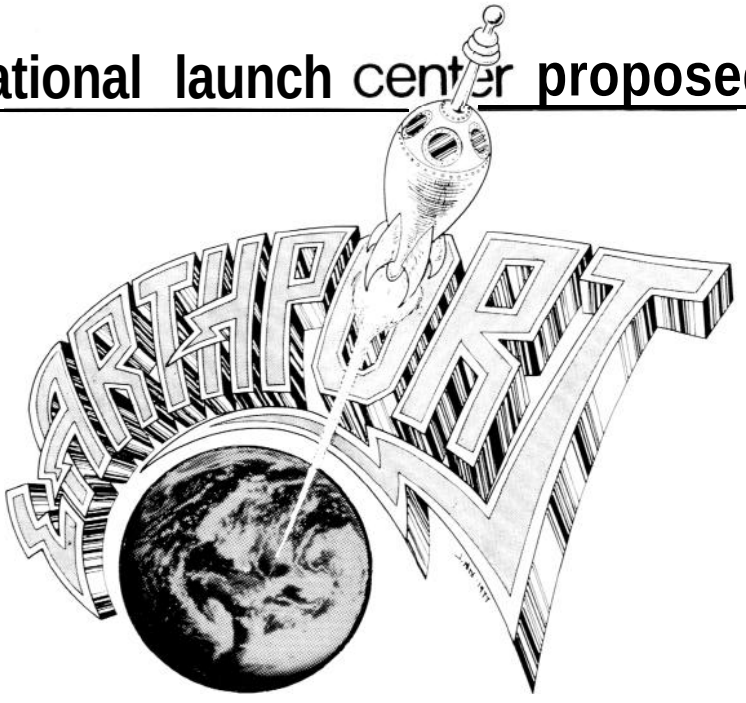
LATEST DEVELOPMENTS IN SPACE INDUSTRIALIZATION, SATELLITE SOLAR POWER. AND SPACE HABITATS

L5 NEWS

VOLUME 2, NUMBER 6 A NEWSLETTER FROM THE L-5 SOCIETY JUNE, 1977

international launch center proposed:



The Sabre Foundation

Space, long accessible only to powerful and affluent nations, will soon provide benefits to all humanity. New technologies promise to cut the cost of orbiting payloads by half or more in the next five years. If put to peaceful uses, these advances will be able to dramatically improve life all over the world.

Manufacturers will begin processing electronics parts and pharmaceuticals in space once launch costs decline, lowering prices to consumers. Many developing nations will be able to afford to launch satellites for the first time. For citizens of these countries, space will hold new systems of communications and long-term weather prediction.

An era of such potential occurs rarely. To reap its full advantage, the Sabre Foundation believes Earth's nations should take an unprecedented step: creation of an "Earthport," an international launch center at the equator.

As a symbol of the coming space age, it is perhaps fitting that the prime site for inexpensive launches lies along the equator rather than in the territory of the major powers. The extra spin of the Earth on the equator gives rockets a greater impetus into orbit, allowing payloads to be launched more cheaply there than elsewhere.

Other benefits attend an equatorial launch site. For example, satellites in equatorial orbit need fewer tracking stations, since they pass overhead in each circuit. Launch, rendezvous, and recovery "windows" are more available.

These advantages-and others-have attracted interest from many launch organizations. France operates a launch site in French Guiana; a smaller facility, under joint Italian-American management, exists in Kenya. Several American aerospace companies have approached the French government with plans for commercial launches at the equator, so far without success.

(Continued on next page)

BOLAND SLASHES SHUTTLE AND JUPITER ORBITER FUNDS

Proxmire Threatens Space Telescope

Carolyn Henson

The House Appropriations Subcommittee on Housing and Urban Development (HUD) / Independent Agencies has slashed $56.7 million from NASA's fiscal year 1978 $141.7 million Shuttle Orbiter production budget, plus $25 million from the Shuttle development budget. Subcommittee Chairman Edward P. Boland (D-Mass.) cut the funds on the basis of a report by an investigative group put together by Appropriations Chairman George H. Mahon (D-Texas) which warned of possible development problems the Shuttle may face.

Boland has defended his budget cuts, saying the Shuttle should prove itself before major expenditures are made in the production of the five-vehicle fleet. He has also pointed to the recently enacted Economic Stimulus Appropriations Act (the "Jobs Bill") which added $70 million to fiscal year 1977 Shuttle production funds, suggesting that the large funding for this year's work should compensate for the cut he hopes to make stick in next year's budget.

A source in the Senate Committee on Commerce, Science and Transportation, which had approved NASA's $141.7 million Shuttle production budget, says that Boland's decision "isn't a very good way to run a railroad," citing inefficiencies which occur when workers on a project are repeatedly hired and fired due to sporadic or uneven funding.

The $20.7 million budgeted to initiate the Jupiter Orbiter Probe was totally deleted by Boland's subcommittee on the grounds that the Space Telescope, which is also planned to be initiated in the fiscal 1978 budget, should be enough to keep the astronomers happy. Unfortunately, this program, if not initiated in 1978, will force the Jet Propulsion Laboratory

(Continued on page 6)

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(Continued from previous page)

Already, however, one private company has won rights for equatorial launches. A West German firm, OT-RAG, has signed an agreement with the government of Zaire to conduct suborbital tests of its commercial rockets in the coming year.

The Sabre Foundation considers a single international launch center to be preferable to scattered private sites. An international Earthport would permit cost savings through consolidation of support facilities, and, if established under proper auspices, run less risk of expropriation or use for military purposes.

More importantly, it would help to set the tone for the reach into space. Earthport would be a place for users from all nations and ideologies, an independent base for peaceful space enterprises of every sort.

