

L-5 NEWS

A Newsletter from the L-5 Society
Number 5 *January * 1976

SENATE HEARINGS ON SOLAR POWER FROM SATELLITES

The Subcommittee on Aerospace Technology and National Needs will hold public hearings on "Solar Power from Satellites," January 19 and 21. Peter Glaser of Arthur D. Little, Inc., will testify on the photovoltaic solar satellite power station (SSPS) concept at 9:30, January 19. Following him at 10:30 will be Gerard K. O'Neill of Princeton University, who will describe his space manufacturing facilities/colonization approach to solar power satellites.

The afternoon of the 19th, the committee will hear testimony from representatives of Econ, Inc., which has been studying the tradeoffs between ground and space-based power systems (see Nov. L-5 News, p. 5), and Boeing Aircraft, which has been developing the photothermal Powersat concept.

Representatives from ERDA's Office of Solar, Geothermal, and Advanced Systems, and from NASA will testify January 21.

These hearings were organized partially as a result of urging by Senator Barry Goldwater. The L-5 staff would like to thank the Subcommittee staff members, who have studied power satellite concepts in depth for the last five months in preparation for the hearings. We also extend our thanks to Jerry Grey of the AIAA (American Institute of Aeronautics and Astronautics), and L-5 members T. Stephen Cheston, Michael Michaud, and Keith and Carolyn Henson, who all provided information to the Subcommittee. We especially appreciate the role played by G. Harry Stine, whose recent book on space, *The Third Industrial Revolution*, has a foreword by one of the Subcommittee members - Barry Goldwater,

SPACE RESEARCH COMMITTEE CALLS FOR ABSTRACTS

The nineteenth meeting of the Committee on Space Research, to be held in Philadelphia, June 8-19, will include a Symposium on Materials Science in Space and an International Symposium on the Future of Science in Space. There will also be several open working group meetings. Two of rather unusual interest are on exobiology and gravitational biology.

The deadline for submission of abstracts is February 13. Those who are interested should contact Mr. Dean T. Kastel, Secretary, Panel on International Relations, Space Science Board, National Academy of Sciences, 2101 Constitution Ave. NW, Washington, DC 20418.

U.N. INTEREST IN SPACE COLONIZATION

In a letter to L-5 Society, Peter Jankowitsch, Austrian Ambassador to the U.N. and Chairman of the U.N. Outer Space Committee, says, "Space colonization as a future possibility for the peaceful use of outer space technology is gaining increasing attention from a number of member countries of the Outer Space Committee of the United Nations." Following are excerpts from a statement by Ambassador Jankowitsch before the Political Committee of this year's General Assembly.

"As this Committee is once again reviewing progress in international cooperation in outer space and means to enhance it further, we are well aware that the process of conquest of outer space continues unabatedly. Indeed, very few fields of modern technology have developed as rapidly over such a short period of years as the technology of what is very justly described as the space age.

"International cooperation in this field has followed technical progress closely even if not always simultaneously. This was all the more so, as it became soon evident that any potential application of space science and technology could only be beneficial if their inherent international character were recognized. The need for a *fundamentally international approach* towards the many questions and problems of outer space is nowadays generally recognized. There is also unanimity that the blessings of space technology must be made available to all nations and people and that, far from being a costly extravagance of a few rich powers, it has particular relevance for economic and social development.

"The United Nations, as the most advanced and most universal form of expression of humanity's interdependence and coherence known today, constitutes a natural organizational basis and framework to ensure that this world-wide spreading of technology is carried out in such a way as to minimize potential dangers of friction among nations.

"The complexity of the issues involved, of course, can only be met adequately if organizational solutions are sought. As is well known in this Committee, the Austrian delegation has consistently expressed the view that solutions sought exclusively or predominantly by means of a regulatory legal approach cannot lead to any optimal - and in fact badly needed - international use of technology.

"I have already had an occasion during this year's session of the Outer Space Committee to discuss some radically new prospects in the application of space technology.

"Within the past year a new dimension of our thrust into space has become the object of public discussion. It is called *space colonization* or the development of

space manufacturing facilities. The central ideas of space colonization are to establish a highly industrialized, self-maintaining human community in free space, at a location along the orbit of the moon where free solar energy is available full time. Costs are to be reduced greatly by obtaining nearly all of the construction materials from the surface of the moon. At the space community lunar surface raw materials would be processed into metals, ceramics, glass, and oxygen for the construction of both additional communities and of products such as satellite solar power stations.

"Such colonies-if we can follow the flights of creative imagination of their inventors-could also relieve the earth of further exploitation and open up at last another new frontier for man."

The complete text of Ambassador Jankowitsch's statement is available to L-5 members.

FORMER DELEGATE CALLS FOR UN CONFERENCE ON OUTER SPACE

Ambassador Peter Jankowitsch of Austria, whose country is a Member of the Committee on Peaceful Uses of Outer Space of the United Nations, recently made an excellent factual brief future-looking statement to the Political Committee of the UN General Assembly. His emphasis upon a fundamentally international approach to outer space; his recognition of the outstanding scientific and technological achievement of the Joint US/USSR Apollo-Soyuz flight of 1975 and the impetus which is given to outer space stations and outer space manufacturing; the recognition of biomedical and biological future programs and research; the benefits already realized from space communications systems for national and international educational purposes, with the assistance of UNESCO and ITU; the future possibilities of direct broadcast satellites and the improvement of the exploration, discovery and use of the world's natural resources for the benefit of all mankind; the future possibilities of energy from outer space; and, most importantly, the recognition that technically and economically advanced countries cannot assume that their interpretations of the Peaceful Uses of Outer Space and its benefits are necessarily shared by all the countries of the world, make his report to the UN Political Committee an outstanding document.

He is quite right that there must be a balance, particularly in remote sensing of data, between the necessity for states to have access to data covering their own territory and efforts to prevent any abuse of this data by others. The nations of the world are well on the way to working out this balance for the future. He recognizes that space colonies not only represent tremendous potential for the Earth in energy, metals, ceramics, and new crystals, but also could relieve the Earth

of further exploitation and open up, at least, another new frontier for man.

He is quite correct that the UN program on space applications, which began several years ago, is essential for the future of outer space and represents the combined efforts of the UN expert, the Outer Space Committee, and the UN specialized agencies.

The distinguished Ambassador emphasizes the public good for everybody, worldwide, for outer space. He has perhaps failed only to emphasize enough the increasing impetus of the economics of outer space, which is a new compelling force for international cooperation.

He calls for a United Nations Conference on Outer Space to be held before 1980, which should have the support of all.

The Executive Committee of the New York Chapter of the L-5 Society extends warm Greetings to all members of the Society for the year 1976 and all the years ahead.

Respectfully submitted,
Edward R. Finch

Edward R. Finch is the Chairman of the American Bar Association Aerospace Law Committee, a former U.S. Special Ambassador and U.S. Delegate to the Fourth and Fifth U. N. Congresses. He presented a paper, 'International Law and Outer Space Stations, "at the 1975 Princeton Space Manufacturing Facilities Conference.

