# THE SPACE AGE SECOND DECADE

SPEECH BEFORE
THE CHAMBER OF COMMERCE,
BALTIMORE, MARYLAND

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AIA

KARL G. HARR, JR. assumed the presidency of the Aerospace Industries Association on April 1, 1963. A 1943 graduate of Princeton University (Phi Beta Kappa), Mr. Harr served three years as a special intelligence officer in the U.S. Army. Following his military service, he attended Yale Law School, from which he graduated in 1948. A Rhodes Scholar, he received his Doctorate from Oxford University in 1950. After fours years in legal practice, Mr. Harr saw extensive Government service with the Departments of State and Defense and, from 1958 to 1961, as a Special Assistant to the President of the United States.

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*The salient fact to keep in mind is not whether this nation can have its space program and the other things it needs as well, but rather how could we possibly have these other things unless we keep pushing ahead with that effort which is the pacesetter of our total technological advance — our cutting edge to the future — the vast technological reach into space.*

## THE SPACE AGE: SECOND DECADE

BY KARL G. HARR, JR.
*President, Aerospace Industries Association*

The subject of my remarks entails a certain risk. For I cannot give a precise space program for the 70s. At this point no one who really knows anything about it can honestly do so. And there is the risk that our future national effort in space will be weighed and evaluated in oversimplified terms of merely projecting from some of the more visible but superficial aspects of what space has involved during its first decade.

There is an all too natural human tendency with respect to a matter so complex, so new and so all encompassing as our national space effort, to think in such simple terms as the little old lady who said, "All Indians walk single file — or at least the one I saw did." Or to make the mistake of the boy who drowned trying to ford a stream he was assured averaged only 2½ feet in depth. Straight-line projections in this new dimension, whether as to cost, direction or significance, are totally misleading. They are comparable to a Motor Vehicle Bureau survey which revealed that in 1940 each car on the road contained an average of 3.2 persons; in 1950 occupancy had declined to 2.1 persons per car and by 1960 the average was down to 1.4 persons. Pursuing this trend to 1980, it proves that every third car going by will have nobody in it.

The reasons for this insusceptibility to such statistical projections are not mysterious, but they are manifold. It is not merely that we are entering such a strange and unknown medium for which our ultimate capabilities are yet to be determined. It is not merely that the international competitive aspects of our national program, by definition, accord a measure of initiative to others. Nor is it

solely because we have not yet as a nation firmly established the relative priority of this effort in terms of other national priorities. It is for all these reasons and many more. But it is also, and perhaps primarily, for the reason that so complex, huge and different an effort, involving so much of our best industrial, economic, scientific and intellectual resources, organized to an unprecedented degree in a common technological reach, has an impact on every aspect of our national life. This impact in turn necessarily becomes part of our national decisions and capabilities in the future of space.

Reviewing what we have done, are planning to do and can do, it is this latter point that I wish most to stress, for I believe this interrelationship between space and our society as a whole truly to be far and away the most significant aspect of our national space effort.

Today we find ourselves both in midstream in our national space effort and at a crossroads as to future efforts. It is essential that we delay no longer in sorting out that which is valid and enduring from that which is superficial or transitory.

## SIGNIFICANT ACCOMPLISHMENTS

As a starting point let's try to appreciate the enormity and significance of what has already been accomplished. The miraculous so quickly becomes commonplace that the true dimensions of these achievements can only be appreciated if we can take our minds back those very few years to the time when space was a word used primarily to describe advertising.

A few days ago someone showed me a ten-year-old article from a national magazine which was published in the first hectic days following the launching of Sputnik I.

The magazine had polled leading aerospace scientists and engineers as to the future of

space flight with the following results.

A consensus of these experts predicted that man could expect to venture into earth orbit by 1970 and that a manned expedition to the moon might be possible by 1990.

Actually, of course, man was launched into space only a little more than three years after publication of the article and today, still two years ahead of the then predicted timetable for the *first* manned space flight, there have been 25 such flights, half of them multi-manned missions. Man has already accumulated more than 2,500 hours of actual space experience and has flown more than 43 million miles in space.

### SPACE HIGHLIGHTS

As for man landing on the moon, whatever the Soviet timetable, America will beat the prediction by more than 20 years.

In terms of American programs alone, mention of just a few of the highlights will illustrate the scope and magnitude of man's achievements and progress in space:

- Pioneered and produced operational systems for global navigation, communications and weather reporting.
- Initiated a program to survey, inventory and better control and manage the earth's resources.
- Sent a series of vehicles to crash-land, soft-land and orbit the moon, a program which produced tens of thousands of lunar photographs and more scientific knowledge of the earth's satellite than man had accumulated in all prior years.
- Initiated a program of planetary probes in which we already have launched complex, data-reporting spacecraft to the vicinities of Venus and Mars.
- Conducted 16 manned space missions, about twice as many as Russia, accumulating in the process almost 2,000 hours of manned

space experience or nearly 80 per cent of the world's total experience.