Simple conditions would have to be met to establish a thriving international space port. Earthport should be an independent entity, administered by a non-political group devoted to humanity's scientific, educational, and material progress. Peaceful organizations, both public and private, from all countries should be guaranteed access to the site. Commercial users should be granted the liberty to build the infrastructure necessary for low-cost launch services.

The Sabre Foundation believes these conditions can be met through creation of an international space freeport. In a sparsely habited area as small as 200 square miles, launch facilities could be provided to serve users of every country. Revenues from leases of land at the site would go to the nation that helped make the freeport possible, as well as to provide basic services.

Given an absolute minimum of taxation and bureaucracy, investments from governments and private users alike would quickly make the freeport a flourishing launch center. The neutrality of the site, coupled with supervision to prevent arms from entering space, would insulate it from the play of international politics.

Among other advantages of Earthport:

Worldpeace. An international launch site would discourage nations from embarking upon duplicative and expensive rocket programs of their own. Weapons delivery systems now in place are dangerous enough. At a neutral international launch site, where inexpensive launch services were readily available, all nations could undertake space programs at far less cost to themselves and at no risk to peace.

Groundrules for space. A freeport would provide an ideal meeting place for nations to negotiate "live and let live" rules for peaceful space endeavors. Such rules will be essential to avoid later conflicts in space.

Space exploration. Earthport, aside from offering launch services with near-term cost savings, could be a center for global space efforts in the future. Space colonies and lunar expeditions in coming decades might be serviced from the site.

Existing launch organizations. Besides offering an equatorial outlet for both established and fledgling launch organizations, Earth port would create business for existing agencies and programs such as the Space Shuttle. The more satellites in orbit, the greater will be the need for help from nations with the ability to rendezvous with them. The Shuttle, for example, might regularly resupply, refurbish, collect materials from, and repair multi-million dollar satellites launched from Earthport. It might also return to Earth with entire satellites for modification or reuse of expensive components.

To assess the practicality of establishing a space freeport, the Sabre Foundation is undertaking a study of the project's potential advantages and drawbacks. Specialists from developed and developing nations will explore the concept's economic, political, legal, and technical aspects. Under the supervision of an international advisory group, the staff will prepare a report on alternative means of establishing Earthport.

The advisory group presently includes the following formal and informal members: Arthur C. Clarke, author; Krafft Ehricke, of North American Rockwell; George Robinson of the Smithsonian Institute; Frank Malina, co-founder of the Jet Propulsion Laboratory; Carolyn Henson of the L-5 Society; Raymond Bisplinghoff, former research director of NASA and former dean of engineering at MIT; Philip Chapman, former astronaut; and Larry Smarr, of Harvard Astrophysics Center.

Three committees have been organized to further the project. The government launch activities committee will explain the benefit of a space freeport to governments. The private users committee will approach aerospace corporations around the world to consider base-launch services. The freeport design committee, headed by Stanford professor Alvin Rabushka, freeport specialist, will investigate the legal and political nature of the freeport including the guarantee of its neutral status.

A detailed prospectus on the Earthport project has been prepared. The prospectus has been given to major multinational corporations and other possible donors of the $149,000 needed to undertake the study. L-5 Society members are welcome to contribute to or comment on the project. Free copies of the prospectus will be sent to people who send a contribution of more than $15.

The Sabre Foundation will invite suggestions and comments from private, national, and international organizations during the study. Assuming the concept is found to be feasible and attractive, the foundation expects negotiations with prospective users and host countries to begin nine months after the study is funded.

The Space Freeport Project is directed by Mark Frazier, a writer and consultant to aerospace publications. Earthport, says Mark, will be featured as the cover story of the September issue of *Reason* magazine. The project is based at 221 West Carrillo St., Santa Barbara, California 93101. Telephone: (805) 965-7947 or (805) 965-7166.

SPACE PROCESSING STUDY

Universities Space Research Association will soon submit to NASA/ Ames Research Center a proposal to begin a modest program to investigate the possible techniques which might be employed to process available lunar and asteroidal materials into material stocks suitable for downstream industrial use. The proposed program, beginning in June 1977, would last for one year. USRA would hire two post-doctoral level researchers who could address engineering aspects of bulk materials processing. Major activities of these two researchers would be as follows:

(1) Development of an inventory of lunar and asteroidal materials based on the available literature in cooperation with personnel at the Johnson Space Center.

(2) Participation in a summer study at the Ames Research Center on the definition of techniques for the bulk processing of raw materials to produce chemical and mineralogical separates (June 22 - August 3, 1977).

(3) Detailed discussions of the processing techniques proposed in the summer study and preparation of papers and experiment plans necessary to confirm the operation of such techniques, at least to the laboratory scale.

(4) Assistance in the development of a workshop on the processing of non-terrestrial materials to be held in conjunction with the Ninth Lunar Science Conference.

Applications (with references and short descriptions of interest) are requested from industrial, chemical or other appropriate disciplines. Please submit applications to: Dr. David R. Criswell, Universities Space Research Association, 3303 NASA Road 1, Houston, Texas 77058, (713) 488-5200.

Chemical engineers or chemists who would like to make useful materials out of dirt should contact David Criswell at once.

