

SPACE: AN ECONOMIC FRONTIER FOR ALL PEOPLE.

Remarks by Dr. Klaus P. Heiss, Founder, ECON, Inc.

Opening Session of the International Astronautics Federation

Innsbruck, October 6, 1986

The theme of this year's IAF Congress, Space for All People, indeed is challenging and promising at the same time. The most advanced industrial nations are currently encountering serious difficulties in assuring the very access to Space, something taken for granted for so long, even forgotten by some as an issue. The problems of the United States are well known. The problems of the European launcher family are known as well. Quite recently two major missile launch failures were reported to have occurred in the Soviet Union, one military missile allegedly hitting Chinese territory by mistake. This was later denied. Even if the current difficulties are overcome, the access to Space will remain an expensive proposition for some time to come.

Despite these difficulties, however, Space holds tremendous promise for mankind: in these remarks I will attempt to briefly outline the basic economic promises of Space, the overriding importance of these to developing countries, and elaborate why these promises to date and in the future can only be achieved with the establishment of free market principles for Space activities. It is the theme of this paper, that Space indeed is meant to be there for all people, not just governments and bureaucratic monopolies, which to-date have denied such access to private enterprise and, thereby, to developing nations.

I. ON SPACE COMMERCIALIZATION.

First, some brief remarks on 'Space Commercialization': let there be no misunderstanding on this issue. If governments had allowed the ventures in Space transportation to go forward as proposed by the private sector in the late 70s and early 1980s the United States would have today

(1) a brand new orbiter rolled out in June of 1986, Orbiter V that we now scramble to finance. This orbiter would have been paid for entirely by private funds, with simple and fair conditions as to its uses. This orbiter would have been built for about \$1 billion, with a 'buy-back' right by the government in case of emergency government uses of the orbiter - for \$1.5 billion.

The discussion today would be about the 'exorbitant excess profits' made by the private sector and the \$500 million in windfall profits; allegations would be made that the private sector 'stole the Washington monument' etc. Instead the situation today is that taxpayers will be 'robbed' of about \$3 billion for the same orbiter, which orbiter will not be available for flight before 1991 or 1992. This is economics lesson number one, as to what the private sector could have done, indeed had arranged to do, if only the government had allowed the private sector to proceed. I do not want to hear again that the private sector was not courageous, had not proposed this in the interests of the United States, or that the private sector was not proposing to take enough risk, or that it proposed too much of a return to its investment: these are the reasons given by government when it turned down the private funding of Orbiter V in 1983! The only fair share the government should ask of the private sector in Space and on Earth is the tax on profits made. That is the fair share of government, nothing else.

(2) We also would have today four Titan 34 Ds financed by the private sector, coming out at a rate of four a year, at roughly half the cost of what the government has to contract for today for the same vehicles, because of restart costs and loss of production continuity. That is economic lesson number two in Space transportation.

Instead we are stuck now here on the ground, not because of a failure of private enterprise, but because the government resisted and did not allow the private sector to proceed in Space transportation.

II. POSITIVE ACHIEVEMENTS OF SPACE TO-DATE.

The achievements in Space enterprise to-date are several, very

significant contributions to the well being of all of us. Among the contributions I would list

(1) The 'Global Awareness' that we have today. Probably the single most important economic - and other - contribution Space has made is the image of the Earth rising above the moon. This has driven one message home: Earth is an extremely vulnerable "soap bubble" ready to "burst" at any moment. The fact that today indeed we have global discussions on the environment, the economies, on information, on military and national security issues, and in many other areas, I attribute foremost to that one image taken on the moon by man. What to us economists was but an abstract notion - the worldwide interdependence of economic systems in open world trade - was shown here in one simple picture. That one image to me, an economist, justifies the Space program and all the costs we sank into it to-date, and in years to come.

