The original documents are located in Box D15, folder "Challenges of the Space Age, 1959" of the Ford Congressional Papers: Press Secretary and Speech File at the Gerald R. Ford Presidential Library.

THE CHALLENGES OF THE SPACE AGE

It was almost a year ago that the first Soviet sputnik rose into orbit, to be followed by two more of great weight and by four of more modest weight put up by the United States. Despite all the headlines which have accompanied launchings, there is reason to question whether the people as a whole fully recognize that our life has begun to change, following a new, irreversible path.

In the late winter of 1958, the House of Representatives established a Select Committee on Astronautics and Space Exploration to consider the legislative needs which the new space age would bring. This committee, of which I am a member, held a month of public hearings and spent several weeks in executive session to study the implications of the new technology for military strategy, for scientific advance, and for the economy. We also considered a large number of possible organizational patterns before there emerged the draft bill which the Congress enacted into law.

This is the National Aeronautics and Space Act of 1958. It implemented the objectives which President Eisenhower set forth in his message to the Congress on this subject last April. The Act as finally signed into law on July 29 compromised the drafts developed by the corresponding House and Senate committees to provide the President withthe organizational tools he needs to give this country an ultimate strong program in space technology. Those of us who were fortunate to be able to participate in these activities are fully aware that the Act is merely the first step in a program which is going to be long and hard, with disappointments along the way. We do have a new National Aeronautics and Space Administration created with a grant of broad powers to pursue civilian interests in space, and to continue the research in aeronautics as well, long conducted by the NACA, which is the nucleus of the space administration. We have also created a Council of which the President is chairman, with high ranking members of Government and leaders of the scientific-engineering community to guide overall policy, both civilian and military.

I want to emphasize that the Congress has felt the program to develop space capabilities was so important and the facts of the situation so compelling that the approach it has followed has been strictly bipartisan. The differences between the two parties make the headlines, and our two-party system represents a key tool to clarify issues and to reflect public will. But in the present instance, we are all in the same grave situation together, and the flexibility of our institutions of Government were demonstrated by the complete team play possible in hammering out the legislative program. John W. McCormack, the Democratic Majority Leader was our chairman. Joseph W. Martin, Jr., the Republican Leader was our vice-chairman. This was something of a departure from tradition where normally one party controls a committee of the Congress. I also want to record that although we debated the issues vigorously in our closed sessions, when it came time for decision, there was such a meeting of the minds that there was never a dissenting vote within the committee.

However much we may wish to dedicate the use of outer space to peace, the immediate realities are that we face a military threat, and only a strong American capability can minimize the risk to ourselves and to the rest of the world. We Middle Westerners are sometimes called isolationists. I don't agree with the label; but there can be no isolationists anywhere when a thermonuclear warhead can flash down from space at hypersonic speed to reach any spot on earth minutes after its launching.

Since the V-2's hit Britain and the Low Countries in World War II, we have been moving slowly, but now at a quickening pace toward major reliance in war on missiles following a ballistic path which arches through space. I doubt if even the experts can really say whether the United States or the Soviet Union will be the first to attain a full operational capability at intercontinental range. But it is clear that unless we give adequate support to the research, development, and engineering of such weapons, we shall come out second best.

It will not be enough for us to create an operational ICBM. Of necessity we must think about putting some launching bases underground, and making others mobile. We must find ways to overcome the time-consuming long count-downs presently required for a launching. We need complicated systems of radar detection. And we must set a high priority on tremendously complex and advanced anti-missile missile systems. Never before has the urgency been so great for new scientific ideas and their rapid translation into practical hardware.

