THE FOUNDATION
COMMERCIAL SPACE REPORT

BUSINESS OPPORTUNITIES AT A WORLD SPACE FREEPORT

The Establishment of Earthport draws closer

Following the pioneering steps of the first two decades of man's excursion into space, opportunities for commercial ventures in the regions beyond the atmosphere are growing more real with each passing day.

Many experts in the field of space industrialization expect a virtual explosion of profitable business activities in the space near the earth over the next few decades. Already, the communication satellite business approaches two billion dollars in total market size, and during the next decade it is anticipated that the market for space services such as remote sensing, manufacturing in microgravity and additional comsat business may grow to several times that amount. In the following years, projects with multi-billion dollar returns may be possible; for example, mining asteroids for useful materials or fabricating large solar power stations in orbit to supply energy to earth.

As with any project which promises vast economic returns, problems stand in the way of realization of these technically practicable endeavors. Foremost among the difficulties is the generally large investments which are needed to develop orbital space projects. Additionally, concerns have been raised about the international political questions of a single nation, or perhaps even a few corporations, engaging in the exploitation of the space environment.

In 1975, among a group of pro-space, pro-private enterprise individuals, these concerns were the driving force in the establishment of a plan to overcome the problems and at the same time to offer new opportunities for space industrialization. At that time the Earthport Project was conceived. Earthport will be an international space freeport open to all parties who wish to use its facilities in a responsible manner. Established on a 200 square mile tract of land, and exempt from regulation, tariffs and taxation for 99 years, this zone will be the largest free trade area in the world. Located near the equator, the site will provide low cost access to space by companies and countries the world over.

OPPORTUNITIES

Earthport will offer several nearly unique business opportunities for both established firms and entrepreneurs. They can be divided between near and long term, earth-related or space-related.

Near-term/Earth-related

The most obvious and near term possibility for business involvement relates to the need to establish and administrate the free trade zone. The chosen site will have to be surveyed, studied and planned to accommodate the wide range of services required by companies leasing land in the zone. Harbor facilities will need some improvement, perhaps involving dredging and modernization, along with airfield construction, and lease parcel development. Roads must be laid out and built. Buildings to house both the leasing companies and the administrative offices of the Earthport authority will be an early necessity. In short, the whole infrastructure of an industrial park of the most modern nature will be needed, including water, sewage, electricity, and communications.

Along with these necessities, contracts for services of a support nature will be let to firms in the U.S. These will include arrangements for management consulting, design and architectural services, and maintenance of the site. Supply contracts for spare parts and other technologically oriented goods will also be let.

Another obvious business opportunity is the establishment of companies in the zone to take advantage of the advantageous commercial climate. With a lease rate that is very competitive with other free zones, and an exemption lasting for 99 years rather than the usual 10 year period, the Earthport Project will attract a large number of corporations. It will probably be possible to develop selected portions of the zone in a condominium fashion for small businesses, where a major firm can sublease prebuilt small manufacturing and office space to a firm which otherwise might not have the resources to get started.

Since the zone will also attract large numbers of employees, housing is another near-term business opportunity. Many of the workers in the early years will be foreign, and a large fraction of those will be American. They will build a market for housing and other community support services which in time will certainly prove to be important.

Long-term/Earth-related

As the Earthport grows to fill the entire 200 square mile zone, and begins operation as a true commercial spaceport, additional large facilities will be required to meet the anticipated traffic levels and other needs of the freeport users.

These facilities will include manufacturing and test areas for different classes of launch vehicles, both manned and unmanned. Launch platforms and associated structures such as gantry towers, control centers and tracking and data processing installations will be required. Propellant manufacturing and storage depots as well as recovery and refurbishment zones will also be needed. Ultimately, these structures will have a

