SPACE POLICIES AND PROBLEMS

20 November 1959

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Dr. T. Keith Glennan, Administrator of the National Aeronautics and Space Administration since its creation in 1958, was born in Enderlin, North Dakota, on 8 September 1905. He was graduated with honors from the Sheffield Scientific School of Yale University and has received honorary degrees at doctorate level from five colleges and universities. He is a fellow of the American Academy of Arts and Sciences. In 1942 he joined the Navy's Underwater Sound Laboratories as administrator and then as director, receiving the Medal for Merit for his contributions to research during the war. His later governmental responsibilities have included membership on the Atomic Energy Commission, on the board of the National Science Foundation, and on the Council on Financial Aid to Education. Since 1947 he has been president of the Case Institute of Technology, and he was on the board of several large corporations. He took leave of absence from Case and resigned from his business obligations in order to assume his present position of responsibility. This is his first lecture at the Industrial College.

SPACE POLICIES AND PROBLEMS

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ADMIRAL PATRICK: Good morning. Without a doubt, the subject of "Space Policies and Problems" is our newest talk in the Industrial College science and security program.

In our National Security Seminars, previously called National Defense Resources Conferences, we give a 50-minute talk on outer space. We state that perhaps our greatest gain from our space program will be the basic knowledge we will obtain. From this we derive our capability to accomplish missions which are beneficial to both our civilian and our military well-being.

Our speaker today is on leave from the presidency of Case Institute of Technology and is the Administrator of the National Aeronautics and Space Administration. You have noted from his biography that he is well qualified for the challenging position he holds. His authority was recently expanded by the Presidential directive moving true space programs from DOD to NASA. This makes him in fact the director of our country's space program.

It is a pleasure to present to the College Dr. T. Keith Glennan on the occasion of his first appearance. Dr. Glennan.

DR. GLENNAN: Thank you Admiral Patrick. Good morning, Gentlemen: I am going to talk to you this morning off the cuff. I have a few notes, in order to give some order to this presentation. I am going to assume that you would like to have an outline of our organization and who we are, what we are attempting to do, and what we think we may be able to do in the future. I am very glad to have an opportunity to discuss with this group particularly the problems that we face, and I will be happy to attempt to answer the questions which you may have.

I think you ought to realize first that NASA was born out of a state of hysteria; that, indeed, if Sputnik number one had not been put into orbit, it is highly improbable that there would be a NASA. This doesn't mean, in my opinion, that there would not be activity in space, but it surely means that there would be less feverish activity and a more orderly program than we presently have. I suspect it would mean in the military services substantially less support going into military activities using the space environment.

But the facts of life are that we are in business and I see no escape from staying in business. You should realize that we are subject to the pressures of scientists who find now an opportunity to do science in a new environment. Space science it is called, but this is really doing science in the space environment, and it may involve any one of the branches of the physical or the life sciences. We have pressures from industry, who find that the handwriting on the wall suggests a reduction in manned aircraft and perhaps a filling at some point of the pipelines in missilery, and so here is the bright new space field which interests them and might keep them going.

My first few weeks in this business were spent in visiting many of the plants that have been active in support of the military. It was very interesting to see the numbers of them that had charts showing the drop-off in employment for their people, and each one of them was quite happy to offer to undertake the entire U.S. national space program for us.

The military have for a long time had interest in this, and a proper interest, in my opinion. I think they may be having a little bit more trouble in really nailing down what that interest may mean. There are plenty of ideas, but, when you bring them down to an attempt at reality, they don't jell quite as well as they do on paper or in the minds of the enthusiasts.

Then we do have these, what I call, just plain enthusiasts, the Christopher Columbus' of the modern-day world. It is interesting to note that the American Rocket Society, meeting here this week, of which society some of you may be members, is gaining members at the rate of 300 a month. They now have some 14,000 members, and almost half of them have been meeting here in some of these sessions this week, almost 7,000.

It is interesting to note this observation. I had lunch there. I was elected an honorary fellow of the Society, and, at a luncheon the other day, when several of us were presented with these certificates, I asked the question: What new has been revealed or proposed at this session? And the answer was, "Nothing." I cite this, not in derogation but rather as an indication of the fact that this is really a very new field, and that we have a very great way to go before we will have the basic information on which to develop further into the field. The things that we started with a year or two years ago are still the elements of the program on which we are concentrating, and will concentrate, until we gain enough information to lead us into the next phase of exploration in space.

Well, with that somewhat, I think, factual background, let me pass on to what one would normally say were the early years. I have to say "the early months," because we have been in business only 15 months--less than that--just about 14 months. The important dates in this business, as far as we are concerned, are 4 October 1957, which was the launching of Sputnik. ARPA, the Advance Research Projects Agency of the Department of Defense, was created by Executive order of the Secretary of Defense in February of 1958. A month or two later the President submitted to the Congress a proposal for the establishment of a civilian agency. This was debated--there were the usual debates: Should it be a military operation or should it be a civilian operation? There was the usual compromise. It was settled upon and the law was passed and signed on 29 July 1958, a year and one-half ago. I was nominated as the first Administrator on 8 August and on 19 August I was sworn in. I finished up some things I had to do at my College and went to work on 9 September and on 1 October last year we declared ourselves to be in business.

Have many of you read this law? A few. I think it is worth while just giving you a very brief summarization of the policy statement, the objectives, and the organization setup in the law to achieve those objectives.

In the first place, the Congress declares it to be the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind. Further, the Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of and shall be directed by a civilian agency, exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States, including the research and development necessary to make effective provision for the defense of the United States, shall be the responsibility of the Defense Department.