THE CONQUEST OF SPACE CAN PAVE THE ROAD TO PEACE

Konrad K. Dannenberg

Economic considerations invite an international approach to the conquest of space, since requirements for investment capital might transcend the political willingness of any one nation to assume such responsibility. Furthermore, it seems that the sociological benefits of space colonization will accrue mostly to the poorer, developing nations. They need new space capabilities for education, communications, and especially for energy, but they do not have the financial means to provide such systems. Thus all nations should be encouraged to pool their resources and to tackle jointly the salvation of our planet.

Most scientists and engineers will agree that the construction of large and permanent habitats in space is within humanity's reach. Progress in these endeavors has been held back by existing sociological, political, and economic conditions, but *not* by technology.

Recent studies have implied that space habitation could become economically viable if used for the construction of solar power stations in orbit. Estimates show that revenues from the sale of space power on Earth will be ample to recover the initial cost as well as the interest expense for these power stations.

The problem seems to narrow down to the sociological and political issues,

amplified by the huge demand for investment funds on a hitherto unprecedented scale.

The key issue is whether or not the world should spend billions of dollars-or equivalent-on the construction of solar power stations at a time when disease, hunger, and even famine are global problems, also requiring the injection of massive funding for their solution.

Meaningful answers must certainly provide for quick contributions to immediate problems, such as food supply, poverty and disease, pollution, conservation of critical resources, etc.

Direct broadcasting from satellites into homes, schools, community centers, and other public places, can obtain many of these objectives by improved communications and dissemination of information. The audiences will be instructed in planting, harvesting, care of crops, health services, and general education. Such a system is presently being tested in India. It (ATS-6) is, furthermore, rather inexpensive, and similar systems can therefore be started as soon as a decision is made.

It is proposed to manage a space colonization program in five major elements: (1) Communication satellite systems; (2) Educational programs; (3) Solar power systems, their construction and operation; (4) Ground simulation, in preparation for "space habitats"; and (5) Establishment of the habitats for permanent living in space and exploration. All five phases of the program should be planned, managed, and implemented by a team of international participants.

To make such a program a reality, it is proposed to conduct planning and early study activities under the aegis and guidance of the United Nations. Ambassador Jankowitsch's presentation to the U.N. Outer Space Committee can become a most important first step in such an undertaking,

Konrad K. Dannenberg helped develop the Redstone and Jupiter missile systems. He was Jupiter Project Director, and later Deputy Manager of the Saturn Program. He presented a paper, "'Organizational Possibilities for Space Habitat Realization,' at the 1975 Princeton Space Manufacturing Facilities Conference. Dannenberg is currently active in the International Association of Educators for World Peace, the World Future Society, and the L-5 Society.

WORLD DYNAMICS

Preprint copies of Peter Vajk's paper "The Impact of Space Colonization on World Dynamics" may be obtained by writing to:

Technical Information Department
Lawrence Livermore Laboratory
P.O. 808
Livermore, California 94550

Request the paper by author, title, report number (UCRL-77584), and date (November 14, 1975).

U.N. ACTION COMMITTEE PROPOSED

Several members have requested that the L-5 Society begin actively working with the United Nations. There are currently two major areas of interest. The first is the need to obtain a U.S. response to Jankowitsch's call for an international approach to space colonization.

The Office of United Nations Political Affairs, Bureau of International Organization Affairs, Department of State, has stated that the time for a U.S. response to the Jankowitsch statement is long past; the real debate in the Committee on the Peaceful Uses of Outer Space takes place each spring, and the Committee report presented to the U.N. General Assembly each fall is routinely accepted with little discussion. If we want the U.S. government to make a statement on space colonization in a U.N. forum, we must focus on preparations for U.S. participation in the spring, 1976, meetings of one or both of the following subcommittees of the Committee on-the Peaceful Use of Outer Space:

Scientific and Technical Subcommittee
Geneva, March 22 - April 9

Legal Subcommittee
Geneva, May 3-28.

Last year our representative to the Scientific and Technical Subcommittee was Arnold Frutkin, Assistant Administrator of NASA for International Affairs, though preparatory work was done in the Office of Technology Policy and Space Affairs in the Department of State, Bureau of Oceans and International Environmental and Scientific Affairs. Our U.N. political experts believe that the Scientific and Technical Subcommittee is the more logical focal point, and comment that it could use some new subjects to deal with.

Another possible focus for U.N. space colonization activity is the proposed Habitat Conference, May 3 to June 11, 1976. We have not yet received an answer to our request to participate from the conference organizers. This is probably because they are having major difficulties. According to *Science*, December 19, 1975, the City Council of Vancouver, Canada, recently voted 10 to 1 to rescind their offer to host the conference because members of the Palestinian Liberation Organization are planning to attend. Also, Margaret Mead, a leader of the "Non-Governmental Organizations" associated with the conference (and a space colonization supporter) has declared that "preparation of the U.S. government for its role in the conference is nil, just plain nil."

If the conference organizers manage to overcome these difficulties and Habitat remains on schedule, it could provide us with a world-wide forum. Those who wish to participate in the L-5 U.N. Action Committee should write to L-5 News or call Carolyn Henson at 602/622-3344.

WHITE HOUSE REPORT

President Ford has created the Office of Public Liaison whereby he and his top advisors could meet with varied elements of society. FASST (which stands for the Federation of Americans Supporting Science and Technology) was asked to participate twice in 1975. The second meeting, on December 2, was equally divided between FASST members and representatives of other science-related organizations brought together by FASST.

The topic was science and technology policy. The speakers came from NASA, NSF, NIH (National Institute of Health), OMB (Office of Management and Budget), and ERDA. There were long question and answer periods.

Mr. John Yardly, Director of NASA's Office of Space Flight, said of O'Neill's space colonization, "We don't think it's quite as near in as he does, but we're very excited about it."

Bill Weigle, an L-5 Director and FASST member, attended the meeting.

SPACE COLONIZATION AT PRINCETON

Brian O'Leary recently moved to Princeton as Visiting Research Staff. He will be working in the fields of space colonization and planetary physics.

O'Leary received his Ph.D. in astronomy at Berkeley in 1967. He has been on the faculties of Cornell, Caltech, Berkeley, and Hampshire College. He is a former scientist-astronaut, and was, until recently, a consultant for the House Committee on Interior and Insular Affairs, Energy and Environmental Subcommittee. He is an author and lecturer with over forty papers in the field of planetary science. He wrote *The Making of an Ex-Astronaut*, Houghton Mifflin, 1970.

Gerard O'Neill, professor of physics at Princeton and the author of the ground-breaking articles, "The Colonization of Space," *Physics Today*, September, 1974, and "Space Colonies and Energy Supply to the Earth," *Science*, December 5, 1975, will be leaving for Stanford this month to work at the Stanford Linear Accelerator (SLAC) for three months.

Virginia Reynolds is O'Neill's research assistant at Princeton; she will remain there while he is working at SLAC. She also puts out a newsletter every few months on O'Neill's activities. Those interested in receiving the newsletter or other information should write to her at P.O. Box 708, Princeton, New Jersey 08540.

Brian O'Leary can also be consulted on technical matters while O'Neill is at SLAC. He can be reached at Princeton University, Department of Physics: Joseph Henry Laboratories, Jadwin Hall, Princeton, NJ 08540.

