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THE FUTURE OF SPACE

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The subject of space is very dear to my heart. It is dear to my heart not solely because I am in the launch-vehicle business, and it serves my vested interest best to speak out as eloquently as I can in favor of it. The space program is also dear to my heart because I am an American citizen, and I truly believe that this program serves the best interests of the United States, both domestically and internationally.

Space is a popular subject. It is popular not only to those of us directly involved in the various phases of the program, but it is a popular subject with the man on the street. I do not believe there is any national program of any nation which captures the imagination of its people, and the people of the whole world, for that matter, as does its space program.

Today the names of various spacecraft and astronauts are household words and are known around the globe. One reason for this unremitting popularity is that for the first time man is invading the heavens, a realm which, since the beginning of time, has generally been left to the vagaries of mystery, superstition, and religious speculation. A second reason is the heroism in a spectacular medium on the part of the astronaut. Heroism is a universal virtue, regardless of tongue, regardless of ideology. A third reason for this worldwide popularity is that any space feat, regardless of the nation that sponsors it, is looked upon by people throughout the world as mankind's assault on the unknown. It represents *man's* effort to conquer his environment and *man's* effort to understand the basic forces of Nature. It is for these reasons that accomplishments in space have had such universal propagandist value. I, personally, do not feel that the propaganda impact of significant space events on the peoples of the world has been overrated.

Every man harbors deep within him certain visions and dreams that he wishes could come true. I would like to share one of my personal dreams with you. I look forward to the day when mankind will join hands and face the heavens in solid phalanx to apply the combined technological ingenuity of all nations to the exploration and utilization of outer space for peaceful purposes. I applaud the efforts of the President of the United States—Lyndon Johnson today and John F. Kennedy before him—to encourage all nations to work together in the great adventure that is just beginning. Steps taken to date have been comparatively meager, but at least we have made a start. Would it not be ironical—as well as instructive—if nations first learn to transcend their national interests many, many miles away from Mother Earth?

This is but the dream. The realities of today's world sober us to the fact that our technological utopia in outer space has not arrived, and indeed may be a long way off. But I am convinced that the objectives of the National Conference on the Peaceful Uses of Space cannot be achieved until the scientists of all nations can work together in an atmosphere of mutual trust and unfettered cooperation. I believe our Nation should continue to work toward this goal without compromising its security, without sacrificing the best interests of its citizens.

I would like to return now to this harsh world of reality. In so doing, my combative instinct immediately becomes aroused because I want to discuss some of the conceptions, or rather misconceptions, about our space program prevailing among certain groups throughout the country.

The first misconception I would like to assault is the idea that the sole mission of the civilian space program is to put a man on the Moon. In the face of the multifarious mission accomplishments of our

satellites to date, it is astonishing that this misconception has been able to survive, much less be as prevalent as it is.

The variety and extent of the peaceful space activities of the United States are well known, and I need not catalog them here. Since 1958 when our first spacecraft, Explorer I, was launched, this country has embarked on a very broad-based space program. We have experienced a variety of spectacular space feats, and I should like to mention a few merely to make the point that the civilian space program is not a one-shot venture.

We all followed Mariner II making the 36-million-mile trip to Venus, passing within 21,000 miles of the planet, and radioing back to Earth important scientific information on its findings. Credit for this outstanding feat goes to D. William Pickering, Director of Jet Propulsion Laboratory. Some of us have enjoyed personally the benefits of other satellites, Telstar and Relay, by seeing clear transatlantic TV broadcasts and hearing telephone conversations. We all know of the Syncom satellite which travels in a synchronous orbit and introduces the era of the continuous worldwide satellite communications system. We have all benefited from the weather information provided by the Tiros weather satellite. We are all familiar with the orbiting solar observatory, which this very minute continues to provide knowledge about the emission of energy from the Sun.

Then there is the Manned Space Flight program. The Mercury program headed by Dr. Robert Gilruth has been completed successfully. Six Mercury spacecraft, each containing an astronaut, have been successfully launched and returned to the Earth. The names Glenn, Grissom, Shepard, Carpenter, Schirra, and Cooper have entered the lexicon of the Nation's heroes. Mercury accomplished its primary objective. It has demonstrated the ability of man to survive in space. It has proven that man is not a liability in outer space, but an asset, and that he can perform useful tasks in a space environment.

