NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
400 MARYLAND AVENUE, SW, WASHINGTON 25, D C
TELEPHONES WORTH 2-4155—WORTH 3-1110

FOR RELEASE: 12:00 Noon
15 February 1962

N64 10348

CODE-1

Release No. 62-30

23 p

Address by Morton J. Stoller, Acting Director
Office of Applications
National Aeronautics and Space Administration
Before the National Security Industrial
Association, Philadelphia, Pennsylvania

THE FUTURE IMPACT OF SPACE TECHNOLOGY

It is a pleasure to have an opportunity to discuss with you the future impact of space technology. I am sure that many of you have been instrumental in the development of the technology to which I will be referring in the course of this talk. Many of you have played vital and important parts in bringing into concrete form the concepts and designs for unmanned spacecraft and space systems which only a short while ago were considered to be dreams by the "hard-headed, realistic" thinkers of a few years ago. In Philadelphia and its neighboring cities there are many companies that have contributed to the development of our booster systems, and to our military and NASA spacecraft. The outstanding performance of the TIROS system in the last two years, and the rapid progress of the development work on the Nimbus meteorological satellite, the Relay communications spacecraft and the Orbiting

Morton J. Stoller Feb. 15, 1962 23 p (refs) Address before the Natl. Security Ind. Assoc., Philadelphia

Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

Astronomical Observatory have resulted from the efforts of companies that are represented here today. Of the many projects now underway, I have mentioned only a few which are particularly familiar to me because of my area of responsibility in NASA. The total variety of projects, which extends appreciably beyond the few I have enumerated, indicates to me that you already appreciate the part that space technology will play as we move into the middle of this decade.

At the same time, I suspect that there are among you those whose knowledge of our projected space program and what it will mean, is somewhat limited because of the pressure of other activities. I will briefly outline to you our plans for program activity and as I do so, I will indicate what we can expect will grow from the technology which is being developed in support of our program. NASA's space program has as one of its prime objectives the realization of the national goal proposed last Spring by President Kennedy -- that of placing a United States' exploration team on the moon within this decade. The President was convinced that this was the "time to act, . . . the time for this nation to take a clearly leading role in space achievement."

Acting on the President's recommendation, the Congress appropriated more than $1,670,000,000 for the activities of the National Aeronautics and Space Administration during the current fiscal year. This national determination, supported so fully by the leaders of our government, reflects the United States' awareness of the need to maintain leadership in space.

The President has budgeted $3,780,000 for the support of NASA programs in fiscal year 1963. This is more than double the NASA appropriation for 1962 and is an indication of the impact that we can expect space technology to make on our national economy. This increase in funding will accelerate very greatly our efforts in the manned lunar program and will continue the rapid development of our scientific and applications programs, as well as our advanced research and technology efforts. All these activities are still growing as we work toward the level of effort which will be characteristic of our continuing activity after the next several years.

I am sure you recognize that the United States needs to lead in space for several reasons, each of which will contribute to the scientific, technological or economic advancement, or to the peace and security of the free world. We must lead because of our basic responsibility for the broadening of our understanding of the universe and our obligation to make available to ourselves and our descendants the resources of the universe which our expanding knowledge will permit us to utilize.

Second, we need to lead because of our desire to realize the direct and immediate benefits from the application of satellites into operational systems, and the technological advances and stimulus to our economy which will emerge from our space effort.

Finally, we need to lead because of the potentially hazardous consequences to ourselves, and free peoples everywhere, were a hostile power to surpass us in the race in space.

These needs are the impetus for what will be the greatest technological achievement man has ever attempted, manned flight to the moon.

There are other elements to NASA's overall program which complement and support the manned space flight program. These include our work in the space sciences, in the applications of space technology and in advanced research and technology in support of all these missions.

If we take first the space science program, we have a typical example of technological growth nurtured by a scientific quest for knowledge. We know roughly when the solar system was formed, some four billion years ago, but we are now endeavoring to find out by our exploratory investigations in space <u>how</u> it was formed. With instruments carried to the moon, and eventually to other planets, bringing back by telemetry, detailed information on interplanetary phenomena and on lunar and planetary conditions, we can infer with far more certainty the history of the solar system and its probable origin.

The moon is a primary target in the space program because its surface has preserved the record of its history for a much longer period than the earth, and probably much longer than Mars and Venus as well. The atmosphere, rainfall, streams and seas have been wearing away the surface features of the earth for countless millions of years. Volcanic action and mountain-building have covered large areas of the surface and turned over others. Consequently, little remains on the surface of the earth of the features that existed several hundreds of millions of years ago.

