

the Foundation Institute Incorporated 1971

REPORT:

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ADVANCES IN COMMERCIAL AND GENERAL SPACE DEVELOPMENTS

FIRST PRIVATE LAUNCH VEHICLE SUCCESS

GERMAN FIRM FLIES SUBORBITAL

The first successful launch of a privately-funded commercial rocket occurred at 10:15 A.M. local time on the 17th of May, 1977 from the OTRAG launch site in Shaba North, Zaire.

Orbital Transport and Rockets is one of a handful of independent companies which is moving to exploit the opportunity of commercial space operations. Located in Stuttgart, West Germany, the company has been developing the vehicles over the last several years. Lutz Kayzer, a German aerospace engineer, and Kurt Debus, former head of the Kennedy Space Center of NASA, are spearheading the project. Several millions of dollars have been raised to date from European investors.

The May launch, which has been ignored by the US news media, marks the first occasion of a non-governmental launch of a segment of an orbital vehicle.

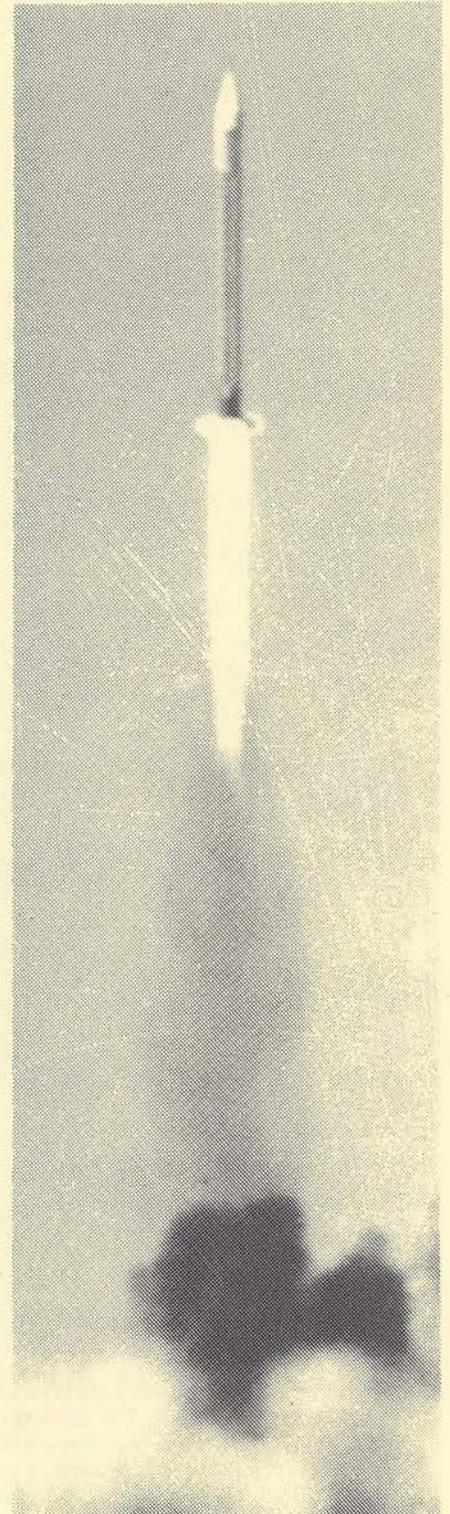
OTRAG has been reported to plan to charge approximately 30 million DM for each launch of their planned thousand-ton heavy-lift booster. The booster has the capability to lift 22,000 pounds to low earth orbits, and 4,400 pounds to geostationary transfer orbits. This places it in competition with the Franco-German Ariane booster, and the US Atlas-Centaur (soon to be replaced by the Space Shuttle). The price OTRAG intends to charge is competitive with the vehicles now used in the communication satellite market.

The design of the OTRAG vehicle is based on small modular units of tankage and engines. Each cluster of modules makes up a total rocket in itself, and it was the smallest cluster which was test flown. Some of the large boosters may have tens or even hundreds of modules.

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A
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PHOTO
EXCLUSIVE
STORY



Test vehicle rises from Zaire launch site, Shaba province, May 17, 1977. Altitude reached was 12 kilometers. OTRAG photo.