(2) The second major benefit of the Space program has been the stability brought about in international strategic relations, thanks to information gathered independently from Space by the major powers. I do not want to rewrite or reinvent history - others are much better at that. But the outbreak of wars, global wars, strategic wars in this century, can be attributed first and foremost to a lack of information, the uncertainty as to the intentions of the major adversaries, e.g. before World War I. The likelihood of any large scale, major strategic conflict for the rest of this century I claim is zero. The reason for this is Space and the information it provides: independent, verifiable information. That has been, and will continue to be the second largest benefit of Space for the United States and for mankind.

(3) Ranked third in terms of significance of benefits from Space activities are global communications. The world today is so radically different from the world of the 1950s because of instant, global Space communications: While other means of communications now exist, the fact that today we are a worldwide, instant information society is due largely to Space communications, and the commercial approach to Space communications at that. It is the only area where we chose the commercial route, with the creation of Comsat in 1962 and later Intelsat. Even the Soviet Union has now applied for membership

in this most commercial of all international organizations.

The benefits of Space communications are "radical", widespread, and taken for granted today. But they are there nevertheless. I do not want to quantify these benefits for the moment. Others have done that, and I have done so elsewhere.

III. CONSTRAINTS TO EXPANDED SPACE ACTIVITIES.

Yet, despite these vast benefits of Space today we are grounded, thanks to government failures and inactions. We cannot launch; if we had operational launch vehicles, we cannot get insurance; if we could get launchers and insurance, we cannot pursue Space observations, because of the 1984 Landsat Remote Sensing 'Commercialization Act', which disallows private property rights to original Space data, even if privately funded (Title 4 of that act). There is no there there.

And finally, if we did reach the Moon again, or any other celestial body, we could not take possession of the resources there, so why go to the Moon and beyond under the UN Outer Space Treaty?

From this I conclude that serious constraints have been imposed on the commercial and beneficial uses of Space and private enterprise. These constraints have to be removed. I will come back to these basic principles later.

In addition to these statutory and bureaucratic constraints, there are other, real economic constraints - i.e. costs - that hinder the full development of Space. These are:

(1) Transportation Costs. Space transportation costs are real, and they are high. The vision in the early 1970s of a fully reusable Space transportation system is still there to be fulfilled. Today we only have a partially reusable Space shuttle, once it is allowed to operate again. We never developed a reusable upper stage as recommended in 1972. We do not have a fully operational space transportation system. A Shuttle launch today still is an individually engineered, handcrafted event. We have to get from here to where we thought we would be getting in the early 1970s to achieve a low-cost, reusable space transportation capability.

Radical advances may be possible in Space transportation, indeed are needed in the decades ahead, possibly based on some of the technology breakthroughs and advances envisioned in kinetic and directed energy technologies envisioned by the Strategic Defense Initiative. Laser propulsion may at some time in the future allow ISPs of 2000 or more and thereby bring about radically lower Space transportation costs. In the meantime, gravity does exist and we can not wish it away. Transportation costs will put a severe limit on Space enterprise - and on how far we ever will go in Space for economic benefits on Earth.

(2) Interest. Just as physicists cannot do away with gravity, economists can not do away with the cost of time - interest. This cost of time - or the cost of the use of capital - is a truly

universal cost inherent to any civilization, wherever that civilization may be. While there may come the day of "anti-gravity" technologies speculated about in science fiction and advanced courses in theoretical physics, the cost of capital is an immutable fact - similar to the second law of thermodynamics. Any civilization has interest costs - there is a cost to time. The more innovative a civilization, the higher this cost. Interest is the "economic gravity well" out of which there is no escape, and which will limit very far flung uses of resources even within our solar system, and certainly beyond that. For example, going to Mars and back over a three year period in a \$1 billion spacecraft with three astronauts will impose an interest cost of about \$300 million, or \$100 million per astronaut. This cost exists, whether it is explicitly paid for or whether it is born by taxpayers. One cannot do away with this cost, even if anti-gravity machines existed. As long as it takes time to go from here to there and back, interest costs exists and are a serious obstacle to the economic uses of resources that travel at less than the speed of light. (Two such commodities exist - information and solar energy - and these are discussed below).