Conditions of the moon, of course, are vastly different. No winds, no rains or oceans exist and astronomical studies show little or no sign of the mountain-building activity which has so often changed the surface of the earth. Thus, examination of the moon's surface at closer range will carry us back very far into the early history of the solar system; perhaps not back to the birth of the sun and the planets, but certainly billions of years into the past; much longer ago than the ten to 20 million years during which surface events transpired on the earth.

From the study of the lunar surface and what we can learn of the internal structure of the moon, we hope to find clues to the early history of the solar system, and to the birth of the planets. The question of whether they were created during a near collision between our sun and another star or were formed out of pockets or condensation in the dust surrounding our sun in the early stages of its lifetime may be answered. To collect the data for the answers to these questions will take many space probe launchings.

The exploration of the moon in its early stages will utilize the Ranger spacecraft. This is the spacecraft, which recently made its first flight past the moon, although it was intended to terminate in lunar impact. I am sure you have all read of the Ranger preparations and the postponements that occurred. The flight was launched finally on January 26, 1962. An excess of velocity at the end of the booster vehicle portion of the flight resulted in the Ranger spacecraft getting to the point when it intercepted the moon's orbit before the moon arrived at the same point and it therefore missed the moon by some 23,000 miles at the time of its closest approach.

Consider some of the detailed operations that such a spacecraft must be capable of accomplishing in the course of its mission. After injection into the proper trajectory, an operation which as I have just noted is no assured technological success, the craft must first unfold its solar cell paddles, to provide power during the flight. It must then be oriented to direct the face of the paddles to the sun and to point the transmitting antenna to the earth. These pointing controls then operate continuously, until the point at which a mid-course correction maneuver is required. Here the spacecraft is required to realign itself, in response to commands from the control station on earth, so as to impart an additional corrective velocity to assure its final impact, when a vernier rocket motor is fired. The amount of correction that was available was not enough to redirect the last Ranger to impact. After this correction maneuver is completed, the original control mode is re-established and the Ranger coasts on to the vicinity of the moon. Here another realignment is required to enable the retro-rocket which will slow down the rough landing instrument capsule to fire in the proper direction for greatest effectiveness. Other operations such as the extension of radiation sensors on booms and the initiation of specific data collection and sampling sequences are initiated at various times in such a flight.

All of these individual steps are required to function exactly as programmed if we are to have a successful mission. All of the subsystem designs are the result of months, and in some cases, years of intensive engineering effort. It is the technology which is building spacecraft such as Ranger that will have a profound effect in the future.

We have, we believe, been realistic in planning our project activities, in not expecting unqualified success in every mission. At the same time, we are exerting every effort to attain a maximum probability of mission accomplishment at each attempt. I think the programs being instituted to improve spacecraft components, preflight test and checkout procedures, and the work on systems design for inherent reliability, all will find their way into the routine of engineering practice in the future. Constant use and familiarity with the expensive quality control techniques necessary for missile and space hardware will lead to lower costs and more general application. They will then be incorporated into regular consumer goods production, thus resulting in improved everyday products. This will be of indirect benefit to the entire economy.

At the same time, it will be possible in the future for NASA to realize direct benefits from these improved techniques. We could plan on a sequence of two lunar spacecraft in order to achieve experimental success, rather than on three which are programmed at this time.

There will be major <u>indirect</u> effects of space technology which also can be exemplified by referring to our scientific effort to explore the moon with unmanned spacecraft. Ranger carries a capsule containing a seismometer, which is to be deposited on the lunar surface to transmit any evidence of lunar seismic activity that it may detect. The instrument, and its associated telemetry, are enclosed in a balsa wood crushable structure for protection on lunar landing. It is powered by a primary battery. Ranger itself uses solar cells and a rechargeable battery. In the last few years, the space program has provided the major impetus for the improvement of solar cells, and of long life, lightweight storage cells and for the development of lightweight nuclear auxiliary power supplies. There are also many studies underway on other means for the conversion of solar energy to electrical energy, which is more readily useable. It is my belief that the efforts now being directed to the improvement of such energy conversion devices will provide enough gain in their technical capabilities to make these other sources of power economically feasible in areas now at an economic disadvantage for lack of controllable energy.

Following Ranger will come the Surveyor project with flights planned for 1963 through 1965. With the Surveyor we hope to make at first, soft landings of about 350 pounds of instruments in various spots on the visible side of the moon. With this spacecraft, we are planning some detailed studies of the local lunar surface characteristics. There is also a variation of the Surveyor design which is intended to make orbital flights about the moon for mapping the lunar surface.

