

# 15 NEWS

NOVEMBER 1977



# L-5 NEWS

A PUBLICATION OF THE L-5 SOCIETY

VOL. 2 NUMBER 11 NOVEMBER 1977

Carolyn Henson, Editor

Membership Services:

Doris Cooper

William Weigle,  
Administrative Services

Peter Blinn,  
Arts Editor

Board of Directors:  
Gordon R. Woodcock  
Barbara Marx Hubbard  
Konrad K. Dannenberg  
Hon. Edward R. Finch, Jr.  
James E. Oberg  
Leonard David  
J. Peter Vajk  
Jack D. Salmon  
Phillip Parker  
David M. Fradin  
Romualdas Sviedries  
Keith Henson  
Carolyn Henson  
William Weigle  
Mark Hopkins  
Norie Huddle  
Magoroh Maruyama  
Harlan Smith  
Carol Motts

Publication office: The L-5 Society,  
1060 E. Elm, Tucson, Arizona 85719.  
Published monthly. Subscription: \$3.00  
per year, included in dues (\$20.00 per  
year, students \$10.00 per year).  
subscription price to non-members  
available on request. Second class  
postage paid at Tucson, Arizona and  
additional offices. Copyright ©1977 by  
the L-5 Society. No part of this  
periodical may be reproduced without  
written consent of the L-5 Society. The  
opinions expressed by the authors do  
not necessarily reflect the policy of the  
L-5 Society. Membership Services: L-5  
Society, 1620 N. Park Avenue, Tucson,  
Arizona 85719. Telephone: 602/622-  
6351

## In this issue:

- 1 Letters to L-5  
*featuring William Proxmire*
- 3 Power Satellites and Space Colonies: What Are the Prospects? *T.A. Heppenheimer*
- 5 Soviets Attack OTRAG  
  
NOVA on Space Concepts
- 6 Life in Space --A Place In Your Future?  
*Gordon Woodcock*
- 7 Rockwell International's Chuck Gould: Time to "Break Free" *Carolyn Henson reports*  
  
Congressional Futures Seminar Features Human Settlements in Space
- 8 Schlesinger Heads Newly-Formed Energy Dept.  
  
Space Shuttle Solid Rocket Motor Fired
- 9 Industrialization of Space Conference *H.K.Henson*  
  
Women in Space? *Stella Culvert*
- 10 Inside the L-5 Society

Cover: Reaching for the stars, a Bernal Sphere space habitat housing 10,000 people is shown against a backdrop of the Andromeda Galaxy (*galaxy photo courtesy Edison Pettit*).

---

The L-5 News is owned entirely by the L-5 Society; there are no stock holders, bondholders, mortgages, or other security holders for the L-5 News. The L-5 Society is a non-profit, tax-exempt 501 (c) - (3) organization. The average number of copies printed of each issue during the preceeding 12 months was 2000. In September 1977 the press run was 2200. Mail subscriptions totaled 1589. Paid circulation through other distribution outlets was 49. Free copies distributed totaled 300, while those left undistributed totaled 262.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to:  
**L-5 Society**  
**Membership Services**  
**1620 N. Park**  
**Tucson, AZ 85719**

# DARTH PROXMIRE

On October 9, 1977 CBS presented a report on Space Colonization on "60 Minutes". I had mixed feelings about the way they presented the O'Neill concept and the people who support it. I was glad to see that we are getting some media coverage, but I couldn't shake the funny feeling that CBS was trying to do a hatchet job on us (perhaps unintentionally). If you saw the program you may understand how I feel. But, of course, this is a free society and we cannot force the news media to cover us in only a favorable light. There are some valid criticisms of the O'Neill concept, especially when its proponents want to do it right now, in our life-time.

I was totally unprepared for what I saw the following week on that same program. Out of all the letters they received, the one they excerpted to read on the air was the one from Senator William Proxmire, who wrote:

"It's the best argument yet for chopping NASA's funding to the bone. As Chairman of the Senate Subcommittee responsible for NASA's appropriations, I say not a penny for this nutty fantasy . . ."

I hope our grandchildren, living out in the Asteroid Belt or on their way to Tau Ceti, will laugh when they read that statement in their history books, but unless we can meet the challenge of "Darth" Proxmire and his anti-science buddies in Washington, "this nutty fantasy" will always remain just that-a fantasy. Most of us would disagree with him; the colonization of space is the best reason for increasing the NASA budget!