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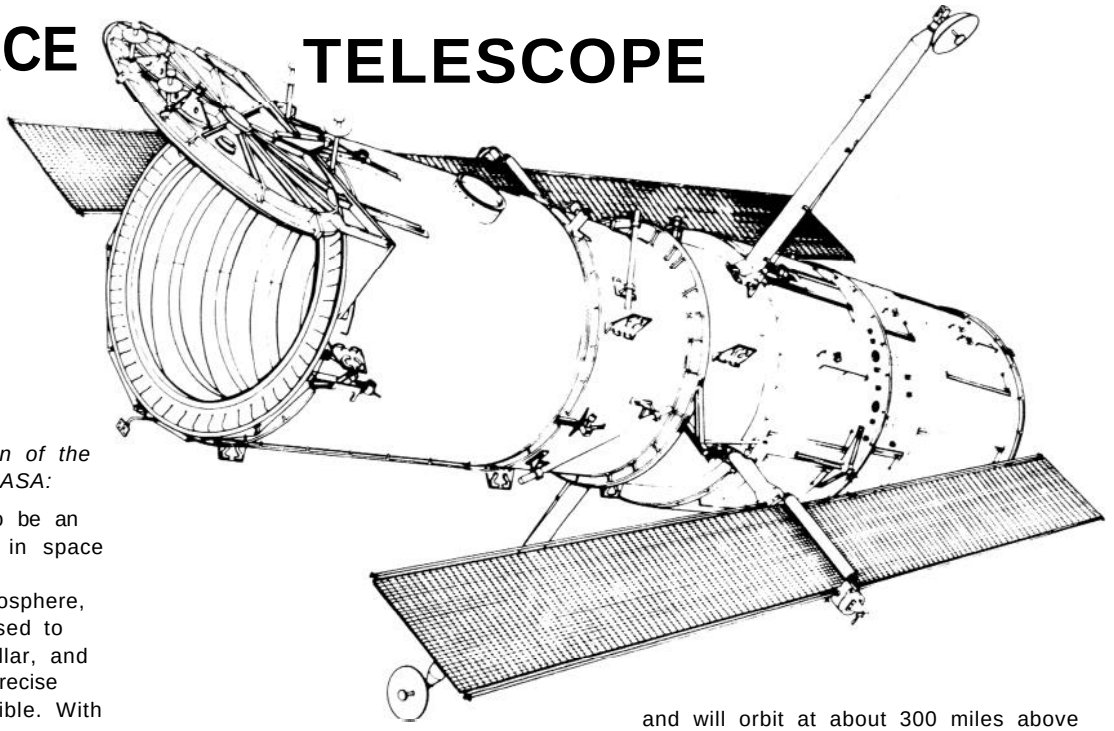
SPACE TELESCOPE



AN EYE IN SPACE

Following is a brief description of the Space Telescope project from NASA:

The Space Telescope (ST) is to be an international observatory located in space for the study of the universe. By operating above the Earth's atmosphere, the optical instruments can be used to study galactic, extra-galactic, stellar, and solar systems with much more precise resolution than is currently possible. With ST, astronomers will be able to:

- Study cosmology -- the limit and destiny of the Universe
- Study extremely powerful energy sources-quasars and pulsars
- Locate black holes
- Study closely the atmosphere and characteristics of our own planets
- Explore the process of star and planet formation
- Continue the process of discovery

The ST is an extension of Earth-based astronomy and has the endorsement of the National Academy of Science. It is expected to provide the next quantum jump in astronomy with associated advances in physics.

The ST is to be a 2.4 meter, diffraction-limited telescope system compatible in size and weight with the capabilities of the Space Shuttle system. It is composed of three major units: the Optical Telescope Assembly (OTA), the Scientific Instruments, and the Support System Module (SSM). The SSM contains the subsystems necessary for power, attitude control, fine pointing, communications, data management, and thermal control.

The ST is scheduled to be carried into orbit by the Shuttle in the mid 1980s. It will be periodically revisited by the Shuttle for maintenance, making the ST usable through the end of the century.

NASA contracted for two Phase B Studies of the Optical Telescope Assembly/Scientific instrument combination. These were completed by Perkin-Elmer and Itek. Itek has since joined Eastman-Kodak (prime) to compete with Perkin-Elmer for the OTA hardware. Teams of astronomers are currently defining the Science Instruments for NASA. Three Phase B Studies of the Support System Module have also been completed by Martin Marietta, Lockheed and Boeing.

NASA has announced a procurement schedule for the Space Telescope hardware in consonance with congressional direction. The Requests for Proposals were released on January 28, 1977. NASA has submitted the ST program in its FY '78 budget request as the highest priority new start. NASA is restricted from completing the procurement process until the program has been approved by Congress.

The Space Telescope uses existing technology, existing hardware and designs, and NASA low-cost systems wherever possible. Cost is a most important design parameter and, throughout the definition phase, cost performance trade studies were emphasized.

THE SPACE TELESCOPE

A Report by Elaine Meinel

Few things have irritated astronomers more than our dense atmosphere which is pulled like a heavy veil over our eyes. Of course, we are thankful for this mantle of breathable air, but to see as far as our already super-sensitive instruments can penetrate one must leave the Earth and step into space. The United States has obtained some experience with orbital telescopes. Two are still in orbit and two others failed before becoming operational -the last one malfunctioned before even reaching orbit. But so far these telescope satellites have been small affairs.

Last January, the *Washington Post* carried an article stating that President Carter was including in the budget a request for funds for developing and launching a large space telescope costing about $435 million. The telescope will have a 95-inch mirror (which is half as large as the largest mirror on Earth), which will be contained in a 46-foot by 14-foot cylinder weighing about ten tons, and will orbit at about 300 miles above the Earth.

The article also quoted Dr. John Bahcall, a professor of astrophysics at the Institute for Advanced Sciences at Princeton University, as saying, "We will be able to see things that are ten times smaller than we see now. . . It would be like reading the writing on a quarter that we could only tell was round before."

Since Princeton is only an hour's ride from New York, Dr. Matloff and Janet Matloff and I drove there on February 2, 1977, and interviewed Dr. Bahcall. He is one of the advisors for NASA on this project and he has testified on behalf of the space telescope before the House Subcommittee on Space Sciences. Before getting into the politics of financing the project, we asked Dr. Bahcall for more details about the telescope and its uses. He informed us, "The telescope is a multi-purpose observatory equipped in much the same way as the major observatories on Earth for a variety of projects. It would be monitored from Earth, the data gathered being sent back to Earth through a Tracking and Data Relay Satellite System which provides' coverage for about eighty percent of the orbit and relays the information to the Marshall Space Flight Center for processing. The telescope would be controlled from Earth but some astronauts may visit the installation while in orbit to make minor adjustments. The space telescope will be one of the first major facilities that will make use of the full potentialities of the Space Shuttle. The Space Shuttle will be used both to place it in orbit and to repair or refurbish any equipment in orbit and to retrieve it if necessary."