(3) Demand. Demand is a "constraint" to the uses of Space resources on Earth. What I mean by that is that the Earth is abundant in most mineral resources. If we had today, say, a huge asteroid of pure platinum to be landed at Edwards Air Force Base, it certainly is not likely to have paid for the

costs of the mission to capture and recover such an asteroid: the first, and probably only, thing that would happen is that the prospect of a successful landing of such a massive asteroid would lead to a total collapse of the platinum prize on the Chicago Commodities Exchange, down to about zero. The economics of the uses of lunar or other celestial mineral resources is seriously limited, even at zero transportation cost: demand for most commodities is at most "unit elastic", meaning that one spends about the same budget on that commodity, irrespective of price. That is true for wheat, for food crops, and it is also true for mineral resources. The `Club of Rome` of the 1960s was wrong, the market was right. The world today is overabundant in resources. Anybody who doubts that should call the Chicago Commodities Exchange and ask what happened to the prices of resources - wheat, barley, oil, energy since the 1970s. To add abundance to abundance makes little sense.

IV. ECONOMIC BENEFITS OF SPACE ACTIVITIES.

Given these serious constraints - and real costs - to Space enterprise, there are nevertheless also important, very basic benefits to such enterprise which amply justify our Space activities. Among the basic benefits I would list

(1) The Survival of Man. As mentioned earlier, the images of Earth from Space, and of the inner and outer solar system, have shown that the solar system is an extremely violent place. Sitting on this "soap bubble" Earth, mankind has a duty to get off Earth and learn how to live and sustain itself outside this Earth. I call this the true "Project Independence", or project survival. Mankind has to pursue manned Space flight. It is a historical, existentialist duty of our generation, and those to come. This exploration will take place with or without the United States. If we do not pursue manned Space exploration the Russians will, and the Japanese, and the Chinese, and of course the Europeans. We have no choice, even if we wanted to. But the United States will go out there again, and the reason for that is survival, ours and mankind's.

Related to survival and the need to go into Space is another factor: today, for the first time the world is "closed", i.e. the known Earth is a closed world for the first time in history. Columbus set out for the unknown. Others set out for

the unknown, some as recently as the early part of this century. Even in the 1950s the atlases of the world contained "white spots" of unknown, unexplored territories. These spots have disappeared today, there are no "white spots" of unknown territories left on Earth today. I believe it is impossible for mankind to live in such a closed world for long - a zero sum world. We have to have open frontiers, the challenge of the unknown, which means we have to go into Space. These are not abstract notions; these are real, indeed the primary reasons for going into Space. The Space Station may not make much economic sense otherwise, but manned Space exploration is reason enough for this pursuit.

(2) The High Ground of National Security. For the past 25 years Space already has made significant contributions to the stability of strategic relations (see above). More importantly, we now do have the President's Strategic Defense Initiative (SDI), which holds the promise to liberate the United States and mankind from the unhealthy current situation of mutually assured destruction (MAD). MAD is a new, unhealthy condition of mankind. The moral equivalence it implies - in Europe and elsewhere - between the Soviet Union and the United States is obnoxious, to say the least. We have to get away from this confrontation, this nightmare, the currently very unstable "stability". SDI holds that promise. This indeed is a benefit of Space, and let us call SDI that.

Now, beyond these basic benefits, possibly transcendental benefits to some, let me come to the more immediate, pecuniary, economic paybacks we may expect from Space in the decades to come. Given the above real constraints - leaving the issues of principles aside, these are transportation costs and the cost of time - there will be two major benefit areas from Space activities: information and energy. Both commodities can be transmitted at low added cost and essentially at the speed of light. Both commodities meet the principle cost obstacles to the uses of Space just listed.

