects Agency has the responsibility for Advent until September 1960.

Actually under that system it was really the Air Force coming into ARPA and saying what the requirements were, schedule, and the dollar funding.

So that ARPA was putting the approval.

Then you remember that in September of 1960, it was transferred over to the Army, responsibility was transferred to the Army. That sounds very clear.

Then it gets a third transfer, and when it gets that one—the basketball is booted that time and it becomes a NASA system and is called Syncom.

But when you look at management responsibility in this situation you can start right up with the President and you could look at the other end of that hammock and probably get the poor project manager, Army project manager of Advent.

In between he has all this. He has the President's Office, he has the new Office of Science and Technology in the President's Office, there is the Space Council, there is in the Department of Defense, of course—the Secretary of Defense—there is the Department of Defense Research and Engineering, there is Advance Research Projects Agency, there are the Joint Chiefs of Staff, there is the Office—I imagine yet remaining—of the President's Scientific Adviser.

There are then the various services, Army, Navy, Air Force, and if you look at the services you get both operational and command types of services as well as the joint and specified commands within the services.

In addition you would get a combination of the Defense Communications Agency, with the Panel on Space Communications that is set up, that is, your Unmanned Spacecraft Panel, that has a finger in the pie.

As a matter of fact, if you look at the Army structure, the program manager has to buy his research material from the new Army Materiel Command and any other kind of material he wants on engineering and development he buys from the Army Logistical Command.

Now, my problem is this, and it gives me some concern: When we take that as a basic structure and then try to build on to it another agency for—we will call it supervision and control—as well as cooperation with what is already there, and that is the National Aeronautics and Space Administration, aren't we getting into just another layer of combinations and management and "cooperation" rather than

cutting through the structure and getting some sort of unified management?

It makes me wonder if we are not just adding more complications to this program.

And the question then I come back to is, on the recommendations of DCA for management will you explain how you think they are going to solve all this stew?

How are they going to solve all that?

And I have not given you it in full, I can give another comment or two, but I better limit myself.

In reference to what I have said, how will these recommendations solve all that division of management?

Mr. RUBEL. I would like to answer your question, but not in reference to everything you have said, because there are a number of things that you brought into the discussion that really are not germane to it.

NASA, for example, has no connection whatsoever with the Advent project or its follow-on, nor with the arrangements made within the Department of Defense for the execution of projects which are the sole responsibility of the Defense Department.

Let me confine my remarks therefore to how we expect this—

Mr. FULTON. May I say, I know NASA is not going to do the Advent, but certainly the Syncom is the basis of what you are going to be doing on your communications satellite.

Mr. RUBEL. Let me address myself to the question of how our organizational arrangements have been spelled out.

To begin with, they have been spelled out not by the Defense Communication Agency but they have been spelled out by the Secretary of Defense.

No. 2, they are explicit with respect to the responsibilities and explicit with respect to the functions of the three principal agencies that are concerned. These are the DCA, Department of the Army, and the Department of the Air Force.

These other agencies, such as the unmanned space draft panel, NASA, and so forth, have no connection with the orderly discharge of responsibilities within this framework.

The DCA has the responsibility for establishing overall system requirements. They have the responsibility for acting as a project manager with respect to the integration of the efforts of the Army and the Air Force to insure you have two things, one, a fully compatible system, and, secondly, a system that is fully compatible with the other elements of the Defense Communications System.

The Defense Communications System is by definition all the long-haul communications systems of the Department of Defense.

These amount to approximately, I believe, 10 percent of total long-line capacity of the United States—perhaps somewhat more.

The functions of the DCA in discharging these and other responsibilities specified in the directive include not only reviewing all the technical matters, not only reviewing all the managerial matters concerned in the administration of a project of this character, but also establishing their own budgets and reviewing and consulting the Army and Air Force budget submittals for all communication satellite programs.

This means you now have a central place, a central agency and a central source for integrated consolidated management action with respect not only to the development phases of the program but toward planning which will insure its compatibility with the long-range needs for operational capabilities within the Defense Department and for the operation of the system once it has passed the R. & D. phase.

Mr. FULTON. You are saying what has been included, but does that automatically eliminate the Defense R. & D. as well as ARPA?

Mr. RUBEL. The role of the Director of Defense Research and Engineering is established by statute and this directive is consistent with his responsibilities to approve, disapprove, modify or initiate plans and projects in the field of research and development in the Department of Defense.

Mr. FULTON. But does he have it or does the DCA?

Mr. RUBEL. The DCA has this responsibility to the extent that any other organization in the Department of Defense charged with corresponding responsibilities has them; namely, subject to review, approval or disapproval by the Director of Defense Research and Engineering—or modification.

Mr. FULTON. So he is above DCA?

Mr. RUBEL. Yes.

Mr. FULTON. Where does ARPA fit in?

Mr. RUBEL. ARPA has no connection whatever with this program.

Mr. FULTON. They were eliminated, as I intimated.

Mr. RUBEL. That is right.

Mr. FULTON. What would the Navy research office do?

Mr. RUBEL. Navy Department will be involved in this program precisely the way they have been before with respect to their seaborne interests and functions and they will relate to the DCA precisely the way the other agencies of the Army and the Air Force concerned with the project will relate to the DCA.

Mr. FULTON. How does General Schriever's specific command relate to it?

Mr. RUBEL. General Schriever will establish a project office within the Air Force systems command charged with responsibility for the development of all the spaceborne portions of communications satellite systems that we have undertaken to develop and charged with responsibility for insuring the associated launching provisions are made, associated launching functions are performed and associated control functions are properly accomplished.

That office under General Schriever then has certain responsibilities with respect to the DCA in the DCA's role as the integrating project manager.

Mr. FULTON. Let me finish then: Can you work with this arrangement, Dr. Seamans, and NASA?

Dr. SEAMANS. This arrangement does not present any problems to NASA. This is strictly management.

Mr. FULTON. You are working in the same field?

Dr. SEAMANS. We work with the Department of Defense, obviously, in the communications field as in many others where we have the responsibility for seeing to it that the technology that is evolving from our program has maximum benefit to the Department of Defense; where everything that we are doing on Syncom, for example,

is directly available to the Department of Defense, but no action we take in running our programs is contingent upon this particular organization structure.

Mr. FULTON. But you see there are certain management recommendations for communications in the Department of Defense. You are working in the same field. It does take liaison, cooperation, and teamwork.

I am asking NASA now, can you work efficiently with such recommendations in the communications field?

Dr. SEAMANS. The answer is "Yes."

Mr. KARTH. You are not, as far as the weather satellite—interface between the booster and satellite—are you, sir?

Mr. SEAMANS. I am not quite sure I get your question, Mr. Chairman.

Mr. KARTH. As far as the weather satellite is concerned, the interface is between the booster and the satellite, isn't it?

Dr. SEAMANS. No. In the case of the meteorological program, NASA is responsible not only for developing the satellite but for placing it in orbit on the experimental program, and once an operational system has been developed, NASA will still have the responsibility for the fabrication and test of the payloads and for placing them in orbit.