Coming up next in the manned-space-flight effort are the Gemini and Apollo programs. Extensive efforts are underway in both programs. Gemini will demonstrate that man can function in the space environment for prolonged periods of time. He will learn to maneuver his spacecraft, and to meet and physically join with other spacecraft in flight.

The Apollo program is even more ambitious. The

Apollo spacecraft will be able to remain in orbit around the Earth for periods up to 2 months. It is the Apollo spacecraft which, after its performance is thoroughly proven in Earth orbit, will accomplish man's first landing on the Moon.

The manned programs suggest another question which has often been posed: What are manned spacecraft going to be able to do in the future, in terms of both peaceful and military missions, after the manned lunar landing has been accomplished? This question can be answered today only with another question: Who knows? We simply are in no position to make predictions here because our experience with men in space is so very, very meager. We have logged only 53 hours of space travel thus far, hardly enough to base predictions on anything more than pure conjecture. The only way we can answer this is to expose a lot of people to a lot of travel time in outer space, and then apply what these people have learned firsthand in their new environment.

This, of course, is not a novel approach. The modern concepts of air power were not developed in "think factories." These concepts evolved from the practical experiences of the brave young members of the Lafayette Escadrille and other flying groups in World War I, second lieutenants who actually took to the air and tried out such things as synchronized propellers, formation flying, instrument flying, and aerial photography.

And so it will be with manned space flight. As our astronauts log additional hours, hundreds and thousands of them, we shall learn many things from their experiences that will enable man to perform feats in the space environment that as yet have not even occurred to the mission planners back here in our Earth-bound think factories.

From the few random examples which I have listed of space achievements to date, it is obvious that our space program is moving forward on a very broad front. My purpose in stressing this fact is to meet head on the rather loose language one hears around the country, language which equates the "NASA Program" with the Moon program, language which constantly refers to the NASA appropriation as the "5-billion-dollar-man-on-the-Moon" budget. The Apollo project is NASA's largest project, but the story does not end there. Far from it. The program upon which NASA has embarked for the peaceful exploration and uses of space is the most versatile space

program employed by any nation on earth. I think the Nation should be aware of this fact and take pride in its accomplishments.

The next proposition I should like to discuss is the one that says we should abandon the space program entirely because we cannot afford it; or, as some would have it, reduce the level of effort to a level we can afford.

It is apparent that a program encompassing such a large variety of complex space activities requires for its accomplishments a major commitment of the Nation's resources. Today about 1 percent of the total income of the United States is devoted to the civilian space effort. In this decade, the United States will invest about \$35 billion in its total civilian space program. About \$20 billion of this will be devoted to the manned-space-flight effort.

In terms of manpower, the costs are equally high. Today, about one-quarter of a million people, both in Government and out, are working in the civilian space program. The bulk of these, about 200,000, are part of the Government-industry team for manned space flight.

In terms of facilities, the investment again is high. The space program involves far more than merely building large boosters and spacecraft. It involves capital investment in large engineering companies throughout the United States for fabricating, assembling, and testing the systems that comprise the launch vehicles and spacecraft. It requires investment in large environmental chambers, centrifuges, and simulators for preparation and training. It demands a worldwide tracking and data-acquisition network feeding into an integrated mission-control center. It requires a highly sophisticated launch complex, such as the Moon port being created as Cape Kennedy. When completed, these facilities will include some of the most massive and complex ground and engineering installations ever designed.

The question presents itself: Can the United States afford a program of such magnitude in the face of its continuing commitments to other national programs such as defense, agriculture, and welfare?

There are those who say that we should cancel this "Moon madness" and divert these space funds into more earthly projects, such as cancer research, aid to the needy, and urban redevelopment. Others say we should continue the program, but at a reduced annual level of effort in deference to these other programs. This latter theory holds that although it may take

longer to get to the Moon, and although the total cost of the program will run higher, at the same time we shall be proceeding at a reduced *annual* rate of effort, a rate of effort the country can better afford.