We are enjoined to be active in a variety of fields, with objectives such as the expansion of human knowledge of phenomena in the atmosphere and in space, improvement of the usefulness of aeronautical and space vehicles, development and operation of vehicles for activities in the atmosphere and in outer space, establishment of long-range studies of the potential benefits that may be gained from the use of outer space, et cetera.

It is a peculiar law in the sense that the President is made an active part of it. He is intimately involved under the law in the management of the space business. He has certain duties, which are to survey all significant aeronautical and space activities, including the policies, plans, programs, and accomplishments of all agencies in the United States engaged in such activities. He is to develop a comprehensive program of aeronautical and space activities to be conducted by the agencies of the United States. And then he is to designate and fix responsibility for the direction of major aeronautical and space activities, and provide for cooperation between the DOD and ourselves--resolve differences between the two agencies.

In order to assist him in this activity, there is set up a space council, the National Aeronautics and Space Council, the membership of which includes by statute the Secretary of Defense, the Secretary of State, the Chairman of the Atomic Energy Commission, myself, the Administrator, and one other person from Government, presently Dr. Alan Waterman of the National Science Foundation; and then three persons from civilian life; presently there is one vacancy and the other two are Jack Ritaliatta, president of Illinois Institute of Technology, and Dr. Detlev Bronk, president of the National Academy of Science.

This is an advisory council. It has no executive functions. It advises the President.

There is further provided a civilian-military liaison committee. This is taken, I am sure, from its counterpart, or partial counterpart, in the Atomic Energy law. As a matter of fact, all through this law there are elements that would indicate a reliance upon the Atomic Energy law as a basic law. The civilian-military liaison committee is composed of representatives of the three services and of the Secretary of Defense. It is chaired by a man appointed by the President, presently William M. Holaday, formerly Director of Guided Missiles in the Department of Defense. The representation from the military services and the Secretary's office is matched by equal representation from the civilian agency.

I think that is enough to give you a feeling for the organizational setup required by law. I think it should be plain to you that there is in this setup ample opportunity for conflict. In a democracy, where we do everything in the open, there are lots of people who would like to point to a great deal of conflict between the military and ourselves, and I will try to deal with this a little bit later and show you that really we

have found a way of living together and dividing up the responsibilities in a very effective manner.

We went into business having to run pretty fast as our feet hit the ground. We were able to do this because NACA was absorbed by law into our organization. In essence we grew out of NACA. This National Advisory Committee for Aeronautics, as many of you know, was a 43-year-old organization which was probably the finest aeronautical research organization in the world, with some 8,000 people, a third of them professional people, with three very large laboratories, at Langley, at Lewis, and at Ames out in California, with a high-speed flight station at Edwards, California, and the Wallops Island station out on the Virginia coast. Interestingly enough--though few people know what Wallops Island is--something more than 10,000 rockets have been fired from Wallops Island of a variety of types, and much of the work on nose-cone development was done in that installation.

We acquired, at the time we went into business, on 1 October the Vanguard program and responsibility for it. A couple hundred scientists came over with that. Then, in December last we acquired the Jet Propulsion Laboratory in Pasadena, California, operated for the Army by Cal Tech. This was transferred to us and is now operated under contract with Cal Tech the manager, and NASA the contractor.

We asked last year for the transfer to NASA of Von Braun's group in Huntsville. This was denied on the basis that the defense posture of the United States would suffer if this was done, and it is only within the last two or three weeks that the President has now indicated his intent to transfer that group to NASA. The law requires now that this lie on the desk of the Congress for 60 days after they come in session. If they don't deny it in that period of time, it will become law. Unfortunately, of course, this means that, for the four-month interval between the time when the President indicated his intention and the time when it can become a fact, we've got an interim management situation which is not the best for a hard-hitting team such as Wernher von Braun has down there.

This grouping of people--8,000 in NACA, 200 in Vanguard, a recruitment which brings us the beginnings of the Goddard Space Flight Station here in Beltsville, and the Huntsville operation of about 5,000--will mean that by 30 June next year there will be somewhat more than 15,000 people on the Federal payroll in this activity, plus the 2,400 contract people at JPL.

What is the size of our budget? On 30 September last we were operating NACA at a $100 million clip. The next morning we were operating at a $335 million clip. Our request for funds for fiscal 1960 was for $530 million, of which $45 million was a supplemental for 1959 but didn't come to us until August 1959, so that it really is lumped with 1960. So it was $530 million and the Congress cut $30 million. We have $500 million this year, and what we will have next year is somewhat more than that, but how much more I can't say. It is still in the lap of the gods and the Budget Bureau.

Our problems as we started off, of course, were to organize. Two serious problems occur here. One is the recruitment of able people, of course. We have very little trouble at the technical level. This is an exciting new field. It is like the atomic energy field 8 or 10 years ago. People want to work in it. They will take less money than they would get elsewhere to work in it. But a significant problem was a change in the objective.

We were built, as I said, on NACA, which was almost entirely an inhouse research and development operation and which probably contracted less than a million dollars outside its own laboratories. We have had to turn that over into an operation where we will contract, this year, perhaps $300 million or $350 million with industry and educational institutions, and where we go from a research and development operation into one where we actually now will build or cause to be built hardware and will carry out field operations of substantial magnitude. This takes quite a different philosophy of operation and one that is a little hard for some of the people we have had to rely on for our top management people to accustom themselves to. I must say that the results to date have been, from my simple viewpoint, fantastically good. One could not ask for a greater dedication or a greater desire to make sense out of this kind of tough or organizational management task.