Mr. KARTH. Who funds it and pays for it?

Dr. SEAMANS. In that case the Department of Commerce.

Mr. KARTH. Total program?

Dr. SEAMANS. The Department of Commerce funds the total program and assigns to NASA the funds and responsibility for placing the operational system into being.

Mr. KARTH. So where is the interface in this program?

Dr. SEAMANS. Which program, Mr. Chairman?

Mr. KARTH. In the meteorological satellite program?

Dr. SEAMANS. In the meteorological program there is no interface as between ground equipment and spaceborne equipment.

The interface is actually between the readout stations and the world net that is operated by the Weather Bureau system.

Mr. KARTH. Doesn't the Weather Bureau have full responsibility for developing the scientific package and the hardware and the satellite, and NASA has the responsibility for launching it, and launching operations facilities, and so forth?

Dr. SEAMANS. No, we are responsible for the total space package.

Mr. KARTH. So, in this instance, you are responsible for everything.

Dr. SEAMANS. We are responsible for everything sitting on the launch pad at Cape Canaveral.

Mr. KARTH. You disburse the funds as you see fit in each phase of the program; is that correct?

Dr. SEAMANS. Yes, subject to overall review by the Department of Commerce.

In other words, we are their agent and we submit to them.

Mr. KARTH. Who determines the specifications for the payload?

Dr. SEAMANS. They establish the overall requirements for the payload. They indicate what kinds of TV coverage they want, what kinds of IR information will be needed, and so forth. But the specifications for the hardware itself are the responsibility of NASA.

Mr. KARTH. So the difference between these two programs—Advent and Tiros—is that, in the case of Tiros, you control and fund the whole operation?

Dr. SEAMANS. I don't myself feel these two programs are analogous.

I don't necessarily say everything has to be done in the same way. I say, in this instance that NASA has complete control of development and operation of the program as opposed to the other situation, where one agency does not have complete control.

In the case of this communication program that Mr. Rubel has been discussing one agency has the responsibility; namely, the Department of Defense. What you are really talking about in that case is the internal arrangements within the Department of Defense.

Mr. KARTH. Two groups are getting funds, the Army and the Air Force. A third group will try to make a decision where the interface should be and how the problem will be resolved, and if they cannot do it they will have to go on to someone else to do it.

Mr. FULTON. You are hitting on a point I think we should specify particularly.

The Army and Air Force have responsibility but the management responsibility has now been taken over by the Defense Communications Agency and that has been inserted between the Department of Defense Research and Engineering Director.

Isn't that the case?

Mr. RUBEL. That is not right, Mr. Fulton.

Mr. FULTON. Who has the responsibility of management?

If the Defense Communications Agency has the responsibility of the management, that is a new function. Then it would take time to set it up. My question would then be, how long will it take to get it properly manned?

Isn't that a new function of DCA? Management?

Mr. RUBEL. It is not a new responsibility but it is a function which they have not discharged on the scale that will be required here, that is true.

Mr. FULTON. So then I come up with the point, how long will it take to get manned?

Mr. RUBEL. I don't think it will be a major problem, frankly. Much of the staff will come by assignment of officers from the three military departments.

We start lots of projects in all of the military departments in the absence of a preexisting project office. Nobody worries much about that because it is possible to acquire these people from various other assignments when needed and put together a good management team. I think we will do much the same here. I don't want to minimize the importance of the problem or indicate we won't have any problems in doing this. I think we will.

I am confident that will not be a major impediment to carrying out the intent of these directives.

Mr. KARTH. Mr. Rubel, getting back to the Weather Bureau satellite program, last year I think you recommended precisely what the Army was recommending insofar as management is concerned of the communications satellite, which now you apparently had a change of heart on.

Mr. RUBEL. I have changed some of my views. I had not thought about this particular management arrangement, for example, last year,

none of us had, and the reason we thought of it this year instead of last year is that we had the experiences of last year to base our new ideas upon.

We made the Advent study for Mr. McNamara, the first one relative to Advent management, early in 1961.

We came up then with a number of alternatives that we contemplated for the management of this communications satellite program, none of which was precisely the one that we have here, and we spent a great deal of time on that study and gave it a tremendous amount of thought.

Then we spent a year implementing the action. We recommended, as a result of that study, and we found out that based on that experience, which perhaps you could consider in a sense to have been a management experiment, that further changes were called for.

I think we also understood better too than we had at first that this was much more than merely the job of developing the satellite, much more than merely the job of launching the satellite, and much more than merely the job of designing pieces of ground equipment to work with the satellite.

I think we have learned in the past year that the emphasis to be placed on system integration, on tying these ground elements in with the operational elements and insuring their compatibility with terminal facilities, I think we have found in the last year these considerations loom larger in our minds than they did a year before.

That is another reason why we moved in this direction.

Mr. KARTH. I sincerely hope you are right in your reappraisal of how a program such as this should be managed.

Getting back to the—

Mr. FULTON. Could I finish on this point?

Mr. KARTH. Yes.

Mr. FULTON. It seems to me to be part of the Department of Defense concentration of management, because what you are doing here is simply combining the Air Force and the Army management under the Defense Communications Agency and expanding the management at that level, rather than having the Air Force have its management, and the Army have its management and then by conferences and joint action working out the various joint projection.

Isn't this further concentration of management at a higher level and expanding the numbers at the higher level rather than leaving them down in the services?

You have even said we will just pick up the officers from the various services working on various R. & D. programs.

Mr. RUBEL. It might be construed as that, and if it is it might even be further employed and I would get the inference from your remarks that perhaps if it was, that this is bad.

Only a few moments ago I thought, Mr. Fulton, you were making the point that management was too diffuse—there were too many agencies involved, and you could not pin it down.

Mr. FULTON. I am a cross-examining attorney and I had a second point in mind. [Laughter.]

Mr. RUBEL. I am hopeful we have come up with a good solution, that is not merely a compromise solution.

We have left as much responsibility with the Army and as much responsibility with the Air Force as we possibly can, recognizing the

soundness of the principle that maximum decentralization is a sound management principle.

We have assigned to DCA those responsibilities which it seems to us demand some kinds of overview and overall effort on the part of at least some agency within the Department of Defense, and the DCA seems to be the logical agency to carry out those functions.

I associate myself with the chairman's remarks, I hope we are right, and I hope a year from now this does work out well.

Mr. KARTH. We will call you back in a year.

Mr. FULTON. Could I make the point: My questioning is to make sure that we are simply not expanding other agencies in the same framework of management and, secondly, that we are not putting in another level of management that will cause delays through one more level being able to say "No," and adding to the number of people that can say "No," and not increasing the number of people who have the responsibility for saying "Yes."

Mr. RUBEL. I hope that is true, too.

I read General Schriever's testimony. I think he made the point very well that was in our minds and that has been addressed in the exchanges here today, somebody has got to take that central role with respect to the creation of a defense-wide satellite communications system.