Another type of project of high priority is the reconnaissance satellite for military purposes. Indeed, it may become an important bulwark in any "open skies" plan of military arms limitation. I am sure that many of you recognize that mapping on a world basis is incomplete, and we do not have accurate information as to the location of one continent in relation to another. That is, we do not know accurately enough target locations so that even a perfectly launched ballistic missile will reach an intended destination across the ocean. Television ground search could supply many kinds of strategic information. A recoverable satellite, which is also in prospect, could bring back important photo coverage. These same positive military capabilities of satellites would figure in any effort to police against military aggression. Sensitive instruments could detect radiation in violation of a nuclear test ban. Infrared detectors could locate underground installations. Short-range communications information could also be listened in on by satellites. The Soviets have already demonstrated the ability to lift into orbit satellites of a size to carry a vast array of reconnaissance devices. Our project sentinel in time will do the job, too.

Official pronouncements have denied any future for the satellite as a bombing platform. However, testimony before the House committee made clear that such a conclusion would be premature in a rapidly evolving technology. It is true that an object loosed from a satellite simply accompanies it in orbit rather than falling to earth because of the Kepler effect. It is also true that a manned station in space in a fixed orbit might be vulnerable to counter measures. But such authoritative witnesses as General Gavin and Dr. Wernher von Braun made clear in open session that there are important possibilities under development for ultimate destructive use of satellites. There is every reason to believe that the Soviets are quite as capable as we are of discovering these possibilities. Roy Johnson, the head of the Pentagon's ARPA space organization has testified figuratively of a potential death ray, long the theme of science fiction stories, which might wreak destruction on the earth below without the reentry problems of a satellite-launched bomb.

There are even military transport uses envisioned for space craft. The people at the Redstone Arsenal believe they can shoot a man into space and bring him back alive within a year of the time they get a go-ahead signal. As Dr. von Braun described the later operational delivery system, small units of military specialists could be shot to particular points far behind enemy lines to arrive without the same dangers of interception as aircraft flight across defended air space now entail. The prospect is that some of these future delivery systems will not be especially costly.

Manned flight into space is coming by stages. The X-15 is half-aircraft, half-space ship which will make brief excursions to altitudes on the general order of 50 or 100 miles up. The B-70 so-called chemical bomber utilizing borane fuels will be able to sustain flight at mach 3 over long ranges. Preliminary contracts have been let for the Dyna-Soar concept. In effect, this will be a manned satelloid, capable of making several passes around the world at 10 to 18 thousand miles per hour. It will be able to maneuver and to choose its reentry point.

My discussion of these military possibilities and realities is to emphasize that we can not afford to neglect the development of space techniques. The Soviets are moving ahead on a broad front, and no procrastination on our part will spare us. They can be expected to refrain from blackmailing or even destroying us only if we have similar capabilities. If we expect any workable agreement for disarmament, it will require that we are as capable of implementing controls as any other nation.

I hardly need tell this audience that sound applications of advanced technology require a thorough understanding of basic principles and much background knowledge. The space sciences depend upon a broad attack on the frontiers of scientific knowledge. We need to know much more about the chemistry of combustion. We need to advance our metallurgy. We need to explore new approaches to computer control. We need to know more about electronic wave propagation. We need to know much more about the effect of new environments on biological processes before space flight will be completely successful.

Similarly, what is discovered in the scientific exploration of space will contribute across the board to other fields of technology and science. It is in the nature of things that some of these ultimate contributions to other fields are quite unpredictable. Our committee understands that along with the spectacular projects such as putting man into orbit or sending rockets to the moon must come much less glamorous work which will back up the big projects of the future.

We have been conducting an upper atmosphere research effort since the end of World War II. This must go on, even on an expanded scale to support growing needs for data. The scientific satellites launched under the IGY must also be continued.
One of our witnesses told us that our first Explorer satellite brought back data in two weeks equivalent to a century of work with sounding rockets of the type he had been using for the previous ten years. However, the two approaches are not strictly interchangeable, and both are needed.

As you know from the extensive publicity given our satellites, they are collecting fundamental data on cosmic ray intensity, on meteoritic dust, on wave propagation, on the mysterious band of radiation around the earth, and on the effects of gravity and magnetism. Before the series is over, we will also have new data on world-wide cloud cover and on energy balances of radiation from the sun and heat loss by the earth. One of the more intriguing studies will be to test a hypothesis of relativity theory that changes in gravity can affect time. Incredibly precise measurements made by a so-called atomic clock in a satellite with signals sent back to earth may provide experimental proof of whether such a change in gravity will slow time as precisely fixed through known rates of atomic disintegration.