We have had to conduct programs which were laid down for us. That is, we took over from the Armed Forces, ARPA principally the parent in this instance, a variety of satellite programs, some of them growing out of the International Geophysical Year, some of them growing out of the desires of the military, desires of ARPA, principally, some of them in the development of vehicles. I think I am correct in saying that Explorer VI was the first satellite which had been laid down as an activity by NASA. All the others were carrying out things that had been laid out, which we took over. We still have some in the program, such as our meteorological satellite. They were laid out by others and we are trying to work those through the operating mechanism at the present time.

Then we have had to try to plan a program for the future. This has taken a lot more time than I had thought it would. I think it is probably a good thing that it has, because we have learned in the last year how little we know about this business and how difficult and expensive it can be. I think the program--which is now on my desk, which looks 10 years ahead, lays out some objectives, lays out an operating program for about 3 years, and then develops the planning between that operating program and the attainment of those objectives--is much more realistic than it would have been six months ago. I suspect as we do it over again, as we will each year from now on, we will find that it gets much more realistic as we go on.

What are the programs on which we are presently engaged? The first is the one you hear most about, I guess, man in space, Project Mercury. This is a program on which a great deal of research and development exploratory work had been done both in service laboratories and in the NACA laboratories prior to the establishment of NASA. On 5 October, five days after we got into business, we set it up as a project, and I think, of all of the activities in which we have engaged, it is probably the cleanest, the best organized, and the hardest hitting. It is more nearly on schedule than any of the others. The support from the armed services has been exceptionally fine. The results today are really almost too good. We have had less in the way of failures in this program than in any of the other programs in which we are presently engaged. It will cost somewhere between $250 million and $350 million before we put a man in orbit around the earth, if indeed we can do it on the schedule which we have set out for ourselves.

In the course of the next year there will be, I would guess, at least 20 firings, which will be composed of proof testing, qualification of devices, instrumentation, life support systems, recovery systems, etcetera. Hopefully, toward the middle of the year, we will be making the first of the piloted flights in the nose of a Redstone, where a man will be fired down-range perhaps 140 or 150 miles. He will have reached an altitude of perhaps 100 to 110 miles. He will have had weightless conditions for a few minutes, and he will have, himself, experienced the accelerations and that type of thing that will be part of the orbital mission.

There may be four or five, and maybe six of these kinds of flights, depending upon the success that we have in qualifying the capsule and its instrumentation and support systems. Hopefully, sometime next year we will put a man into orbit around the earth, the plan there being

for a three-orbit mission, 4-1/2 hours. He will fly out of Canaveral in a northeasterly direction. By the time he is over Bermuda, which will be only a few minutes, we will have to know whether to bring him down by an abort mechanism or let him fly.

If the mission is successful and he stands the gaff, the mission should bring him down along the chain of islands which make up the tracking stations of the Atlantic missile range, and he ought to be picked up some place off Antigua.

Our first test on trying a capsule down there and exercising the recovery system with the Navy was absolutely wonderful. The Atlas, unfortunately, did not perform quite as planned, because the boost arrangements did not drop off. This reduced the range of the test. I think it was intended to go 1,800 miles and went some 1,300 miles down-range. But it gave it somewhat more severe reentry conditions and somewhat more severe heating conditions. Everything that we got back from that tells us that we are safe on that kind of planning. In spite of the fact that the task force was centered at the intended recovery area some 400 miles down-range, in six hours the capsule had been picked up and was on its way to Puerto Rico and then back to Canaveral.

We have had two or three other tests which indicate to us that the planning and the preparation for this are now really fairly solid. One should know that we will be in communication with this astronaut practically continuously, not wholly continuously. I think there are 17 stations. In each station, in addition to the technicians, there will be a doctor. We will be talking to him most of the time he is in orbit and we will have means of aborting the flight, principally, as I say, in the initial stage, where we want to know that he is going in orbit, but even later on, should it appear that he is himself in trouble.

That, as I say, is our highest priority. It does have the highest national priority, ranking along with the missile systems and the discoverer system.

A second broad area is in the field of research and development. This is made up of several subareas. I would speak first of the space sciences. We are interested in the sounding rockets, which are defined as rockets which extend in a range perhaps 4,000 miles out of the atmosphere and come right back down. These are really taking a cross-section of the conditions of the atmosphere in space up to that distance. Beyond that we talk about putting things into satellite orbit. We are looking at radiation fields, intensity and distribution, magnetic and

gravitational fields. We will be doing things with the life sciences, with astronomy, actually putting telescopes up there, we expect, so they will be out of the sensible atmosphere which now fairly well limits what can be done with an optical system. You can't go very much larger, I am told, than the Palomar telescope and really get useful results with an optical system. We would hope, by 1964 or 1965 to be able to fly and manage such a system in space.

We will be accumulating a tremendous amount of information about phenomena in space and variations of these phenomena with time and with location. It is very interesting to me to note that we continue to find new information that tells us that the conditions in space are not at all stable. The interrelationship of some flares of the sun and that type of thing manage to mess up the space environment a good bit. All of this has great bearing on what needs to be done should we ever get a man to the moon, which we confidently expect we will do. But, until we know what these conditions are, we can't plan against them, as indeed we must.

Space sciences might be a program that runs at $100 million a year or something like that, including the cost of the vehicles.