(3) The Information Economy. The payback from Space in the next decades will not be from Space processing or from natural resource uses of Space on Earth as envisioned by some. The high cost of transport of these massive commodities alone will prevent such large scale uses. The one immediate area that has

and will `pay back` in multiples is Space based information-communications, remote sensing, worldwide data bases and information management. Today's economies are information economies. In the United States, of the \$4 trillion or so of GNP, about \$2 trillion can be related to informational activities: the garnering of information, the creation of information, the storage and distribution of information, passing on information from one generation to the next. Furthermore, and often overlooked, is the information content of products: an airplane today - in terms of manpower and materials expended on its design and construction - is mostly "information": CAD/CAM, avionics systems, fly by wire technologies, airtraffic control systems, scheduling and operations of the aircraft etc. This is true for many other products as well.

Communications satellites of today are just the beginning. Let me give you a vision: we have today the capability to commit the US to putting all the information contained in the Library of Congress "into orbit" and make this information accessible to all mankind worldwide through small, portable terminals, without any intervening controls or groundbased network `interfaces`. This would require two or three large platforms in geo-synchronous orbit. The Library of Congress comprises about 80 trillion bits of data in all the books and documents stored there.

Such "Information Platforms" will be the end of the control of information, the control of societies, where governments often deny access to information to their own people. Such "Information Platforms" are in my mind among the most revolutionary, new frontiers, that still remain to be conquered. Such "Information Platforms" would also go a long way to assure the "survival" of man's knowledge, should indeed a major nuclear war ever destroy the main repositories of man's knowledge today, which are few indeed.

Instead of pursuing such ideas and technologies, we have cut back - indeed eliminated - any NASA communications R&D.

(4) Energy. The other major payback from Space - not in the next decade, but certainly in the next century - will be the collection of solar energy in Space and its transmission to

Earth to provide for mankind's energy needs. The reason for this, once more, is that energy once garnered can be transmitted at low additional cost and essentially at the speed of light, the two necessary attributes for any large scale economic uses of Space. And again we have managed to terminate all R&D into this potential in the United States: I was a member of the National Research Council committee that concluded that the US should not even do research on the Solar Power Satellite (SPS). Tom Paine and I dissented, but that did not change the conclusion of that illustrious committee.

Let me just briefly sketch out for you this potential. The "disk" described by the Earth in Space has incident solar energy at one AU and over ten days equivalent to the TOTAL KNOWN AND SPECULATED ABOUT fossil fuel resources accumulated on Earth over millions and millions of years. Again, all this energy is equivalent to but ten days of solar energy that passes through a circle with about 5,000 miles in diameter.

If one were to put such a disk closer to the Sun, say at the distance of Mercury, that energy equivalent disk would "shrink" to 3,200 miles, roughly the distance from Bar Harbor, Maine, to San Diego, California, with a total area equivalent to that of the Soviet Union. In one day more energy passes through that disk than the energy needed by all mankind to put it on the same per capita energy availability as that enjoyed by Europe.

Instead today we have an insurmountable contradiction: we say that we want all mankind to have "our" standard of living, i.e. 5 billion people. At the average European energy consumption, i.e. much less than in the United States, that would mean 40 billion tons of coal equivalent energy consumption per year. Nobody can do that on Earth, even if the fossil resources were available, which of course they are not. And even if they were available, the environment would not allow such use.

V. SPACE AND THE DEVELOPING COUNTRIES.

With the above observations it becomes self-evident that Space holds a particularly important role for developing nations. It should be obvious by now that many 'tenets' held by so-called development experts of the past few decades - geared toward the

export of industrial goods from industrial countries at great expense to the developing countries was a mistaken notion. Just as some of us always have maintained that the real promise for developing countries was a market oriented development approach - and that it was protectionism that was the bottleneck to rapid economic development - now applied in the reverse by many industrial nations to keep developing countries out of established industrial markets - so it is with Space and Space applications today: the foremost need and opportunity of developing countries lies in the full and rapid development of advanced, modern Space based information technology systems. Rather than try to insulate oneself from the worldwide, rapid information revolution and information flow, developing countries have to insist on an open market access to these technologies and their uses. Countries that insulate themselves from this information flow do so only at great harm to themselves. In analogy to the protectionism in the trade of physical goods, the real problem for developing nations is the danger of 'information' and 'technology' protectionism by the industrial nations.