I hope I will be proved wrong in the following prediction, but I think our budget-cutting friends in Congress will be out to "get" NASA in 1978, especially after their surprise defeat at the hands of the suddenly-organized scientific community in the funding battle for the Jupiter Orbiter Probe. We may be well advised to start gearing up for a possible "Save the Shuttle" campaign, as I seriously doubt that the enemies of space will be content to slash just the long-range stuff like space colonies or the SSPS.



For the sake of our future (and our children) we must prevail against the Proxmires of this world, using whatever means are available to us. We must write to our elected representatives. We must present our case to the public. We must devote our time and money and intelligence to achieving our goals. If we do not, we'd better be content to just read about space colonies in the science fiction magazines. The point is, it's not going to happen unless WE make it happen.

Fortunately, 1978 is an election year for 1/3 of our Senators and all of our Congresspeople, and they will be paying attention to what their constituents have to say. Come on, people, this is our chance to show the Proxmires of this world that WE have an idea whose time has finally come. I just hope it won't be our last chance.

Yours for a better future,  
Robert Lovell  
10908 W. 65th Terrace  
Shawnee, Kansas 66203

P.S. Carolyn Henson: If you see fit to publish this letter or any part of it (or even if you don't) I'd appreciate it if you would tell your readers that I would like to hear from them. I'm serious about this; we'd better start flexing whatever political muscles we have while we still have the time. The best defense is a

Last night I was watching "60 Minutes". I was shocked at the letter sent in by Senator William Proxmire, commenting on the show that was presented last week on space colonies. He wrote that it was another reason for cutting NASA's funds, and that developing space colonies is a "nutty" idea. That letter made me absolutely furious!

I am writing to you to ask if he is serious enough, and has enough power, to cause damage. I also want to know if there is something I can do to help. Because of the shock of such a tremendously stupid statement-and coming from someone who has made it to the level of Senator, I didn't have time to copy down the information they had on him. Did they say he was on a funding committee for NASA? If he is, who else is on the committee?

Janet S. Willock  
Milwaukie, OR

---

*He chairs the SENATE APPROPRIATIONS SUBCOMMITTEE ON HUD-INDEPENDENT AGENCIES, S-128 (Capitol), 202/224-7274*

*Democrats:*

*William Proxmire, Chairman*

*John C. Stennis*

*Birch Bayh*

*Walter Huddleston*

*Patrick Leahy*

*James Sasser*

*Republicans:*

*Charles McC. Mathias, Jr.*

*Clifford P. Case*

*Edward W. Brooke*

*Henry Bellman*

---

Senator William Proxmire  
Capital Building  
Washington, D.C.

Sir,

I wish to take issue with you on your opinion which appeared on the letters section of "60 Minutes," 16 October 1977,

concerning space habitations as envisioned by Dr. G. K. O'Neill. This truly innovative proposal deserves a more serious study of the facts by our government.

I find it difficult to comprehend how a usually well informed and erudite senator, such as yourself, can dismiss as a fantasy a serious project with such great potential. The large scale colonization needed for optimum results will certainly be expensive, several billion dollars over half a century. But with its goal of providing the world's total demand for electrical energy within that 50 years, I believe it more than justifies the expenditure.

The energy crisis is real and colossal in its implications. It demands a comparable solution. This is a golden opportunity for the government to get in on the ground floor of a major, if not the major energy source of the future. Our government could break the stranglehold the oil industry has been recently tightening upon the government and people, most recently manifested in the Senate's cowardly acquiescence on deregulation of gas prices. Various corporations have had the foresight to see the great benefits a space colony producing solar energy satellites can provide, and are already involved with manpower and money in developing this concept. If the government doesn't act soon it will again be dealing with large corporations on their own terms.

The greatest thing about this plan is that it can be followed through with today's technology. The cost estimates are considered in those terms. With additional breakthroughs in technology, the original time schedule will undoubtedly be cut, if not the original cost.

In my opinion, freezing in the winter for lack of gas, or dying from the radioactive wastes of nuclear reactors or from a terrorist's A-bomb is not a fantasy, but a nightmare. Please reconsider your initial hasty reaction towards Dr. O'Neill's proposal.