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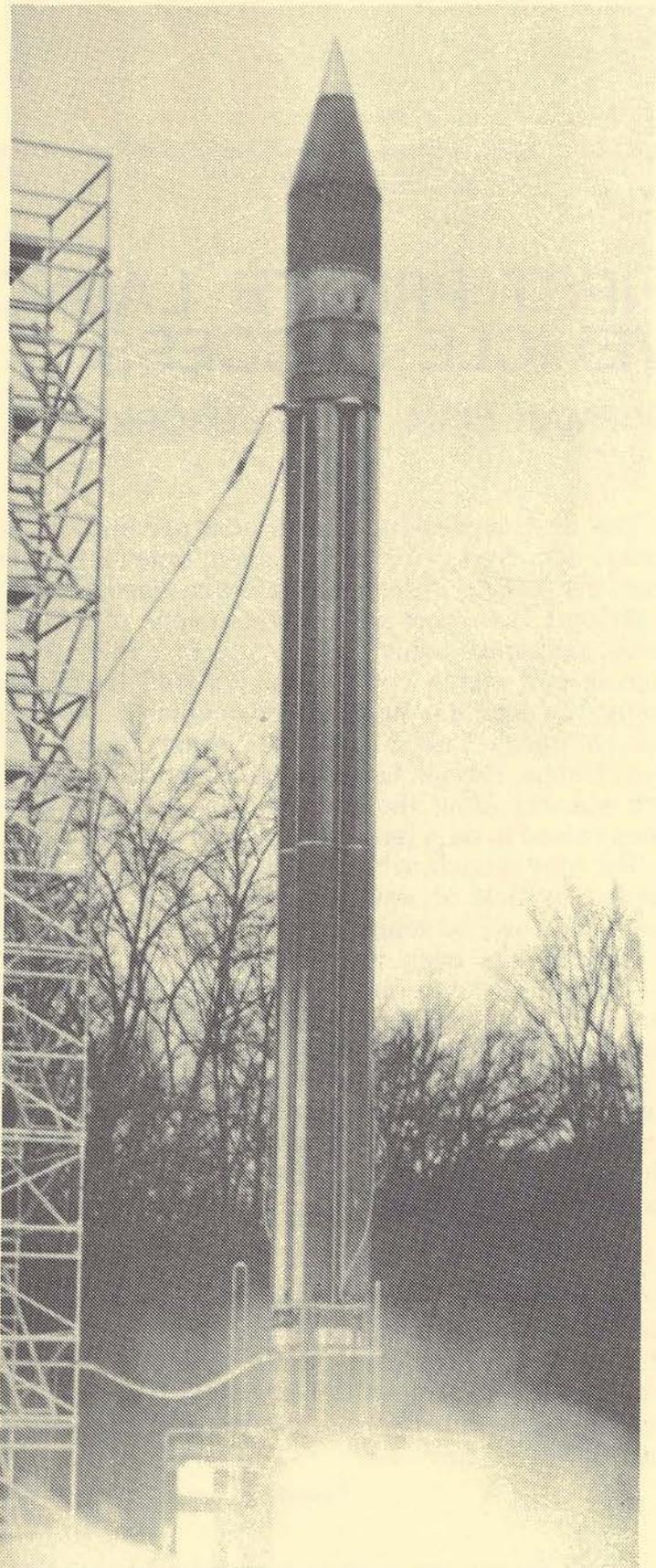
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The May flight was flown without guidance on a ballistic trajectory which took it a reported 12 kilometers high. Future flights will use a guidance system supplied by Space Vector Company, an American firm which manufactures low-cost guidance systems for sounding rockets.

Testing of the prototype system was done at the German aerospace facility at Lampoldshausen near Heilbronn. In 1976, hot firing tests of the vehicle main engine were conducted successfully. Also in 1976, the company negotiated a lease on 40,000 square miles of land in Shaba province, Republic of Zaire. Shaba province was the scene of recent fighting between Zaire regular forces and units of the Katangan gendarmery.