ERDA NEWS:

ERDA Request for Feedback

The Energy Research and Development Administration has initiated a "consumer representation plan," saying:

"The purpose of the Plan is to strengthen two-way communication mechanisms to induce consumer and public interest group participation in planning and conducting the national energy technology program assigned to ERDA, and to aid consumer groups to focus their attention on issues of special concern within broad technology programs, particularly when R D&D decisions are being made.

"The Plan indicates that existing formal and informal mechanisms of communication need to be strengthened in order to provide the public with sufficient information to permit value judgments to be made on the full range of energy technology options encompassed in ERDA's *National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future*, first published in June, 1975.

Following is a list of some of the hearings to be held as part of this plan, with the participation of Environmental Protection Agency, Energy Research and Development Administration, Federal Energy Administration, Interior and State Departments:

Friday, January 16, 1976

Boston, Sheraton Boston Hotel

For registration information contact Frank Prout, P.O. Box 8948, Boston, MA 02114; 617-223-6300.

Wednesday, January 21, 1976

Houston, University of Houston

For registration information contact: James Evans, P.O. Box 20694, Houston, TX 77025; 713-226-4851.

Monday, January 26, 1976

Denver, Brown Palace Hotel

For registration information contact Janice Cavaliere, P.O. Box 25628, Denver, CO 80225; 303-234-4215.

February, To Be Announced

Washington, DC

Those who would like information on ERDA's RD&D Plan or ERDA's Consumer Representation Plan should write to Alfred P. Alibrando, Assistant Director for Public Information, ERDA, Washington, DC 20545. To submit comments on the Consumer Representation Plan, contact Bart J. McGarry, 8th Floor, ERDA, Washington, DC 20545. Deadline is February 24, 1976. He is also available by telephone, 202-376-4074, to answer questions about consumer representation.

Solar Cell R&D

The "Low Cost Silicon Array Project," sponsored by ERDA and conducted by the Jet Propulsion Laboratory, will award \$12 million in contracts for (1) the production of low cost solar grade silicon;

(2) the economical production of silicon in large sheets; (3) improvement of solar cell array lifetimes so that they can exceed 20 years; (4) the development of automated production methods.

ERDA Office of Public Affairs

ERDA has established a permanent organization for its Office of Public Affairs to replace an interim one which had been in effect since ERDA officially began operation in January, 1975.

John (Jack) W. King is the OPA Director, and Robert W. Newlin is Assistant Director. They can be reached at 202/376-4070. Major functions within the office are headed by four assistant directors for specific programs. They are:

Alfred P. Alibrando (202/376-4074), Assistant Director for Public Information, with responsibility for providing information to the news media and the public on all ERDA activities;

Bart J. McGarry (202/376-4074) Assistant Director for Public Services, among whose functions are to increase public awareness of national energy options, to foster educational programs, and to sponsor special projects;

Charles W. Pelzer (301/973-4357), Assistant Director for Communication Services, whose functions include planning and producing science demonstrations and exhibits, films, radio and TV materials, and publications and reports;

Edwin E. Stokely (301/973-3388), Assistant Director for Technical Information, among whose functions are to acquire, organize, and disseminate scientific, technical and practical information.

The Office of Public Affairs is split between two locations - 20 Massachusetts Avenue in Washington, D.C., and Germantown, Maryland.

Located in Washington, D.C., are the Director and the Assistant Directors for Public Services and Public Information; In Germantown, Maryland, are the Assistant Directors for Communication Services and Technical Information; the public information news branch covering nuclear and national security programs; the Historian; and the Program Coordination personnel.

Charles J. Hitch Elected Chairman of ERDA General Advisory Committee

Charles J. Hitch, president of a Washington-based private research institution and former President of the University of California, has been elected Chairman of the General Advisory Committee to ERDA.

Hitch is President of Resources for the Future, a nonprofit corporation for environmental research and education. He will serve a one-year term as chairman of the nine-member General Advisory Committee which advises ERDA on scientific and technical matters relating to its energy programs. The committee was transferred from the former Atomic

Energy Commission to ERDA by the Energy Reorganization Act of 1974.

Appointed to the General Advisory Committee by the President on September 24, 1975, Hitch will serve as a committee member for a term which expires on August 1, 1978. Other members of the committee, appointed by the President to serve varying terms, are: William R. Gould, Executive Vice President, Southern California Edison Company; Arthur G. Hansen, President, Purdue University; Henry R. Linden, President, Institute of Gas Technology; Michael M. May, Associate Director-at-Large, Lawrence Livermore Laboratory; Richard S. Morse, President, Massachusetts Institute of Technology Development Foundation, Inc.; Ruth Patrick, Chairman, Board of Trustees of the Academy of Natural Sciences of Philadelphia; Gerald F. Tape, President, Associated Universities, Inc.; and Martin J. Ward, General President, United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada.

Fisher Howe is Secretary of the General Advisory Committee.

ERDA BACKGROUND REPORT

ERDA'S REPORT TO CONGRESS

The Energy Research and Development Administration report submitted to Congress, June 30, 1975, and recently revised in response to public hearings (see "L-5 Society Presents Testimony at ERDA Meeting," Nov. '75 L-5 News) calls for "Inclusion of the solar electric approach among the 'inexhaustible' resource technologies to be given high priority. . . . The technologies for producing essentially inexhaustible supplies of electric power from solar energy will be given priority comparable to fusion and the breeder reactor." However, ERDA currently is not planning to bring solar electric funding up to levels comparable to nuclear R&D until after the year 2000.

ERDA'S BUDGET

In fiscal 1975, ERDA allocated \$8.8 million to all forms of solar energy research, and \$1.8 billion to nuclear energy research. Incidentally, \$1.1 billion of ERDA's budget was devoted to military purposes, i.e., related to making bombs.

For fiscal 1976, ERDA has requested a total of \$1.9 billion for all forms of energy R&D, with \$50 million to be allocated to all forms of solar electric research. In the light of ERDA's total proposed energy R&D budget, the \$1 million that Presidential candidate Morris Udall has requested for O'Neill's space solar power option is trivial (Sept. L-5 News). But viewed in relation to the current priority that ERDA has placed on solar power, it is a great deal

SEAMANS ON NUCLEAR AND SOLAR POWER

A degree of insight into ERDA's current attitudes toward the relative priorities of nuclear and fusion power can be gained from the following excerpts of a speech by Robert C. Seamans, Jr., the Administrator of ERDA, delivered to the Atomic Industrial Forum, November 18, 1975.

"We here, more than anyone else, must recognize the absolute need for nuclear power, and the urgency with which we must develop the potential of nuclear power for the service and the survival of the Nation. Yet in the face of this obvious fact of life, we find an industry beset with problems, hobbled by self-doubts and mired in uncertainty.

"So, I think the first thing that is needed here is a renewed commitment on the part of all of us that we need a nuclear industry; that we will have a nuclear industry; and that we will overcome whatever obstacles present themselves. Once we make that commitment, I believe we will find that the problems are solvable.

"Similarly, we need your support in our work on the nuclear breeder. It is pointless to worry about exactly what year the breeder should come on line. It is sufficient to know that it has great potential, and we must get on with the development now.

"A successful breeder, of course, can expand out fuel supply by as much as fifty times or more. It can assure our Nation of a plentiful supply of energy for centuries to come. But, we know the breeder requires further development, and that much engineering and tests remain before we can resolve all technical, economic, environmental, and safety issues.