The techniques required for the successful accomplishment of such missions will stretch our existing technology to its limit and in meeting this challenge I am sure that we will again build a background of new knowledge that will be felt throughout many industrial fields which are not now thought of as being related to the national space program.

To accomplish a Surveyor mission will not only require the routine application of the capabilities developed in the course of our present phase of the lunar program, but will also require improvements in data processing aboard the spacecraft, the development of sophisticated instrumentation for geophysical and chemical analysis of lunar material and a re-examination of the logic of systems design so as to improve the command of the spacecraft on the moon and the rapid interpretation of the data as it is returned. These techniques will, I believe, find their way into many other complex applications, where the remote operation of sensory devices and a command procedure for action, based on the automatic processing of telemetered data, can be effectively applied.

Flights of unmanned lunar spacecraft in the period preceding the manned lunar flights will be used to collect design data for the manned spacecraft and for fundamental scientific studies. After the initiation of the manned lunar spaceflight program, these flights will continue so long as additional scientific data can be effectively collected with unmanned craft.

We are often asked why we intend to send men on hazardous space flights when instrumented satellites and probes can now be used to collect vast quantities of information. The answer is first that the integration of the human pilot into a spacecraft system greatly improves the reliability. While instruments can accomplish tasks of which man is incapable, so can man accomplish many of which machines are incapable.

For example, a man cannot only make tests while in flight but he can also effect repairs in flight. A striking example of this is NASA's X-15 rocket airplane. In at least 18 of 44 X-15 missions to date, flights would have failed without a pilot in the cockpit to correct malfunctions of equipment, instruments or power plant. In two other cases, if the mission had been unmanned, we would have obtained no information because either instruments or telemetry failed. The X-15 pilot, however, was able to land with valuable information recorded by his own senses.

Second, the most advanced instruments can gather and transmit only the information that they are programmed for. They have no flexibility to meet unforeseen situations. Scientific data acquired mechanically must be balanced by on the spot human senses and human reasoning, and by the power of judgment compounded of these human elements.

This country's first project for manned space flight, called Mercury, is designed to take a man in orbit at an altitude of more than 100 miles, to have the spacecraft circle the earth three times and to effect the recovery in a designated landing area. Its basic purpose is to study the medical effects of the space environment and to develop the technology required for further manned exploration in space.

Last year we achieved the successful suborbital flights of Alan B. Shepard and Virgil Grissom and the orbital flight of the chimpanzee Enos. Five more flights are planned in this program, which should be completed by late 1962. We are almost on the eve of the first of these, for which John H. Glenn, Jr. was selected as the astronaut, and Scott Carpenter, his backup, for three trips around the earth.

Modifications of the present Mercury spacecraft are in progress which will increase the battery, the attitude control and the life support systems capacity to allow one-day orbital flights. This flight program will begin in late 1962 and extend into early 1963. From it we will determine man's physiological and mental responses to the extension of zero gravity flight time.

The lunar exploration phase of the manned program will be conducted, as part of Project Apollo, in a capsule carrying a crew of three in a nearly "shirt-sleeve" environment. Apollo will require space techniques far in advance of those needed for Mercury. The Apollo spacecraft must be built for flights of two weeks duration. It must be capable of guidance toward the moon, gently landing on the moon. Then it must be launched from the moon and guided back for safe return into the earth's atmosphere at a speed of 25,000 miles per hour.

Like other achievements in space, the Apollo flights must be realized by a step-by-step process. The spacecraft will first be flown in orbit around the earth so that the many components and systems of the vehicle can be tested and evaluated.

These earth-orbiting flights will also be used for training the space crew and for development of operational techniques. Each will also include important scientific experiments.

As the competence of the Apollo vehicle and the men who will operate it increases, the flights will go farther and farther from earth, and will be of longer duration and complexity. A major step will be a manned flight around the moon, on which the crew will perform many of the guidance and control tasks that will be needed later on in the lunar landing mission.

The Advanced Saturn will be the vehicle to power the Apollo flights around the moon. The first stage of this vehicle will consist of a cluster of five kerosene and liquid oxygen fueled engines (F-1), each developing 1,500,000 pounds of thrust, built by the Boeing Aircraft Company. The second stage (S-II), built by North American Aviation, utilizes five 200,000 pound thrust liquid-hydrogen, liquid-oxygen engines (J-2), and the third stage (S-IVB), built by the

Douglas Aircraft Company, will be powered by a single (J-2) 200,000 pound thrust engine.