Several OTRAG subsidiary companies are involved in civil engineering projects in Zaire, including the construction of a bridge, a quarry, and an airfield.

Hot firing test of the OTRAG rocket with four clustered engines of three tons thrust each. Firing occurred at DFVLR test facility at Lampoldshausen near Heilbronn, West Germany. *OTRAG photo.*



Transportation of the first flight unit via the company Argosy transport aircraft. The Zaire launch site, equipped with a dirt runway, occupies 40,000 square miles of leased territory. *OTRAG photo.*

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THIRD AMES STUDY

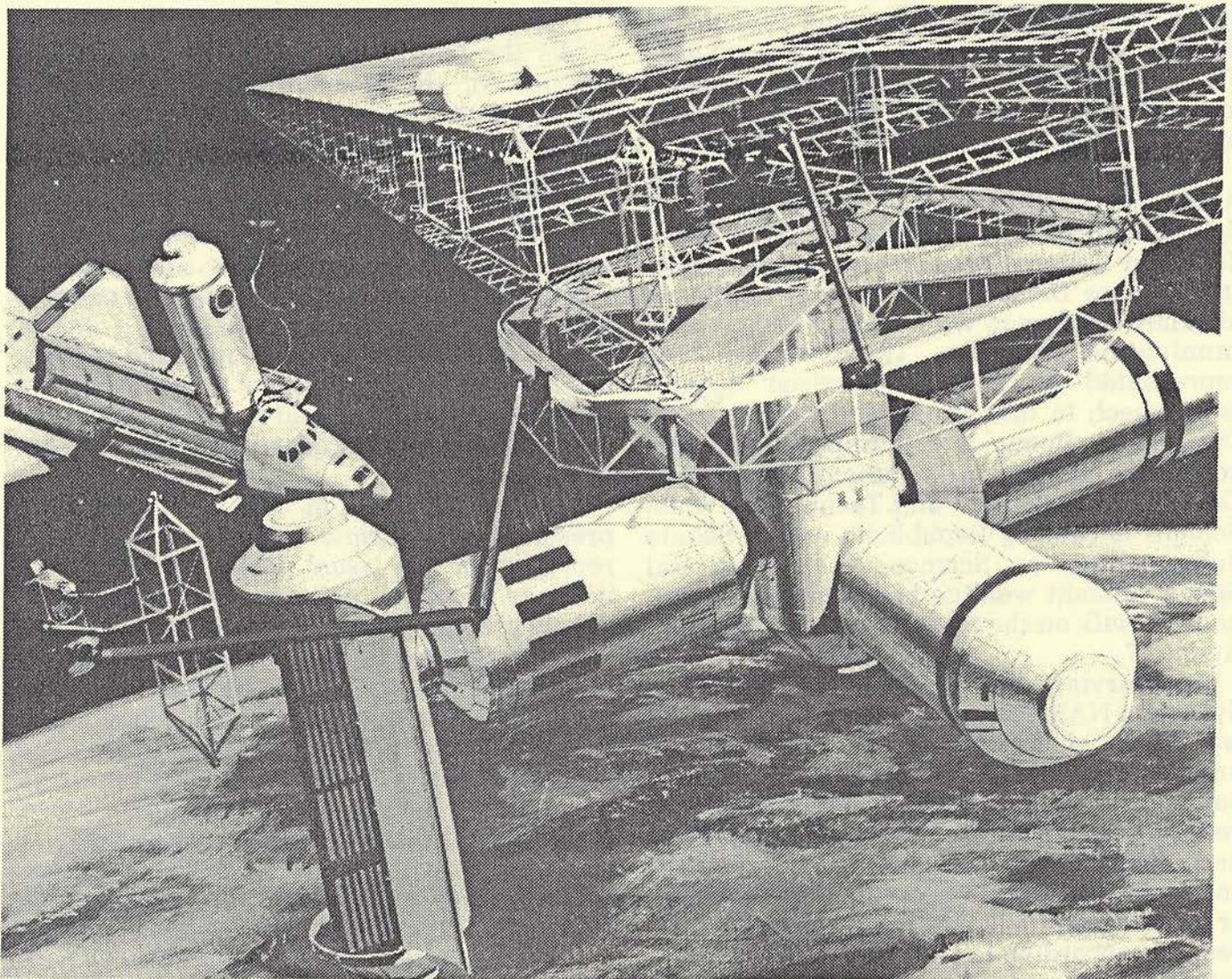
The 1977 NASA-Ames Research Center Summer Study was the largest yet conducted on the subject of space manufacturing and settlement. The study, now in its third year, attracted several hundred people to a public final briefing conducted August 2nd at the Ames Research Center in Moun-

tain View, California.

