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The Future of Space Travel

Anyone who discusses "The Future of Space Travel," as I shall attempt to do this evening, assumes the role of a prophet. This position is filled with danger for, sooner or later, events will test the validity of the forecast.

There is no safety in removing your prophecy to the distant future. Advances in science and technology, and changes in our economic and social life, are coming at a violent, pell-mell pace. Events safely forecast by a would-be seer to occur long after his death, may happen -- or fail to occur -- within his lifetime, causing him to live daily with the accuracy of his forecast.

In this respect, how would you like to be a weatherman?

History tells us that prophets have erred most often on the side of negative conservatism.

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For instance, in 1844 Henry L. Ellsworth, who was the U. S. Commissioner of Patents, made this statement about inventions: "The advancement of the arts from year to year taxes our credulity and seems to presage the arrival of that period when further improvement must end."

And in 1908 Professor William H. Pickering of the Harvard College Observatory, despite his brilliance in astronomy, could not foresee the potential of the airplane. He said: "The popular mind often pictures gigantic flying machines speeding across the Atlantic carrying passengers in a way analogous to our modern steamships. It seems safe to say that such ideas must be wholly visionary. Another popular fallacy is to expect enormous speeds to be obtained. Another popular fallacy is to suppose that the flying machine could be used to drop dynamite on an enemy in time of war."

Far more visionary was the prediction of future space travel made by Jules Verne in his famous book, "From the Earth to the Moon," published in 1865. Forty years before the flight of the Wright Brothers' fragile plane at Kitty Hawk, Jules Verne described a journey in a spacecraft by three men (and two dogs), launched from the coast of Florida to circle the moon, and return to earth after a round trip of 11 days.

Jules Verne also said, "Anything that one man can imagine, other men can make real."

As you know, the National Aeronautics and Space Administration is changing Jules Verne's fantasy to fact in Project Apollo, the U. S. Manned Lunar Landing Program. There is a great deal of similarity in his account and the journey that will actually take place before the end of this decade -- in less than 39 months. We are not sending two dogs along, however, and two of our astronauts will do more than circle the moon. They will land on it and explore its surface for about 18 hours before returning to earth.

Jules Verne used a huge cannon buried in the sand to boost his spacecraft to escape velocity for its space voyage. The three-man Apollo spacecraft will be started on its journey to the moon by the huge three-man Saturn V launch vehicle being developed by the Marshall Space Flight Center and its contractors. All stages of the Saturn V have been static tested on the ground many times. Its F-1 and J-2 engines were certified last month as ready for manned space flight, and the first complete Saturn V is at NASA's Kennedy Space Center now undergoing preparations for an unmanned launch in the first quarter of 1967.

Scheduled for use initially in Project Apollo, the Saturn vehicles provide a space launch capability that will make them the workhorses of NASA's space program for a long time to come. The Saturn V will place a quarter of a million pounds of payload into earth orbit, or send almost 50 tons to the moon.

After we have landed men on the moon and returned them safely to earth, there are a number of options we can exercise to exploit the capability that has been developed. We will extend our reach into space, in both the manned and unmanned programs.

The moon is a big place -- larger than the continents of North and South America combined. It will take some time to explore its surface thoroughly. We will have the capability to extend our stay time on the moon, build a base camp, or even semi-permanent and ultimately permanent bases there, shuttling astronauts and scientists back and forth on a routine basis from earth to the moon on the Antartica pattern.

One of the key laboratory facilities on the moon could be an astronomical observatory where scientists using several large telescopes would study the heavens unhindered by the blur and distortion caused by the earth's atmosphere.

Lunar jeeps or larger ground vehicles could be designed for exploring the lunar surface locally, while small rocket-powered craft could be used for travel between bases.

Manned flybys of Venus and Mars could be accomplished in the late 1970's with a crew of three men, based on the Project Apollo technology. A probe could be sent down to the surface of Mars during the flyby, and a sample recovered. And a manned landing expedition could be sent to the Red Planet by 1985, establishing beyond a doubt the intriguing mystery of the significance of the seasonal changes on the Martian surface, and revealing much new information about our nearest planetary neighbor.

Studies are now underway for increasing the capabilities of the Saturn I and the Saturn V launch vehicles by uprating the thrust of the engines, adding strap-on solid propellant boosters, and other techniques. These advances would enable the Saturn V to place almost half a million pounds into earth orbit on a single launch.

Serious planetary exploration, however, and even extensive exploration of the moon, would be more efficient with the use of nuclear powered stages.