In the applications field, still in research and development, because all of this is really research and development now, we have quite a good program in meteorology. We expect to fly the first of the meteorological satellites early next year, and we have agreed with the Defense Department to limit our interest in communications to what we call passive communications. We put this big balloon up at the moment. It carries no electronics other than a beacon so that we can track it, a small radio beacon. We simply beam toward it radio frequency waves, and expect that these will be reflected back to stations elsewhere on the earth. The military are continuing--the Army having the management of this--the active communication satellite. One sends information to the satellite and the satellite in turn amplifies and rebroadcasts that back to the station.

The lunar and interplanetary program is handicapped by the lack of thrust in our space vehicles, but it is a long-range program. I will mention it again in this paper. It is perhaps one of the most difficult, in many ways, of the tasks that we are taking on, because, as one goes out to Mars, 150 or 170 days, the ability to provide auxiliary power which will transmit information back to us, and censors which will live through the environment through which they are passing, will take, I think, a good bit of testing of the type one would want to take in any devolopment program of this magnitude and complexity.

Then there is a broad band of supporting research in advanced technology, which is done here on the earth in our laboratories and under contract with industry.

I have said nothing here about our responsibility for aeronautical research at all. We continue to have that, as you know, in the law. We are active, but in limited fields. Research on the supersonic transport, the 3 March transport activity at Langley is fairly heavy. And at Langley and at Ames work on the vertical take-off and landing and short take-off and landing aircraft is continuing to have substantial support. But it is clear that, where the NACA was spending perhaps $100 million in these fields, we will be at the $50 million to $60 million level in supporting the activities with both the industry and the military.

Now, underlying these two programs are the vehicle program and the tracking and data-acquisition program. The vehicle program is perhaps the thing that one ought to spend most time on, frankly. When one asks where do we stand vis-a-vis the Russians, we are doing all right except in thrust. I am sure that many of you realize that we believe, and I think the military believe, that the reason we are handicapped in this matter of thrust is that the Russians, back after the war, knowing that they could make an atomic bomb because we had made one, and knowing something about the size and the weight of them, and not having a lot of bases such as we had, and long-range aircraft, decided that their delivery system had to be a rocket, and so they built rockets which would carry those heavy weights. We at that time could deliver the Mark VI and other designs which were in the mill, with our heavy bombers. We had bases from which they could fly. We concentrated on that aspect of it, and it wasn't until the developments in atomic energy and the atomic and hydrogen bombs came along to allow us to package these destructive forces in very much smaller and very much lighter packages that we moved into the development of rocket systems in a big and important way, actually on a crash basis. As Herb York says, there is no point in making a rocket bigger than the one you need. It is just more complicated and harder to carry around, and you get more of them if you can make them as small as possible to do the job that is necessary to be done. While the Atlas started out perhaps twice the size it presently is, it was cut back to its present size, when we knew what we could do with the hydrogen weapon.

We have laid on a program called the national program of a small rocket, a poor man's rocket. It will cost only $600,000 per firing. This is the Scout and it should take 150 to 225 pounds to an orbit of

300 miles above the surface of the earth. It ought to be ready early in 1960 for its initial proof test. It is a solid rocket, four stages. The services are interested in this for a variety of purposes. It promises to be something that is quite useful throughout Government activities in these fields.

We have had a variety of Thor-based vehicles. Most of these are things that we put together from parts that could be proof tested. They have not really made the most of the initial thrust that is available to us in base rockets such as the Thor, the Jupiter, or the Atlas. But they give us a capacity, at least, a capability of putting a few tens of pounds into orbit, and next year a few hundreds of pounds into orbit. The Thor-based boosters probably come back to the Thor Agena B, which is the follow-on of the booster system now used in Discoverer. We anticipate that, for the kinds of pay loads that can use that kind of thrust, we will be concentrating on Thor and Atlas boosters using the Agena B. They will have the greatest number of firings behind them, hence the greatest chance for being a reliable system; and reliability is what we need above everything else here.

Going over to the Atlas-based vehicles, we will fire later this month the Atlas-Able, which is a vehicle using the Atlas, with a Vanguard second state as its second stage. We don't expect to fire many of these. The second stage of the Vanguard certainly does not make use of all the thrusts that are available to us in the Atlas. We won't be able to do this until we get properly proportioned second and third stages. These we will have in 1961 with the Centaur, which is the first of the systems which use the high-energy propellents, liquid hydrogen and liquid oxygen. By the time we get those, we will be able to put into orbit or into deep space payloads that are substantially larger than those thus far demonstrated by the Russians.

I would point out to you, however, that it is our estimate that, whereas the Atlas is a 360,000-pound vehicle booster, the Russians are using probably a 600,000 to 700,000 pound rocket. If they then optimize their upper stages, they ought to have that much more payload capability than we have. I don't know how they are operating in this field. They won't tell us.

Finally we come to the Saturn, which is the grouping or clustering of eight engines of the type that are used on the Thor or the Jupiter, and ought to give a thrust initially of about 1 million to 1.5 million pounds, depending upon the rating of the engines at the time we fly them.

This is the booster which was transferred to us very recently, having been developed by von Braun and his group at Huntsville. It will be the first real breakthrough in very substantial thrust vehicles. It should put perhaps 30,000 pounds into orbit. And may I say to you at this moment, that we really don't know what we'd do with the 30,000 pounds as yet, and I don't think anybody else does. But we are working very hard to make certain that we use intelligently that level of thrust. There have been lots of ideas but, when you start putting these down on paper and deciding what you will do with them, they don't just fall out like eggs out of a basket.