Hopefully we can make the arrangements that are specified here work out so that they will be better and not worse than the arrangements they have had in the past.

Mr. KARTH. Mr. Rubel, getting back to the proposition of overruns in the Advent contract, and what those overruns were, and when these overruns were called to your attention or not called to your attention, I would like to ask Mr. Peacock to proceed with the questioning on that point.

Mr. PEACOCK. In reference to the Clark White Paper under section B, Mr. Rubel, the indication is that the original estimate on the General Electric contract was \$56.4 million and the total amount spent by the end of 1962 was \$70 million. You said you gave the Army only \$72 million, and you told them to stay within this \$72 million; is that true?

We understand this contract which was under the cognizance of the Air Force sustained an overrun in the neighborhood of \$55 million, but this overrun was not brought to the Army's attention until it was accomplished fact.

Now, when this actually came to your attention, was the \$70 million figure in the General Electric contract a reality? Did the Army only have \$72 million in the fiscal year 1962 to meet their overall obligations?

Mr. RUBEL. No. I don't remember the exact number.

But I can look it up although it will take a couple of minutes to do it in all probability.

Mr. PEACOCK. Maybe you could submit it for the record.

Mr. RUBEL. I would rather do that, sir.

But the situation was that General Electric had had a substantial overrun but also had a substantial amount of money left at the time that the total overrun was called to our attention.

As I recall—I would rather not try to recall the numbers.

Mr. PEACOCK. All right.

Mr. RUBEL. I will submit them for the record.

Nevertheless the numbers as you have stated them did not apply in November or even in December and January.

The situation was one which if we had adhered to the rate of expenditure that was then going on at the General Electric Co. we would have run out of the money at General Electric altogether well before the end of the year—just exactly when I am not sure—but probably some time in April.

So we cut down that expenditure right there and stretched the thing out.

I will give you the exact numbers.

By the way, I would like to ask you the date of that so-called Clark White Paper.

We have been mystified about what that means.

Mr. PEACOCK. The 22nd of May 1962, and it is addressed to the Secretary of Defense, subject, DOD communications satellite.

It is attached to Mr. McNamara's directive of the 23d May 1962.

Mr. RUBEL. I understand.

Mr. PEACOCK. Referred to as the "White paper?"

Mr. RUBEL. Right.

I just did not know which particular one you referred to.

(The material referred to is as follows:)

ASSISTANT SECRETARY OF DEFENSE,
DEPUTY DIRECTOR OF DEFENSE
RESEARCH AND ENGINEERING,
Washington, D.C., August 24, 1962.

Hon. JOSEPH E. KARTH,
Chairman, Subcommittee on Space Sciences,
Committee on Science and Astronautics,
House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: I promised to provide you with additional information during the hearing before your special subcommittee on August 17, 1962.

Colonel Peacock, in discussing the so-called Clark white paper, asked me to state whether the \$70 million figure in the GE contract was a reality when it actually came to my attention. (See pp. 285 and 286, steno record.)

On November 3, 1961, when the Army overrun letter was submitted, \$62.8 million was on contract with the following qualifications:

	<i>Millions</i>
The contract had been definitized and signed in August 1961 at a value of...	\$56.395
As of November 1, SSD had negotiated changes in amount of \$2,370,000, total.....	58.77
As of November 1, SSD had placed contract change notices which were negotiated later at a value of \$4,000,000 so the true total at November 3, 1961 was.....	62.8
All elements of the \$62,800,000 have been negotiated.	
Costs were stretched out, but funds had been obligated in the amount of.....	70.8
Actual expenditure through partial termination (May 29, 1962) was.....	63.2000
Termination costs were estimated at.....	3.2000
The total costs up to May 29, 1962, were.....	66.4000
Residual effort was negotiated at.....	5.0000
As of June 30, 1962, the total obligations had reached the final value of.....	71.0000
Of the foregoing \$71,400,000 obligated, that already spent prior to fiscal year 1962 was.....	29.4000
Therefore, the fiscal year 1962 cost of the GE contract was approximately.....	42.0000
The overall Advent fiscal year 1962 program authorization was.....	72.0000

With respect to the DOD decision on whether to pursue the medium-altitude, random-orbit, communications satellite system (see pp. 323 and 324, steno record), I will certainly notify you when the decision is reached.

Sincerely,

JOHN H. RUBEL.

Mr. PEACOCK. I would like to clear up one other point for the record in reference to the meteorological satellite program. It is our understanding that the Weather Bureau is responsible for total funding of the operational program and in addition to that responsibility they have the responsibility for the design and the fabrication of the spacecraft which they have subcontracted to NASA. The Weather Bureau have procured their boosters from NASA but the design and the type of booster to be used are NASA responsibility as far as selection is concerned. The interface between the two agencies as far as design control would be between the spacecraft and the booster, is that correct, Doctor Seamans?

Dr. SEAMANS. Colonel Peacock, that is not my understanding of the manner in which we are operating.

Mr. PEACOCK. What is your understanding for the operational program?

Dr. SEAMANS. For the operational program it is true that the Department of Commerce is responsible for the overall funding and responsible for spelling out the total requirements for the system.

Mr. PEACOCK. That is, the spacecraft?

Dr. SEAMANS. Total system. What measurements are required, over what latitudes, what—

Mr. PEACOCK. Overall specifications?

Dr. SEAMANS. Overall performance specifications.

Mr. PEACOCK. All right.

Dr. SEAMANS. And that this is then the input to the NASA.

We then must carry out the design of the total system: spacecraft, launch vehicle, and ground environment.

If it is not possible to meet these performance requirements or funding requirements, or scheduling requirements, obviously we have to work this back and forth with the Department of Commerce, with the Weather Bureau.

Mr. PEACOCK. For the complete system?

Dr. SEAMANS. Yes.

Mr. PEACOCK. One other point.

Dr. Rubel, in going back to the advanced study, Bridges report and the Clark white paper, regarding the location of the interface, we understand that the Vance study and the Bridges report both recommended the interface between the space vehicle and the booster, just for that portion of it, and that the Clark white paper changed the structure as it existed by giving the communications package in the spacecraft, which was the Army's responsibility, to the Air Force, along with the spacecraft, which was the Air Force responsibility formerly.

That was one of the basic reasons or basic ingredients of the reorientation on May 23.

Now, I would like to ask in the case of the Transit program, is it not true that the interface is between the spacecraft and the booster for the Navy and the Air Force and in the case of the Ranger program with NASA, isn't the interface between the spacecraft and the booster with DOD and NASA?

What are the management principles in the case of the Advent which negate following that pattern, or that formula, that was followed in Transit and Ranger and some highly classified programs?

What is the change that you would not go to that particular solution based on those recommendations, from a management standpoint?

Mr. RUBEL. Well, there were several reasons behind it.

One of the most important ones is a technical reason, having to do with the problems associated with putting anything into synchronous equatorial orbit.