We wondered how often the telescope would be retrieved from orbit. "NASA calculates it should be taken in about every five years for a retooling job, though I'm not sure that this would actually happen because if the telescope

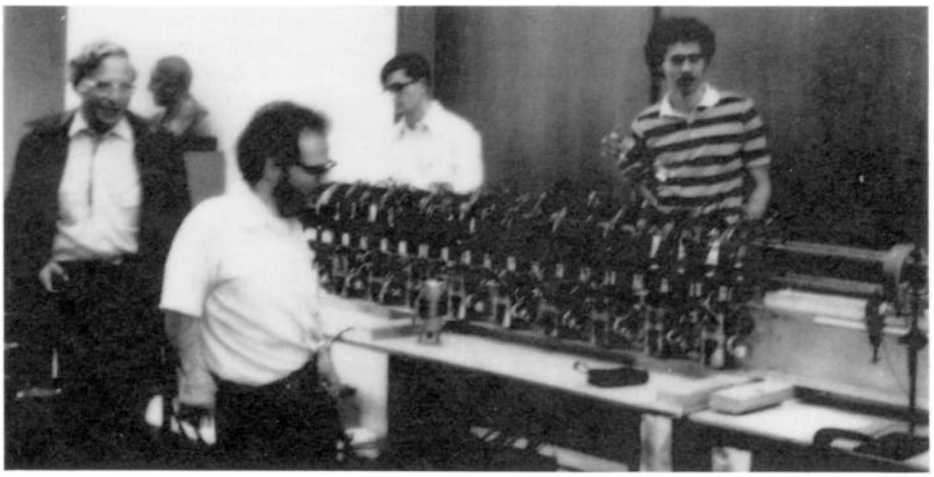
is functioning well, the instruments are working, and people are doing exciting research, I'd expect there would be tremendous pressure not to monkey with it," explained Dr. Bahcall. He added that the expected working lifespan of the space telescope would be approximately twenty-five to thirty years.

The space telescope would open our eyes to the wonders of the vast universe. It would allow us to observe light over the entire spectrum from the far ultraviolet to the far infrared or from 1100 Angstroms to about 1 mm (1 Angstrom = 10^{-8}cm). This will increase our ability to see a thousandfold (using an F/24 Cassegrain, Ritchey-Chretien optical with mirrors made from light-weight, ultra-low-expansion, fused silica). Dr. Bahcall told the House Committee on Space Sciences that, "I am probably among a small minority of scientists when I say that I hope, and believe, that the space telescope might make the Big Bang cosmology appear incorrect to future generations, perhaps somewhat analogous to the way that Galileo's first telescope showed that the Earth-centered, Ptolemaic system was inadequate." Because of the precision of the instruments, we will be able to see so far back in time, according to Dr. Bahcall, that we may even see the beginning of the universe! Actually, that is an optimistic estimate, but he is sure the telescope with that sort of magnitude could detect objects between seventy-five and ninety-five percent of the way back in time-talk about time machines!

In addition to this, the space telescope will perform more local studies such as surveying small asteroids for eventual mining and searching for planets of nearby stars. Just recently, astronomers in the NASA Flying Laboratory discovered that there are rings around Uranus which are too dim to see from Earth. This sort of discovery may become routine when the telescope is orbited.

But this will remain a tantalizing dream if Congress doesn't act on the bill. President Carter has given the bill his support but if the bill doesn't pass before recess, the $88 million funds which several of the European governments set aside for this project might be withdrawn. Worse yet, the aerospace and astronomical equipment manufacturers have already spent over ten million dollars of their own money and stand to take a loss if the project dies. But Dr. Bahcall is cautiously optimistic.

Lastly, we asked Dr. Bahcall how, assuming the telescope is launched, the astronomers plan to parcel out the privilege of using it. He said he believed NASA would set up a peer-review committee of astronomers who would evaluate proposals sent in by other scientists. He hopes to be involved in this fashion some time. We wish him luck and hope to see our first glimpse of a whole new universe by 1983.



The MIT construction team shows off the mass driver prototype at the Princeton Conference. From left to right: Professor Henry Kolm, Bill Wheaton, Bill Snow, Kevin Fine.

1977 SPACE MANUFACTURING FACILITIES CONFERENCE

Keith and Carolyn Henson

The stars of this conference, without any doubt, were Professor Henry Kolm of Massachusetts Institute of Technology and and the group of student volunteers who built the first mass driver (a linear synchronous motor designed as a catapult). This device is a prototype of a mass driver which is planned to be located located on the lunar surface for the purpose of catapulting lunar materials into space for processing. In its best test, the mass driver prototype produced an acceleration of thirty-three gravities. This is more than Dr. O'Neill, in his ground-breaking *Physics Today* article ("The Colonization of Space," September 1974). had considered necessary for the lunar surface mass driver.

The mass driver was demonstrated several times during breaks between conference sessions, each time with a round of applause for the team who built it in less than four months on a budget of $2,000. Plans are underway to upgrade its performance and possibly to demonstrate the model mass driver at the first Shuttle glide test this summer.

A round table discussion on the "people problems" of space was chaired by Georgetown University Dean Stephen Cheston. No conclusions were reached, but potential problems were discussed. For example, there was an animated exchange between space proponents who feel that environmentalists are natural enemies of the space solar power satellites project (they proposed that we ignore or attack the environmentalists), and those space proponents who consider themselves to be environmentalists first and space enthusiasts second (it should be noted that at the time of the conference one of the L-5 Society's Directors, Norie Huddle, was being held in a New Hampshire armory for her role in the Seabrook nuclear power protest).