We are developing not only the capacity to boost large loads into space but the means to create a stabilized platform out there. You will recall that photographs reveal the Soviet sputniks tumble end over end in their free fall around the earth. Our later satellites will first be spin-stabilized, and then even equipped with vernier rockets to keep them in a fixed relation to the earth. This will be extremely important to several kinds of earth surveillance. It will also be important to future observation of the heavens. You know how our observation of other planets and of distant stars is handicapped by our atmosphere with its screening and distorting effects. The inability to photograph Mars to determine the truth of the canali, and many other problems should be overcome by our more sophisticated satellites when they can carry moderate-sized telescopes. One school of thought is that all such experimental and observing work can be done by remote control, as exemplified by Dr. Fred Whipple's scheme for telepuppets. Another group believes that the full potentialities for space research will not be realized until a manned station can be constructed. It was Krafft Ehricke of Convair Astronautics who demonstrated before our committee quite detailed plans for establishing a permanent station based upon use of the Atlas missile as a booster unit and building material in space.

Although it is still speculative, I think one of the more intriguing ideas of recent months is the plan to use the earth itself as an observing instrument. Since light is bent by the effects on space-time by material bodies in space, the idea is that a satellite placed the right distance from the earth could use the earth itself as the equivalent of a huge lense which might even make possible the observation of other stars to see whether in fact they have families of planets. Observation of a planet as close as Mars by this technique might provide astonishing detail. Now this may sound pretty fantastic, but the possibilities of giving it a test are not particularly distant and are no stranger than many other aspects of the unfolding space program.

The publicised lunar probe program for this year with its pictures from the back side of the moon is only a start on what is to come for both this country and for the Soviet Union. Instrumented probes to Mars and Venus should be launched within the decade, and may come much sooner. Dr. Dryden of the NASA testified before our committee that our ICBM guidance system probably has sufficient accuracy to send a probe within several diameters of Mars or Venus. But work is underway on mid-trip guidance devides and on final guidance to increase the chances that what we send out will accomplish its mission of coming close enough to get pictures and make other useful readings of data on these planets which have held man's interest for so many centuries. There are only certain launching times which would be good in terms of the relative positions of earth and these other planets in the same way that lunar probes must be timed for best results.

Making soft landings on the moon with instruments should come within five years. If a big enough effort is launched, we may even have the capability of a round trip to the moon with men in less than ten years. This is not just a matter of money, but one of scientific and industrial mobilization. I can't tell you whether such a project is practical in terms of the results to be obtained. But I think that General Boushey of the Air Force makes a good point when he says that until we do some of these things we can not know whether the moon will be important as a military base or for other purposes. The Soviets certainly are determined to get there, and I just don't think we can afford to neglect the possibilities.

Many of the things I have been discussing are projects which are going to cost a lot of money. As a member of the Appropriations Committee of the House, I have something of a reputation with my colleagues for being pretty careful with the tax payers' money. I certainly expect to continue to insist upon prudent use of our revenues in order to keep our free economy strong. I think it is in the light of this background that you must assess my plea for national support of the space program.

I am especially interested from the practical point of view in what economic benefits may flow from the space program. Some people have stressed that we can expect a tremendous employment boom in the years ahead as a result of expenditures for space. I know that we all welcome this. But I would contend that this is not by itself a justification for expenditure. A good economic rathole can provide that kind of employment, too.

Fortunately, there are other promising benefits which will flow from the space program to help all sections of our country, and indeed the world. One of the chief of these is more accurate weather prediction. It was Dr. Reichelderfer, the Chief of the Weather Bureau, before our committee who testified that a fairly conservative estimate of the annual savings to the United States to be expected as a result of weather observation satellites could be expected to run to about $4 billion. His Bureau in collecting figures on the importance of weather prediction savings has come up with such astonishingly large totals that they have been afraid to release them as too fantastic. The estimates he presented to us were well scaled down. Weather experts think that satellites should afford us with the world-wide data required to enable new computers within the next decade to provide us with accurate estimates.

