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NEWS

NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: UPON DELIVERY

SPEECH
by
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at the
Eighth Annual Briefing on New Horizons in Science
Council for the Advancement of Science Writing
Raleigh, North Carolina

November 19, 1970

One month ago I addressed a meeting of the American Institute of Aeronautics and Astronautics, in Houston. In that speech, I developed the following theme:

> We have clearly achieved and demonstrated a position of world leadership in space science and technology. However, our leadership is under continual challenge by a capable and determined competitor -- the Soviet Union. At the same time, our concern about domestic problems has caused sharp and substantial reductions in U. S. efforts in aerospace research and development work in the past several years. As a result, our national capabilities are steadily diminishing, and our lead may soon disappear.

Given this situation, I then said that it was most important to maintain our leadership in science and technology; and that our space programs for the 1970's and beyond were designed to do just that.

At the end of my speech, I was challenged by a distinguished member of your organization. He accused us of talking to ourselves and said that we must state the value of our space program in "earth terms."

Of course, he was right! We were talking to ourselves in that meeting in Houston. I stated the value of the space program only in terms of the economic and strategic importance of maintaining the nation's leadership in science and technology. I neglected to explain the value of science and technology in general -- and the space program in particular -- to humanity.

I will not be able to answer his challenge this evening. I alone cannot do this -- in fact, the challenge is yours as much as mine; you must share this responsibility with me. But, perhaps I can add a few points to the debate.

During the last 100 years or so the application of scientific understanding has steadily improved the life of man on earth. He can now live in comfort; move about his planet with ease; and in increasing numbers he can apply his mind, rather than his muscle, to the job that needs to be done. For the most part, man welcomed this growth through science and technology, the industries that came with it, and the tremendous economic development it made possible.

But suddenly man has realized that these advancements brought the bad along with the good: as our population increased enormously, the rate of human consumption of the earth's resources grew even faster. If unchecked, the growth of population and the exploitation of resources could threaten the very existence of mankind. And so, there is a rising tide of domestic concern; a heightened awareness of our social needs and responsibilities; an awakening of social conscience; and an awareness that our physical environment has deteriorated to the point where there is an absolute recognition that we must do something about it.

And there are many who believe that science and technology as instruments of change are the roots of all those concerns.

I cannot support that belief. I agree that many of today's problems are the penalities of an insufficiently regulated technology. But the solution will not come if we blindly and arbitrarily stop all progress; it can only come from a <u>responsible</u> application of science and technology.

We speak glibly about cleaning up our environment. But what do we mean by "environment?" Is it the smog in Los Angeles, or the algae in Lake Erie? Is it the congestion of our traffic or the noise at our airports?

These are merely symptoms of the problem. The real importance of the environment does not lie in these isolated abuses. It lies instead in the cumulative effects of all of these, in the change that is taking place in the world in which we live.

It is a change that is largely brought about by man; and it is the effect of that change on man that is of so much concern -- concern that this change will produce an imbalance in the fundamental conditions which govern the life of all men and mankind. Today we believe that we must slow the rate of that change. But must we halt it completely? Could we halt it completely even if we wanted to? Or, isn't the real question: what rate of change is acceptable to man as he evolves into the kind of being he will be 100 and 1,000 and 10,000 years from now? Only science, and the application of science, can answer these questions.

So, when we ask: "Is NASA relevant?," I do not view that question in the context in the narrowest of definitions of environment. Should NASA clean up the Los Angeles basin or Lake Erie? The answer is no! The solution of those problems as isolated abuses of the environment does not require new knowledge. Existing technology can solve them, once they are stated and defined, once a commitment is made to do so. They require regulation more than engineering. Other agencies are charged with these responsibilities; we will, of course, assist wherever we can.

But if we are talking about the impact of man on his total environment, if we are concerned about the cumulative effect of man's modification of his environment, if we are concerned about the implications of these modifications on the future of mankind, then NASA's role is not only clear but the relevance of it certain.

It is NASA's mission to explore space, to gain a better understanding of the universe, and to use the tools of space to study our earth as a whole.