"To solve the issues, we need your support, your imagination, your creativity, your determination, your vision, and your commitment.

"We currently are working on three so-called infinite energy technologies for the next century: solar electric, fusion, and the breeder. In their current stages of development it would be foolish to put all of our hopes on only one. But, I should note that we are farther along in our development of the breeder than either of the other two.

"We noted in our plan that we submitted to Congress in June of this year that the breeder, fusion and solar can provide energy for the long term, but we must not rule out the possibility of using the breeder in 15 or 20 years. The sooner, the better."

The work in recent years of O'Neill, Glaser, Woodcock, Gregory, and others in the filed of space-generated solar electric power has done a great deal to raise the credibility of their concepts. Especially with the publication of Gerard O'Neill's "Space Colonies and Energy Supply to the Earth," *Science*, December 5, 1975, the solar satellite power station concept

is sufficiently well-documented that it can be taken seriously as an energy alternative.

The problem now is to communicate this to ERDA. Its administrators are justifiably leery of new energy proposals. Various individuals and groups are promoting thousands of novel energy sources. Some of these proposals violate the laws of thermodynamics; others are hopelessly expensive and inefficient; some have an intolerable environmental cost. A few are worth serious study and R&D funding. ERDA is faced with the task of sorting out the serious proposals from those that are either impractical or just plain kooky.

SOLAR IS FOREVER

(Reprinted from *Energy Reporter*, the Federal Energy Administration Citizen Newsletter, December, 1975.)

In the spy thriller, *Diamonds are Forever*, agent James Bond uncovers a sinister plot to use orbiting, diamond-laden satellites as solar-power laser weapons.

Author Ian Fleming's device was pure fantasy, but under NASA sponsorship several American firms are designing a giant array of solar energy panels to orbit the earth.

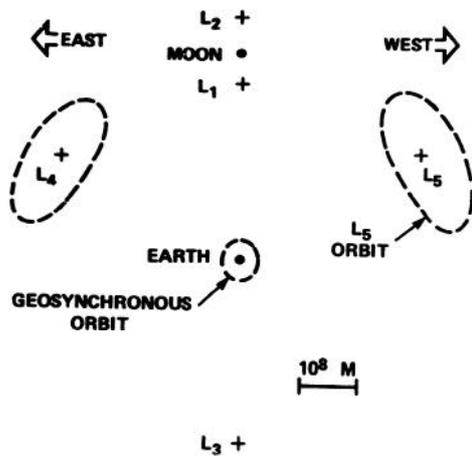
In space, the availability of usable solar rays twenty-four hours a day eliminates an obstacle to harnessing solar energy on the earth's surface-nighttime. Lacking available landmasses to house giant, solar collector systems, Japan, Israel, and some European nations are expressing interest in the concept.

Hardy photovoltaic cells in the eighteen-square-mile panels would turn sunlight into electricity. The proposed unit could generate several times as much electricity as the average nuclear plant. This solar electricity is fed into microwave transmitters on the satellite, then beamed to earth, where it is safely changed back into usable current. Program officials are aiming for a flight experiment by 1985 and an operating system by 1997.

Is it safe to have such a beam aimed at the earth? Project Director Peter Glaser of Arthur D. Little, Inc., tells *Energy Reporter* that birds, flying through the thickest part of the beam, cannot be injured. If the beam went haywire, could it burn a strip of desert across the earth's surface? "No," says Glaser, "if the directional control device should accidentally slip, the microwave energy would be scattered, reducing the power to a level of harmless communications signals here on earth."

The unit would cost about \$7.5 billion, a "per-megawatt cost" comparable to that of other energy sources. Free information packets are available from Ellen McCauley, Arthur D. Little, Acorn Park, Cambridge, Massachusetts 02 140.

Energy Reporter is available free to citizens from FEA, see page 8 of this issue of L-5 News.



WHAT ARE LIBRATION POINTS?

T. A. Heppenheimer

Our organization name is the L-5 Society, and our newsletter has stated that L-5 is one of the libration points in the Earth-Moon system. But what are libration points? The answer is that libration points are locations where a spacecraft may be placed so as always to remain in the same position with respect to the Earth and the Moon.

Suppose the Earth and Moon were fixed in space and did not move. Then a single libration point would exist at the point where the gravity fields of Earth and Moon cancel out. A body placed there would feel equal and opposite attractions from Earth and Moon, and so would stay fixed in place. But if the body were moved slightly, it would feel a slightly greater attraction from either Earth or Moon, and so would fall down, moving rapidly away from the libration point. That point, therefore, is unstable.

In reality, the Earth and Moon are in motion about their center of mass. (It is the Moon, of course, which does most of the moving.) This means that, in addition to the gravity of Earth and Moon, we must take account of the centrifugal force acting on a body in orbit. Libration points are then the points where these three effects cancel out: the two gravity fields, and the centrifugal force.

The French mathematician, Lagrange, in 1772, showed that there are five such points. Three of them lie on a line connecting the Earth and Moon; these are L-1, L-2, and L-3. They are unstable; a body placed there and moved slightly will tend to move away, though it will not usually crash directly onto the Earth or Moon. The other two are L-4 and L-5. They lie at equal distance from Earth and Moon, in the Moon's orbit, thus forming equilateral triangles with Earth and Moon. These points are stable. It is a curious fact that they are stable because the Moon is only 0.01215 times the total mass of Earth and Moon together. If the Moon were greater than 0.03852 times the total mass, L-4 and L-5 would be unstable.

The situation, however, is even more complex than this. The Sun is in the picture, and it disturbs the orbits of spacecraft and colonies. It turns out

(from an extremely messy calculation done only in 1968) that with the Sun in the picture, a colony should be placed not directly at L-4 or L-5, but rather in an orbit around one of these points. The orbit keeps the colony about 90,000 miles from its central libration point. The orbit is roughly bean- or kidney-shaped. It may seem curious to speak of an orbit about a point. Actually, the colony is in orbit about the Earth, but the simplest way to describe the orbit is from the point of view of an observer sitting always at the libration point.

In the colonization project, the colonies are to be located in the vicinity of L-4 or L-5. L-2, located behind the Moon, is the site of a catcher vehicle, which collects mass shot up from the Moon by the mass-driver. L-1, between the Earth and Moon, is the location of a satellite power station, to provide power for the moon base. No use has yet been found for L-3. However, at L-3 the Moon is permanently eclipsed by the Earth, so it could serve as an asylum for people suffering from lycanthropy (werewolf tendencies).

POWER FROM SPACE

Microwave transmission of power rests upon two recent advances in electronics: a means for efficiently generating large quantities of microwave energy, and a means of directly converting this energy back to direct-current electricity.

The microwave generator is a somewhat remote descendant of the tubes first used in World War I to generate radar beams. These tubes were wasteful of power, short-lived, and prone to heat up when high power levels were demanded. But the basic principle of operation has not changed over the years: electrons are made to spiral around a permanent magnet, to produce the microwave energy.

Over the years, these tubes were improved, and now are mass-produced in the hundreds of thousands per year, for use in microwave ovens. A major advance came about with the introduction of the new material for the magnets, samarium cobalt. This not only permitted the magnets to be reduced in size by ninety percent, it also meant great improvements in efficiency, since the electrons would spiral in further and give up more energy, before striking the magnet. Another advance came about through the use of platinum, to supply electrons through the process known as secondary emission, wherein a small amount of microwave energy is made to stimulate a flow of electrons from the thin layer of platinum.