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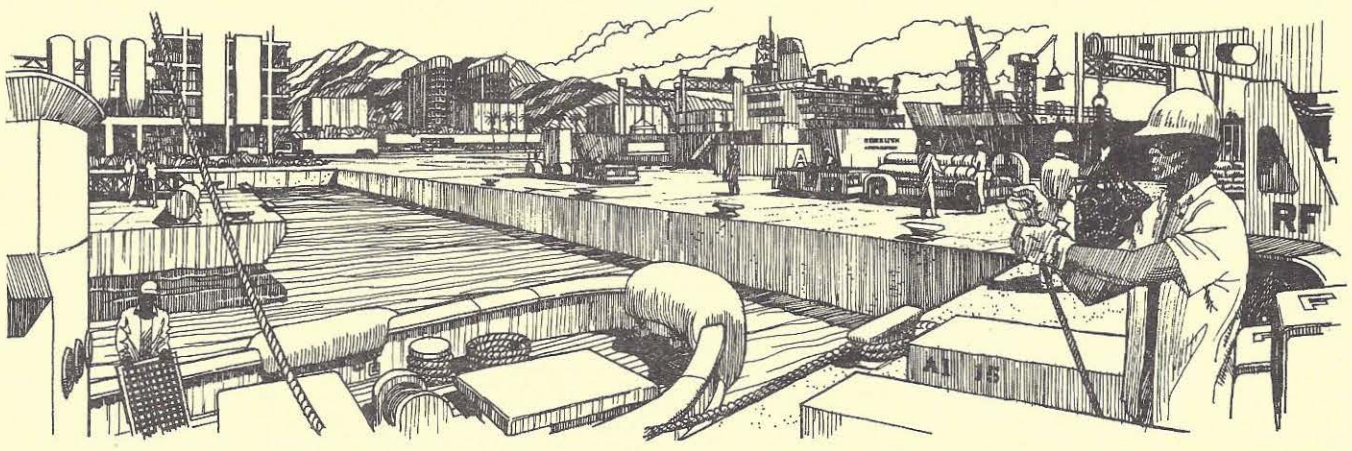

value in excess of several billions of dollars; more than a large international airport, for example.

As large space-related research and development programs mature into production programs (for example, solar power satellites), extensive ground manufacturing facilities must be built to supply the heavy lift boosters which will depart the freeport. It has been estimated that as much as 300 billion dollars will have to be spent on powersats in the last years of this century if the energy needs of the developing earth are to be met. A significant portion of these funds (on the order of 10%) will be used for ground support equipment.

Earthport should be viewed as a 200 square mile industrial park with a powerful group of incentives to promote growth. While aimed at beginning the development of space industrialization, its first contribution to prosperity will come in the actual establishment of the zone and the development of the ground facilities which will support humankind's move to exploit space resources.

Near-term/Space-related

As we enter the third decade of the space program, the emphasis is shifting from the exploration of space to the exploitation of potential space resources. Among those resources are microgravity, materials more abundant than are found on earth, undiminished solar energy, and most important in the short run, the unobstructed "view from a height"

Two space services afforded by this all-encompassing view from orbit above the earth bear special examination. First, satellites placed in geosynchronous earth orbit can image a full one-third of the planet without changing position. Used by nearly all communication satellites presently operating, this so-called "24 hour equatorial" orbit is a key to many space services. Present comsats are relatively small in both size and capacity, generally weighing under 5000 pounds and capable of carrying a few thousand telephone or a few dozen TV signals. This style of comsat will continue to be operated for the next decade, and Earthport's location on the equator will afford the satellite owners the chance to increase the capability of their comsat by about 20%. This will be due to the larger payload that a rocket can carry from an equatorial launch site contrasted with a site at higher latitudes. Such an advantage may mean that present providers of commercial launch services will seek out a site at Earthport for the direct financial benefits which it can provide.

The remote sensing of earth resources is also a profitable business opportunity in the near future. With an operational form of satellite similar to the NASA Landsat series, companies and countries will be able to locate promising new resources of gas, oil and minerals. Additionally, remote sensing is useful in checking the spread of crop infestations and disease. All of this information is of prime economic value, both for the direct user of the service and also for the investor or commodity trader. Space sensing of earth may help prevent unruly markets for certain goods, or warn interested parties well in advance of a commodity crisis.

A further market will develop in the education and training of experts in the fields of communications and earth sensing. While the World Space Center (affiliated with Earthport) has plans to offer courses in at least one of these fields, it is probable that the market is large enough to warrant both major consulting and training activities of a commercial nature.