Fifty participants in the study addressed several short-term technical issues vital to the achievement of a low-cost, high-return program of manufacturing in space from non-terrestrial materials. The goal of their studies was the production of satellite solar power stations which could send clean electrical energy to the earth within the next two decades. The study staff included people from universities, government and private industry.

Details of solar satellite design were

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Manufacture of a Satellite Solar Power Station (SPS) in orbit. After assembly, the station would be raised to geostationary orbit to begin operation. The Ames study concluded that such stations, which could be in operation by the middle 1990's, may be built of extraterrestrial materials rather than structural components ferried up from earth. *NASA artwork.*

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A.B.A. EXPLORES SPACE USES

Bar Association Holds Space Industry Seminar

"Where there is great wealth to be had, there will be a lot of work for lawyers". With that statement, NASA Deputy General Counsel Gerald Mossinghoff opened a seminar on space industry of the Science and Technology Section of the American Bar Association. The seminar, held as part of the annual meeting in Chicago August 10th, was co-sponsored by the Banking and Corporate Law Section.

Among the presentors was John Yardley, Associate Administrator for the Office of Spaceflight, NASA; Daniel Fink, Vice President and General Manager of General Electric's Space Division; and Delbert Smith, an attorney concerned with space law and communication satellites. The Congress was represented by Senator Harrison Schmitt (see speech in this issue), and Congressman Don Fuqua. Fuqua is Chairman of the Subcommittee on Space Applications of the House Committee on Science and Technology, while Schmitt is ranking Republican on the Senate Subcommittee on Science, Technology and Space. Schmitt was the last American astronaut to walk on the moon, during the flight of Apollo 17.

An overview of the Space Transportation System of NASA (including the Space Shuttle) was given by Yardley. Fink reviewed some prospects for space manufacturing, pointing out that GE has studied the field for several years under NASA contracts. Space could be used as a place to locate relay platforms for communications, for observation of the earth, or as an operations site for research or processing, according to Fink. During his presentation, he showed a film clip from one of the Skylab experiments concerned with zero-gravity studies. The short film dealt with a

mixing experiment—using two spheres of colored water floating freely in the air on-board the space station. They were allowed to come together, yet the larger globe of water that they formed retained two independently colored sections. This demonstration of non-mixing, or lack of convection in the zero-gravity environment of space, is but one example of the techniques which are available for new industrial processes in orbit.

Fink went on to say that the non-technical areas in space processing are now of more concern to industry than the technology. There are three important considerations: physical (make it work), economic (make it pay), and legal (make it equitable).

Fuqua, in his presentation on how congress views the Shuttle, stated flatly: "the opportunities for the commercialization of space are upon us". He suggested that the time has come for lawyers to begin to specialize in space law.

Delbert Smith, one of the first attorneys to follow Fuqua's advice, and the author of several books on communication satellites and space law, commented that he was an optimist with regard to the commercial use of space. But as an observer, he noted the need to begin now to address international questions of law in these matters. He said the past resolution of international legal questions was generally by *ad hoc* means.

Senator Schmitt, in the most "far-out" presentation (*Starlaw and the Enterprise*—reprinted in this issue), looked at the future in space. He began by saying that technological concerns no longer constrain us to earth—a familiar theme to those expert observers of progress in the space industry field—but that the problems are in the ways we think about space and the future. Schmitt believes the motivating force to go into space in a major way will not be commercial as much as psychological. It is necessary for civilization to have a frontier, a safety valve, where it can expand, grow and develop. "Space can provide a light at the end of the tunnel", he remarked. "We have an obligation to move with all deliberate speed into this new area."