This launch vehicle will place over 200,000 pounds in a near-earth orbit and 80,000 to 90,000 pounds around the moon in circumlunar flight. However, if we use the direct ascent approach for manned lunar landing, we will have to build a launch vehicle twice again as large as this advanced version of the Saturn. No detailed specifications have been established, but we are planning a vehicle, which we have named the Nova, in the neighborhood of 350 feet tall, with this capability.

Because of the time we estimate it will take to build and test Nova, we have been carefully examining proposed concepts by which some of that time might be saved. One proposed solution is to launch the Apollo spacecraft and its auxiliary rockets into orbit in segments and to join them in space. This operation, which we call the rendezvous technique, would make it possible to carry out the mission with Saturn vehicles rather than with the Nova.

If the rendezvous approach is used for the flight to the moon, for each manned flight there will be two launches of the Advanced Saturn. First, the Saturn will launch into orbit a large, fully fueled rocket stage. After its precise orbit is established, another Saturn will launch the Apollo spacecraft into the same orbit and the men aboard will pilot it to a junction with the rocket stage. After the two segments have been joined, and the orbit of the assembled vehicle has been carefully established, the rocket stage will launch the Apollo onto its flight path toward the moon.

There is now approved a new manned space flight project called Gemini, which will follow Project Mercury, to develop the technique of manned space flight rendezvous. In the new project, we will develop a spacecraft which will carry two astronauts. NASA's current astronauts will serve as pilots in the program, and additional crew members may be phased in for later flights.

Project Gemini provides the earliest means of experimenting with manned rendezvous techniques. In addition, the spacecraft will be capable of remaining in orbit about the earth for a week or more. The McDonnell Aircraft Corporation, prime contractor for the Mercury spacecraft, will produce the larger two-man spacecraft. The launch vehicle will be a modified Titan II missile, developed for the Air Force by a team headed by the Martin-Marietta Corporation.

However, to provide insurance in case we are not able to perfect the rendezvous technique in time to meet our schedule, we have decided to begin development of the Nova launching vehicle as well. We shall bring it along so that it will be available if required for the first manned lunar landing and for the ambitious missions into space that will follow the landing on the moon.

In summary the program of manned space flights for this decade is as follows:

In 1961, the United States conducted two sub-orbital flights in Project Mercury. Beginning early in 1962, we shall enter the phase of three-orbit manned flights. Then late in 1962 or early in 1963, the program will move into a phase of longer flights, lasting up to a day.

The two man flights will take place in 1963-64. This new program, Project Gemini, provides the earliest means of experimenting with manned rendezvous techniques.

Then we shall move into Project Apollo, utilizing a three-man spacecraft in its three phases -- earth orbit, circumlunar flight, and the lunar landing.

It is clear that much of the research in advanced medical instrumentation, now being developed as we prepare for manned space flight, will vastly increase our ability to measure and analyze human reactions under other stresses. This research may eventually be applied to situations in many industrial and professional callings where there are excessive physical and psychological pressures, thus providing valuable tools for medical researchers and practitioners.

In Project Mercury we have developed miniature instruments that are attached to the bodies of our astronauts for measuring heart action, brain waves, blood pressure, and breathing rates -- information that was telemetered back to earth during the space flights of Alan B. Shepard and Virgil Grissom and, recently, during the November 29 flight of the chimpanzee Enos.

The management of Roosevelt Hospital in New York City has applied instruments of this type to some of the patients on the critical list. The information registered by the instruments is reported electronically on a display board at a central point.

One day, soon after the equipment was introduced, it saved the life of an accident victim who had suddenly collapsed into shock. The monitor signalled the nurse who, in turn, summoned a cardiologist in time to revive the patient. At least two other hospitals in the United States have such experimental units in operation.

We can expect that the studies being made on closed life support systems in preparation for the Apollo lunar flights will develop medical data on the human ability to adapt to such sequences which will feed back both into our general scientific and into defense systems designs. The search for regenerative food and oxygen supply systems may lead to improved techniques for the recovery of potable water on a large scale or to the adoption of algal cultures as a supplementary protein source.

Besides these medical developments, the engineering technology developed in the construction of the Saturn, the advanced Saturn and the Nova are certain to result in a continuous flow of new materials, techniques and processes. All of these will have a growing effect on our economy as they diffuse from their original sources to the nation's industry.

There are two direct, and immediate applications of space technology which have already made their first impact on the world. These are the meteorological and communications satellites.