Later in the decade of the eighties, other opportunities for the near-term use of space will mature. Foremost among these will be

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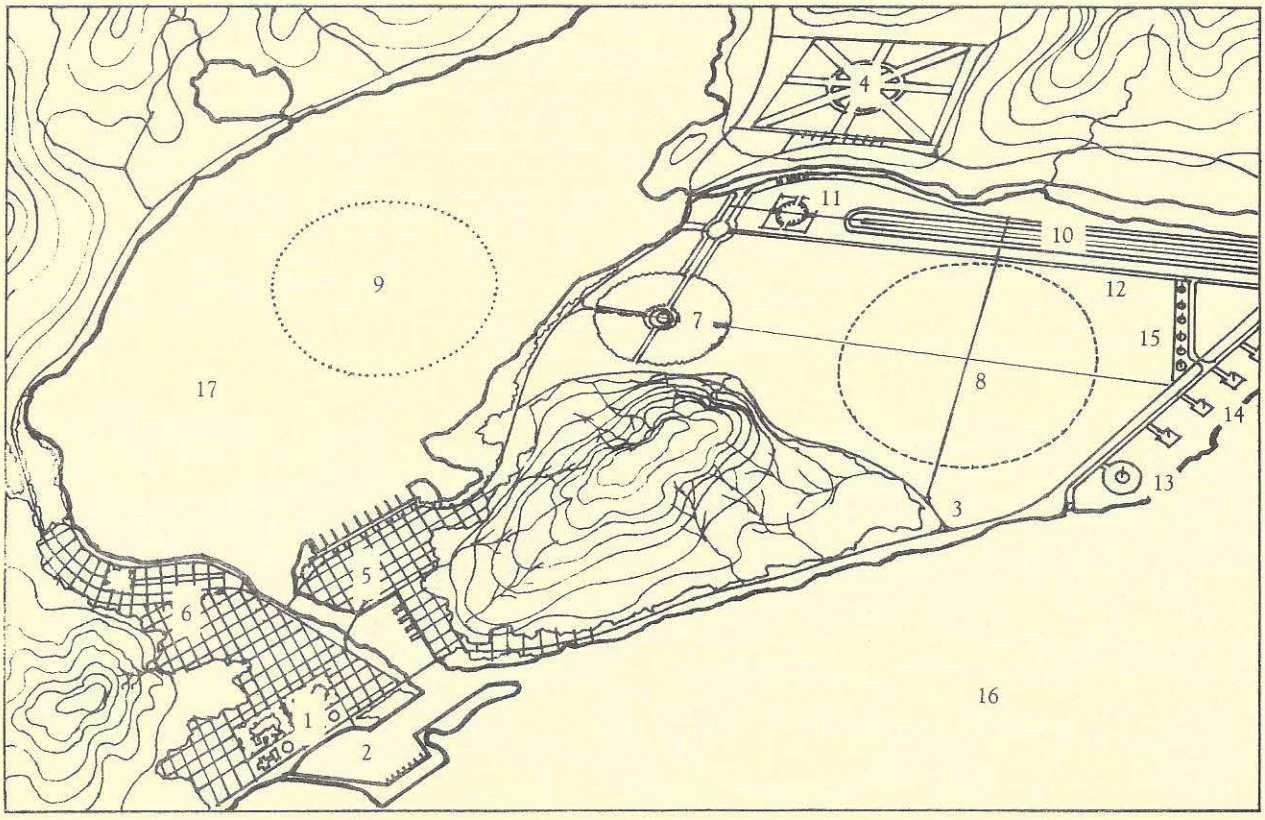
(Facing page) The International Division of the Sabre Foundation has published a one-page newsletter for December, 1978. Aim of the Sabre project is to help transfer technology to developing nations which would be candidates for establishing free trade zones. Ultimately, these zones would become affiliates of the World Space Center and the Earthport Project. Past issues of the Report (see for example 1978 issues: January, May, September) have provided background on Earthport and the World Space Center.

An artist's rendering shows possible design for Earthport. To accommodate a wide range of future as well as present launch providers, the site would offer protected areas for heavy lift launch vehicles, and wet and dry recovery zones.