The result of these advances is a device known as the amplitron. A single such device, only a few inches in diameter, can produce up to five kilowatts of microwave power, at efficiencies approaching ninety percent. Then, if a given amount of energy is fed into a bank of amplitrons (as direct-current electricity), only ten percent of

that energy will be rejected as waste heat. The rest will be converted into microwaves.

Microwaves are easy to form into a beam, and can travel long distances with very little absorption in the atmosphere. They readily penetrate even the thickest clouds and rain, to arrive at the receiving antenna, or rectenna. The heart of the rectenna is a system of small dipole antennas, similar to the rabbit ears of a TV, each connected to a device known as a Schottky-barrier diode. Microwaves, collected by the dipoles and fed into the Schottky diodes, are converted there to DC electricity with an efficiency of over eighty percent.

In the Goldstone experiments, the seventeen receiver panels on the tower mounted 4,590 of these dipoles. Each one was T-shaped, and about four inches long, with the T-arms held vertically to discourage birds from roosting. The receiver panels were not designed to intercept the entire beam, but rather covered only about ten percent of the beam area. But they demonstrated a maximum efficiency of 82.5% in collecting their portion of the microwave beam and converting it to electricity. Other experiments showed overall efficiencies of 54% for the total system, so that, of the power initially fed into the amplitrons, 54% was subsequently recovered from the rectenna. This is not the limit, however; engineers such as Richard Dickinson talk confidently of achieving an overall efficiency of seventy or even eighty percent.

In an actual application, the rectenna would be several miles in diameter; the small antenna elements and Schottky diodes would be turned out by the millions. They would be mounted on panels, which would simply be set upright at a convenient angle. There would be no need for precision adjustment of these panels, or of close tolerances and high accuracy in their assembly. The rectenna could be placed wherever land is cheap: in desert country, in rocky or hilly terrain, or even in the ocean. A floating rectenna, out at sea, its panels bobbing up and down, would be a distinct possibility. The electricity gathered from the large number of individual panels would be fed through solid-state devices known as inverters, to convert it from direct current to alternating current at the usual 60 cycle frequency. It would then be fed directly into the nation's power grid, being transmitted up to hundreds of miles by standard overhead power lines or by undersea cable.

The first serious proposal for a solar power satellite was made by Peter Glaser, a vice-president of Arthur D. Little, Inc., a research firm in Cambridge, Massachusetts. The original discussion was in an article, "Power from the Sun: Its Future," in *Science*, late in 1968. With support from NASA, he teamed up with William C. Brown of the Raytheon Company, inventor of the amplitron, and with a group of engineers from Grumman

Aerospace Corporation.

Glaser's powersat design consists of two large panels, each over three miles on a side, with the entire powersat being some seven miles long and weighing 25 million pounds, 25 times as much as the Power Relay Satellite. The panels are not completely covered with the solar cells, rather, mirrors are used to concentrate the sunlight, so that only half the area of the panels needs to be covered.

The panels are to always face the Sun. Mounted between them, free to turn to always face the Earth, is the transmitting antenna, three thousand feet in diameter. Within this antenna are the amplitrans; in the vacuum of space, they need no glass tubes. The microwave energy produced by the amplitrans passes down hollow aluminum tubes or waveguides, escaping through slots in the direction of the Earth. Phaseshifters are used to produce a tight, well-focused beam.

An important result of their work was the devising of a means to prevent the power beam from wandering off from the rectenna. Their solution calls for a small portion of the microwave energy to be reflected back up to the satellite, as a pilot beam, to provide a reference signal for controlling the phaseshifters. If the power beam were to wander off, this pilot signal would be lost, the phase-shifters would fail to keep the beam properly focused, and the beam would spread out, dissipating its energy harmlessly over the entire Earth and surrounding space. The spread-out beam would then be no more harmful than the signal from a radio station.

The power beam would be deliberately designed to spread out slightly on its way to the ground, to meet environmental restrictions on allowable power per square foot. Radiation leaking from a microwave oven is pulsed, and can thus be dangerous, but power-beam radiation would be continuous, which is much safer. Animals wandering into the beam, or birds flying through, would find their bodies warming up slightly. It is not true, however, that they would be cooked: turkeys flying into the beam would not fall out, ready for the Thanksgiving table. (The biggest problem may be keeping birds off the rectennas on cold nights.) Airplanes flying into the beam would find the microwaves would bounce off their aluminum skins.

The U.S. standard for exposure to microwaves is ten watts per square foot. In the center of the rectenna, there would be ten times this limit, but at the outer edges, only one-tenth the limit. So the main safety feature would be a chain-link fence, to prevent people from wandering into the rectenna area. Microwaves are not a penetrating, ionizing form of radiation, like x-rays or the radiation from radioactive substances, and do not cause cancer or genetic damage. They merely warm the body.

Inevitably, some microwave energy will leak from the transmitting antenna,

at levels far below even the strictest medical limits but quite sufficient to cause radio interference. It will thus be necessary to assign certain radio frequencies for purposes of power transmission only. The ten-centimeter wavelength is particularly desirable for this, since it is associated with particularly high efficiencies of the amplitrans and the Schottky diode, and penetrates the atmosphere well. Of course, any time there is a new allocation of radio frequencies, some people will get upset, and the radio astronomers will be particularly unhappy. But a space program which can build powersats can also build very large new radio telescopes in space, so maybe the astronomers can be bribed.

The above is an excerpt from Chapter 3 of a forthcoming book "Colonies in Space," by T. A. Heppenheimer and Richard C. Mesce.

CULTURAL FICTION GROUP TO DISCUSS EXTRATERRESTRIAL COMMUNITIES

Magoroh Maruyama

At an American Anthropological Association meeting in San Francisco, December 2, a group was formed consisting of those who are interested in future cultural alternatives of human societies both on the Earth and outside the Earth. The group will explore and develop fictional and non-fictional methods and formats for a new type of literature to discuss, describe, and communicate possible future cultural alternatives, both desirable and undesirable. Topics include: large complex societies, heterogenistic planning, international development, post-industrial cultures, design of extraterrestrial communities, and contact situations with non-human extraterrestrial cultures.

This informal group grew out of the Symposium on Future Cultures, and includes Judith Merrill, science fiction writer. The group will publish a newsletter *Speculative Anthropology* as a means for idea exchange, development of manuscripts, information on related activities in other fields, etc. If you are interested in obtaining the newsletter, contact Darlene Thomas, Lock Haven State College, Lock Haven, PA 17745. A list of members in your geographical area may be obtained.

KRAFT EHRICKE AND SPACE INDUSTRIALIZATION

T. A. Heppenheimer

Kraft Ehricke, scientific advisor to Rockwell International Corporation, is among the most distinguished scientists involved in the space program. He was one of the original group at Peenemunde which developed the V-2, under Wernher von Braun, during World War II. In the postwar years, he was involved in early studies of large manned spacecraft, while at Bell Aircraft. He held major

responsibilities for the development of the Atlas booster, and subsequently of the Centaur upper stage, while at Convair. In recent years, with Rockwell, he has been involved in studies of space projects offering major economic returns.