Suppose we were to move forward, for example, at one juncture the Army recommended, and as we anticipate ourselves, suppose we move forward with a lightweight version of a fundamentally Advent type device—

Mr. PEACOCK. Synchronous?

Mr. RUBEL. Which would be synchronous.

Mr. PEACOCK. Yes.

Mr. RUBEL (continuing). That weighs in the neighborhood of 500 pounds. And suppose also that we decided to put it into orbit basically using the Atlas-Agena.

Now we have discovered or I would not say, perhaps we have discovered—but all of us have begun to appreciate much more keenly, in the last 6 months especially, that any of these launch vehicles, whether Atlas-Agena putting 500 pounds, or Atlas-Centaur putting 1,000 pounds into orbit, has got to have some kind of injection stage on top of it to make it really successful.

We did not really fully appreciate that previously. Many times we computed these trajectories based on three burns of the upper stage, and on paper it looked all right.

In practice it does not. Many of the problems associated with the forward predictions, for example, for Centaur capability are based on the presumption you will have to have a third burn. That is where you get into so much trouble.

We know well we have to have, to make it a practical mission—will have to have some kind of injection stage.

So that associated with the development of the spacecraft now is the development of some kind of an injection engine that will be suitably designed to go with it, suitably married to the launch vehicle combination, et cetera.

Mr. KARTH. Built right into the spacecraft?

Mr. RUBEL. Yes, Mr. Chairman.

We have had a number of discussions about that among ourselves, with our friends in the NASA, with some of the folks we talk to in industry, and we have put a lot of emphasis, in the last year especially, on standardizing on launch vehicles.

NASA and the Department of Defense have concerted between themselves a national launch vehicle program.

We do not want to proliferate launch vehicles. We want to use them repetitively and get the reliability that comes from that.

So we said wouldn't it be good, if we are to put lots of things eventually to synchronous equatorial orbit, would it not be a good thing to have this injection stage on top of the Atlas-Agena combination a standard stage.

Then you would have Atlas and Agena. We have got a standard Agena, Agena D. We undoubtedly will move forward to develop a standardized Atlas booster.

Now, if we had a standardized injection stage on top of that anybody with a payload to go into synchronous equatorial orbit could orbit to ride that vehicle in orbit.

It turns out the consensus of opinion is overwhelmingly against that approach.

Mr. PEACOCK. Why?

Mr. RUBEL. Owing to the fact that it simply turns out to be much easier, much more practical, much easier to consider the injection stage to be part of the final stage vehicle as long as they have to stay together.

And they do have to stay together when you get to these kinds of sizes, until you go to the added but unnecessary expense of separating them in orbit. That is the way Syncom is being handled. That is the way this Atlas would be handled—I mean, this Advent would be handled.

For that reason the launching provisions associated with the space technology aspects and launching provisions associated with the development of this satellite are considerably more complex and result in considerably more coordination across the interface between the launch vehicle and spacecraft than is the case with Mariner or Transit or with many another space program in which the payloads—

Mr. KARTH. Surveyor?

Mr. RUBEL. Yes—can ride on the launch vehicle. In fact Surveyor has an injection device integral to the Surveyor which we call the Surveyor Bus, I believe—isn't that right?

Dr. SEAMANS. Yes.

Mr. RUBEL. That is another example, in that case at least, of the injection stage and the gadget itself is unified.

Now, in the case of working with the Army on the one hand, and the Air Force on the other, it has seemed to us after the experience of the last couple of years that it makes the best sense to make the interface as we did between the spaceborne equipment and provisions on the one hand and the ground-based equipment and provisions on the other.

That seems to us to be a clearer interface than the other way around. That was the principal reason for moving into this direction. If we had had a program more like Transit, which is relatively much more straightforward with respect to space technology implications, we probably would have gone the Transit route and not have drawn the interface as we did.

Mr. KARTH. Thank you very much, Mr. Rubel.

There is one other phase that I would like to get into. I know Mr. Hammill and Mr. Boone also have some questions.

Yesterday I heard some very optimistic testimony on the development of a brandnew satellite communications system and the likelihood of getting this thing into an operational stage at a very early date.

I would like to ask you this question: Knowing what you know about leadtime, how complicated the problem is, all of the various pieces of hardware and advanced technology that are involved, when do you think the Department of Defense medium altitude communications satellite system will be operational?

Mr. RUBEL. Well, I have read the testimony, and I have also read the reports on which that testimony is based, which suggests that you can get into operation during the 1964-65 period with the medium altitude satellite type of system.

Mr. KARTH. Do you believe this? We're talking about an operational system now, that will give us the kind of capabilities that we want?

Mr. RUBEL. I want to withhold my judgment on that, Mr. Chairman, because—

Mr. KARTH. I think it is very important, and I think it is important for this reason, Mr. Rubel: If we are going to spend hundreds of millions of dollars on a medium altitude system that will not be available by the very optimistic date of late 1964 or early 1965, when, according to General Schriever, we are going to need a system of some kind, then I say we should forget about that kind of program and go to the synchronous orbit system, because I think that one can be ready by 1966 and our so-called period of concern is 1964 and 1965. Even the most optimistic speculation was that it would not be ready until late 1964 and possibly not until 1965.

I would like an expert answer, an expert judgment from you on this question. I think it is very important.

Mr. RUBEL. Mr. Chairman, let me answer the question this way: On large programs, of the kind we are talking about here, that involve lots of technical unknowns and that imply very large expenditures once you have been committed to a full-scale program, we have adopted a very distinct philosophy of approach in the Department of Defense, which we are determined to follow in every case, and that is that before we embark on a full-scale development project we will embark first on a program definition phase, and during that program definition phase we will support, assess, and evaluate detailed preliminary designs, detailed hardware experiments, where necessary and germane, detailed management arrangements necessary to insure the success of a full-scale program, and all the other administrative, managerial, and technical factors that probably go into making up a decision.

Mr. KARTH. How long does it take to do this, Mr. Rubel?

Mr. RUBEL. I think that there is no fixed time associated with defining a program. I think that depends on the state of knowledge when you begin. It depends on the scope of the program which you are contemplating.

Mr. KARTH. Just a minute now.

Knowing what you know about the state of the art, and knowing what you know about the requirements of this satellite communications system, and the technology that is involved, and the questions which we will need to answer, and knowing how long it would normally take to have this phase I study made, when do you think we could, in fact, have an operational communications satellite system of the type previously mentioned?

Mr. RUBEL. Well, Mr. Chairman, we will perform the phase I study efforts in order to determine the answer to the question you are asking me.

I can guess, if you wish, and can give an answer, but I don't want you to pin me down to a particular date because I want to feel that I

can really make an objective judgment based upon facts, which I don't presently have before me.

Mr. KARTH. Yes, but, Mr. Rubel, if this phase I study takes 6 months, that puts us into 1963, and we will be well into it. Then you have to evaluate the phase study.

Then you have to make your decision whether you do or do not feel that the desired effect can be had within a certain time period.