Another hot topic was the question of how to deal with potential objections of the governments of the world. The firebrands proposed that we ignore these protests and rely on a strong defensive position in space. Others, however, felt that even those countries which don't at present have their own space programs should play a role in the planning of future space activities.

Crew selection and community planning were also lively topics, as most people have opinions as to who should go and how they should live once they get there. One hardy soul held out for self-selection on the basis of ability to buy a ticket to orbit, and for self-determination of community structure.

Overall, the conference had a different mood from the previous conference held at Princeton in 1975. There was less of the feeling of launching a world-saving crusade into space, and more of a realization of the work to be done. Whatever else might be said, no one was bored by the conference. The staff of the *L-5 News* hopes to print further discussion of the issues raised at the conference.

SOLAR CELL EFFICIENCY STATUS REPORTED

The University of Delaware has achieved 8.2 percent efficiency for a cadmium sulfide solar cell. This means that 8.2 percent of the sunlight falling on the cell is converted to electrical energy. Nine percent efficiency is expected by the end of the year.

Photon Power, El Paso, Texas, plans to produce a five-percent efficient cadmium sulfide spray process cell on a commercial pilot line by the end of 1978.

Colorado State University reports twelve percent efficiency with conducting oxide on single crystal silicon cells.

Each of the cells is being developed under Solar contract, from ERDA. The optimum efficiency possible varies from material to material. This figure may be as high as twenty percent in many cases, but for cadmium sulfide, the goal is closer to fifteen percent.

bibliography

RECENTLY PUBLISHED ARTICLES RELATED TO SPACE

Reviewed by Conrad Schneiker

"Comments on Generalized Criterion for Feasibility of Controlled Fusion and its Application to Nonideal D-D Systems," *Journal of Applied Physics,* Jan. 1977.

This article is a reply to a previous article in the same journal. The previous article was authored by researchers of the Fusion Energy Corporation. It discussed the feasibility of the MIGMA fusion concept, which has been seriously proposed as an ideal, near-to-medium term solution to the energy crisis. The present article states that "In attempting to 'generalize' the Lawson Criterion, the authors introduce errors of physics that lead them to draw incorrect conclusions about the feasibility of controlled fusion and the relative advantages of various reactor concepts." The rest of the article contains a very technical discussion supporting this statement. The article concludes, "The intimation . . . that 'advanced fuel' reactors are near at hand . . . is not based on serious arguments."

"Colonizing Mars: The Age of Planetary Engineering Begins," *Science,* Feb. 18, 1977.

This article is a discussion of a NASA report (NASA SP-414) titled: "On the Habitability of Mars: An Approach to Planetary Ecosynthesis." The authors of this report humbly conclude: "While not minimizing the enormous complexity of designing a planet-wide, efficient, steady-state microbial ecology . . . this task does not seem to be insuperable." To quote *Science: "* . . . NASA seems determined to find life on Mars-even if Earthmen have to put it there themselves."

"Isaac Asimov Advises the President: Here's the 'Only Road' to Save Civilization," *Science Digest,* Feb. 1977.

In an open letter to President Carter, Asimov reviews the prospect for present and future energy generation options and find all but one lacking. He then makes h-is case for solar power stations in space. Along the way he discusses how it will help prevent wars and solve other world problems. From there he leads into space habitation/industrialization: "The techniques developed for building such [space solar power] stations could be used to build other structures in space. There could be space observatories for the study of astronomy, and other sciences; space laboratories where dangerous experiments in nuclear physics and genetic engineering could be conducted with little risk to Earth itself; factories that would take advantage of peculiar properties in space (e.g., high vacuum, high and low temperatures, hard radiation) to carry on industrial procedures difficult or impossible to accomplish in Earth's surface environment." Asimov continues on to note that most of the necessary materials are available from the Moon. He proceeds to detail "Three great ultimate consequences [that] may result from our space activities, aside from obtaining energy and gaining world cooperation." He then closes by stating: "You can become space-oriented, then, President Carter; you can begin the planning, on an international scale, of the steps by which we may safely take what I believe to be the only road that will lead to the salvation of civilization."

"China in Space," James Oberg, *Science Digest,* Feb. 1977.

Oberg opens with: "After a belated and inauspicious beginning, China may emerge within the next five years as the third most advanced spacefaring nation." The article closes with: "We should not, therefore, be surprised in the next few years to see Chinese manned suborbital flights, orbital reconnaissance missions lasting many weeks, satellite interceptors destroying Soviet spy satellites, and possibly lunar and even interplanetary probes. As the USSR proved in 1957-1961, becoming a space power represents a big step towards world power. China has all the capabilities needed to attain such rank." The rest of the article does a good job of justifying these statements, while presenting a lot of interesting material along the way.

"Towards Laser Weapons in Space," *Science News,* March 5. 1977.

This article lists several breakthroughs in the field of high-power lasers. As things stand now, it appears that the use of high-energy laser weapons in space is imminent. As for the expected impact on the world, George H. Heilmeier (director of the Defense Department's Advanced Research Projects Agency) put it nicely: "It is my belief that the high-energy laser in space could represent a Sputnik-like event-a technical achievement which could influence the perceptions of foreign countries as to who is the leader in defense-related technology." Any comments?

"Living in Space -- How It'll Be," *Science Digest,* April 1977.

This article is a good "popular science" introduction to O'Neill type space habitats. Unfortunately it is out of date. Although published well into 1977, no mention is made of the outstanding results of the 1976 NASA/Ames Summer Study. In fact, the author states that the mass driver "is the one vital piece of equipment yet to be designed"! Many of the facts and figures are obsolete, making space colonization look more difficult and expensive than current studies indicate. The article closes by airing the opposing views of Dr. Johnson (NASA/ Ames) and Paul Siegler (Earth/Space Inc.) on how space colonization should be achieved.