General Facilities

1. *Freeport Administrative Center and World Space Center*
2. *Harbor facilities*
3. *Railroads and highways*
4. *Airport*
5. *Commercial/industrial zone*
6. *Residential zone*
7. *Space launch and flight control facility*
8. *Dry landing area for spacecraft (5 km. diameter)*
9. *Water landing area for spacecraft (5 km, diameter)*
10. *Shuttle landing strips*
11. *World Space Center*
12. *Canal for spacecraft transport*
13. *Water launch area, heavy lift vehicle*
14. *Launch pads, medium lift vehicles*
15. *Launch pads, light lift vehicles*
16. *Ocean*
17. *Bay, lake or estuary*



FREE ZONE NEWS

Sabre Foundation International Division — December, 1978

New Enclaves for Trade Seen Lifting Third World

A new path for economic and technological development, based upon creation of free trade zones, is drawing support from a number of quarters in developing nations.

The free zones would offer new commercial opportunities for business and the host country, by exempting enterprises for an extended period from taxes and tariffs.

Revenues from lease of land in such zones are expected to amount to about $3.7 million per square mile each year, given the experience of existing free zones in the Third World. A portion of the lease income is to be set aside by developing nations for utilization of ocean and space-related resources.

More than a dozen nations, ranging from Kenya to Venezuela, have expressed interest in the creation of free zones for international technology transfer purposes. The zones would form a partnership of benefit to business, the host country, and the developing world.

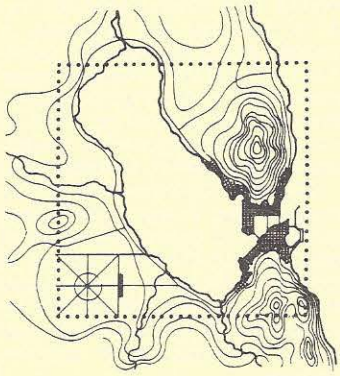
Among the benefits expected:

- **Freedom for investors.** A full 99-year exemption from levies will be offered to business at the zone, in contrast to exemptions of one-tenth the duration in standard free trade areas.
- **Revenues for technological development.** By offering outstanding exemptions, the host country will reap a maximum in lease revenues from tenants. The income will be applied to domestic needs and technology transfer programs.
- **Cooperative framework.** Through free zones, developing countries can establish footholds in the growing frontiers of oceans and space. The framework of free zones could help to reduce polarization between present "have" and "have-not" nations.

Preparations for site visits to potential freeport host countries are now underway. Under the direction of Dr. Philip K. Chapman, a former scientist-astronaut now at Arthur D. Little, Inc., the site visit group will determine the optimal location for the initial zone within the next four months.

The first free zone is expected to be dedicated to widening access to satellite technologies. The government of Liberia has already announced its willingness to establish a free trade area to help finance such initiatives.

Stages of Freeport Development

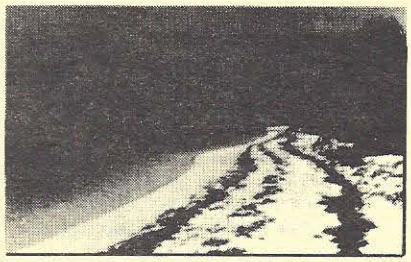


1 **SITE VISIT**—A team of specialists selects optimum location for a 200 square mile freeport.

2 **LEASE SALE**—Land in the tax and tariff free zone is leased to users at $1.44 per sq. meter yearly.

3 **PROGRAMS**—Lease income is set aside to support new ocean and space initiatives, and meet other national needs.

Technology Transfer Programs Planned



Future mariculture bay at the Island for Science, Bahamas

Programs to expand uses of oceans and space will start in 1979 upon establishment of a free trade zone.

One training program will bring individuals from a variety of nations to study advanced mariculture systems at a newly-formed "Island for Science" in the Bahamas.

The island has an extensive shallow-water area for shrimp and seaweed farming. More than $2 million has been invested to date to make the island an interdisciplinary scientific research and development center.