That would bring us up to the middle of 1963, in my judgment. I may be wrong.

What General Schriever was saying yesterday, I say was optimistic. I do not mean to be critical, but he is talking about developing an operational communications systems in a year and a half. I think it is impossible.

Would you care to address yourself to this?

Mr. RUBEL. I would like to say that we have found by looking over the history of past projects that we have gotten in a lot of trouble in the past by establishing operational objectives too soon.

Mr. KARTH. Yes, sir.

Mr. RUBEL. We also have succumbed to a natural human tendency to solve first the problems that we understand best and to solve last—or to leave to later solution—the problems that are toughest and that we understand least.

This was one of the problems on Advent, which is well equipped with operation control room, but with nothing to operate.

I can assure you that as long as I have anything to do with this, and Dr. Brown, and the others among us who are presently in the D.D.R. & E., are not going to make that mistake if we can avoid it. We can make mistakes and have made them in the past.

Mr. KARTH. We all do.

Mr. RUBEL. We will do the best we can not to make that mistake again. If it turns out—and I will agree with you—18 months—actually I would count the program definition phases as part of the total time period, because during that period we accomplish precisely those preliminary designs, precisely those early program definition efforts which any orderly program has got to accomplish sooner or later before you have a program anyway, so we do not lose that time, we gain it, as a matter of fact, by not making false starts, we save time in the long run.

In my personal opinion, we will be able only to demonstrate that in the years to come. I don't count that 6 months of program definition as lost time, I count it as gained time and part of the program material period.

Mr. KARTH. Let me talk about 2 years again instead of a year and a half.

Mr. RUBEL. That sounds to me like a tight schedule.

The question one is confronted with is, if you acknowledge, or admit, or recognize that there is a very real need, from an operational standpoint, to supplement our communications capabilities with some kind of a minimum essential communication system during the mid-part of the 1965 decade, how do you match that requirement on the one hand with the technical facts of life on the other hand, and where do you give?

I think the answer is that every case requires the exercise of independent judgment that is matched by the particular set of circumstances that you are confronted with.

I don't think we should blindly move ahead just because there is a requirement. There are other ways of fulfilling that besides merely this particular route.

Mr. KARTH. I think the answer we want is full speed ahead on Syncom or its counterpart in the Department of Defense, and use that system as soon as it is available.

Mr. RUBEL. I think the same problems or perhaps more so are associated with any hard gamble on something as far out as that.

We also have a tendency, which I think matches this other one I have mentioned, to feel that if it is far enough away it is more certain of attainment.

If it is 1966 we are more sure we will get these than the thing we know we cannot get by 1964.

Mr. KARTH. We are not sure of 1965 until 1965 comes around.

Mr. RUBEL. Yes, I think we have to guard against that; our hopes as well as our requirements in an intelligent manner. We will probably not satisfy all of our requirements, we will probably make the same kind of compromises in that respect that all of us are familiar with making with respect to projection and with respect to our daily lives, but we will do the best we can to have an intelligent development and operational program.

Mr. KARTH. Mr. Hammill?

Mr. HAMMILL. We understand the military requirements are such that the Department of Defense looks to a worldwide system, Mr. Rubel, and that ultimately it intends to have the synchronous system, whenever it comes. General Schriever indicated, I think, it would be available in the 1966-67 time period.

Now, in the meantime the Department intends to establish a medium altitude operational system, hopefully within 2 years. But this would be an interim system.

Now, an operational system at medium altitude would probably require 30 to 40 satellites in orbit to have worldwide coverage.

In addition, such a system would require very complex and very expensive ground stations all over the world.

I wonder, in light of the Department's stated policy to utilize commercial facilities to the extent that it is possible, whether such an interim system, which will be terribly expensive, will have sufficient military traffic to justify its establishment in the first place; whether it will get sufficient exercise to keep the system immediately responsive, because if it is not exercised very day we understand that you cannot depend on these electronic devices.

Mr. RUBEL. I think you have asked will the cost be worth the gain. Is the effectiveness of the system worth what it will cost to implement the system.

Mr. HAMMILL. Or are there alternatives?

Mr. RUBEL. And the decision to go forward or not to go forward will be based on cost effectiveness analyses.

I can assure you no decision to implement expensive ground stations and expensive interim communications systems will be made unless the cost effectiveness system analyze compared with alternative

ways of attempting to meet our requirements objectives are fully assessed.

That is the way all major decisions are being made in the Department of Defense and that is the way this will be made too.

I think it is a very hopeful sign that so many of us including our military colleagues, have gained as much experience as we have in previous years, as evidence by the fact that the requirements that have been specified by the Defense Communications Agency are for a minimum essential system.

It may be that even that will not stand the test of cost effectiveness analyses as we develop more facts during our program definition efforts.

If it does not we won't move forward.

Mr. HAMMILL. I would like to follow that with a question for Dr. Seamans, if I may. If the Department of Defense decides to have an operational medium altitude system, and it is already clear that we are going to have a commercial system that will probably follow the Telstar lead, do we really need the research and development effort known as Relay, or does this constitute undesirable duplication?

Dr. SEAMANS. The Relay experimental program is well underway with the launching schedule in the next several months.

Relay is giving us added information to what is obtained on Telstar and will serve as the basis for a decision by the DOD on the one hand and whatever organization comes into being on the other as to what can be done to satisfy this military requirement.

On the one hand, DOD may require a completely separate system.

On the other hand, they may be able to make use of this commercial system if and when it becomes available. All we are doing is to lay the technical groundwork for whatever design is finally put into being.

Mr. KARTH. You mean by the commercial group, sir?

Dr. SEAMANS. Yes. We are carrying out a series of experiments using the Echo and Relay and Syncom which will be the basis, the foundation, for important design decisions that will have to be made for implementation of an operational system.

We are not developing an operational system at NASA.

Mr. KARTH. But the commercial interests, as I have understood them—and maybe this is just from reading too many newspapers—will fund the entire cost of this commercial satellite system.

If this is true, if they really want to do this, I think Mr. Hammill's interest—and my own certainly—is why then do we insist upon spending more taxpayer's dollars to do what this private enterprise group says it wants to do and will do.

Dr. SEAMANS. Well, when this organization, hypothetical organization, comes into being, and when they have actual funds that they are putting into particular projects, we obviously will be aware, and should be aware, of what they are doing, so that we do not duplicate their activity.

They will be going after not a series of experiments, but a cheap, reliable, spacecraft and ground environment for communication purposes.

Our job is to broaden the technological base.

Mr. KARTH. I understand that, but are you saying then that we are after a complicated, expensive system?

Dr. SEAMANS. I thought that point might come up.

Of course, we are not after an expensive system.

Mr. KARTH. All we want is something that works, isn't it, Doctor, the cheaper the better, the more simple the better, I suppose.

Dr. SEAMANS. Obviously the military, with whatever system they use, as well as the commercial interests will want the cheapest and most reliable components and systems that they can fabricate.