This is the next major step in propulsion technology. The 86,000-pound thrust nuclear Nerva 1 engine developed jointly by NASA and the Atomic Energy Commission has made a number of highly successful runs. We can make manned Venus and Mars flybys with the all-chemical Saturn V, although a nuclear stage for these missions would be the logical choice if we want to follow up on these flybys with manned landings. A manned Mars landing mission would definitely require nuclear propulsion, probably a cluster of stages powered by Nerva 2 engines, which develop 200,000 pounds of thrust.

The joint Atomic Energy Commission-NASA project is also trying to develop a reactor for space travel that will be small enough to fit inside a Volkswagen bus, yet powerful enough to produce twice the power of the Beauharnois hydroelectric generating plant.

Nuclear power will make it possible in due time to colonize the moon and the planets. Before the end of the next decade nuclear reactors could be flown to the moon to heat and cool small lunar bases, help produce synthetic food, and possibly draw water from rocks.

The exploration of deep space will yield returns in scientific knowledge that will be priceless, but we must not overlook the bread and butter utilization of our newly-acquired space technology in the near-earth region.

Use of the space near earth is already yielding practical dividends, and holds the promise of global participation.

All of you are familiar with the success of NASA's early communications satellites, and the operation of the commercial Communications Satellite Corporation. Through these satellites U. S. audiences have witnessed events ranging from the funeral of Sir Winston Churchill, to religious activities in Rome, the Olympic games in Japan, to the recovery of Gemini astronauts from the Atlantic Ocean.

The demonstrated possibilities of this newest method of linking the peoples of the world together has led the Ford Foundation to propose that a satellite communication system for both commercial and non-commercial television be established, with as many as 25 satellites in synchronous, equatorial orbits that would cover the entire globe. The Ford Foundation said the system could be established by mid-1968, and could be operated at a cost of $20 million -- against an estimated $200 million for the same coverage through ground systems. I understand that the American Telephone and Telegraph Company is not in complete agreement with the Ford Foundation on its 10-to-1 cost savings estimate.

Nevertheless, the proposal has created a great deal of interest, and we in this room shall see this idea, too, transformed from fantasy to fact in the near future. Based on the superb performance of Tiros and Nimbus satellites, the future for meteorological satellites now seems unlimited. Nimbus II can photograph cloud cover at day or night, and relay the pictures to 150 ground stations, including 44 receivers in 26 foreign countries. By 1969 the U.S. Environmental Science Services Administration hopes to launch weather satellites into synchronous orbits -- 22,300 miles high, like the communications satellites -- where they will constantly monitor the same area of the earth. By studying weather patterns, and measuring the albedo, or heat balance, by calculating the percentage of the sun's radiation absorbed by the earth, and the amount reflected into the atmosphere, scientists hope to unlock some of the mysteries about the weather. Long-range weather forecasts would then be possible for any spot on earth. The savings to agriculture, forestry, shipping, and commerce would total billions of dollars. And it would retire all those shopworn jokes about the weatherman's erroneous predictions.

The biggest bonanza from the utilization of space near earth will come from satellites that will constantly inventory the earth's resources and its population. The world population is doubling at a frightening rate.

Famines are commonplace in several countries today, such as India, and the situation is worsening. If the present trends are not reversed, within the next century there will be so many hungry mouths on earth to be fed, that the daily activities of the greater part of mankind could be reduced to a sheer struggle for survival.

The U. S. Department of Agriculture is already putting space technology to work to help underdeveloped countries step up lagging food production and to develop their natural resources.

Under a Department of Agriculture-NASA contract signed this year, remote sensing equipment will be used to make quick large-area surveys of land use; to detect calamitous situations, such as plant diseases, insect infestations, and drought; to assess crop stands and vigor and to predict future yields; and to determine whether soils in specific locations are suitable for growing certain needed crops.

We believe that the satellite will offer a unique opportunity in this area. The U. S. Department of Agriculture already maps every acre of cropland in the country annually. This survey could be completed much more quickly by satellite, and it would be a continuous survey instead of a single flyover. Every acre of land planted to wheat, rye, corn, cotton, or rice could be measured, not only in the United States, but in every country in the world.

And the satellites would do more than measure the acreage. They would reveal whether the crops had enough water, or were inadequately fertilized. Black stain rust, one of the most damaging of crop diseases, is difficult to detect in its early stages. Remote sensors can spot the rust several days earlier than a man walking through the fields.

The U. S. Department of Interior is also working with NASA on plans for an Earth Resources Observation Satellite, using aerial photography, and such remote sensing devices as radar, infrared and ultra-violent scanners, infrared spectrometers, magnetometers, and passive-microwave devices. In addition to geological surveys, the satellites would be useful in the areas of cartography, hydrology, geography, oceanography, and fish and wild-life management.