Barry L. Cole  
Shepherd, MI

I sense something in the air. Space shuttle, feature stories on space settlements and SPS. It won't be long, and L-5 is one reason why.

Paul Greiman  
State College, PA.

Having just completed a six-week, cross-country bus trip, I have concluded that there is a great deal of potential public

interest in space that has so far gone untapped. While talking with people who happened to sit next to me, I would usually work the conversation around to space. Their first comment would usually be, "There isn't much going on in space anymore." I would then proceed to tell them about the space shuttle (the most common misconception is that the 747 is taking it into orbit), solar power satellites and how space habitats would build them, and of course the L-5 Society. The reaction was always, "Why isn't anybody else talking about this? It's a great idea!"

This hidden interest in space became very evident anytime there was something for the public to see. More surprising than the 70,000 people at the first shuttle free-flight was the fact that the night before the launching of Voyager 2 it was impossible to find a motel room within twenty miles of Cape Canaveral. At the space museums that I visited (in Houston, Huntsville, KSC, and at the Smithsonian) there were always big crowds. The people were trying to find out how we've gotten as far as we have in space, and where we are going. Wonder, amazement, awe, and perhaps more importantly, an increased awareness of space activities was the rule at these various centers.

Howard Gluckman  
Encino, CA.

I would like to reply to John Sotos' letter in the August 1977 issue, in which he states that: "The characteristics of evolution are that it takes tremendous amounts of time, is conducted by a trial and error process, and is beset by an innumerable number of failures."

Although this view of evolution (here meaning organic evolution) is the one which most of us learned in school, it is no longer the generally accepted view of geneticists, biologists and others who study evolution. Rather, the modern theory of evolution holds that new species can appear within a very few generations, even one generation! Specifically, it has first been demonstrated over many species that their gene pools are not essentially fixed, with few variations, but rather extremely diverse. Secondly, the apparent stability of various species on this planet is now seen as the result of very strong steady selection pressure operating on these diverse gene pools. A change in these selection pressures causes the selection of new characteristics from the diverse gene pool, and can result (in insects, for example) in distinct subspecies in a single generation. These effects have been shown over a range of species. In addition, it now seems clear that evolutionary shifts and

accompanying structural changes are often preceeded, in fact initiated, by changes in behavior, rather than the reverse.

I, therefore, feel comfortable and scientifically accurate in characterizing the move from Earth to space as evolutionary. Space industrialization and colonization can be viewed in virtually every frame of reference as either being or creating major shifts in selection pressures for our species. Further, this view of evolution is entirely in concert with the extremely fast evolution of the human species itself, an evolution which is not adequately explained by the more conservative "slow, trial and error, failures" viewpoint.

Finally, I would point out that if Mr. Sotos' feelings that trial and error cannot be afforded in our move to space had been the standard for exploration and colonization of the New World, we'd still be presenting proposals for the perfect scheme to the descendants of Elizabeth's Privy Council.

A thorough treatment of the modern evolutionary view may be found in Glayde Whitney's excellent chapter "Genetic Considerations in Studies of the Evolution of the Nervous System and Behavior" in *Evolution Bruin and Behavior*; ed. R.B. Masterton, et al; John Wiley & Sons, New York 1976.

George A. Koopman  
Huntington Beach, CA

There's another donation check enclosed with this letter. And if you *really* want to show gratitude, don't trumpet my name to the world. Wangle me a position on a lunar surface base. And reserve passage for me on the first crew-carrying ship to Mars.

O'Neill is damn right. It is time to stop letting Artoo Detoo have all the fun. In fact, since the Space Age has begun, there has been a misuse of the word "exploration" in some quarters. Exploration is *not* sending out an instrument or a machine to look over a new place for you. You can call that reconnaissance, perhaps, but not exploration. Exploration is when you go yourself, in person.

So my donations to L-5 are really a way of putting my money where my mouth is. ("Where a man's treasure is, there will his heart be also.") I hope to thus speed the day when more people can go into space, and in particular, to speed the day when Z get into space.

Anonymous  
Webster, TX

# Power Satellites and Space Colonies: What Are the Prospects?

by T. A. Heppenheimer

Among L-5 members and supporters, there appears to be a distinct impression that the problems of space colonization are chiefly those of public relations. Given suitable publicity at the grass-roots level, and given sufficient exposure of the concept in Washington, then the engineering and economic studies which have appeared to date, or which are in progress, will suffice to compel serious national attention and perhaps even a national commitment to proceed with the project.