There is finally a new engine development. You have heard of a thing called Nova. It is really not properly called Nova. I don't know how we fell into that trap. Nomenclature in this field is not very sensible as yet. Nova is really an engine development, a million and one-half pound single-barreled engine. I witnessed a firing of the uncooled chamber of this thing out on the west coast about two months ago. For 3-1/2 seconds it operated at a thrust level of 1.9 million pounds. This, gentlemen, is something pretty horrendous to experience. The tongue of flame coming out of the flame deflector must have extended 150 feet. It just shook the blockhouse, which was certainly 150 yards away from the stand. I'd hate to think what the noise level was out there.

These boosters, these very large boosters, have their real purpose in sending man some place out into space. When I talk about noise level, this is a serious problem in putting a man on top of these things. Can a man live in this noise field that will be generated? How do you insulate him against that kind of noise level, and how much of your payload is taken up in that insulation, as is the case with insulation against destructive radiation?

This, then, is the program: Man in space; a broad program of research and development, involving the space sciences; the applications; the programs in meteorology and communications; the long-range lunar and interplanetary space activities, and the supporting research; then the vehicle program; and I didn't even speak of tracking and data acquisition. I think these are rather well understood. This goes into about $30 million a year, and construction goes into the vehicle tracking and data acquisition activities, with an operations cost of about $30 million a year.

Incidentally, here is just an idea. Every Vanguard flight costs about $10 million. When Saturn is operative, my guess is that these

devices are going to cost--ignoring now the development cost, which will be a half-billion dollars--perhaps $20 million. The payload on top of them will cost hardly less than $20 million.

Our success to date has been on the order of 30 percent. So, when you fire one of these, you are apt to be sending out $120 million for a successful flight. It's a serious business. The only way we are going to get reliability in these things is to fire lots of them. I don't think that there is any way around that, although we are sure trying to find a way around it.

That is the program as it is today. Where are we going? We are trying to lay on an orderly program of research and development. We are trying to acquire the kind of information out of which can come sensible military operational systems in support of the military, and sensible operational systems in civilian life.

You will be interested to know that the Bell Laboratories are spending some millions of their own money to work with us on the communications satellite program. They are actively interested in this and, I think, have long-range faith that the satellite communication systems will be an important part of our total worldwide communication net at some time in the future.

Financially, as I say, I think this program is going, on our side of the Potomac, to $1 billion or to $1.3 billion or $1.4 billion a year. One would expect that the development of the booster systems, the vehicles themselves, will go up through a period of perhaps as much as $400 million to $500 million a year for two or three years, and then drop off, because we do not have the same reasons--or I would expect that we would not have the same reasons--that the military would have for continual improvements in their missile programs. Once we get one that works we ought to be able to continue to use it. It is really only a truck to get the thing up into orbit that you want up there to do the work for you.

Man in space goes to a program of probably $350 million to $400 million a year. Here there will be some interaction with the Defense Department's Dyna Soar program, of which you have been reading in the newspapers recently.

I would point out plainly to you that NASA is not in the business of developing an operating system for either governmental activity or

civilian activity. Ours is really a research and development and an exploration activity.

Organizationally I think we ought to level off at somewhere near the personnel strength we presently have, with our expansion coming in contracting with industry.

The relationships with the DOD are, as I said a little bit earlier, much more effective than most people would think. They occur at varying levels. We have lots of technical committees between the DOD and ourselves on all of these projects. This was the case with NACA in years past, and I think that those of you who have had that kind of association would say that it was an effective relationship. We are attempting to continue it exactly that same way.

Most of the technical committee-level relationships do not call for policy decisions. Technical men can get together and beat their brains bloody and finally come out with some kind of an agreement. But then we go to an operating level where Dick Horner, formerly Assistant Secretary of the Air Force for Research and Development, is probably the counterpart of York, who in the DOD was with Roy Johnson in ARPA, but ARPA has now been taken out of the space business. Here one gets into operating policy problems and decisions at this level have to be made, and should be made, by York and Horner. At the strictly policy level they are made by the Secretary of Defense and myself. And, finally, if we have troubles here, we have the CMLC, which is an activity which can investigate problem areas and make recommendations for their solution. If we don't accept their recommendations, they can take them to the President and to the Space Council. It sounds a little bit top heavy. It has not proven to be as yet.

The Defense Department has taken the attitude that space is not a program. We talk about a national space program, because that is the kind of thing we are doing in R and D. The Defense Department says space is not a program; it is a place. It is a place in which we will do whatever is necessary to be done to achieve a military objective or to meet a military requirement. We will do it in space if it makes more sense to do it that way, if it is more effectively done in space, or if it is less expensively done in space.

Mr. McElroy's recent directive designating the Air Force as the space transportation agent, as it were, for the military, concentrates there all of the activities with respect to vehicle systems. This

makes a nice tie between one agency, now, and ourselves for space-vehicle development work. The Air Force continues to have the responsibility for the reconnaissance and early-warning satellites. The Army is to have responsibility for the communications satellite. I guess this is the field which all of you recognize as one in which they have had substantial competence over many, many years--a basic responsibility, as a matter of fact. The Navy continues to have responsibility for the navigation satellite program.