My personal view is that we can afford to invest 1 percent of our annual gross national product in space. I believe that we can afford to continue to invest 4 or 5 percent of our annual Federal budget in the civilian space effort. I do not believe that if this budget were cut, any substantial increase would automatically accrue to these other programs—programs which, incidentally, I consider very worthwhile. Based on my own personal experiences before congressional committees, I do not believe that these annual appropriations are solely the result of fiscal finagling with figures, with funds being taken from this agency and applied to that agency, like some juggling act carried out under a master plan. I believe the approach taken by our elected officials is one in which each program must stand or fall on its own merits, as viewed by the American voter.

I believe the pace of our space program is entirely reasonable. Although the goals are ambitious and the schedules tight, it is not a crash program. We are moving forward vigorously, now that our immediate space goals have been clearly defined. I believe we are moving at a pace the American people expect, now that they have given the program their stamp of approval. There is no harm in setting one's goals high. This is the rigorous life. This is the American tradition.

I could not possibly take leave of you without briefly discussing the question which is probably put to me personally more often than any other. It runs something like this: We agree that the Nation should have a space program. We further agree that it should move forward on a broad mission front. But to do these things, why is it necessary to go to the Moon? Why can we not develop a space capability second to none through manned applications in near-Earth space, and forget this business about going to the Moon?

I think I can best make my point here by using an example. When Charles Lindbergh made his famous first flight to Paris, I do not believe anyone thought that his purpose in going was simply to get to Paris. If going to Paris had been his sole objective, he could have traveled by boat in much greater security and comfort. His purpose was more than personal transportation. His purpose was to demonstrate the feasi-

bility of transoceanic air travel—not to get to Paris, but to fly across the ocean. He could have selected a wheatfield in Alsace-Lorraine, or perhaps he could have landed in one of the moors in Scotland. But Colonel Lindbergh had the farsightedness to realize that the best way to demonstrate his point to his world audience was to select a target familiar to everyone. Everybody knew where New York was, and everybody knew where Paris was. The history books have recorded the immediate impact of his voyage.

Lindbergh achieved his objective, and today we are using air transoceanic transportation, not only to go to Paris, but to deliver cargo to Copenhagen, mail to Manila, and tourists to Tokyo, and, on selected occasions, to maintain the Berlin airlift.

In the Apollo program, the Moon is our Paris. We have selected a target familiar to everyone. Rather than asking the man on the street to accept the esoteric language of the trade, such as "rendezvous," "docking," and "orbital transfer," in defining the immediate objectives of man in space, the late President Kennedy selected a goal which is entirely familiar to the man on the street: sending men to the Moon before the end of this decade. The fellow next door knows what a man is, where the Moon is, and when this decade is out.

To prepare for this lunar trip, we shall have developed space vehicles with the versatility to perform all the orbital operations presently envisioned by this or any other nation. After the Moon is conquered, this versatile capability remains for other manned-space-flight applications, in both near and outer space.

The purpose of the manned-space-flight program, then, is to build an important national resource, a broad space capability, that will enable the United States to investigate and utilize the environment of space for a long time to come. It is providing the muscle which will undergird the Nation's posture in this newest dimension of national power—outer space.

I can illustrate this same point by treating it in terms of dollars. In this decade we expect to spend about \$20 billion on the Manned Space Flight program. We consider that about 92 percent of this money, or well over \$18 billion, is being and will be used to create permanent capital for the United States. Some of this permanent capital will be measured in terms of new technology, industrial manufacturing complexes, and governmental test and launch sites. But the greater part of this newly created capital will be the large numbers of highly trained technical

people who will provide the nucleus of talent for the space missions following the lunar landing.

The other 8 percent of this \$20 billion may be regarded as the consumables, as that part of the program which is used up in the process of developing this new capability. This includes such things as materials used up in ground tests, and the hardware and fuels that are actually launched into space.

I have saved until last the question which intrigues me most: Why invest in space at all? Money aside, is there really any purpose to be served by the space program?