Addressing the future of space settlement, Schmitt commented, "Among those alive

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Congressman Fuqua (right), responds to a question from the audience during the seminar of the American Bar Association in Chicago, August 10th. Left, Mr. Delbert Smith, Madison, Wisconsin attorney who spoke at the seminar. *Photo: A. Dula.*

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today are the parents of the first Martians". He feels the movement of civilization into space will require the development of what he called "Starlaw": new and different laws which will look back on the history of "Earth's common law" in much the same way that American law looks to English common law for many of its fundamental principles.

Following the Section seminar, the ABA Assembly luncheon was addressed by Neil Armstrong, the first man to land on the moon. His unforgettable speech addressed the third century for America, and the parts that law and justice play in our nation today. A multimedia show organized for the luncheon introduced more than two thousand Bar Association members to the idea of space industry as the next frontier for the human race.

Newsletter Commences Publication

The *Foundation Institute Report* began publication with its September issue. As a monthly newsletter devoted to "advances in commercial and general space developments", it will concentrate on business opportunities in the 1980's and 1990's in space industry, space transportation, economics and law of commercial space activities, as well as progress in related fields.

The function of the publication is to inform and stimulate interest among businessmen in both the aerospace and non-aerospace communities.

Beginning with the next issue of the REPORT, Mr. Arthur Dula, General Counsel to Foundation, and member of the Houston law firm Butler, Binion, Rice, Cook and Knapp, will have a regular feature. It will be concerned with policy, business and legal questions in the commercialization of outer space.

The Foundation Institute REPORT:

STARLAW and the ENTERPRISE

*Presented to the American Bar
Association
August 10th, 1977
Chicago, Illinois
Copyright by Senator
Harrison Schmitt*

The Space Shuttle Enterprise flies alone in a few days; the first major milestone in our leap from Apollo to Star Trek. The explorers of the near frontier of Earth have passed; the pioneers have arrived; civilization and "starlaw" will soon follow.

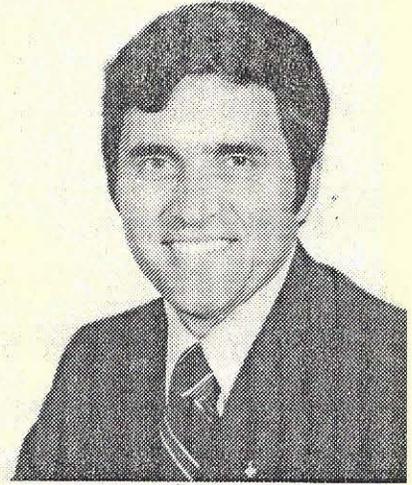
Compressed into one decade of activity in space, history has seen the equivalent of two centuries of exploration of the great American West. History is not in the habit of waiting for us to proceed further; history is proceeding with or without us in a rather impersonal way. Nations traditionally have some difficulty in recognizing or remembering this fact until events suddenly indicate, in no uncertain way, that it is time to move or be left behind.

We have been more than just part of history during the past decade; we have been part of evolution. By the use of his mind, man has made evolution through technology historically equivalent to biological evolution. By constructing a shield for life around himself, man has made the universe an accessible part of his environment.

The evolution of man into space has opened new opportunities for us and for all men. There are now new resources, in the broadest sense of that word, which never before have been available to mankind. These resources are available for research, for manufacturing, and possibly most importantly, for service to our fellow man. One of the major questions before the nation, as I see it, is whether or not we of this generation will continue to develop our technological resources. The answers to this question lie within the limits of our imagination. The first movements into space, which culminated in Apollo, catalyzed our imagination. Skylab gave direction to our imagination. The Space Shuttle now gives license to our imagination.

The Space Shuttle is the first major step in a positive answer to the question of our space future. Once the Space Shuttle exists, that is, when we have relatively economical and convenient access to the near-Earth space environment, then imaginative use of that environment becomes possible. To evaluate the benefits of the Space Shuttle to this and future generations, let us look first at the nature of our new space resources.