One such proposal is the Power Relay Satellite. Its purpose is not to generate space power, but rather to transport large amounts of power through space, between points on the Earth's surface. There are many reasons why this is desirable. Conventional power lines cannot span oceans, nor can they be built economically over thousands of miles. Thus, there are power sources which might never be developed for want of a means to transport the power to a market.

There are ten to twelve gigawatts of hydroelectric power developable in New Guinea, as well as vast amounts of solar power available in the great equatorial deserts, such as the Atacama (Peru) and the Kalahari (Southwest Africa). There is the possibility of large-scale power production using thermal gradients in mid-ocean. Moreover, it would be useful to run many power plants at a more economical full time rate, rather than shutting them off and on to match demand; this continuous operation would be possible if there were a world-wide power distribution system.

Dr. Ehricke envisions such terrestrial power sources powering phased-array microwave transmitting antennas, which produce power beams directed into space. These are reflected from Power Relay Satellites: lightweight radio reflectors, which reflect the beams back to the ground. There, they are intercepted by rectennas, and the power is recovered, to be fed into the local or regional network.

This system could be highly competitive since it could deliver electricity at an added cost of less than one cent per kilowatt-hour. The competitive nature of this concept has already been demonstrated, even for an Earth-launched relay satellite, and even with a launch vehicle no more advanced than the Space Shuttle. Even greater economic advantages may follow from building the relay satellite in a space colony. This is a concept deserving further study.

The interplay of the concepts proposed by Ehricke, by O'Neill, by Glaser and Woodcock, and by other workers, certainly will lead to a deeper understanding of the implications of the new ideas of space colonization and of space industrialization.

The following bibliography cites a number of Kraft Ehricke's writings: "Space Industrial Productivity: New Options for the Future." Presentation before the House Subcommittee on Space Science and Applications hearings on Future Space Programs, July 22-30, 1975. "Lunar Industries, Their Value to the Human Environment on Earth," *Acta Astronautica*, Vol. 1, pp. 585-622. May-

June, 1974.

"The Power Relay Satellite: A Means of Global Energy Transmission through Space," Rockwell International, Report E74-3-1, March, 1974.

"Extraterrestrial Industry-A Challenge to Growth Limitations," Essential Resources Conference, The Conference Board, Washington, D.C., April, 1973.

"Statement," 1973 NASA Authorization - Part 2 (record of Congressional hearings), pp. 375-428, March 8, 1972.

"The Extraterrestrial Imperative," *Bulletin of the Atomic Scientists*, pp. 18-26, November, 1971.

"Philosophy and Outline of Long-Range Space Planning for the Needs of This Nation and Mankind," Rockwell International, Report PD71-16, July 1971.

"Planning Space Stations for Long-Range Utilization of Space for Earthians," Rockwell International, Report SD71-562, 1971.

"Space Tourism," in Vol. 23, *Advances in the Astronautical Sciences*, American Astronautical Society, 1968.

"The Nexus Concept," *Astronautics and Aeronautics*, Jan., 1964.

"The Anthropology of Astronautics," *Journal of the American Rocket Society*, November, 1957.

PSYCHOCULTURAL ASPECTS OF L-5 SOCIETIES

Some psychological and cultural considerations in the design of space communities are outlined in an as-yet unpublished paper by Magoroh Maruyama of Portland State University. Maruyama's discussion arises from the premise that many of the natural restraints which restrict life on Earth, such as temperature, humidity, lighting, weather, etc., can be removed or manipulated at will, permitting new types of cultures and social organizations.

"In the future," he writes, "the Earth might be looked at as an uncomfortable and inconvenient place to live as compared to the extraterrestrial communities. . . . The Earth might be regarded as a historical museum, a biological preserve, a place which contains harsh climate and uncontrolled weather for those who love physical adventure, or as a primitive and primeval place for tourism."

Maruyama then discusses the principle of heterogeneity (vs. that of homogeneity), describing it as the source of growth, enrichment, resource diversification, evolution, symbioticism, and survival. He concludes that space communities should be heterogeneous in design.

After briefly mentioning the macro-geometry of the community structure, and concluding that "different geometrical forms of the communities may also influence the types of social

interactions and social organization which take place in them," he discusses the solipsism syndrome, a dreamlike state of mind which may occur when everything in the environment is viewed as artificial. He proposes several methods for combating solipsism: (a) living in a large macrogeometry; (b) the introduction of unpredictability, either artificially, by means of a random number generator, or naturally, by allowing animals and plants a degree of independence; (c) being able to contribute personally toward something that grows-a child, or even plants-as it "is important to feel that the Universe is not static or thermodynamically and informationally decaying, but is self-generating and morphogenic"; and (d) having "something beyond the horizon," giving the feeling that the world is larger than that which is visible.

Turning to social organization, he then proposes three "exaggerated" examples: (1) A hierarchal and homogeneous community which believes in the "best" way to live, seeks universal criteria and categories, and regards diversity, non-standard behavior, and minority groups as abnormal and undesirable. Such a community would design most living units alike, concentrating then in one zone, placing recreational and industrial facilities in other zones. (2) An individualist and isolationist community, which believes independence is a virtue and self-sufficiency the highest form of existence. A living unit in this society would be like "a self-contained castle . . . insulated against others in terms of sight, sound, and smell." (3) A heterogeneous, mutualist, and symbiotic community, which believes that the basic principle of biological and social processes is heterogenization and symbiotization due to mutual interaction. In this society every building (and every apartment within each building) would be different. The basic design criterion would be "harmony of diversity."

He then addresses problems related to the sociological concepts of *Gesellschaft* and *Gemeinschaft*, localization and interweaving in heterogenization, matching, self-sufficiency, turnover of personnel, and the Shimanagashi syndrome-the isolation felt when confined to remote places (which has even affected some people living in Hawaii). Maruyama believes that, in spite of extremely well-developed electronic communications, the inhabitants of space communities will feel the effects of restricted travel to the Earth, but that after several communities are built, and travel between them become easy and inexpensive, there will be less problem.

The final topics considered are sensory esthetics, epistemological and philosophical esthetics related to architecture and landscaping, and possible international participation in the development of space communities. In conclusion, he states that "it might well

be that some other ways of living-not necessarily those found in other existing cultures, but possible new ways of living that do not yet exist-may turn out to be more desirable under extraterrestrial conditions and these ways of living may be based on epistemologies and logics different from the one prevailing in European and American cultures."

Professor Maruyama is in the Systems Science program at Portland State University, and is well known in anthropological circles. He was a member of the NASA/Ames-Stanford-ASEE Summer Study on Space Colonization, is co-editor of *Cultures Beyond the Earth*, and organized the Cultural Futuristics Contest of the American Anthropological Association (see Oct. 1975 L-5 News).

INSIDE THE L-5 SOCIETY FINANCIAL STATUS

The L-5 Society staff is proud to announce that this month the L-5 Society, thanks to new memberships and donations, did not run in the red!

L-5 Director Dave Fradin has called for the formation of a Finance Committee. As the founder of FASST, Dave was quite successful in raising funds. He hopes to repeat his success in working with this organization.