To understand the mechanism of change here on earth, we must understand all of the physical, chemical and biological processes that affect us; we must also understand our history, and the history of solar system; and we must understand the sources of energy that may be available in the future.

We cannot do these things in our laboratories here on earth. Our past has been largely erased; and we need to look beyond our own limited sphere to discover the laws of science that will govern our future.

We can do many of these things through the use of space -- space science and space technology. We can examine our earth from the vantage point of space. We can study the moon, which appears to be an old planet formed about the same time as the earth, to study the history of the early solar system. We have done these things, and have made many new discoveries; but more needs to be done.

Look at the future possibilities, the challenge and the opportunities that the work of the past decade has placed within our technological grasp: Is there life on Mars? What can we learn from Jupiter, Saturn, Uranus, Neptune and Pluto? What physical processes take place in our sun? What are the energy systems of quasars and pulsars? What is the significance of each new finding -- for instance, the clouds of formaldehyde, cyanogen and alcohol discovered in interstellar space?

From answers to these questions, and others like them, will evolve a blueprint for our environment here on earth. Only with this kind of knowledge, with this kind of understanding, will we be able to consider and decide what needs to be done.

And so, while many of today's ills can be attributed to our use of modern technology, the long range cure -- and more important, the prevention of future ills -- can only be based upon facts not now well established, and in many cases even unknown. That requires a search for knowledge. That is science, and the application of science, on earth and in space.

That was NASA's mission before men began to state their ecological concerns in social, political and economic terms. And it will be NASA's mission long after the air is clear again, and the lakes and rivers pure again, and the balance of man and nature restored more nearly to the condition man's sense of values deems necessary.

But what about now? What are today's applications of our space programs?

There are two basic kinds of space applications we have identified -- and you are familiar with the valuable operational examples of each. First, there is the use of space as a unique vantage point from which to observe or measure terrestrial phenomena, such as the operational weather satellites, the geodetic satellites, and in the future, earth resources satellites. Second, there is the use of space systems as communication relays, such as provided by Intelsat and the Navy's Transit Navigation System.

It is important to note that these space applications are not self-sufficient; they do not represent a complete answer to a problem. They simply add a capability, a tool, to the inventory from which we can draw. For example, a meteorological function must be in being to benefit from the added values of satellite observations; a satellite geodesy program is only valuable when added to an existing base of measurement; a satellite relay is only warranted when communications' traffic reaches a certain level.

Space applications are therefore services -- but they are important ones. And each class of new service brings with it, directly and indirectly, potential new problems which we must recognize early. NASA's job is to perform sufficient experimentation and gain sufficient experience with each space application to provide sober, realistic appraisals of its value -- and of its impact.

Take earth observations. Operational weather satellites have steadily evolved, and the first reliable weather and climate models are beginning to be constructed. Forecasts are getting more accurate; storms are now routinely spotted and tracked long before they pose a danger: 50,000 lives were saved in Hurricane Camille by prompt evacuation, and $3 million was saved in Hurricane Laurie by not having to evacuate. Early next year, the National Oceanic and Atmospheric Administration will be issuing a regular global sea-surface temperature map, accurate to 1° centigrade, using space-acquired data; only the satellite can provide that kind of repetitive total coverage. In early 1969, the middle west was properly prepared -- perhaps for the first time -- for the spring floods; combined space, air, and ground surveys had defined the snow pack water content, and sound models of thaw conditions had been developed. The levees had been strengthened in the proper places, supplies and stores had been positioned, and evacuation plans made, all well in advance. The space input was only one of many, but it catalyzed the rest.

This bringing together of techniques and disciplines is characteristic of the applications program. When a tornado struck the city of Lubbock earlier this year, NASA earth resources survey aircraft were able to record the damage immediately for assessment and to assist in recovery operations. These data, together with weather radar, local observations, and pictures from stationary satellites, have permitted researches to model this storm in detail --

a meteorological achievement of note. Its practical value lies in the indicated feasibility of using data from synchronous satellites to predict such occurrences in time for early warning.

It was, by the way, these same aircraft that surveyed the recent offshore Gulf Coast oil well leak, using many different sensors. The U. S. Coast Guard is modeling its oil spill monitoring system on those data. A space system appears highly desirable for this application in that its coverage is so much more complete than that possible from aircraft.