Director of the training program is Neil Ruzic, an associate of the Sabre Foundation and a principal developer of the Island for Science. Ruzic was formerly publisher of Oceanology magazine.

A space-oriented training program is scheduled to begin in mid-1979 on satellite imagery interpretation. With cooperation from remote sensing specialists at the University of California, the training will emphasize uses by developing nations of satellite data in crop management, resource detection, pollution control, and other fields.

The Santa Barbara program is expected to be a prototype for future training centers in the developing world. Specialists in space sciences from more than 20 nations are now participating in the development of possible freeport-financed programs.

In response to a Liberian initiative, the United Nations has begun to explore cooperation with freeport-linked training courses.

the possibility of manufacturing in microgravity. Several hundred U.S. and foreign firms have already contacted NASA (which is sponsoring early studies of materials processing in space [MPS] and planning flight experiments aboard the Space Shuttle) and more than two hundred have purchased space on future Shuttle flights to test their own MPS ideas.

Space processing may mean the development of exotic new materials which cannot be manufactured in the gravitational field of earth for any of several reasons. Among the products envisioned by NASA and industry experts are new or improved biologicals and pharmaceuticals, unusual electronic devices with potentially large markets, and ultrahigh strength materials. One enticing possibility is the manufacture of room-temperature superconductors, which would completely revolutionize the power storage, generation and transmission industry.

As a final illustration of the potential of MPS, a recent study of the potential of space industry suggested a possible 15 billion dollar per year market for manufactured goods in space by the end of the century.

Long-term/Space-related

As experience is gained from the next decade of commercial activities in space, several projects may become possible which could radically alter business and industrial practices on earth.

While most communication satellites are quite small at this stage, the prospect is for them to grow by tens and even hundreds of times in size, power and weight on-orbit. Higher power transmitters coupled to large antennas and sensitive receivers will permit the use of very small companion units by ground-based users. This "complexity inversion" process (i.e., complex, heavy satellites; simple, cheap terminals) will allow direct broadcast of information and programming into the home or the office of the future. The number of TV channels, for example, may be increased to several tens of thousands, receivable the world over. Telecommunications will be changed dramatically by the use of small, calculator-sized pocket phones which will eliminate the need to be restricted to a single location, such as an office, to receive calls. Data communications will become much easier and cheaper, leading to electronic mail communication and widespread use of computers in all aspects of business life. Information banks will funnel their information through the large comsat platforms of the future, giving us access to vast amounts of data on which to base strategies and plans.

All of these market opportunities will be enhanced at a world space freeport. With the equatorial launch capability of Earthport, larger (and thus cheaper) satellites will be possible. Further, by the time that such projects can be reasonably considered, Earthport should be a single source site for all the technical and manufacturing competence necessary to establish the platforms.

New launch vehicles, or extensions of the Space Shuttle, will be needed to help realize future space goals. Earthport will be the largest launch site in the world, with nearly 100 square miles of land set aside for that purpose. It is natural to expect that commercial firms interested in supplying transport to earth orbit and beyond will consider locating at the Earthport site. Exotic new types of vehicles, for example using ground or orbital lasers for prime power sources, might be developed at Earthport by a consortium of private firms. Other vehicle concepts for the 21st century might also be tested at the Earthport, with its mild regulatory climate, that could not be developed in the United States.

Once large boosters are developed, and commercial space transport really begins, many new and highly profitable business ventures in space will be possible. Two of great interest and importance are powersats and extraterrestrial mining.

Powersats, or satellite solar power stations, would be large platforms (many kilometers on a side) assembled in equatorial geosynchronous orbit. Able to convert sunlight into electrical energy, which would be beamed to earth users in the form of microwaves or laser light, such powerplants may be competitive with earth-based forms of electricity generation. At the same time, they will be non-polluting and more efficient than ground-based solar installations. Ultimately, hundreds of powersats might be placed into orbit, each with a worth of as much as 10 billion dollars, according to NASA estimates. Firms at Earthport which develop a capability for space construction during the decade of the eighties may well find themselves sought after to build these large platforms in space in the 1990's. As with comsats, launching from Earthport will mean an increase in the amount of payload which may be transported to space.