Dave has called for the Society to put a greater emphasis on providing information to the public. For example, we are currently limited to providing speakers only in their own local areas. L-5 members who are "stuck in the middle of nowhere" would be greatly assisted in their work if the Society could fund speakers to travel to their communities. By the way, the Tucson L-5 Chapter has found that the arrival of an out-of-town expert is an occasion suitable for local TV and newspaper coverage, so that one lecture can indirectly reach a significant percentage of the population of a community. The U.N. Conference on Habitat is another example of a project where a comparatively small amount of money could provide information to a large number of people.

Those with ideas and a willingness to work on ways to raise and spend money efficiently are invited to join the L-5 Finance Committee. Please write to the L-5 News office at 1620 N. Park, Tucson, AZ 85719, or call 602/622-1344.

The much overworked L-5 Staff was pleased to have the assistance of T. A. Heppenheimer of Fountain Valley, California, and Charles Barnard of Menomonie, Wisconsin, both of whom put in many hours of labor at the L-5 News office. We were also joined by Tucsonan Daniel Lomax of Community Data Systems. Staffers Keith and Carolyn Henson renew their offer of room and board to those who wish to work on the L-5 News while visiting the balmy winter resort of Tucson.

We are still operating entirely with

volunteer labor, office space donated by Analog Precision, Inc., and computer services donated by Digitgraph.

The current L-5 News format is less expensive to print than the one previously used. We hope it meets with your approval. If not, we will return to our previous format in exchange for a \$75 per month contribution earmarked for that purpose! All kidding aside, we welcome your comments and suggestions regarding the newsletter.

PUBLICITY

Philip J. Parker, who has organized the United Kingdom Chapter of the L-5 Society, has recently gotten articles on space colonization into several British newspapers with a combined circulation of some three million, as well as doing two radio interviews.

The next most active publicist was Alabaman William C. Bush, who was responsible for several in-depth articles on space colonization in the Huntsville Times.

LOCAL ACTION

A number of members have written in to ask what is involved in becoming "active locally." The L-5 Staff has been making up lists of those who indicated they wished to be active locally on their membership forms, sorted by geographical area. When a reasonable number have joined from a given area, we send copies of the list to all those on it.

The New York Metropolitan Chapter is an excellent example of what can be done by members who wish to be locally active. For information, call Loren Abdulezar at 212/582-7287, or Dan McHugh at 212/439-6840. The mailing address of their chapter is 333 J St., Brooklyn, N.Y. 11201.

The Legal Subcommittee of the New York Metropolitan Chapter, consisting of Gene Cronin of the Fordham Law Review and Ambassador Edward Finch, is currently working on an amendment to the L-5 Bylaws to facilitate the operations of local chapters.

Konrad Dannenberg, one of Huntsville's L-5 activists, has proposed that we offer a special organizational membership rate for local chapters. In exchange, the local group would have the monthly newsletters mailed to one address for local distribution. The more expensive membership services, such as providing slides and copies of unpublished articles, would be reserved for full members only.

If the L-5 Society had no slide reproduction, copying, or mailing expense expenses, and assuming continued free labor and overhead, the newsletter could be produced for \$10 per member per year, assuming an average of 50-60 new or renewal memberships per month. On this basis it seems reasonable to extend the student rate to those who wish to pick up the L-5 News through their local chapter. The L-5 Staff would like to hear some feedback on this proposal before bringing it to the Board of Directors for a vote.

BOOK REVIEWS

THE THIRD INDUSTRIAL REVOLUTION

G. Harry Stine, G.P. Putnam's Sons, New York, 1975.

This book is a very enjoyable and readable book of optimistic capitalism extended into space. It can be enjoyed by a reader with technical interests but only semitechnical background. It has sufficient technical curiosities to stimulate the practicing engineer into dreams of applications.

That is what *The Third Industrial Revolution* is all about: applying and using space for a profit.

The book relates this coming commercial thrust into space to our past industrial revolutions. It contains a brief description of the possible transportation systems and what is in space that is useful. The bulk of the book is devoted to describing what can be done easier, cheaper, or only in space. Catchy chapter titles announce: "Energy Enough for Everything," "Room With a View," "Made in the Solar System, I," "Made in the Solar System, I I," "Engineering with Atoms," and more.

A very interesting table of "space industrial processes" is attributed to Wuescher, who unfortunately is not listed in the references. At least one of the recent suggestions, vacuum vapor fabrication, is missing.

The last few chapters of the book become more philosophical, with the titles, "People and Human Institutions in Space" and "Return to Eden." The final chapter is entitled "The Action." However, specific actions are difficult to project and optimistic enthusiasm comes across in large doses with lines such as "The first billionaire space moguls are now alive."

Mr. Stine has written a book to be profited by and enjoyed. It is just the sort of bill of fare for L-5 enthusiasts. It can be obtained by writing to G. P. Putnam's Sons, 200 Madison Avenue, New York, NY 10016.

Review by Ralph C. Sklarew, *Science Applications, Inc.*

THE FOURTH KINGDOM

William J. Sauber
Aquari Corp., Midland, Mich. 48640
115 pp., \$6.95

A single period of instability in the sun's energy output has the potential of wiping life from this planet. This book brings forth a reason for human existence in the development of a "fourth kingdom": non-living devices which are lifelike in form and function, machines capable of transporting life away from the dangers inherent in an unstable sun.

Under this premise, the colonization of space becomes an imperative built into the human animal. The development of both human civilization and machine technology is traced and related to this premise.

This is a good book for the general reader.

BIBLIOGRAPHY UPDATE: POWER SATELLITES

"The Satellite Solar Power Station-A Step Toward the Industrial Use of Space," Peter E. Glaser, September, 1975.

This is a paper prepared for the International Astronautical Federation 26th Congress in Lisbon, Portugal, this year. Leonard David, Director of the Aerospace Student Programs for FASST, 1785 Massachusetts Ave., Washington, D.C. 20036, has several copies of this paper which he will make available to L-5 members on request.

"Wireless Power Transmission Test Aims at Harnessing Sun One Day," John F. Mason, *Electronic Design*, Vol. 23, No. 25, Dec. 6, 1975, pp. 32-34.

"Space Colonies and Energy Supply to the Earth," Gerard K. O'Neill, *Science*, Vol. 190, No. 4218, Dec. 5, 1975, pp. 943-947.

GENERAL INTEREST

"Colonies in Space," Philip Friedman, *New Engineer*, Vol. 4, Number 10, Nov. 1975, pp. 36-39.

"Space Colonies by 1990: A Solution to Global Crises?" *The Futurist*, Vol. 9, No. 5, Oct. 1975, pp. 273-274.

NEWSLETTERS: SPACE

Earth/Space Newsletter

"Dedicated to free space enterprise," this newsletter has promised to put a major emphasis on space colonization. \$5 per year: 2319 Sierra, Palo Alto, CA 94303; 415/326-3216.

FASST News

This newsletter, available to members of the Federation of Americans Supporting Science and Technology, includes information on space activities, including space colonization. Membership, \$5 per year: 1785 Massachusetts Ave., N.W., Washington, DC 20036; 202/483-2900.

National Space Club Newsletter

"Pledged to United States leadership in rocketry and astronautics." 1629 K St., N.W., Washington, DC 20006; 202/296-4690.