Some of us have advocated the establishment of Global Resources Information Systems more than a decade ago, for use by all nations, making use of the most advanced remote sensing and communications technologies. Nothing of the sort has happened, and often at the ill-informed insistence of international conference participants concerned about 'the benefits of mankind', rather than the dire needs of developing nations.

In addition to the vast information benefits, developing nations must expect the development of Space as a source of energy: all the promises and hopes held by 4 out of the 5 billion people living today in developing regions will come to naught if mankind does not find a practically inexhaustible, clean, safe and hopefully affordable energy source. Fusion energy may never be such a source, if only for the high degree of contamination. Nuclear fission energy could be an interim solution, but issues of non-proliferation seem to hinder a worldwide reliance on such energy supplies. This leaves Space based, solar energy supplies even for use down here on Earth as the only realistic, long-term hope for such an energy source. Vast strides are being made in the Space technology areas that bear directly on making the vision of Space based power

supplies a likely promise for the 21st century.

The other option would be the massive use of nuclear energy worldwide, a prospect disturbing to many.

VI. THE NEED FOR FREE MARKET PRINCIPLES IN SPACE.

These are the broad potentials for payback from Space that largely still lie ahead to be realized. But before we will see a large scale expansion in the economic uses of Space - which can only come about through private enterprise (see Space communications to-date) we have to revisit and change the groundrules that govern Space activities.

Today we have outlawed private property in Space with the 1967 Outer Space Treaty. How the United States - of all countries - did so is beyond me, only five years after setting an enlightened precedent with the creation of Comsat in 1962.

We now have also outlawed proprietary data rights to original Space data with the so-called Landsat Remote Sensing Commercialization Act, an Act in fundamental violation of the First Amendment of the US constitution, in that it requires a government license before one can operate a television camera in Space.

If we want to go into Space we cannot do so today without a host of government approvals, consents and other unwarranted and unnecessary requirements artificially imposed to assure government control of these activities. We have to re-establish in Space the same principles that govern our activities on Earth and which make the United States and other free market societies so dynamic and great. Private property rights to any and all mineral resources, private property rights any and all lands, private property rights to any data gathered in Space and from Space, private property rights to all intellectual knowledge developed in the pursuit of Space enterprise, and last but not least, the principle of the free, worldwide flow of information from and to all men, irrespective of race, ideology or location, these have to be restored before one will see the full payback from Space for the United States and for mankind.

Unless we do so, if we simply dispense with free enterprise and the freedoms known to some on Earth as soon as we lift off from a launch pad to enter Space as a region governed by totalitarian principles so contradictory to the values we hold on Earth, I do not see any economic or other reason for us to go into Space, whether privately funded or at taxpayers' expense. We have to change the ground rules and establish in Space the same principles that govern successful and democratic societies on Earth, all of which are based on private property, risk and gain. If that means abolishing the 1967 Outer Space Treaty, so be it. Why should we advocate and defend a treaty that is contrary to our fundamental, constitutional principles?

The ultimate payback from Space are profits, and profits gained from Space enterprise will be the ultimate benefits for mankind. That is why it is important that we go back and re-establish the fundamental principles of free enterprise, so indeed all of us can and will benefit from Space, industrial as well as developing countries, and most important, all the people, not just the select few government and industry representatives who already have made Space a very enjoyable activity here on Earth with conferences as this one here in Innsbruck, Tyrol, the country where free men never owed allegiance to anyone, where serfdom was never known.