Remote sensing aircraft were used this past summer to map the extent of corn blight in the midwest; the same techniques proved useful to the Brazilian Government in assessing the coffee blight and to the Indian Government in measuring the damage from a coconut blight. These are small examples stemming from a program in its early research phase.

We know useful information can be extracted from space data and acted upon here on earth; for example, the state of Alabama used Apollo photography to assess its water resources -- and has taken steps to repair reservoirs that those pictures showed to be seeping. We are certain that many applications yet untested lie before us; for example, the Nimbus satellite is right now remotely monitoring the temperature of Mount Rainier, a quiescent volcano. At our Goddard Center we have been measuring polar motion through laser observations of a geodetic satellite; there is some indication that major seismic events can be predicted through this technique.

We are in the research phases of such applications: we are developing an earth resources survey satellite; we have earth sensing instruments on Skylab; we plan an oceanographic satellite altimeter on the next Geos; we are developing a synchronous meteorological satellite for the National Oceanic and Atmospheric Administration.

All of the earth observation programs have a dual purpose: they help us gain an understanding of our physical environment so that ultimately we can better manage our resources; and they generally provide services of an immediate nature. Our development of communication relays, on the other hand, is entirely service-oriented.

Take the problem of the North Atlantic Air Corridor. Because of the absence of direct ground control over the entire distance, airliners are kept well separated in altitude and time. The technology exists today to provide, via satellite, continuous monitoring, communication, and control for aircraft in the corridor; one estimate is that we could permit four times as many international flights with such an approach. But the problem is larger; we cannot overlook the problems of airport congestion, passenger access, and air traffic control over the U. S.; we cannot afford to solve a smaller part of the problem at the expense of exacerbating the whole. For that reason, we are engaged with the Department of Transportation in a research and evaluation program covering the whole spectrum of air transportation, rather than pressing for the deployment of a premature operational capability.

Take broadcast by satellite. We are providing India with an experimental community broadcast capability. The Indian Government will place television receivers in 5,000 villages and will transmit educational programs to them via a NASA R&D satellite. This is technology in the service of a developing nation; the satellite replaces the otherwise necessary large investment in ground transmitters, cables, and microwave networks. If successful, the experiment will evolve to an operational system involving maybe 500,000 villages, a significant fraction of the Indian population. The capability to reach so many so easily, to bring to bear instructional material on agricultural practices, sanitation, family planning, and a common language, may make a major difference in India's ability to meet its many cultural and economic problems. But in the U. S., where the same capability for deployment exists, far different problems would be raised; these are the political and economic questions of impact on existing distribution systems, for example.

As we look downstream, we see the technology in hand for direct broadcast satellites, for informational networking -- tying together entire libraries of information for rapid retrieval anywhere, and for combined traffic control/navigation/position location systems; we also recognize that each has social and economic implications which have not been fully developed and exposed.

Our first steps are to understand how these systems perform technically, and what useful information can be derived from their data; there are many questions to be investigated as to their possible operational roles. We must have blueprints for hardware; equally, we must understand the relationship between hardware costs and systems benefits, the alternative management roles of public, private, and international institutions, and the long-term impact on society of accepting these new capabilities.

These are some aspects of the immediate relevance of the aeronautics and space program; others would include our work in air safety, noise abatement, and pollutant identification. I have touched upon some of the "what's" and "why's" of our applications programs; more importantly, I believe, I have stressed how we look at our work, how we keep it in perspective.

We must remain responsive to real problems to which we can contribute; we must be responsible in making that contribution; above all, we must remain realistic about what we can -- and cannot -- do.

The overwhelming relevance of the space program is the same today as it was in 1958; the forcing functions and the environment have changed, the underlying rationale has not. As a society we are dependent upon a high level of science-based technology for our security, for our comfort, for our well-being. As mankind, we depend on science, and the application of science, for our survival. The NASA mission is to contribute to the human understanding of our universe, and to the human advance of science and technology, for the United States and for the world. There is real relevance in that mission.

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