Our objective in NASA is to carry out research and development leading to operational systems, but we are not responsible for building operational systems or operating them. There is a very important distinction there.

Mr. KARTH. One final question on my part. This to Mr. Rubel.

I understood that you agreed with me that a 2-year estimate on establishment of a low altitude operational communications satellite system is very optimistic indeed but, I don't know if you have answered, if you have ventured a guess on your part as to when such a system would become operational.

Mr. RUBEL. I did not venture a guess.

Mr. KARTH. May we have the benefit of your good judgment?

Mr. RUBEL. Well, I would say that 2 years would be a minimum. I would agree with that. That is another way of saying that that is an optimistic assumption.

Mr. KARTH. That is, if we get started right now?

Mr. RUBEL. Yes; it is.

Mr. KARTH. When did you expect to make this decision?

Mr. RUBEL. We do expect to commence our phase I period very shortly, hopefully within the next couple of months. I suppose a pessimistic guess would be in the neighborhood of 5 or 6 years, would it not?

Mr. KARTH. I would say so.

Mr. RUBEL. So if we were to make those something like the bounds on where we might end up, that perhaps would place upper and lower limits on the sort of thinking we might be doing at the moment.

Mr. KARTH. Mr. Boone?

Mr. BOONE. I wanted to ask Mr. Rubel, Mr. Chairman, if his remarks a moment ago meant that the requirement has not really been established for 1964 in this particular satellite system.

Mr. RUBEL. We are talking about the minimum essential?

Mr. BOONE. Right.

Mr. RUBEL. No; there has been what is called a requirement established by the Defense Communications Agency for a minimum essential system described in a variety of phases. A really minimum system with certain growth as the years go by, and to a greater capability, aimed particularly at the command and control functions of the military departments.

A reading of that requirement, I think, is very convincing for a person. The kind of people they intend to hook up with, the kind of simplicity they are willing to settle for, are all very refreshing and indicate that it really is a minimum rather than the maximum desired sort of capability that is being called for here, and that is a firm requirement.

Mr. BOONE. This decision that has been made as well as the study phase would not determine whether you would have a medium altitude orbit or a synchronous orbit?

Mr. RUBEL. Well, actually the requirement does contemplate the medium altitude type of system.

Mr. BOONE. Are you really shooting for that now?

Mr. RUBEL. We are going to have a program definition effort in which we are trying to flush out the schedule of our ideas now with considerably more detail.

It is going to be aimed at that requirement.

We are going to get designs which are explicit and complete and comprehensive, with respect to what do you need in the satellites, what do you need on the ground, what are your problems of satellite management, transfer of the communication from one to another—things of that sort. Nor are we going to confine our attention to one particular system but rather carry on parallel investigations relative to the various candidates that exist.

A very real possibility presents itself that, when we were through, we would postulate no new system but exploitation of others that are under development, either by NASA or possibly by private industry.

I would say that the result of our studies just cannot be predicted with confidence now because they have not been done.

Mr. BOONE. From my experience once these dates get set they are set in concrete and very difficult to change.

To make an operational system in 1964 somebody will have to get busy. Your money is gone before you make up your mind that is the way you are going to go.

Mr. RUBEL. The dates on the requirement may be fixed. I don't agree they are any longer set in concrete except that in this case, of course, the requirement really does flow from the consideration that, as we all know, due to the low sunspot cycle during the middle part of this decade, communications in the upper end of the HF band, say from 28 to 20 megacycles, will begin to close out down to well below 20 megacycles, and in some important cases to well below 10 megacycles.

Those bands are useful half of the day at least. Of our HF communication capability, 25 percent will essentially disappear. We also know the remainder of the band is very crowded and there is not an awful lot you can do to put more communications on it.

We know we have a problem. We know this requirement does stem from a very real examination of very real facts.

This is not the same, however, as a date in a program plan. It is not the same as a date in a project development or deployment plan. That date has not been established yet.

Mr. BOONE. Since that has to be, would it not be better to shoot for the ultimate system?

Mr. RUBEL. It depends on whether you want to take the requirement seriously or not. If you were to convince yourself that you could have the synchronous satellite system by 1966, but the requirement speaks of 1964, then you have also said to yourself, "OK, I am willing to ignore the requirement to that extent."

Mr. KARTH. Let me back up a moment. The reason General Schriever said it was important that we have an operational system in 1964 and 1965 is because the 11-year sunspot cycle reaches its height at that time.

He was not worried about 1966 so much. If we did not have a medium orbit communication satellite system in 1966, this apparently did not bother him, but we did need it in 1964 and 1965.

I say we cannot make such an early date even if we put all of our brainpower to work.

Mr. RUBEL. I would say we don't fully know the answer. We want to find out.

Mr. KARTH. Let's confine ourselves to 1964 and 1965 without putting too much emphasis on whether or not a synchronous system would be available in 1966.

We are not really talking about whether or not it would be. As I understood the general yesterday, it was not too important at that stage. The real importance was 1964 and 1965.

I wonder whether we could possibly do this under any set of circumstances.

Mr. RUBEL. I just don't know the answer, sir.

We have in operation today—the United States has in operation today—one Telstar satellite and it is working pretty well.

Who knows that 2 or 3 years from now you could not have quite a few satellites in a medium orbit that would work very well. It is not obvious that you could not do that.

Mr. KARTH. The reason we cannot use this for military purposes is that we have a lot of things to build in that we don't have answers to—antijamming and cryptographic requirements—all of these things that would not be available in commercial systems.

Mr. RUBEL. Many of these requirements are not included in the minimum essential statement of requirements.

Mr. KARTH. Maybe we should go ahead with the commercial system and push that as rapidly as we can then.

Mr. RUBEL. That is a possibility.

Mr. KARTH. And utilize that during 1964 and 1965.

Mr. RUBEL. That is a very real possibility.

As I mentioned earlier, that is one of the possibilities we are definitely intending to look at.

Mr. KARTH. If we could utilize a commercial system during that very critical period why, with a little more time in building in that system a little more capability, why could not we use it on a long-term basis?

Mr. RUBEL. I want to be careful.

Earlier I said "Yes," when the word "system" was used, and what I really mean is satellites of a design comparable with that which would be postulated for the so-called commercial system.

Mr. KARTH. These minimum requirements can rather easily be built into the commercial system; isn't this true?

Mr. RUBEL. I don't know the answer to that.

For one thing, Telstar works on frequencies different from those allocated to military use. Just as a simple straightforward fact probably we do not have traveling wave tubes that will transmit down on a military frequency. So there are development problems associated with moving ahead for a military adaptation even of a commercial design, but we are certainly going to explore that very thoroughly.

Mr. BOONE. It seems to me, in fact, from the testimony given yesterday, the reason for changing from the old Advent was to go to the traveling wave tube, because such a tube exists.

If it did not, why, then you might reduce the capability of the old Advent satellite and put it in orbit anyway, then you have the capability.