Mining the moon and the asteroids might be considered a ridiculous notion at first consideration, but NASA and industry studies indicate that such is far from being the case. While first studies concentrated on the moon following the successful Apollo missions to the lunar surface, later reports suggest that certain asteroids, notably the nickel-iron class, may be the first target for extraterrestrial prospectors. Using the boosters which will be flying from Earthport in the 1990's, it will be possible to mine a nickel-iron asteroid and return loads of cobalt, platinum, rhenium, vanadium, osmium, iridium and gold to earth profitably. As an illustration, the total economic value of a single 100 yard diameter nickel-iron asteroid is over 4 billion dollars (.25 billion iron, 1.5 billion nickel, .5 billion platinum, 1.6 billion cobalt, more than 1 billion trace elements). Some astronomers calculate that more than 100,000 bodies this size or larger exist in the solar system, yet the energy requirement to reach them is no greater than that needed to travel half-way around the earth, once the transportation system has been developed.

Earthport will become a focus for the businesses which will both make possible the exploitation of the solar system and those who will actively engage in it. □

Note: The opinions expressed in this article are those of Foundation, Inc. and do not necessarily reflect the plans or opinions of the Sabre Foundation or the Earthport Project. A more detailed assessment of business prospects at a world space center will be completed by Foundation later this year, subsequent to the establishment of a free zone.

The **Report** is published monthly, and has a subscription price of $20 per year ($15 per year for students, $25 per year for institutional and library subscriptions and $25 per year for overseas airmail). Back issues are available at $2 each from September, 1977. Xerographic copies may be substituted as stocks are depleted. Address all correspondence to Foundation, 85 East Geranium Avenue, St. Paul, MN 55117 or call (612) 370-0990. Editorial Direction: Gary C. Hudson; Special Assistance: Resident Fellow E. Anne Roebke and T.A. Brosz; Staff Artist: David Egge. The **Commercial Space Report** accepts VISA/Bankamericard and Master Charge. Please give us your full credit card number, expiration date, and the four digit Interbank number (Master Charge only). Your signature is also required on mail orders. Phone orders accepted at (612) 370-0990. No collect calls please. **Foundation, Inc.** was incorporated in 1971 as a non-profit 501(c)(3) Minnesota Corporation. The company is a diversified research and development organization formed to engage in advanced scientific and technology studies. Funds are provided by contract research for industry, as well as by donations, gifts and internal business profits. 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. **Foundation** 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 **Commercial Space 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.

NEWS NOTES:

NASA LAUNCHES IN 1979... Washington...Eleven of the sixteen launches on NASA's schedule for 1979 are reimbursibles - satellites launched by NASA for other agencies or corporations. The space agency's activities in 1979 will include the first manned launch and orbital flight of the Space Shuttle, as well as Jupiter and Saturn encounters by the Voyager (Jupiter - March, July) and Pioneer (Saturn - September) spacecraft. Astronauts John Young and Robert Crippen have been named as crew for the Shuttle mission, which is scheduled for liftoff on September 29th, provided that further main engine problems do not force another delay. The planned 53 hour flight will depart the Kennedy Space Center and land at the NASA Dryden Flight Research Center at Edwards Air Force Base, California. Among the other missions for 1979 are: NOAA-A, a weather satellite for the National Oceanic and Atmospheric Administration; FleetSatCom-B, a Navy communications satellite; Westar-C, Western Union's comsat; Intelsat-V A and B, for Comsat Corporation; and RCA-C, a domestic comsat for RCA.

SPACE TECHNOLOGY TO RED CHINA...A delegation from the People's Republic of China has been holding discussions with NASA officials since the 28th of November, 1978, regarding possible U.S. - China cooperation in the peaceful utilization of space technology. The U.S. delegation is headed by Robert A. Frosch, NASA Administrator, following a PRC visit by Frank Press, Science Advisor to the President. In conjunction with the Washington negotiations, the Chinese delegation visited several NASA centers and aerospace facilities. As a result of the negotiations, informal agreement has been reached in principle on joint cooperation in the development of a domestic satellite communication system for China. The satellite portion of the system would be orbited by the U.S. A similar informal agreement has been reached regarding th purchase by China of a Landsat receiving ground station. The delegation will remain in the U.S. until mid-January.