A Systems Design for a Prototype Space Colony, MIT, Spring 1976.

This is a wide-ranging, lengthy report produced by a student project in systems engineering at MIT. A 1000-person prototype colony design is presented in detail. Many system and structural issues are discussed. A construction scenario is described, along with inspection and repair methods. In addition, the needed transportation system is designed. To round out the study, cost estimates and projections are given. An interesting result of the study is that the costs for a second colony are only fifteen percent of the costs for the initial colony.

"Buying a Shuttle Ticket," William F. Moore and Lt. Col. Conrad Forsythe, *Astronautics & Aeronautics,* Jan. 1977.

This article discusses how to go about getting space on the Space Shuttle. Also covered are pricing policy, contracts, user patent rights, revisit and retrieval services, optional and standard services.

"Experimenters Named for Unmanned Lunar Mission," *JBIS / Space Science,* Jan. 1977.

This article reports on the JPL study of the proposed 1980 lunar polar-orbiter mission spacecraft and a smaller companion spacecraft.

"Astronomical Notebook / 1.4 -- The Stability of L-5," J.S. Griffith, *JBIS / Space Science,* Jan. 1977.

A report on a numerical investigation using elliptical (instead of circular approximation) orbits to study the Earth-Moon and Sun-Earth system. The result shows that the orbits of small bodies near the L-4 and L-5 libration points are not stable. *[Editor'snote: An authority in the field says there are numerical errors in the computer program. In any case, a very small thruster would keep a colony in the L-5 orbit, or as seems likely, the 2:1 resonant orbit (see Sept. '76* L-5 News) *could be home instead.]*

"Brief Human Vacuum Exposure in Relation to Space Rescue Operations," M.A. Bodin, *JBIS / Space Science,* Feb. 1977.

With increasing levels of human activities in space, the opportunities for accidents in space and the need to deal

with them successfully will greatly increase. This article presents fascinating and radical (yet apparently sound) ideas on how this may be accomplished in special situations. The remarkable conclusion is "that voluntary vacuum-exposure may, in rare instances, be used as a volitional procedure to facilitate rescue. . . ."

"Space Power Systems-What Environmental Impact?" Barbara K. Ching, *Aeronautics and Astronautics,* Feb. 1977.

This article discusses the effects of microwave beams and vehicle exhaust on the ionosphere and the upper atmosphere. Included is a list of areas requiring further research.

"Small High-Technology Communities on the Moon," Dr. R.C. Parkinson, *Spaceflight,* Feb. 1977.

Major topics discussed here are: a lunar Skylab, extended stay surface missions, life support and power, permanent bases, nuclear power and natural resources.

"An Alternative Technology for the Lunar Colony," Dr. D.J. Sheppard, *Spaceflight,* Feb. 1977.

The author proposes low-technology/ civil engineering methods of lunar base construction. These proposals are then integrated with discussions of the lunar mass driver, economic self-sufficiency, and the "lunar handicap factor."

"Small High-Technology Communities on the Moon," Dr. R.C. Parkinson, *Spaceflight,* March 1977.

A continuation of the article by the same name in the February issue. Topics covered in this issue are: the mid-term base, the colonists, space transportation system, ecosystems on the Moon, natural resources, and the problem of value.

"Powersat: An Astronautical Energy Solution," *Spaceflight,* March 1977.

Based on a supplement to a statement by Richard W. Taylor, Vice-President of Boeing, before the U.S. Senate Subcommittee on Aerospace Technology and National Needs. It discusses Powersat concepts being considered by the Boeing Company.

"Priorities: Defense, Energy, Transportation /Whither Cost-Benefits in Space," John Newbaner, *Aeronautics and Astronautics,* March 1977.

This article discusses views contrasting with the following statement of Dr. Gerard O'Neill: "It is possible to go far and fast in space under the right circumstances. . . ."

2:1 IN 2001

BIBLIOGRAPHY UPDATE

"Social and Political Interactions among Extraterrestrial Human Communities: Contrasting Models" Magoroh Maruyama, *Technological Forecasting and Social Change,* vol. 9, pp. 349-360. 1976.

Abstract

The author discusses various models of interaction, such as symbiosis, redundancy, isolationist, competition, and hostility models. Various models have different epistemological bases. The author relates these models to five epistemologies: (a) homogenistic and hierarchical; (b) classificational, categorical, substance-based; (c) independent-event; (d) homeostatic, and (e) morphogenetic epistemology.

The author suggests that the heterogenistic, symbiotic model based on the morphogenetic epistemology is the most viable one, and biologically correct.

In the second part of the article, the author points out that: (1) contrary to the popular notion, many animals are non-territorial, and even territorial animals are seasonally territorial; (2) many animals and many human cultures are non-hierarchical; (3) intra-specific killings are rare in animals and occur only in very specified situations; (4) killings between species rarely occur beyond food needs; (5) extraterrestrial humans may follow divergent paths of biological and cultural evolution which can lead to symbiosis; (6) humanity's ability for intraspecific and inter-specific killings, abnormal compared to other animals, must be counteracted by another ability for long-range planning, which cannot be attained by a succession of short-range optimizations.

Space Manufacturing Facilities (Space Colonies), proceedings of the 1974 and 1975 Princeton conferences, American Institute of Aeronautics and Astronautics, 400 pages, hardcover, $20.

The proceedings of the May 1975 Princeton/AIAA/NASA Conference on "Space Manufacturing Facilities" covers all bases: space habitat construction, transportation, and costs; commercial products, services, and the economics of trade with Earth; human considerations -- physiology, psychology, sociology, politics, architecture, and law; current government activities and plans.