- Proven that man can survive in the space environment, and that he can work there.
- Conducted space rendezvous and docking at speeds of 17,500 miles per hour.
- Put into earth orbit a payload of 250,000 pounds, compared to Explorer I's payload — our first in orbit — of *30* pounds.
- Constructed and successfully tested the Apollo Command Module at a reentry speed of 25,000 miles per hour and through heat of 4,500 degrees Fahrenheit.

MEANING OF ACHIEVEMENTS

Now what do these achievements to date really mean?

They mean infinitely superior communication, navigation and weather prognostication systems.

They mean quantum jumps in our scientific knowledge about the universe.

They mean jobs by the hundreds of thousands involving new cities and towns.

They mean new industrial techniques and procedures resulting in better ways of doing things and better consumer end products.

They mean inspiration from children all the way to graduate students both here and abroad.

They mean insurance against the possibility that space can be used against us militarily.

They mean that America not only has the capacity but the will to accept the greatest challenge offered mankind and has made the decision to go forward as a growing, dynamic society rather than to get off the mainstream of history.

They have meanings all the way from better razor blades and TV circuitry to the most fundamental national decisions as to the scope of our future.

Little wonder Dr. Willard F. Libby, distin-

guished professor of chemistry at UCLA, recently said: "We have seen enough already to know that this program is one of the best bargains the American people have ever made. We have seen enough to know that the returns in all the walks of life, but particularly in science, are very great indeed."

EUROPEAN REPORT

Another interesting appraisal of the impact of the U. S. and Russian space programs was contained in a recent report by European space companies. Their conclusion was that the techniques developed were of greatest significance and that these techniques, particularly those affecting reliability and automation, had profoundly affected the whole of the engineering industries. To document that conclusion they listed significant developments in:

- Biology and medicine
- Electrical engineering
- Electronic components
- Instrumentation and controls
- Communications
- Power sources
- Structural and mechanical engineering (particularly stress measurement and fail safe devices)
- Bearings
- Servo-mechanisms
- Metallic and non-metallic materials
- Finishes
- Matching techniques
- Vacuum engineering, and
- Chemical and electronic propellants

A noted European finance minister somewhat wistfully estimated that every dollar America invested in its space program 10 years ago is returning four dollars worth of value today.

Dr. Simon Ramo, Vice Chairman of the Board, TRW, Inc., discussing the applications of our capabilities to our way of life, put it

this way: "We have it within our power of choice to so exploit what we have learned about space technology as to produce values for our society in the 70s substantially greater than the entire space program will have cost us in the 60s."

My point simply is that even at this very early and preliminary stage in man's most exciting adventure the return can be quantified in terms which show it to be well in the black. And in terms of return we are just on the threshold of realizing the full beneficial impact here on earth.

### THE NEXT DECADE

So let us now look at the second decade that lies before us, a decade for which we have laid the base and established the capability, a decade in which man will for the first time look at earth with his feet planted on luna firma, and look out at the universe with a clear and untrammeled view. While no one can tell you exactly what the specific programs will be throughout this decade, we can say with confidence that the second decade of the Space Age will produce two things: The pace of change sparked by our space program will move into high gear. The pervasive beneficial effect of our space effort throughout our national life will move into full flow.

In the next decade we will undoubtedly see the following:

- Manned exploration of the moon with missions of thirty days' duration and the establishment of one or more bases there, probably international in nature.
- Manned orbital space stations of a year's duration to which new personnel and supplies will be transported periodically. They will contain as many as five laboratories capable of conducting studies and experiments in virtually all the scientific disciplines. A typical example will be the Apollo telescope mount

which will provide a capability in astronomy many times greater than the best of our earth-bound observatories.

- An accelerated program of unmanned probes throughout the solar system with special emphasis on Mars and Venus. We will launch our first planetary probes to Mercury and Jupiter, and send probes to explore the vast void outside the ecliptic.
- We will develop lifting bodies and winged spacecraft launched by means of recoverable and reusable launch vehicles with landings as well as takeoffs from spaceports. In effect, we will see the marriage of astronautics and aeronautics.
- We will develop an operational space rescue capability for astronauts and the ability to repair spacecraft in orbit.
- Tremendous advances will be made in our meteorological, navigational, and communications satellite systems resulting in such developments as direct broadcast of both TV and voice to home receivers, and providing us with a limited but ever increasing ability to control the weather as well as accurately forecast it.
- The Earth Resources Observation Satellite program will provide us with a new and real degree of ability to improve harvests, prevent crop diseases, attack air and water pollution, inventory our agricultural, mineral and marine resources and control floods. This program alone would justify all that the space effort is costing.
- The development of nuclear propulsion systems, as well as the refinement of our present chemical power plants, will provide us with much greater flexibility and capability. For example, we will be able to put into earth orbit a million pound payload compared to our current capability of 250,000 pounds.
- Moving into more difficult areas we might

adopt a program involving gradually extended earth orbital operations with manned spacecraft, building on our existing technology toward the large "permanent" space station supplied by earth-to-orbit ferry craft. Or we could gradually extend "stay-time" on the moon toward the construction of a manned lunar base.