There have been many attacks on this management problem. As I said earlier, I think the law sets up the opportunity for people to get their knife in and start to twist it, and there are plenty of people who like to do this. There have been statements--I read one in the paper this morning--that there are 62 agencies involved in the space program. I'd like to try to convince you that there are only two that are really involved. They are the Defense Department and ourselves. There are, throughout the Government, just any number of agencies that have peripheral interests. The National Science Foundation, in discharging its normal obligations, is certainly going to support research which has interest in the space business. This may be celestial mechanics at some university. You can say that these people are involved in our business, and they certainly are, because we'd like to make use of what they come up with. But they do not have any management responsibility in the business at all. The Bureau of Standards has a good bit to do in its normal operation which impinges upon the space business. OCDM is concerned about the allocation of portions of the frequency spectrum for communications in space. FAA we have intimately tied in with our launching operations at Wallops Island. As a matter of fact, we are controlled by, I guess it is, the FAA office in New York. They tell us when we can fire. We support 60 or 65 people at the Weather Bureau, who are developing ways and means of interpreting, analyzing, and rebroadcasting the information that we hope to get from meteorological satellites. ONR has a variety of contracts in support of basic research which impinge on a field such as space. It is kind of an all-pervasive business.

But none of those has management responsibility. So far as I know, none of them has really thrown its weight into the management picture in any way. So that basically there are only the two agencies, the Defense Department and ourselves.

To finish up, I would say to you that this is really an exciting business. It is a very difficult business, and it is a business about which we know very little and about which we talk a lot. It is also a very costly

business, and I don't think it is going to get any cheaper. It is a business which has its benefits, certainly, accruing to mankind through the discovery of new information, to industry through the development of new techniques, probably as difficult a technical job as you will find, and it will have great impact on philosophy and religion if we find some life on one of the planets--and it is clear that we will be trying to do this. It is a business which has its long-range goal as one of allowing man to fly wherever he wants to fly, whenever he wants to go. And it is not going to stop until man does this, in my opinion. I don't want to climb Mt. Everest, but there are some people who do, and they have done it, and they spent years getting there, and many lives were lost in that process. Man is not going to stop until he achieves this kind of mastery over space, in my opinion.

Competitively, it is just one part of the total competition with the Soviet Union. It is the bright, the shining, the dramatic part of that competition. As such I think it cannot be ignored as competition. I think, however, we need to compete on terms which we lay down, not on the basis of follow-the-leader. When someone asks me how far behind the Russians we are, I have to say, "I don't play in this league. To be behind the Russians means that I am following them, and I don't anticipate following them." We are attempting, gentlemen, to lay on the kind of program that five years from now will have given us the kind of information and the kind of grasp on this so that no one can head us, I think.

Whereas in the hot wars of today, we think we are going to have to fight, if we do fight, with the weapons that are available to us the day the first shot is fired, in this economic and political realm, we are still back in the situation where perhaps time will be on our side. It isn't going to be played as it used to, because we've got a fast-running antagonist here. But there is a little bit more of the sort of cranking up of the energies of a free people to extra efforts needed. This is needed very badly, in my opinion, across the whole gamut of competitive fields with the Soviet Union. I was there last year for a short time. I saw the kind of dedication that they have. You've heard this from many people, I am sure, but I believe it. It is one of the reasons that I took this job. There are lots of better ways to make a living, believe me. I believe it sincerely enough to come down here and give whatever I can to try to make a sensible program out of this; and one of our most difficult tasks is just that, to make a sensible program against the tremendous pressures to do some spectacular thing that is here today and gone tomorrow. I don't discount the importance of these in the eyes of the

rest of the world. I simply say to you that, when we have laid on and aggressively followed a sensible program, there will be enough of these attractive, exciting, spectacular achievements to gain back for us some portion of the admiration of the rest of the world. I think we have lost some portion of it forever. I think we have been caught with our pants down. I don't propose that we continue forever in that condition.

Thank you, gentlemen.

COLONEL FORBES: Who has the first question?

QUESTION: Sir, will you give us any information that might be available on the nuclear rocket propulsion program?

DR. GLENNAN: The nuclear propulsion program, on which we are particularly interested, is the Rover program. The actual nuclear development activity is under the support and management of the Atomic Energy Commission. The Air Force did support some portion of this. That was transferred to us, and we continue to support it with the nonnuclear activities at the rate of about $10 million a year, or some such thing. We think of this as a long-range program. It is not an easy business to be in. I think that the Atomic Energy Commission is quite convinced that it can solve the problems.

The first of the test devices, called Kiwi, was tested this year out in Nevada. It performed rather well. We would expect not to use a nuclear propulsion device as a first-stage device, at least not for a long time, because of the hazards involved.

There is one committee presently active--I guess we set it up, actually--to try to understand more of the probable hazards in using nuclear propulsion. I noted yesterday that the Atomic Energy Commission had set up a committee inhouse to deal with the problems of nuclear units in space, both as auxiliary power units and as propulsion units.

Certainly, most of our people believe that in time some form of nuclear propulsion is going to be a necessity for deep space travel. We do not expect this to be next year.

QUESTION: Dr. Glennan, the Russians have hit the moon. They say they have photographed the dark side of the moon. We have also claimed that we have gotten a certain degree of accuracy. I wonder if you would evaluate for us the relative degree of accuracy that we have vis-a-vis the Russians, in missile launchings.

DR. GLENNAN: I will be glad to do that. In the first place, we continue to get questions, such as: Was that really a photograph of the other side of the moon? I think all of you would agree that we intend to photograph the other side of the moon and, if we come up with a photograph that is very different from theirs, this might be the greatest hoax of all time.

We are inclined to believe what they have said and what they continue to say about their space feats.

As to this matter of accuracy, we get this continuously, every time the Russians exhibit a particular degree of accuracy in the guidance of their space vehicles, hitting the Moon, going into orbit around the Moon and the Earth, and that type of thing. We, with our lower thrust, are not able to do similar things quite as well. Doesn't this mean that they can shoot a missile, a nuclear-warhead-carrying missile, with pinpoint accuracy at New York City or Cleveland or Washington, and doesn't it on the other hand mean our inability to match them in space at the moment? Doesn't it mean that we have less than adequate accuracy in our own nuclear-warhead-carrying missiles?