To me, the question, "Why invest in space?" is the same as asking, "Why have an age of Science?" Man has been born an insatiably curious creature concerning his natural environment. And I think if there is any lesson man has really learned during the last 2,000 years of his violent history here on Earth, it is the fact that it seems to pay off handsomely, but often in the most unexpected way, to keep satisfying his curiosity about the world around him. The only restraints upon his satisfying this innate curiosity, now that he has shed the shackles of superstition and myth, have been the lack of the proper tools, such as the microscope, telescope, bathysphere, or spacecraft to enable him to carry his investigations further and his probes deeper.

In today's explosion of technology, man is rapidly developing these tools. He is rapidly developing the capability both to explore the Earth more thoroughly and to explore the celestial environment that surrounds him. And because he is developing the means, man will follow his natural nosiness and will capitalize on his opportunity to investigate and uncover new phenomena of nature. He will, and should, apply these tools to firsthand observations of the environment of space.

Indeed, this is what we have already set out to do. For the first time, we are in a position to examine and measure the Sun. For the first time, we stand on the threshold of determining the origin and nature of the solar system. And we have already demonstrated our ability to use this new space environment for practical purposes, such as communications and weather observation.

These are the questions that I wanted to discuss with you.

Time permitting, there are many other noteworthy aspects of our space program that I should have liked to discuss. There is the subject of the very bene-

ficial impact the program has had on the American economy, in all sections of the United States. There is the vast subject of program management, and the managerial revolution that has swept the country to find adequate means to marshal the varied, dispersed talents of our Government-industry team in massive array to accomplish mammoth projects such as the Apollo program. Literally thousands of private business, both large and small, are participating in the Apollo program alone.

I also could have discussed the contribution that the civilian space program is making to higher education, and the stimulus it has provided to the research programs of our universities and the training of our young scientists and engineers. I could have discussed what we are doing in NASA to transfer to the industrial sector of our economy the results or "spin-off" of our space-oriented research that may have application as new tools, devices, materials, processes, and techniques of benefit to the American consumer in everyday life.

And, finally, I could have discussed some of the tangible steps that this country, represented by some of our own high-ranking officials in NASA, notably Dr. Hugh Dryden, have taken with other nations regarding international programs for the peaceful uses of space.

I have avoided all these subjects because I feel that the basic questions, which I have discussed, command priority attention. It is these questions that reach to the vitals of our entire space effort, and it is these questions that must be answered, if this country is to have an adequate space program, or, indeed, if this country is to have a space program at all.

The United States has made monumental strides forward into the Space Age. At the same time, we have hardly begun. The present phase of our space program brings to my mind an earlier period in the history of the Western World, the period when man

first laid the great foundation, both in thought and achievement, for the better world we enjoy today.

I speak of the Renaissance. I speak of the era of Michelangelo and Da Vinci, the era of Shakespeare, Cervantes, Raphael, and Rabelais. It was in this period, beginning in the 15th century, that man took his first great strides forward to emancipate himself from his environment, when man first undertook the conquest of the planet Earth as a place of human occupation.

The Renaissance is often called the Age of Discovery, the age when men summoned forth their courage and set out on the high seas to explore the four corners of the Earth. It was the age of Sir Walter Raleigh and Sir Francis Drake. It was the age of Columbus, Diaz, Pizarro, and da Gama.

We have not yet entered the Second Age of Discovery, the exploration of outer space. We are still in the harbor. We are still building and checking out the seaworthiness of our craft. We are still learning the things we need to know about the new medium through which we shall have to travel. The Mercury astronauts were not the explorers. The Mercury astronauts were the test pilots, but they did not leave the harbor of Mother Earth.

But we do stand on the threshold of the Second Age of Discovery. When the craft is ready and the oceans of space are calm—calm because we have learned the new medium and have prepared to sail on it—the new explorers will venture forth. The Space-Age Columbus and Magellan are presently unknown, but they are sitting somewhere today in a public schoolhouse preparing for an adventure that exceeds the wildest daydream which today distracts them from their books.

These are the beneficiaries of our crude efforts today. Here are the people to whom we shall pass the baton. But the first lap of the race is ours. And we shall not falter.