Mr. RUBEL. The traveling wave tube they were talking about for that satellite transmitted down on 2,000 megacycles, but the negotiations that have been conducted in recent months relative to frequency allocation indicates to us that that band is not going to be useful for military purposes for transmissions outside of the continental U.S. areas so that the down frequency might very likely turn out to be 8,000 megacycles.

For that band we do not have a traveling wave tube.

Mr. FULTON. I had pointed out previously that the frequency allocation is subject to international agreement and that it might not suit the military, and, secondly, that there is a preparatory conference in 1963 preparing for the final conference in 1963 under the International Telecommunications Union, so it is not set and you cannot therefore depend upon it, so that the military should not be so quick in saying they can depend on the commercial system.

Mr. RUBEL. It is a very important factor, Mr. Fulton; yes, sir.

Mr. BOONE. If what you just said is true, in response to my previous question, then the Advent satellite is truly not obsolete?

Mr. RUBEL. The Advent satellite is obsolete with respect to its weight but not with respect to its function.

Mr. BOONE. If you have nothing better than what was designed in the Advent satellite, how can you say that the thing is obsolete?

Mr. RUBEL. There are under development, and there are even available, traveling wave tubes for the Advent time period that would be suitable for downward transmission on 2,000 megacycles that would enable you to get this economy of weight.

Mr. BOONE. The real problem is getting the satellite in synchronous orbit, isn't it?

Mr. RUBEL. That is right.

Mr. BOONE. And a number of satellite vehicles exist that might be used with the appropriate electronics to be put into the synchronous orbit?

Mr. RUBEL. If the weight problem had not presented itself, then the fact that one could make the Advent much lighter would have been a much less important consideration than it is, and the word "obsolescence" or "obsolete" is, in my opinion, really misused in talking about these things as if they were no good any more.

There are all kinds of things which you can do differently. That does not make the old thing worthless.

A good, solid but heavy design of an Advent might be the best thing from many points of view, except that if you cannot get it to the place where you need it to make it operate you begin to say it is obsolete because we can use some trickier technology or, more advanced technology, to solve that problem.

Mr. BOONE. Was some attempt made to reduce, say, the capability of the Advent satellite such that the weight could be reduced and you could continue with it?

Mr. RUBEL. We exercised that repeatedly but it is a bootstrapping sort of thing and you do not make much money that way.

You can start eliminating channels, for example, but you are up against a very fundamental problem, that once you have committed yourself to the kind of output tubes we were using in the transmitter of Advent, even one channel still calls for a final stage vehicle that is just too heavy to really make sense, whereas if you use a traveling wave tube in the output that consumes a lot less power, your power supplies are smaller and they weigh less, and your solar paddles are smaller, they weigh less, now the structure weighs less to support this, so it also weighs less, and everything goes down together.

It simply turns out you really cannot find enough things to throw out of the original Advent design to solve the weight problem. You can get it down by a few hundred pounds but cannot cut it in half. That is what you really had to do.

Mr. BOONE. The requirement really is not for a low data rate system, is it then?

Mr. RUBEL. No, not the way Advent was contemplated.

Mr. BOONE. I mean the new model.

Mr. RUBEL. You mean for the synchronous satellite?

Mr. BOONE. Well, I believe it is the medium altitude.

Mr. RUBEL. The medium altitude satellite is a very low data rate, very narrow bandwidth requirement, probably would be the equivalent of only somewhere in the order of a hundred kc. bandwidth. Not more than a few telephone channels.

Mr. FULTON. Could I comment on that?

The difference in requirements between the military and the civilian, one of them is in the requirement of bandwidths, you want the narrow bands and, of course, the civilian and peacetime users will use the wide bands.

The other is on the frequency allocation for military uses. You have very limited requirements on frequencies and bands which you certainly have high requirement on—and antijamming and anti-destructibility of the capsule, as well as on ground stations.

The military has use of ground stations in places where if they are stationary or fixed there is no commercial usage.

For example, it could be in the Asiatic sectors where only Communist China would be an available user.

The other point is, the military might want portable or movable ground stations. So that you would have a quite different approach to your synchronous satellites.

Could I ask Dr. Seamans, Syncom actually is a small satellite, so you will not be able to load it up with equipment very much?

Dr. SEAMANS. That is correct. It is a payload weighing approximately 60 pounds and has just a relatively few channels.

Mr. FULTON. Until you come to something like 500 pounds it would be hard to crowd all the purposes for the commercial peacetime uses onto the research and development projects of the military and stick them in this capsule.

Dr. SEAMANS. You definitely could not satisfy commercial requirements with this first Syncom experiment. It is an experiment to get—

Mr. FULTON. I am talking of research.

Dr. SEAMANS. Right. Syncom will give us very valuable information relative to putting payloads in at least nearly synchronous orbit,

and it is also going to give us a chance to exercise a ground environment that is important to the military.

Mr. FULTON. There are two problems here.

One is do you need two systems as between NASA for research and development, and the DOD for research and development, and then in each of those places do you need a low level system.

The other is, can the military just as well, and at a great saving in money, use the commercial development system.

Now those are different aspects. My answer to each is "No"; I want the five systems. I don't think the military should depend on a commercial system, for example, that has the philosophy that Ed Murrow on July 14, 1961, when before the Science Committee he stated, that the commercial system will be open to Communist China and will be a global system and we will not shut the system off for narrow national purposes—

Mr. KARTH. Let's not talk about philosophy, because you do not agree with General Eisenhower's philosophy that we should slow up the space program either, do you?

Mr. FULTON. I think he said "keep out of the space race."

I don't agree with the present administration's program on what I would say is leaving very little room for the military, and I think that in each of these space programs there is room enough for work by everybody.

So that—

Mr. KARTH. Let us argue that another time.

Mr. FULTON. When I hear a Department of Defense official say there are no security aspects of manned maneuverable vehicles I urge him to make up his mind in a hurry.

Mr. KARTH. Write a letter to Mr. McNamara.

Mr. HAMMILL. I have one other question of Mr. Rubel.

One of the talented people from NASA was here before our committee not too long ago—

Mr. FULTON. One of the many talented people.

Mr. HAMMILL. One of the many talented people—right.

He said it was his judgment that one of the bad features of our research and development programs is that those programs which should be cancelled are not cancelled soon enough, with the result that an awful lot more money goes down the drain than is necessary. The reason for this is that as a program progresses, people seem to have some sort of stake in the continuation of the program—a sort of vested interest in seeing it through to the very end—the bitter end.

I think that he made reference to the ANP program as a shining example.

Now, if the Advent satellite can be called obsolete, even in the narrow sense in which you have used that term, I wonder when that fact first became obvious. Let me put it differently. Should not it have become obvious at an earlier date? After all, over \$170 million was spent on the program and we understand that a very large percentage of that is unrecoverable loss.

Mr. RUBEL. I think the answer is it probably should have become obvious at an earlier date, but it's an imperfect world.

Dr. Seamans, and I went into this matter for over a period of about 4 or 5 months beginning in the spring of 1961, not just once or twice but many times.