The resources of near-Earth space are basically three in number: 1) instantaneous and continuous view of the Earth, the sun, and of deep space; 2) an infinite quantity of clean, ultrahigh



Senator Harrison Schmitt, last American astronaut to walk on the moon, now Republican senator from New Mexico. He has a PhD from Harvard University.

vacuum; and 3) a weightless environment, that is, an environment of gravitational stress.

An instantaneous and continuous view of the Earth and its total environment makes possible a wide spectrum of space activities. Observatories become possible from which research and services in meteorology, oceanography, geology, and environment can be conducted and from which broad-scale explorations for new terrestrial resources can be carried out. Man's application of his eyes and mind to the direction of old and new remote sensing systems has presently unlimited potential.

Starlawyers must quickly come to grips with the implications of this new view of Earth. Litigation involving a wide variety of problems concerning weather, ocean, land and environment will have increasingly new and potentially definitive evidence with which to deal.

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Knowledge of the distribution of earth and ocean resources will become general knowledge with increased complexity for international and anti-trust litigation.

The sun remains the major contributor to the stability and the changes of our magnetic, atmospheric, oceanic, and biological environments. However, our knowledge of how the sun's energy and magnetism influence changes in our environment is extremely limited. A continuous view of the sun outside the shielding effects of the Earth's atmosphere first will allow attempts at understanding processes taking place on and in the sun and the nature of their interactions with the Earth. Then, eventually this view will allow efforts to forecast and protect against, or take advantage of, the effects of these interactions.

As our understanding of the detailed nature of the interaction between Sun and Earth increases, so will our ability to monitor and assign blame or credit for changes in that interaction. As we work to expand the limits within which mankind can survive and prosper on Earth, so must we develop the technical and legal means to monitor the global effects of this expansion. For a case in point, we need look only as far as the controversy over the effect of fluorocarbons on the ozone in the ionosphere and in turn, its effects on the incidence of skin cancer.

The continuous view of the

sun from near-Earth space offers another potentially great resource. Our short-term energy problem is that of producing more fossil fuel, whereas our long-term problem is the conversion of a society dependent on fossil fuels to one where fossil fuels are a minor source of energy. Solar power stations in space are some of many potentially feasible alternatives to fossil fuels, alternatives that we as a nation must develop soon.

There are numerous legal and regulatory questions that arise when one contemplates solar power systems in synchronous orbit around the Earth. How do we establish national and/or international rates for the power generated and transmitted to receiving points on Earth? As more and more men and women work in space stations like this, what laws and judicial system will govern their inter-relationships?

One of man's greatest sources of intellectual strength and scientific vitality is in his continued observations of the universe and his attempts to understand the stars and interstellar space. The greatest discoveries of the future probably lie in investigations of stellar and interstellar phenomena. The nature of gravity; the origin of planets; the limits on our ability to manipulate matter, energy, and time; and our future as explorers of the universe are all issues at stake.

One of the major limita-

tions to experimentation and manufacturing in many areas of physics and chemistry is the difficulty in creating and maintaining clean, ultrahigh vacuums in large volumes. The existence and accessibility of such a vacuum and high pumping rates in near-Earth space open new dimensions to the study and use of physical and chemical theory.

The continuous absence of gravitational stress, that is, weightlessness, provides a unique experimental and practical environment heretofore unavailable to man. Extensive experimentation and manufacturing never before have been possible where convection does not exist, where containers for fluids are not required, and where unconstrained crystal or biological growth can occur.

Possibly the most urgent area of Starlaw that requires attention is the extension of medical, corporate and patent law to cover the infinite range of treatment, research and industrial activities that will soon begin in space. Precedents are being set which may not be in the right direction either with respect to the interests of business, the interests of future consumers, or the interests of our country.

In spite of the obvious limitations on our ability to have all that would be useful all at once, the Space Shuttle will allow us to bring the benefits of our new space resources to more and more

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JAPAN MAPS FUTURE SPACE GOALS

Japanese Propose Manned Booster

The July 25 issue of *Aviation Week & Space Technology* magazine revealed the aggressive plans of the Long-Range Study Committee of the Japan Space Activities Commission. Among the plans considered by the committee were Japanese booster development, including a manned system before 1990; participation in the Space Shuttle program; lunar and planetary missions; interest in an international space station; and deep space probes to planets around other stars.