NEW LANDSAT TO BE BUILT... The General Electric Company's Space Division in Valley Forge, Pennsylvania, has signed a $77 million contract with NASA to build Landsat D, the most advanced earth resources monitoring satellite system to date. The incentive contract cost includes a $5 million fee with a bonus of up to $4.3 million depending on how well the satellite performs while in earth orbit. Scheduled for launch in the fall of 1981, Landsat D is the fourth in a series of experimental satellites designed to explore the earth from more than 400 miles altitude. In addition to the multispectral scanner carried by the first three Landsats, the D model will fly a sensor called the Thematic Mapper which will provide resolution of ground images three times better than the multispectral scanner. In fact, resolution with the TM will be as small as 0.2 acres or a square 90 feet on a side. The Landsat D instruments will be installed aboard a multi-mission modular spacecraft, which is a general purpose earth satellite bus being developed by NASA to supply the basic functions of power, propulsion, attitude control, communications and data handling as well as the structure to accomodate a broad range of scientific and applications-type payloads. The bus can be retrieved by the Shuttle. Landsat will begin operation in 1981 with a planned three year lifetime. Both U.S. government agencies and foreign governments are expected to participate in the program.

"60 MINUTES" BEAM WEAPONS STORY AIRED...New York...The weekly CBS TV newsmagazine "60 MINUTES" aired a 20 minute long feature on the Soviet beam weapons project in December. Following up on the several articles which have appeared in the trade journal Aviation Week & Space Technology, the CBS reporters interviewed principles in the controversy surrounding the matter of whether or not the U.S.S.R is actually building or testing directed energy weapons. Later this year the Commercial Space Report will feature a three part article on the possiblities of space conflict and it's implications for space industrialization.

STUDENT OBERTH AWARD...Dubrovnik, Yugoslavia...The Hermann Oberth Gold Medal for the most outstanding student research paper in the field of astronautics has been awarded to Stan Kent of Boeing Aerospace Corporation. Kent, who has been active in the space industrialization - space settlement field for several years, was formerly editor of Space Age Review and did the work on his award-winning paper while a student at Stanford University. The paper is titled: "The Space Shuttle External Tank as a Re-Entry Module". Kent proposes the use of the Shuttle tank, which would otherwise be expended, as a recovery capsule for manufactured goods developed in orbit.

EUROPE'S CREWS BEGIN TRAINING...Huntsville...Five European and American scientists selected last July to operate the experiments aboard the first NASA SpaceLab mission will begin training the U.S. this month. The training tour, which will take them to seven U.S. cities and two in Canada, will prepare them to operate the equipment associated with the scientific investigations previously identified to take place in the laboratory when it is carried into orbit aboard the Shuttle in 1981. The selection and training of these scientists represents a departure from the previous NASA practice of only flying career astronauts into orbit. The team was selected by scientists who have designed the experiments to be flown on SpaceLab. Additionally, this will be the first time that Western Europeans will fly in space, and the first time that NASA has flown anyone who was not an American citizen. Three of the payload specialists are European and two are American. The SpaceLab is a joint project of the European Space Agency and NASA.

SHUTTLE MAIN ENGINE FACES NEW PROBLEMS...Bay St. Louis, Miss...As if it didn't have enought problems already, the main engine of the Space Shuttle (SSME) has suffered a major catastrophic failure during tests at a NASA facility in Mississippi. The problem is unrelated to the earlier solved problems in the turbines of the complex high performance system. NASA officials report that the heat exchanger, which is used to warm liquid oxygen into a gas which is used to pressurize the LOX tank of the vehicle, suffered the failure. The heat exchanger is a very complex structure with many welds and convolutions resembling a radiator in an automobile. On one side of the exchanger is very hot hydrogen gas from the engine turbines, while the oxygen is on the other. The smallest leak will set off an explosion, and this is apparently what occurred in the recent test. In the last year the National Academy of Engineering reviewed the progress and problems of the SSME and concluded that, while at that time the heat exchanger had given NASA no trouble, it was a potential problem source which needed review.