Some very prominent scientists also foresee the day when weather control will become a reality. Satellites may provide some part of this technology. As strange as it may seem, engineering studies show some possibilities for reflecting solar energy from satellites to influence growing rates in some locations, and another scheme would supply enough light in thesky as to substitute for present city lighting systems now in use.

One of the early uses for satellites will be for communication. Three satellites in position over the equator, with a speed to match the rotation of the earth can be used to give world wide broadcast coverage of television programs. Undoubtedly you have read how an Explorer satellite has carried a tape recorder capable of playing back in a few seconds all the data accumulated in more than an hour of travel around the world. [Dr. von Braun estimates that six larger satellites with such tape recorders could be placed in orbits to permit broadcast from major cities to these satellites for recording on tape, with the stored messages being triggered from the ground at another city for replay. These six would have the capacity to convey the entire overseas mail volume of the world.] Presumably either solar converters would supply the power needed for the communications devices, or one of our developing SNAP nuclear power units would do the trick.

Other witnesses looked forward to the day when freight and mail ballistic rockets will give long distance delivery in a matter of minutes. Even passenger delivery transatlantic in 30 minutes is possible, once engineering reliability has been achieved in our rockets. The Soviets long ago announced plans for rocket passenger ships between Moscow and Peking based on the ideas of Professor Tsien who used to teach at CalTech before he went to Red China. It would be premature for us to announce plans, but it is within the realm of possibility.

With the space sciences still so new, it would be foolish to try to anticipate all the things which may flow from these developments. One responsible major industrial firm in this country has proposed to our committee a plan for moving to Earth selected asteroids of alloy metals to meet a large part of the world demand for special steels at a cost which in time may be less than that of our present metallurgical methods. Who knows, too, whether the mysterious band of radiation around the earth which now poses a limited threat to manned satellites may not be turned to some practical use as a power source? Cryogenic research in space may bring tremendous advances in computers and in communication techniques. Where else could experimental conditions of cold, weightlessness, and high vacuum be obtained on the same scale for many types of experiments?

Every indication of past experience suggests that the real advantages of our space developments are not even foreseeable now. In the nuclear energy field, no one seriously considered that the nuisance byproducts in the form of isotopes would afford such savings to industry, agriculture, and medicine as to yield a capitalized return in excess of our total investment in nuclear energy, both military and civilian. Space may very well afford some of the same pleasant surprises.

As engineers, you are aware that these advances will not come automatically and easily. We will need more scientists, engineers, and technicians with the proper training to support the space effort. We will need to give the same kind of meticulous attention to engineering detail as was required for the nuclear submarine before we can translate scientific ideas into working engineering.

Our committee is especially concerned with the propulsion problem where now the Soviets seem to have a lead with their big boosters. American chemical know-how should be able to overcome the Soviet lead if it is used properly. Before the year is out we expect to sponsor a symposium on propulsion to act as a catalyst between scientific ideas and industrial application. Hydrocarbons and liquid oxygen will continue to play a major role in rocketry. When present development work on a million to a million and a half pound thrust engine is complete in five to ten years, we should be able to put up to 40,000 pounds into orbit, or land 10,000 pounds on the moon. These are estimates of the flight propulsion experts at the Lewis Laboratory at Cleveland, a part ofthe NASA. If we can develop newer fuels related to the boranes or incorporating hydrogen and fluorine, we may even be able to return 10,000 pounds from the moon. This means practical round trips with ships carrying several men.

Our committee is also interested in nuclear propulsion. Project Rover, the simplest of these schemes, involves enormous complexities. With the right effort, success is certainly possible. A nuclear reactor heating a hydrogen propellant should give several times as much weight-lifting capacity as the best chemical fuels, and could make possible manned flights to Mars which would be extremely costly if purely chemical means were used. The project looks promising enough to deserve support. The first working model reactor, called Kiwi because it can't fly, is to be tested in Nevada shortly.