While not specifically mentioned in the *AW&ST* article, space industrialization is known to rank high on the list of Japanese interests in space.

Much interest has centered around the proposed launch vehicle development plans. Presently the Japanese operate a satellite launcher derived from the McDonnell-Douglas Delta (known as the "N" vehicle). The planned vehicles suggested by the Study Committee include a booster in the Atlas-Centaur class (about 10,000-11,000 pounds in

low earth orbit) and a Titan IIIC class vehicle with payloads from 22,000 to 33,000 pounds. The latter would be the manned vehicle. Both of these systems would compete with the US Space Shuttle and the European OTRAG and Ariane vehicles.

The Japan Space Activities Committee reports directly to the Prime Minister and is under his direct control.

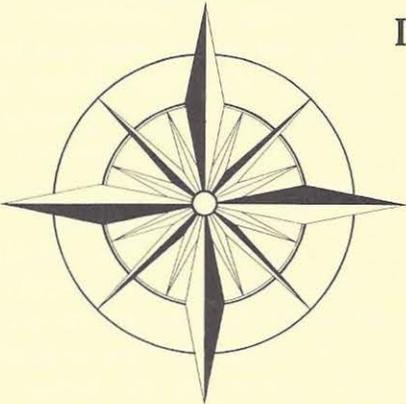
Interest in Space Industry Increases

With the publication of articles in *Business Week*, *Time*, and *Newsweek* during the month of August, the topic of commercial space industry has seemingly come of age. Most notably, the *Business Week* story was a cover article with seven pages devoted to it in the August 22 issue. While heavily Space Shuttle oriented, the story touched briefly on the OTRAG launch (see lead article, this issue), and mentioned foreign interest in space manufacturing. An editorial elsewhere in the issue urged American industry not to "Miss the Bus" in space industrialization by waiting for federal government funding of space activities, while foreign competition exploits the US Shuttle.

Other magazines are reportedly doing articles or features on space industry, including *Signature*, the Diner's Club official publication.

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of mankind. Our obligation to the present and to the future is to move with all deliberate speed into the new era and into the Earth's frontier now open before us. Now is the time for Starlaw to be born and take its permanent place in history of society. As we consider our national and international priorities, I hope that we find the compassion and wisdom to survive the present, but I also hope that we find the imagination and wisdom to see the future.



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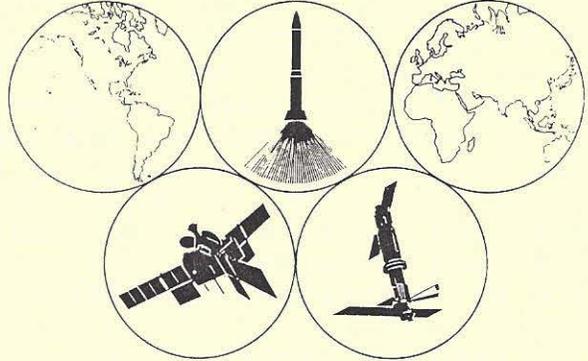
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not addressed, since these have been studied by several other NASA research contracts. Instead, the summer study looked at ways to use existing transportation systems, beginning in the 1980's, to set up mining facilities on the moon or an asteroid. From the mining site, these raw materials would be shipped to an assembly orbit, where they would be manufactured into the powersats. Many thousands of tons of lunar materials, for example, would be transported to orbit about the earth, where they can be processed with solar energy (providing process heat) into metals, fiberglass, glass, silicon and oxygen. Such a scenario would obviate the need for transporting the large quantities of material up from earth by rocket freighter. It is about twenty times more efficient to use space-based resources for the task of building large space structures than bringing the products up from the bottom of a "gravity well", like the surface of the earth. Each powersat weighs as much as an ocean liner.

A new propulsion system for orbit-to-orbit transfer was studied at the workshop, and demonstrated to the assembled crowd at the briefing. Built by a group of MIT students, the "mass-driver" was fired several times in a parking lot of the research center. The device is essentially an electromagnetic gun which fires small slugs of matter (such as chunks of asteroids) down a long tube. The system acts like a rocket engine, and could propel small, hundred meter diameter planetoids into earth orbit, where they could be processed.