I remember that we were concerned about this narrow aspect of obsolescence, alleged incompatibility of the Centaur vehicle with the Advent satellite, and on two separate occasions we had General Thames, who was at that time head of the Advent project, and General Ostrander, at that time on the NASA staff in charge of launch vehicles; we deputized those two individuals to work together to give us jointly an answer to that question, which they did.

They told us on August 3, 1961, that everything was OK, they were both satisfied.

We have those papers in the file.

About 1 month later we found out everything was not OK.

They were not trying to mislead us. They were conscientious and competent men doing the best they knew how, and this is true of everybody working on the program.

We are working in new fields, without much past experience to guide us and the best people in the country will make misjudgments from time to time.

Retrospectively, maybe Bob Seamans and I should have decided in April or May or June or July or August of 1961 that the time had come to cut this thing off.

Maybe had we done so it would appear today retrospectively to have been a terrific decision.

But neither of us were smart enough to see it that way at the time. At least I was not. I don't think if I had to do it over again, without benefit of this 20/20 hindsight that I have today, that I would be smart enough to figure out by myself, especially, and not with the best advice and intensive investigation we do get by people up and down the line and independent agencies, giving us the same answer.

It did not take us long after that investigation to find out we were in deep and serious trouble on the Advent project.

Maybe we should have found that out sooner too.

Maybe the fellows on the project should have told us sooner.

I think they should have. Anyway that is the answer to the question. Sometimes in the past I think we have—and I think the ANP program is a good example—failed to make a decision when it had become obvious we should have, even to the people at the time, but they lacked courage or the will to do it.

I don't think that is true on Advent. When it finally became evident to us we did take the action and were willing to stand up and defend it.

There may be some people who think we did not do it right but we think we did.

Mr. FULTON. You have a defender in the opposition on that score. So I don't really oppose on everything, Mr. Chairman. This is a very peculiar thing on the committee, where the opposition is in defense of the administration.

Mr. RUBEL. For which we are deeply grateful.

Mr. KARTH. Any contribution you may make will be gratefully received.

Mr. FULTON. Just a little rib.

Mr. BOONE. One other question.

Did I understand you to say peculiar requirement for certain sophisticated circuitry could not be initially designed into the thing?

Mr. RUBEL. The objective to which our initial efforts will be aimed is what we called a minimum essential communication satellite system.

The minimum essential. Those are the key words. This is a real austerity program.

It is a program conceived originally by its military sponsors. It is not something where they have come up with a grandiose plan and the engineering and scientific people have said it is too grandiose, make it essential.

They are the ones who have specified that they would like us to work toward a minimum essential system.

That is what we will try to do.

It will not have in its initial form these ultimately desirable but initially difficult characteristics of antijamming and what-not mentioned earlier.

Mr. BOONE. Would an existing satellite be used?

Mr. RUBEL. No.

Mr. BOONE. Will you design a new satellite?

Mr. RUBEL. There is not any such thing as an existing satellite unless you were to count, perhaps, the one Telstar in orbit. That would be a candidate.

Mr. BOONE. There are satellites in effect in the air.

Mr. RUBEL. No, I don't know of any. Do you know of any?

Dr. SEAMANS. There is Telstar.

Mr. RUBEL. That is the only one.

Mr. FULTON. "Air" is the wrong word.

Mr. BOONE. I meant in orbit. Yes, it is the wrong word.

Mr. RUBEL. I don't know of any.

Mr. FULTON. Maybe in the air but not the orbit.

Mr. KARTH. In closing, Mr. Rubel, I would like to ask that you inform the subcommittee when you make your decision on this medium altitude system we have been talking about.

Mr. RUBEL. I would be delighted to.

Mr. KARTH. Whatever the recommendations are and why the recommendations were made.

Mr. RUBEL. Yes.

Mr. KARTH. Because we probably won't get you two friendly gentlemen together before the committee again, I would like to ask this as a last question, and direct it to both of you.

Inasmuch as NASA is charged with responsibility for research and development, and inasmuch as the communications satellite programs are in the research and development stage, don't you think that the responsibility should be within NASA?

Dr. SEAMANS. I would like to start in to answer that, if I may, Mr. Chairman.

I think we jointly have a very great responsibility to see that the total research and development that is carried out in the communications field makes sense, that there is not undue duplication, that we are considering the total requirements of the Nation, both for commercial and for military purposes, and for this reason we have agreed to discuss each one of these developments as they came along and not proceed as—NASA will not proceed on a Syncom II without thorough discussion with the Department of Defense.

We may not proceed at all, but if we decide we should, that we think it makes sense, we will discuss this with the Department of Defense to be sure they agree that it is a desirable program.

A second point is that NASA has not been assigned the responsibility for research and development in space on an exclusive basis in the Space Act that established NASA.

It was pointed out that the military must have R. & D. programs in space, and for that reason I feel that it would be incorrect to state that we should be the only ones in this field.

Mr. KARTH. My distinguished colleague would disagree with you on that.

Mr. FULTON. No. The military does have under the original act as passed in 1958 a very special field for research in space on its own, NASA for peacetime purposes, we hope they work this cooperation, but the NASA, when a military requirement supervenes, must yield to the military.

Dr. SEAMANS. Correct.

Mr. FULTON. On higher decision, possibly with the President, isn't that the case?

Dr. SEAMANS. I think that is well stated.

I agree with that statement. However, it is not necessary to go to the President.

Mr. KARTH. Mr. Fulton disagreed with that theory before.

Dr. SEAMANS. I don't think it is necessary to go to the President. I think we have been able to work these possible differences out in a very desirable way working directly with the Department of Defense.

Mr. KARTH. Both agencies are to be commended for that.

Mr. RUBEL. I would like to associate myself with the remarks Dr. Seamans has just made.

I think it reflects very well the way in which we have been approaching it for the last couple of years since we have been working together.

I think it reflects our view as well as I could express myself.

Mr. KARTH. If there are no further questions, I want to—

Mr. FULTON. May I ask if he would be willing to give up this program?

Mr. RUBEL. The answer is "Yes."

There are many examples where we have done so. After we had an agreement with NASA that they would handle the passive satellites they agreed we should do West Ford.

After we had agreed—

Mr. KARTH. There was reciprocity.

Mr. RUBEL. Not synchronized reciprocity.

I think you will find neither agency has given evidence of trying to grab off particular programs.

Mr. FULTON. No. There was no inference.

You each think a high and low level program is necessary, you each think it is necessary and neither one wants to give it up.

Mr. KARTH. Or do you?

Mr. RUBEL. I don't think we have made our final decision. We gave them Saturn.

Mr. FULTON. No answers.

Mr. KARTH. Thank you.

You have been excellent witnesses.

The meeting is adjourned.

Mr. FULTON. Let the record show in your last question, Mr. Chairman, no answer.

Mr. KARTH. They both volunteered so we are back where we started. (Whereupon, at 4:15 p.m., the subcommittee was adjourned, subject to call of the Chair.)