Trees afflicted with certain diseases can be easily spotted from a satellite. This would be a tremendous boon to the forestry industry in Canada, for observers could keep constant watch over millions of acres of woodsland, and see how the pattern of diseased trees is spreading. Infrared techniques can detect some of these diseases much earlier than a forest ranger who is walking through the woods. And if that ranger were walking in the area where we were moose hunting this week, the trees would be dead before he got back to civilization.

These earth satellites may also predict volcanic eruptions and earthquakes, and locate underground streams of water to offset the growing consumption of surface water. These underground streams hold many times more water than all known surface rivers. They can also predict the melting of snow for better management of lake and reservoir levels, and observe the presence of plankton which feed the fish in our oceans. The world's fishing fleets could then be directed to the best spots for catches that would help feed hungry mouths throughout the world.

One could raise the question, "Why go into orbit to do all this? why not use airplanes?" Now if you have a static problem, like locating minerals or oil deposits, you could survey a certain area by plane, gather your information, and it would be valid for all eternity unless someone goes in and opens up the area. This is not the case with crops, forests, rainfall, river pollution, erosion, plant diseases, or population growth. The picture is changing daily, and you must keep producing data.

If you put your observation satellite or space station into a polar orbit, it will cut a different swath over the earth each orbit, and you can make a fresh, new survey of the entire globe every day. And the longer the satellite stays up, the more mileage you are getting from your expensive launch. It beats a Volkswagen for miles to the gallon.

To be meaningful, the mass of data that you gather every day must be fed into computers, analyzed, and evaluated. The same system that gives you the information on earth's resources also shows you where the population increases are located. To get the two together will require a resources management system on a world-wide basis. An efficient system would obviously require the cooperation of all nations on a more understanding basis than we have witnessed heretofore. But we have the need to be met, and the tools and technology for the solution. An international airlines system has been established, in spite of the difficulties of national boundaries and customs. This is one area in which practically everyone in the world has something to gain, and nobody can lose. I believe that we can apply the solution that we have in hand.

Canada and the United States have set an example in the area of international cooperation in space. Two Canadian-built Alouette spacecraft for ionospheric studies have scored perfect successes, the first in 1962 and the most recent in November of 1965.

The Alouettes were launched by NASA but designed, funded, and engineered by the Canadian Telecommunications Establishment. The Alouettes were the first satellites to sound the ionosphere from above and proved so successful that the Canadian government then offered to assume full responsibility for a larger portion of the NASA program for ionospheric studies.

Out of this Canadian offer has evolved the ISIS program, International Satellites for Ionospheric Studies. Under the program, NASA will launch four additional Canadian Satellites to monitor the ionosphere through the next maximum of the solar cycle.

The extensive program of the United States for international cooperation in space has touched about 70 nations. Outer space, by its very nature, demands that all peoples of the earth work together. Only through worldwide cooperation can we make a meaningful use of our space ability.

I have always had wonder and respect for the peaceful and unguarded border between our two nations. I know that all Canadians share with us in the exploration of the new frontier of space. The people in the United States are beginning to realize that this space challenge is not just a temporary program intended to bolster our national prestige in technological know-how.

The motives behind our effort in space are -- and always will be -- pointed toward the advancement of all mankind. It is encouraging to note throughout the world that the space program is considered less and less as a race to the moon, and accepted more and more on the basis of the needs of humanity.

President Johnson has stated our case in clear and uncertain terms. The president has said:

"We expect to explore the moon, not just visit it or photograph it. We plan to explore and chart planets as well. We shall expand our earth laboratories into space laboratories and extend our national strength into the space dimension. We are determined that space shall be an avenue toward peace and we both invite and welcome all men to join with us in this great opportunity."

Just recently Congressman George P. Miller of California, chairman of the Space Committee in the House of Representatives, predicted that the U.S. space program would continue at the five-billion-dollar level "for some time to come." The congressman said he feels that the Space Act was "the most important legislation to be passed by the Congress in the last 20 years" and spoke of the powerful stimulus the space program has given to the scientific community.

He noted that the space program is an investment in people, not in hardware. He said that the people have accepted a new challenge as a constant source of motivation for our culture. The space program, he said, is only now "emerging from its infancy" to maturity.

The space program is a challenge for all people, for Americans, Europeans, Australians, Africans, and Asians. The new space dimension which permits our astronauts to view and photograph from their lofty heights entire continents demands that all people on this globe must take a greater interest in what they have in common than what sets them apart. The new perspective which space flight has given us demands that we must begin together the practical job of solving worldwide problems. As true men of the world, as loyal citizens of that blue planet called earth, we must then go on and probe more deeply into our mysterious and exciting extraterrestrial future. I firmly believe that man's destiny is in space.

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