These must be separated. They are hard to separate in the minds of people. The accuracy and the propulsive capacity of our nuclear-warhead-carrying missiles, the Atlas, the Jupiter, and the Thor are very adequate for the jobs that they will do and are intended to do. They will carry what you want to the target. The results in the last several firings on all these systems have been fantastically good.

The fact that we don't have the same kind of accuracy in our space shots is that we just don't have the capacity, the thrust capacity, to carry guidance systems as well as payloads. It is just as simple as that.

The Thor-Able series, if you are going to put any payload in it at all, as with the Juno II series, you just don't put the kind of accurate guidance the Russians have. You can't carry it. As we get the Centaur, we will be carrying the guidance components that are necessary, and certainly in the fallout of the weapon systems development and the missilery the guidance components are available to be put together in systems, and this is being done.

But, to sum up the accuracy of the Russians with respect to their space shots really has nothing to do with the accuracy available in the ballistic missile program of the United States.

QUESTION: Recently a distinguished speaker from this platform pointed out as a problem the lack of a single agency responsible for launching, communication, and tracking. Would you comment on that? Is there a problem and do you have any plans for its solution?

DR. GLENNAN: I don't have any plans, but I think the Defense Department does. There certainly has been confusion in the launch business. If any of you have been out to Vandenburg and PMR I think you must come away with a kind of headachy feeling. But I think this is on the way to solution with the Cisler committee acting under the request of Secretary McElroy.

We, as an agency, will continue to use whatever the military has available in the way of launch facilities. I might say that at AMR, for instance, down at Patrick, 2 or 3 years from now 60 or 70 percent of the activity there is going to be space launchings, not missile launchings.

We would expect to continue to use the military management of those activities. So far as tracking systems are concerned, you run into a little bit different situation. It seems to me that, while the space activities are in the research and development stage, we could make a substantial use of stations which might have been installed by the military as part of our networks. Indeed this is what is being done in the Mercury network of some 17 stations.

Actually, the support of that whole program by the military is quite substantial. When one gets to operational systems--suppose the Discoverer becomes a reconnaissance satellite system, and so forth--then you can't use those tracking stations and readout stations for research and development, except under the strict control of the people who are managing the operational program.

The research and development program by definition is one in which change is expected. So, every time you fire one of these things, you have a little bit different information to get out of the satellite, and there will be modifications to equipment almost constantly. That's why I say that we look to our tracking network as a construction problem of perhaps as much as $30 million a year, just keeping these things modernized.

Now, I guess my answer to your question, after all of this wordage, is that in operational systems it seems clear to me that the military must set up, man, and operate and manage their own operational

tracking systems. In the research and development phase we have what is known as a committee on ground support facilities, which now acts upon any change in any tracking facility costing more than $250,000. This is working quite well, and we are finding it possible to interweave our requirements with that kind of management, where we manage some stations and the military manages some stations, and they are brought together into a network when it is necessary.

I don't anticipate this is a tough problem, once they get the range problem straightened out.

QUESTION: You mentioned, Doctor, that in the old NACA the organization was not set up really to handle outside contracting. There was no need for it. I notice that when NASA started into business you made up for this deficiency by working through the services. Do you plan to continue this, or will you set up your own procurement organization?

DR. GLENNAN: We do both. Actually we have set up our own contract negotiation and procurement activity, but we plan to continue to use contract monitoring services from the military organizations, and contract negotiation to the extent that this seems feasible. We don't want to duplicate if we can avoid it.

Out at the McDonnell Plant in St. Louis, where the capsules for Mercury are being made, our contract is being managed by the Navy. Out at Rocketdyne the Air Force is helpful in the monitoring of the contract there. The Centaur system is under the Air Force. Actually, we provide the money back to the Air Force and they have the contract with Convair, for the Centaur system, and they are managing that for us.

So we will do whatever seems best at the time, utilizing the services available to us, in an attempt to avoid duplication.

QUESTION: With all this coming activity in space, it seems that we are getting enough activity up there to run across problems of international law. Do you envisage these problems, and do you have any solutions to them?

DR. GLENNAN: Yes, the problems are there all right. The problem of sovereignty on the moon is one in question now, I suppose, although Mr. K. has said he is not claiming it for Russia, but in the name of all mankind. There is a very great deal of literature, particularly in the legal field, on this particular subject.

The United Nations have a subcommittee, established early this year. Its report is ready and will be presented to the General Assembly this fall. It identifies the principal legal areas. It is intended that that ultimately develop into an activity of the U. N., where they will not themselves conduct or control research and development but would be active in the allocation of portions of the spectrum for communications and that sort of thing, and they would in time, I think, deal with some of the legal problems.

There is a school of thought that one shouldn't move too quickly to declare outer space just a place for free transit. I think actually our military friends would say that they don't want to jump too quickly on this, because this is a portion of a total disarmament problem if you get into that activity.

Suffice it to say that there is a very great deal of effort going on this almost constantly. We have in our own organization a small group that is dealing with this and is responsive to the U. N. directly on this matter.

ADMIRAL PATRICK: Dr. Glennan, I understand that we have an electronic surveillance fence which tells us whenever a satellite passes over the United States. This would permit us to know when Russia had actually launched something they hadn't said something about. Could you tell us a bit about that surveillance?