Also included as a self-contained Appendix are the proceedings of the very first assemblage convened for the serious discussion of space colonization: the Princeton Conference of May 1974. This historical meeting was instrumental in launching the entire space colonization concept as a practical and realizable endeavor.

Profusely illustrated with charts, tables, drawings, and photographs, this is required reading for anyone seriously interested in space colonization.

Send $20 per copy to: American Institute of Aeronautics and Astronautics, Publications Order Dept., 1290 Avenue of the Americas, New York, NY 10019.

USRA News and Notes

This is a newsletter published by the Universities Space Research Association. To receive the newsletter, write USRA, P.O. Box 1892, Houston, Texas 77001.

Information from ERDA

This is a free weekly newsletter containing news and announcements from the Energy Research and Development Administration. Most of our "News from ERDA" column is excerpted from it. To receive it, write: Office of Public Affairs, Program Coordination Branch, A1-5107-XXI, USERDA, Washington, DC 20545. Phone: (301) 353-5474 or -5475.

"Project Columbus - 1992" Brian O'Leary, *The Bulletin of the Atomic Scientists,* vol. 33, no. 3, March 1977.

"Economic Analysis of Materials Processing in Space," (Synoptic), *Journal of Spacecraft and Rockets,* Jan. 1977.

(Continued from page 1)

to disband a large team of scientists who have been working together for many years. It will take more than just money to recreate such a team. Also, unless the program starts next year, we will miss the best launch "window" for Jupiter in a decade, delaying the mission until the late 1980s.

On the brighter side, Boland added $5 million for solar power satellite research and $5 million for space industrialization research. He didn't explain, however, how these projects could get off paper and into the sky given a nonexistent or badly delayed Shuttle fleet.

How can the budget cuts be reinstated? The Senate Appropriations Subcommittee on HUD/Independent Agencies will pass on NASA's budget next before it goes to a vote on the floor, and make additions or cuts as it feels fit. Unfortunately, the subcommittee chairman, William Proxmire (D-Wis.), has already publicly vowed to cut out the Space Telescope project as well. One Senate insider recently complained to the L-5 staff, "Why doesn't anyone point out that while Proxmire has consistently attacked NASA's budget, he has approved some of the biggest boondoggles in the country-I'm speaking of housing and urban renewal programs which have been utter failures."

Our Wisconsin readers are reminded that Senator Proxmire is from your state. Congresspeople are rumored to listen to their constituents.

Inside the L-5 Society

BOARD OF DIRECTORS

Konrad K. Dannenberg, Leonard David, Edward R. Finch, David M. Fradin, Carolyn Meinel Henson, H. Keith Henson, Mark M. Hopkins, Barbara Marx Hubbard, Norrie Huddle, Magoroh Maruyama, Jim Oberg, Phillip Parker, Jack Salmon, Romualdas Sviedrys, J. Peter Vajk, William H. Weigle.

MICHIGAN STATE CHAPTER

An L-5 local chapter called the Space Colonization Organization at Michigan State University has been formed. The president is Jim Gottleber; vice president is Linda Mattingly and secretary is Tammy Hopkins. Those who wish to contact this group should write to: Space Colonization Organization, 603 W. Holmes, MSU, East Lansing, MI 48824.

NEW ADDRESS IN HOUSTON

The Houston Chapter has a post office box. Our mailing address is now: Houston Chapter, L-5 Society, P.O. Box 57598, Webster, TX 77598.

AEROSPACE LAW MEETING

Any members of the L-5 Society who are in Chicago on Friday, August 5, 1977, would be welcome to sit in as non-voting guests at the meeting of the American Bar Association, Aerospace Law Committee, at 8:30 P.M. at the Sheraton Chicago Hotel. At this meeting, matters concerning the new Moon Treaty in the United Nations and the alleged claims by certain Equatorial Nations to positions on the Geostationary Orbit will be discussed as well as other matters on international law of outer space.

NORTHWEST L-5 CHAPTER

Greg Bennett, Boeing engineer and president of the Northwest chapter, will be appearing on a panel to discuss space colonization with writers Larry Niven, Jerry Pournelle and Frank Herbert at Westercon Science Fiction Convention being held in Vancouver, B.C., July 1-4. Interested persons should contact the organizational committee, Box 48701, Bentall Sta., Vancouver, B.C., Canada, V7X 1A6.

INSIDE THE OFFICE

Reorganization of the office for efficiency combined with producing the May issue, staffing a table at the 1977 Science Fiction, Fantasy, Horror World Exposition held in Tucson and an interview session with CBS 60 *Minutes,* have put order processing several weeks behind, a situation which should be resolved presently. As with any rapidly changing system, mistakes are bound to be made, so if your order is over eight' weeks old, and you have not heard from us, please write and we'll try to resolve the situation.

We'd like to thank Danny Lee, Tucson, and Chuck Barnard of our paid staff for their efforts in the reorganization, literally working around the clock to put things in order.

SLIDE CHANGES

Once again, our slide offerings are under scrutiny to remove those which have become obsolete and to add the new slides that we've obtained. In order to cut duplicating and handling costs, the newly organized sets will be sold as sets of five slides only. The old set will still be available for a limited time after the reorganized set is announced.

WHAT'S AVAILABLE FROM THE L-5 SOCIETY?