■ At the far end of the spectrum, as currently envisioned, is the manned expedition to a nearby planet, most likely Mars, the celestial body least hostile to human exploration. Such a mission is deemed feasible in the decade of the 80s, probably about 15 years after the initial lunar landing. Of course we do not have the technology today for such a venture; but we can now confidently calculate that we can build such capability within that time span.

This is only a brief survey of what has happened in the first space decade and what will happen in the second, together with some of their implications.

COMMITMENT TO CHALLENGE

But that is only the top of the iceberg. The real significance lies in the fact that beginning with America's decision to commit itself to this vast new challenge, a door opened on our future unlike anything since we opted out from under George III.

In the late 50s and early 60s by accepting the space challenge, we chose, as a nation, to advance on all fronts instead of choosing to call a halt to our progress. And we are already seeing, in these 10 short years since our standing start, the fruits of this choice.

In a large segment of American industry we have seen an industrial revolution and the effects of that revolution are permeating more and more of our total economy.

The same is true in our natural sciences where we are acquiring new knowledge at a

rate unprecedented in man's history, not just about the universe, its construction, composition and genesis (about which we have at least doubled our knowledge in these few short years) but about virtually all scientific questions that have faced us through the ages.

The same is true of education, in terms of technique, stimulus and demand.

It is true of technology — where man has had to invent or develop capabilities sufficient to conquer the cruelest and most complex absolute technological challenges he has ever faced.

It is true of management techniques, both private and governmental — where we have had to cope with management systems problems of totally unprecedented scope and complexity.

### NATIONAL EFFECTS

One can already make a case that our national space effort has sparked, influenced or affected virtually every aspect of our national economic, political and social life toward a more dynamic, secure and prosperous future.

It is as though, starting from the moment of our commitment, one visualizes two lines forming an ever widening "V" into the future. Through the center runs our space effort — the greatest organized technological reach in history engaging the best governmental, intellectual and industrial talents — and on each side, as this advance is pushed, are the ever spreading areas simulated, prodded, educated and otherwise brought along by this central advance.

Maybe we in industry see these effects most tangibly. We will certainly never be the same again. Our notions of tolerances, standards, reliability requirements — our techniques for research, for production, for management have advanced by orders of magnitude. We can do things on a thousand fronts today that

were only dreams a decade ago; and we are willing to undertake jobs of a complexity and degree of difficulty that would have been deemed far beyond our threshold of risk in the earlier pre-Space Age.

What does all this mean to you as businessmen or, as it is more commonly put, to the man in the street?

Well, benefitting the man in the street is what it's all about.

Technological advance is not only a principal key to over-all national welfare and security, to which each individual's destiny is linked, it is also a key to the individual's opportunity within his society.

## TECHNOLOGICAL REACH

Most of the important identifiable problems that lie before our nation are going to be solved primarily through organized technological reach of a high order. Such a list certainly includes air and water pollution control, solving the multiple problems arising from increasing urban congestion, providing adequate transportation systems for a rapidly growing population, insuring adequate food and water supply and distribution systems and even providing the housing and school systems which our burgeoning population will demand.

The simple listing of specifics does not convey the true significance to us of technological advance. The fact is that the security, well being and prosperity of our nation have always depended in major part on technological advance, and the dependence will increase as we move into the dangerous, crowded, fast moving future. After all we comprise but a tiny percentage of the world's population, and we seek not only to maintain the world's highest standard of living, but we seek to do so as free men living under free institutions. Constant technological advance is the key to

achieving such national goals.

It certainly represents the best and truest hope for the poor man to improve his lot. There is merit to the ancient Chinese proverb which says, "If you give a man rice you feed his hunger, but if you teach him how to grow it you solve the problem of famine." Only through constantly advancing technology will the solutions be found in this rapidly growing nation not only to provide him minimum essentials, but also to afford him a means to participate.

We have seen already his betterment in tangible ways as a result of our space effort to date and we have only enjoyed the early fruits of the building, preparatory, developing phase.

The healthy trickle of such benefits is just now turning into a flow as the impact of our over-all national upgrading to excellence begins to have its effect fully felt — in science, in industry, in education and elsewhere.

To repeat: What will happen in the second decade of space?

### IMPACT OF TECHNOLOGY

We will see the realization of the programs and developments I outlined earlier. But far more importantly, we will see the total beneficial impact, collectively and individually, of a widespread capability to do things that we could never have done had we not risen to this mammoth and inspiring national challenge.

The salient fact to keep in mind is not whether this nation can have its space program and the other things it needs as well, but rather how could we possibly have these other things unless we keep pushing ahead with that effort which is the pacesetter of our total technological advance — our cutting edge to the future — the vast technological reach into space.

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