DR. GLENNAN: I think this is the fence that extends across the southern portion of the United States, made up of some minitrack stations and some that have been augmented, and operated by the military. It is what is known as a dark fence. It illuminates satellites in the atmosphere, picks them up, and identifies them, even though they themselves are not actively broadcasting. I am told this is very effective, that it has resolution enough to see almost anything that we would expect to be up there, and it is constantly manned at the present time.

QUESTION: You gave a great deal of credit to what the Russians said as being usually accurate, especially the launching of the satellite to the moon. You mentioned the Rocket Society meeting here. They have some distinguished people here at the Rocket Society meeting, and they have left me at least with the impression that they do not have an extensive man-in-space program. Would you care to talk on that?

DR. GLENNAN: We have a very delightful man in our organization whom some of you know, Dr. Hugh Dryden. He is one of the great scientists of this country. He was Director of NACA and is now the Deputy Administrator at NASA. He has known Professor Sedov for a number of years and he took Sedov and Blagonravov and a couple of the others whose names I can't pronounce to lunch the day before yesterday. It was the usual sparring match. Each of these men said that he was not involved in any man-in-space project. They would not make a flat statement that the apparatus was not involved in a man-in-space project. If one looks at the fact that Blagonravov, I believe, did a paper on their animal experimentation, one would expect that there is no reason to believe that they are not involved in it.

I suspect that these gentlemen, interested more in what we term space science than in man's flight in space, and expressing their personal opinions, I think said it is a lot of nonsense. This is for the birds. They can do anything they want to do with instruments. So I think there is a little bit of inhouse jealousy involved. I don't think they are speaking for the Soviet Union. I think they are speaking personally. We fully expect that they will try to fly a man into space.

QUESTION: I have a two-part question. First, do you think that the high-thrust vehicles of the future will have to be fired outside the continental United States due to the blast and shock effect? Second, do you plan to use equatorial launchings?

DR. GLENNAN: The answer to the first question is, I don't believe our people have any feeling that it will have to be done outside the United States. The question of equatorial launch sites is one which I think has to be kept under very careful and continuous study. We have had a group activity in this in which the armed services were involved, and their present opinion seems to be that there is not now the need for development of an equatorial launch site. We get adequate thrust. The equatorial launch site has its principal use, or at least one of its principal uses, in putting a satellite into 24-hour orbit. With enough thrust, we can dogleg a satellite into a 24-hour orbit from Patrick by simply putting it into a parking orbit and then employing restart and sending it out to the 24-hour orbit.

There is another element in this, though, that is beginning to rear its ugly head. These vehicles themselves, on some of these more exotic missions, are sufficiently large so that they probably will not burn up as they come back into the atmosphere. As a matter of fact,

we have changed some trajectories to avoid the possibility of these portions of the vehicles falling on the territory of others. This, I think, could be avoided by an equatorial launch site, and this might indeed be the principal reason for such a site at some time in the future. Anything that I have looked at looks like $300 million as a base cost for such a site.

QUESTION: Sir, I wonder if you would tell us the extent and scope of your medical program, your medical research program.

DR. GLENNAN: That's an easy one for me, because we really don't have one as yet. We will have by the end of the year the report of a committee of very high-level, able, professional people in the medical and life science field. The intent is to try to determine what our responsibilities really are as an agency in this field. As you probably know, the work on Mercury is being supported handsomely by the services in the assignment of their people to our task force at Langley, and we are in pretty close touch with the biomed people in the three services.

I would guess that we will engage in a program in the life sciences in the biosciences that might cost as much as $20 million a year one of these days, with perhaps $4 million or $5 million of that inhouse, inhouse only in the sense that if we are going to have that much in contract activity, we had better have some people who know what the field is all about and give them the opportunity to do a little work themselves.

We would expect that a fair amount of this support would go to the service laboratories, the hope being that we might provide some portion of the mechanism for tying together these service laboratories even more than they presently are. You know that there are sometimes voids in these matters between the services.

QUESTION: Doctor, how do you make distribution of your findings in the Research and Development area? Is this classified information? Can anybody obtain it?

DR. GLENNAN: We make distribution. Most of it is unclassified. It is classified usually when the military puts classification on it. Where we are dealing with anything that has to do with missiles, it is classified. I would guess that the best way to say this is that material information in our shop is born unclassified and it takes a positive action to classify it.

This information is distributed through the regular publications of NASA, and anybody can get those in the unclassified version, yes. I guess there is a fairly thick distribution every month. If you have a problem on that, we have a technical information section. Just call them on the phone.

STUDENT: I don't see any problem in my behalf, but I can easily see how we can be assisting the Russians and anybody else in basic research at our expense.

DR. GLENNAN: They are pretty smart. They can keep us off balance with the small number of shots that they fire. This is an interesting question. I talked yesterday with Dr. Homer Newell, one of the bright young men in this field, who has been active in it for a long time. He came to us from NRL. I asked him where we stood in the matter of scientific information. He said it seems very clear that we are being very much more thorough in our examination of the space adjacent to the earth, say a thousand miles up, that our whole program was laid on to really strip that field and understand what is going on in all of these phenomena of which I spoke earlier in my discussion, and he says the Russians are not doing this. They are going, as we have seen, for the more spectacular, single-shot type of thing. It seems clear to me that we are going to fill in for them a lot of that kind of information. But in order to make the kind of progress that we need to make in this field, I don't think you can classify this without hurting yourself a lot more than you will hurt the Russians. This is the old debate of: Can you do science in a vacuum? I don't think you can.

COLONEL FORBES: Dr. Glennan, It is almost superfluous to note that we are somewhat more enriched this morning through your presence. On behalf of the Commandant, the faculty, and the student body, thank you very much.