Our committee has also been interested in more exotic forms of propulsion. These may be more years away but still will be important to any large scale interplanetary movement. Ion propulsion was demonstrated before the committee with a small working model. It will provide extremely high escape velocities for the cesium propellant, the metal most often proposed for such a device. The problem is one of creating a compact, light weight source of electricity to accelerate the cesium ions.

A number of plasma jet schemes are under discussion, too. Magnetohydrodynamics as a growing science has all kinds of space applications including solutions to reentry through electrical braking. One approach to propulsion which came up in our hearings seems quite remote, but we would favor continued study of it. This is photon propulsion. If we ever learn to make total conversion of matter into energy, a directed beam of photons might supply thrust over a sufficient period of time as to build up tremendous velocities. Photon power is the only approach which so far would seem to offer the prospect for manned flight beyond our solar system.

Many of our scientists believe that the challenges of travel to the nearby planets will offer sufficient field for some generations to come, and do not see much point to discussion of really long distance travel. At several points in our hearings, however, the concepts of such travel, and models of the universe were discussed by reputable scientists.

Following the principles of relativity which have stood up against experimental test successfully so far, some very amazing phenomena emerge. New perhaps some of you are more familiar than I am with the concepts, as my professional field is the law. However, let me repeat what our scientific witnesses agreed is our best understanding today of what high speed travel can mean. One of the constants in the universe is the speed of light. It is part of the equation between what we know as energy and what we know as matter. Light travels at a speed of 186,300 miles per second, and this is true whether its source is stationary or shows relative motion. The committee showed great interest in questioning selected witnesses about the consequences of maintained accelerations which would build up velocity close to that of light. No speed can exceed that of light. One member wanted to know, what would be the effect of throwing forward a baseball in empty space from a space ship just short of the speed of light. Would it leave the front of the ship and exceed the speed of light? We were told that since all motion is relative, and there would be no sensation of movement in such a space ship maintaining a constant speed just short of light, the baseball would appear to move forward with the same increment of velocity as it would here on earth as far as the space ship was concerned. After all, the earth itself travels at high speed around the sun, and our sun travels around in our galaxy, and our galaxy is moving away from other galaxies without discomforting us. But to a stationary observer, the baseball would not appear to exceed the speed of light. We postulate for a variety of reasons I could not explain here without help, that at the speed of light, any material object would have infinite mass. This is not the same as infinite size, but means infinite inertial resistance to movement. As a matter of fact, as one approaches the speed of light, to the stationary observer, the traveling object shrinks in its length, finally having no length at the speed of light.

Now what I think particularly intrigued us was the solemn assurance that such high speed travel would make time shrink for the occupants of the space ship, as compared with the stationary observer. For example, the nearest known star is Alpha Centauri which is about four light years away. This means that if we could build a space ship with photon power to travel there and back at close to the speed of light, it would take something over eight years for the round trip, not making the necessary allowance for acceleration and deceleration. Now this would be a pretty long voyage in terms of the people here at home waiting to see how the trip turned out. But to the crew, it might seem as if they had been gone only a few weeks, in terms of their cycles of eating, and sleeping, and how little they would age. Indeed, one calculation is that the estimated universe could be circled at that speed in an apparent lapsed time of 30 years, as far as the crew was concerned. Yet actually, billions of years would have passed, and the earth might not even exist at the time such a ship returned.

In a time of rapid scientific advance, it is hard to predict how soon the speculation of today will become the practical question of tomorrow. The hard work which must be done meanwhile will be concerned not with fuels alone, but with materials to stand high temperatures. And the super speeds of which I speak also raise questions of the density of scattered ions in space which at very high speeds might be the same kind of barrier that the atmosphere is to today's top speeds.

I think the discussions I have brought you on this occasion can be summarized as a message of hope and of faith in our country and in mankind. We stand at the edge of a new age. We have but to lift our eyes, to work to meet the challenge, and the destiny of our kind will be shaped by these great opportunies now before us.

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