- Xerographic reproductions of articles from other publications (please ask for list).
- *The Hunger of Eve: A Woman's Odyssey Toward the Future,* Barbara Marx Hubbard, Stackpole Books, 1976. $8.00
- *The High Frontier: Human Colonies in Space,* Gerard K. O'Neill, Wm. Morrow and Co., 1977. $8.00.
- *The Fourth Kingdom,* William J. Sauber, Aquari Corp., 1975. $6.
- *Colonies in Space,* T.A. Heppenheimer, Stackpole Books, $12.
- *War and Space,* Robert Salkeld, Prentice Hall, Inc., *unbound,* $7.
- *L-5 News,* back issues $1 each (Vol. 1:1-16, Vol. 2:1-4).
- *Space Settlement,* special edition of *L-5 News* (Vol. 2:5), $2.
- Pioneer XI in the Rings of Saturn 17" x 22" color poster, $3 each.
- Bernal Sphere color postcards (interior, exterior). 15¢ each; 50 of one kind, $3.
- Bernal Sphere 14" x 17" color posters (interior, exterior). $2 each.
- Introduction to the L-5 Concept, 18 slides, $9.
- Space Industrialization, 28 slides, $14.
- Satellite Solar Power Stations, 12 slides, $6.
- Space Habitats, 18 slides, $9.
- The L-5 Society Slide Show, all 76 slides, $38.

Note: **Postage and handling per order, add $1. Prices subject to change without notice. Wholesale pricing available on some items. Write for details.**

L-5 SOCIETY MEMBERSHIP FORM (please type or print)

NL 706

L-5 SOCIETY
1620 N. PARK AVE.
TUCSON, AZ 85719

NAME: _____

ADDRESS: _____

CITY/STATE/ZIP: _____

AFFILIATION/TITLE OR POSITION: _____
(OPTIONAL)

I am am not interested in being active locally. Phone (optional) _____

__ Please enroll me as a member of L-5 Society ($20 per year regular, $10 per year for students). A check or money order is enclosed. (Membership includes *L-5 News,* $3 to members; the balance -- $17 or $7 -- is a tax-deductible donation.)

__ Please enter the above as a nonmember *L-5 News* subscriber ($20 per year). A check or purchase order is enclosed.

__ Enclosed find a donation of $_____. (Donations to L-5 Society are tax-deductible.)

Letters

My Princeton paper is a definitive treatment of the flight mechanics of space colonization, and I will put the final nails in the coffin of L-5 as a place for the colony. So you better think about 2:1 resonant orbits instead, and the idea of changing the society name looks better and better.

T.A. Heppenheimer
Heidelberg, West Germany

Can we put a little colony at L-5 just for sentimental reasons?

I vote to keep the L-5 Society name. It's catchy, easy to remember and has been used more than once to start a conversation and generate interest in our cause. There is so much to do, that worrying about a change in our name is one of our least problems.

I've come across such varying responses to space colonization that even though I feel that there is a large body of people cut there who would be willing to support us, I believe we face an uphill fight against entrenched politicians and a public that is totally ignorant of even the basic concepts of space development. Getting our point of view across will continue to be one of our main objectives in the years to come. We should all dig in and prepare for a long hard fight.

Richard W. Bowers
Philadelphia, Pennsylvania

Last September, the U.S. Congress passed the U.S. Space Week resolution, designating the Apollo 11 anniversary (July 16-24 of each year) as U.S. Space Observance; calling upon the citizens of the United States to observe this period with appropriate ceremonies and activities.

The Utah Space Association would like to invite the L-5 Society and its affiliates throughout the nation to participate in the U.S. Space Observance. We believe the anniversary of Apollo 11 will be an excellent opportunity to stress the past achievements of the space program, and to encourage increased public interest. Space Week will also be a unique opportunity for space-related organizations throughout the nation to encourage America to do its best in space achievement, and to stress the ways humanity is benefited. I believe the U.S. Space Observance will be an excellent opportunity for L-5 Society Chapters throughout the nation to stress to the public the benefits of the L-5 space concept towards our nation's and the world's economic and energy development.

I had the opportunity of originating U.S. Space Week in 1971. It started as a locally based effort, but has since developed into a growing national effort. The American Institute of Aeronautics and Astronautics had aided the effort substantially. Articles about Space Week appeared in the December 1976 and January 1977 issues of *Astronautics and Aeronautics.* Last year the governors of 32 states declared Space Week in their states, and President Ford declared July 20, 1976 as Space Exploration Day.

Any help the L-5 Society could give towards bringing the U.S. Space Observance closer to the public, would be sincerely appreciated. I'd appreciate knowing your views concerning these matters.

J. David Baxter
Utah Space Association
378 I St.
Salt Lake City, UT 84103
(801) 359-0251

I would like to recommend a book to you. It is entitled *Hothouse Earth* and is written by Dr. Howard A. Wilcox.

He warns of the danger of thermal pollution that is caused by many of our energy sources (including fossil fuels and nuclear energy). Thermal pollution is simply the addition of heat into the air causing an increase in temperature. Within my lifetime (I'm fifteen), the thermal pollution could build up to a point of melting the ice caps, which would cause floods in many cities around the world. These include New York, London, Tokyo, and my hometown, San Diego. This is strong enough evidence to switch to solar energy, which doesn't pollute the air or land.

The solution Dr. Wilcox offers is to put solar panels in the ocean, which would attain energy and food from installed kelp farms. I believe, though, we should use Peter Glaser's approach. But we definitely need to switch to solar energy, the ultimate and unlimited energy source.

A famous Russian scientist, Kardashev, classifies energy-famished societies in three groups. A civilization of Type I (something like our own stage of progress) occupies the entire surface of its planet and relies entirely on the energy sources of its territory. A civilization of Type I I exploits the total resources of its planetary system, colonizes other areas in the solar system, and derives the utmost benefit from its solar heat.

A supercivilization of Type I I I has already expanded beyond its solar system. It utilizes the sources of energy provided by some of the tens of billions of stars.

Kardashev's deductions indicate a technological community's conversion from Type I to Type II must be fairly rapid. The Earth's population now stands at the threshold of its transmutation to Type II. We must now switch to a Type I I civilization!

Fossil fuels and nuclear energy are just temporary and dangerous sources and should be recognized by the people of the entire world as temporary and dangerous sources.

Richard Hankins
La Mesa, California

The experts split on weather: we will roast or freeze. Either way, I would rather watch it from a space habitat!
--KH

IN THIS ISSUE