It is unnecessary, I am sure, to discuss the success of TIROS with this group. I will point out though, that as only about one-fifth of the globe is covered by ground-based weather reporting systems, that a television observational satellite system can improve the coverage, of cloud cover information, by a factor of 5. TIROS was the first step in the development of a satellite system which is planned to provide global coverage, with a new data sample being collected every twelve hours. To accomplish this, the Nimbus satellite, which is earth stabilized, rather than space stabilized, is under development. Both TIROS and Nimbus, in addition to the television cameras, carry infrared sensors which make it possible to obtain earth surface temperatures, snow cover and limited data on nighttime cloud cover.

The global data coverage will greatly enhance the ability of the meteorologist to observe and predict the weather. Improved forecasting, which will result as detailed information flows regularly to the meteorologists, will be reflected in large returns to the economy. Many industrial and commercial enterprises are deeply affected by local and regional weather conditions, and improvements in weather-forecasting will permit much closer scheduling of their operations. The possibility also exists, of course, that the better understanding of the weather process, which will develop as the new source of data becomes operational, will lead to some form of weather modification.

NASA's communication satellite program has been planned to support the early establishment of a global communications satellite system for general use. Our studies and experiments pertain to both passive and active satellite systems. The feasibility of passive systems has been demonstrated by NASA's Echo I, the 100-foot aluminized plastic sphere which you have seen moving in the night sky. This experiment proved that it is possible to transmit telephone and other electronic signals over transoceanic distances by reflecting radio signals from an artificial earth satellite. The feasibility of active communications satellite systems was demonstrated by the Score and Courier projects of the Department of Defense.

NASA is continuing its studies of passive satellites by experimenting with an inflatable sphere larger than Echo, and designed to result in greater rigidity in space. A few weeks ago when a test of the new design was attempted the sphere ruptured when the inflation started. Therefore a change in inflation procedure will be incorporated before the next test. This was the first time, sofar as we know, that the separation of a payload from the booster was observed on the ground by a television camera located in the booster. A recoverable capsule containing a movie camera also provided film records of the separation and inflation events.

NASA's active satellite projects are three in number. We are supporting the Telstar project of the American Telephone and Telegraph Company by providing, on a reimbursable basis, the launching vehicle and tracking services. Telstar is an experimental satellite capable of transmitting one television channel or an equivalent number of telephone channels. It will be placed in an elliptical orbit whose peak altitude is about 3000 miles. In such an orbit, continuous communications over transoceanic distances are obviously not possible with only one satellite, and only experimental transmission and tracking tests will be conducted with the first of these satellites.

NASA's Project Relay satellite has similar orbital characteristics and will be used for related experimental investigations. Great Britain, France, Germany, Brazil and perhaps later, Italy, will take part in the Relay tests.

Several of these countries will also cooperate on the Telstar project.

The Syncom satellite, an active repeater with a capacity limited to a single telephone channel, is to be placed in the 24-hour orbit from which it is possible to provide continuous transoceanic service with only one satellite. Syncom too, is an experiment in that the method of placing it in the circular orbit at 22,300 miles above the earth will be tried for the first time. The controls for its attitude and position in orbit will also receive their initial tests. The Syncom project draws on the U. S. Army's Advent Management Agency for ground station support. Advent is the military, 24-hour orbit, communications satellite. It will provide the special characteristics that the Defense Department requires in its communications system. Syncom will evaluate launch and control techniques which may make it possible to establish a commercial 24-hour orbit satellite system at a fairly early date.

The communication satellite systems analyses point out that a tremendous increase in global communications capabilities is in the offing. Hundreds of times the number of presently available overseas channels will be opened and service to points where present day cable and microwave systems do not reach will become feasible.

Lower costs for overseas services should be realized, and such techniques as the use of closed circuit television conferences to obviate the need for some transatlantic travel should come into being. The satellite system will also open the possibility of establishing local communications networks centered on a satellite terminal in areas which now have little or no external communications services.

The technology we are developing in our space program is certain to have immense and growing effects on the national economy, the professions and on everyday life. Already industry is profiting from new techniques, alloys, plastics, fabrics, and compounds of many kinds, originally created to do space jobs. We are merely at the beginning of an era of profound technological change, whose end no one can foresee. Today, far more than in the past, scientific progress determines the character of tomorrow's civilization.

The accelerated U. S. space program will stretch the abilities and minds of our people for years to come. It will provide a continuing, long-term stimulant to our economy. The magnitude of the task will test the resources and cooperative will of all major elements of our society. Still, space exploration, and manned space flight in particular, offer the United States the opportunity for unparalleled progress in the future. I am sure that we will all respond to President Kennedy's call in his Inaugural Address when he urged the world:

> "To invoke the wonders of science instead of its terrors. . . to explore the stars, to conquer the deserts, eradicate disease, tap the ocean depths and encourage the arts and commerce."