NEWSLETTERS: ENERGY

Energy Reporter, The Federal Energy Administration Citizen Newsletter

Free of charge: Room 2115, Office of Communications and Public Affairs, FEA, Washington, DC 20461.

Information from ERDA

Free of charge: Office of Public Affairs, ERDA, Washington, DC 20545.

Energy Info

This newsletter provides information on both industry and governmental energy research. \$35 per year: Robert Morey Associates, P.O. Box 98, Dana Point, CA 92629; 714/496-2574.

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LATE FLASH: AMAZING DISCOVERY

H. A. Bethe, Nobel-Prize-winning physicist, has announced, in the January, 1976, issue of *Scientific American*, that "the sun shines for only part of the day."



NAIVE OPTIMISM

Make that *two* fanzines that have published articles on L5 colonization. If any of your readers would like a copy, write to: Alan Hanna, Editor, *Aphelion*, The University of Georgia Science-Fiction Appreciation Club, Athens, Georgia 30601.

To get the article on colonization, ask for the first issue. Copies are free as long as supplies hold out, although a charge may be made for later issues of the 'zine (which are yet to be published).

In regard to Dr. Kantrowitz's comments on philosophers who label a belief that humanity can continue to improve its lot and its worth "naive optimism": Many philosophers never seem to grasp the idea that they should test their assumptions against the facts. The facts in this case are that throughout history individuals and groups have demonstrated that they *have* been able to better their conditions and themselves *when they have taken the trouble to try*. Of course, if one is to make that effort, one must believe that it is possible to succeed.

The most common type of opposition to space colonization I seem to run across doesn't seem to fit into either of the categories you described. It comes rather from persons who don't look far enough ahead, or aren't able to understand that this is a really viable concept now. Such people do seem to increase interest once they are finally made to understand that it is something that is actually possible and practical to do.

Larry Friesan
Clay Center, Kansas

GIFT SUBSCRIPTIONS

Scott Royce of Houston, Texas, tells us "You're missing a bet not making a splash about gift memberships for Christmas."

Thanks anyhow to those of you who sent out gift memberships. As for the rest of you, don't wait until next Christmas-after all, Groundhog's Day approaches fast!

ZERO WASTE

We recently had the pleasure of meeting Peter Vajk for a discussion of industrial recycling in space. We were most receptive to his visit, having devoured last month's *Coevolution Quarterly* article by Gerard O'Neill. Space colonies make infinitely more sense to us than the military and industrial projects now eating up the available investment capital.

After Peter left, it came to me that, before moving twenty thousand people into a colony, a demonstration project will be needed to prove the feasibility of total recycling. Outside of the efforts of Zero Waste Systems over the past two and a half years, no institution or company has tried to deal with industrial recycling. Industry is uninterested for a variety of reasons. The EPA in its bureaucratic arrogance is more a part of the problem than of the solution. No study of industrial waste generation at the fine-grained level needed for recycling applications has ever been performed in this country to the best of our knowledge. We are hoping to perform the first one, for the city of Berkeley, California. It seems clear, however, that some kind of earth-bound experimentation will have to precede blast-off.

Yours truly,
Dr. Paul Palmer
Zero Waste Systems, Inc.

EVEN THE MOB?

I am unfamiliar with current plans for space usage on the L-5 station. Is it planned to rent laboratory space to "friendly" Earth-based corporations and interested parties? By the way-how will the L-5 Society disband? It seems most probable to assume that there will be some groups of people who would prefer to take advantage of the L-5 environment to develop new technology, further space travel capabilities, and leave. Indeed, I approach this category.

Also, do we really want the mob involved? Unfortunately I lack faith in their social intelligence and hence ability

L-5 SOCIETY MEMBERSHIP FORM (PLEASE TYPE OR PRINT)

NAME: _____

COMPLETE ADDRESS: _____

AFFILIATION (OPTIONAL): _____

TITLE or POSITION (OPTIONAL): _____

I am - - a m n o t - - interested in being active locally.

Back issues available, \$1.00 each.

Please enroll me as an L-5 Society Member. I am enclosing a check for \$ _____ (regular membership \$20.00; student membership \$10.00).

Please enter an institutional membership to receive the "L-5 News" for our organization/library as indicated above. We enclose a check for \$ _____ (institutional or library membership \$100; special library subscription with one month delayed mailing \$20).

COMMENTS AND REQUESTS _____

to allow the freedom (to research) desired on the L-5 station. Certainly they can help us with expenses, but I would prefer a less lean-eyed group overseeing any laboratories I work in. If we should ever begin "working for the Mob" I would appreciate your notifying me of this. Maybe you have some arguments for an inclusion of the Mob? I'd like to hear them!

Carl R. Gilroy
Pasadena, Calif.

Unfortunately, "the Mob" has not yet shown any interest in funding us.

COMMENT ON VAJK

I have been following the debate about technology and the limits to growth for some time, since the publication of Dr. Forrester's book, in fact. For several years, I was of the opinion that industrial growth and technology are undesirable,

because of pollution and the depletion of resources which industrial growth seemed to entail. Now, however, I have reversed my thinking, for two very strong reasons.

Personal experience has played a large role. Presently, I am serving as a Peace Corps volunteer in Micronesia, helping develop a three-acre milkfish pond. Palau, the district where I am stationed, is rapidly undergoing the transition from a subsistence farming and fishing society to a modern, technological society. Although there are definite problems, those Palauans who can afford the fruits of modern technology are generally happier and more comfortable than those who cannot. One would have a hard time convincing a Palauan to give up his speedboat for an outrigger canoe.

I think the limits to growth will vanish when the possibility of space colonization and industrialization are inserted into the

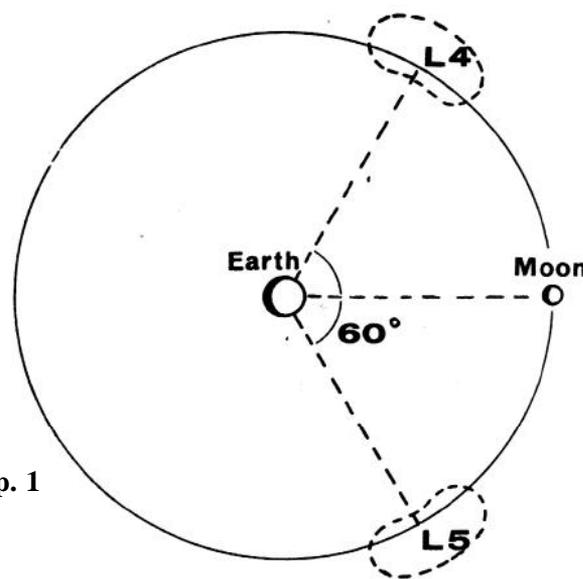
computer programs. Materials and energy limitations will disappear, when confronted by the vast amounts of extraterrestrial matter and energy, and pollution problems become nonexistent when solar energy is considered. As an example of what space industrialization would mean to Palau, the proposal to build solar power stations in orbit, if carried through, would mean that the islands would have a source of safe, dependable electric power, twenty-four hours a day. Space colonization represents the most exciting idea to emerge since the discovery of America.

In the mean time, I would be glad to help with the world dynamics study, as it relates to Micronesia, in any way I can.

James Kempf
Koror, Palau
West Caroline Islands

Jan. 1976-10

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