The study group came to the general conclusion that much more research and development was warranted. At the same time, they suggest the task would be no more difficult to accomplish than was the Apollo project.

Foundation News



Foundation Studies Pulse Fission Engine

The Foundation Institute has announced it will commence a study of a high-thrust, high specific impulse pulsed fission engine. The engine is similar to the Orion concept system proposed in the early 1960's, except that it is scaled down by ten thousand times in thrust.

Recent fusion energy studies have allowed consideration of the engine, due to the high compressions which may be achieved by electron beam driven ablation/compression techniques.

The study, which will run for one year, will produce a development plan for the engine. Carried to its ultimate potential, the system would allow transit times to Mars of ten to thirty days, and to the outer planets in ninety to one thousand days.

Study for Large Launch Vehicle

Foundation researchers have completed a study for a Large Launch Vehicle (LLV) which can loft Space Shuttle-sized unmanned payloads into low earth orbits at a cost five times cheaper than the manned shuttle.

Uses of the vehicle would include launching segments of space stations, factories and solar satellite power stations.

The system uses liquid oxygen and aviation grade kerosene, in a two stage modular configuration to produce the low costs. Tanks are expended.

The vehicle uses conventional technology to produce the low costs.

Ad Card Available

This issue of the Foundation Institute Report will reach nearly one thousand people who have an interest in space industrialization and commerce. If you are planning to offer services or products which relate to these fields, there is no better place to advertise than the Report.

Careful targeting of your market can be achieved. Please contact the Foundation office for further information and a rate card for future issues.

Engine Test Slated

A test of a one quarter scale chemical rocket engine for a modular Foundation launch vehicle will be conducted in late December, according to staff personnel associated with the project. The test will be part of a continuing Foundation effort to reduce the cost of launching payloads into earth orbit.

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news notes...

SPACE STUDIES INSTITUTE...Princeton... Professor Gerard K. O'Neill has formed the non-profit Institute for Space Studies, Inc. in Princeton, New Jersey. O'Neill, one of the developers of the space colony concept, is soliciting interest and contributions for the newly-formed corporation. Write to P.O.Box 82, Princeton, N.J. 08540.

PROJECT DAEDALUS REPORT...London...The British Interplanetary Society will publish the results of a four-year study on a Starship Probe to Barnard's Star. The 160 page report, first of it's kind ever, is available for \$8, postage paid, from BIS, 12 Bessborough Gardens, London, SW1V 2JJ, United Kingdom. Publication is scheduled for April, 1978; advance orders suggested.

INTERSTELLAR ENTERPRISES...Mass...Newly formed company named Interstellar Enterprises, 201 North Mill Street, Holliston, MA 01746, will publish The Starflight Handbook. Emphasis of the book will be on propulsion systems. Along with the Daedalus report, this book may point the way to powerful and economic applications of starship engine technology to commercial vehicle systems for planetary commerce. Advanced engines can make utilization of extraterrestrial resources, such as asteroid mining, practical.

SPACE INDUSTRIALIZATION LECTURES..... The Foundation Institute announces a series of new illustrated lectures on the future, space commerce, advanced and decentralized new technologies. Previous lectures given to academic and corporate audiences. For price and scheduling contact the Foundation at (612) 489-4466.

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Capabilities include theoretical research and study, systems research and development of services and products. A high level of effort is presently being expended in astronautics, especially the commercial utilization of outer space and the need for economical space transportation.

The Institute has a permanent and consulting staff of professionals to call upon including engineers, designers, scientists, communications experts, management specialists and the like. Corporate headquarters is presently in St. Paul, Minnesota.

THE FOUNDATION INSTITUTE REPORT is a concentrated effort to report all areas of private and industrial initiatives in the development of space. We hope it will stimulate ideas by raising questions and offering innovative concepts contributed by acknowledged leaders in the field.

If you have any comments, ideas or requests for information or articles, we encourage you to contact us. The REPORT is published monthly, and has a subscription price of \$10/year.

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