One comes away with the view that among L-5ers, the concept is regarded as a technology in being, ready to be brought into mainstream engineering development, and requiring for this purpose only the commitment of funding -- commitment which, again, may be forthcoming through proper PR efforts.

It thus may be of interest to consider the current status of the power satellite within ERDA, and to discuss the present level of understanding of two key technologies, namely space transport and space assembly.

## Power Satellite Status

At the recent Princeton Conference, R.A. Summers reported ERDA's views on the Solar Power Satellite (SPS):

"In early 1976 the Office of Management and Budget requested that ERDA consider the SPS concept as a part of its solar energy program. An ERDA Task Group on Satellite Power Stations reviewed the NASA work and recommended a three-year study program to answer certain key questions."

Within ERDA, there are a number of concepts now receiving active attention, falling under the rubric of "solar energy" or "solar electric generation"; these include terrestrial photovoltaic, solar thermal (the "power tower"), wind generation, and ocean-thermal-gradient generation. All of these systems are currently under development; all have active constituencies within ERDA; and, as Table 1 shows, all are regarded as being available both earlier and with lower developmental cost than SPS. However, the SPS (to be specific, the ground-launched photovoltaic concept) nevertheless is regarded as of interest because the near-continuous availability of its power represents a baseload solar-electric capability. Other solar-electric systems concepts are regarded as not having this capability, that is to say, of being limited in availability due to diurnal or seasonal factors.

Table 2 gives NASA's estimates of key parameters required for the cost-effective development of the SPS, together with the SPS Task Group comments. The clear conclusion is that the SPS, whether as a photovoltaic system or as a design of the rather heavier solar-thermal type, will need intensive developments.

The assesment of the SPS, offered by Ref. 1, is as follows:

No obvious and clearly insurmountable problems have been identified by the ERDA Task Group. However, realizing such a system . . . would require very large advances in solar arrays (including cost, weight, and efficiency) and very large reductions in transportation costs. There is at this time, *and probably will be until several years of work are completed (emphasis added), insufficient information (technical and environmental) available to allow any significant program decisions.* The only reasonable steps at this time are more properly focused studies . . . These studies will seek to (1) build confidence in the viability of SPS as a promising energy technology or (2) at as early a date as possible, clearly identify barriers to SPS that suggest that all significant R & D investment in SPS be halted.

TABLE 1. ERDA comparison of energy systems.

	Terrestrial solar electric				Orbital	Other terrestrial	
	Solar thermal	Solar photovoltaic	Wind	Ocean thermal	Solar SPS	LMFBR*	Fusion†
Investment unit cost, \$kW(e)	1300	1100	750	1200	1500-4000	400-560	1500-2500
Capacity factor	0.33	0.33	0.35	0.9	0.95	0.66	0.90
Energy unit cost, \$ mills/kWh	81	68	44	27	32-86	12-17	34-57
Key development problems	Heliostat	Materials	Rotor	Heat exchanger	Materials, solar cell, launch vehicle and tug, launch complex, orbital operations	Steam generator, fuel cycle, fuel options, safeguards	Materials
Approx. Development cost	\$1B	\$1B	\$500M	\$1B	\$60B	\$11B	\$15B
Operational date	1985	1990	1983	1985	2000+	1993	2000+

\*LMFBR Environmental Impact Statement, December 1975.

†Speculative; Division of Magnetic Fusion Energy.

§18% cost of money.

TABLE 2. Assessment of key issues.  
NASA initial

Space Transportation

Space Construction

Parameter	NASA initial assumption	Task Group comment
Satellite System		
Power	5,10 GW(e)	very large for utility integration
Gross weight	65 to 66 × 10 <sup>6</sup> kg (10GW(e))	Over 500 heavy lift launch vehicle launches required per SPS
Life	30 years	Must be maintained in space with reliability equal to ground station
Size	Up to 10 × 20 km	No previous experience, limited ground demonstration feasible.
Overall Efficiency	57%	Not yet demonstrated.
Solar Array		
Material	Silicon	GaAs would permit greater concentration ratio
Thickness	50-100 pm	Not a "natural" thin-film material
Efficiency	16%	Not consistent with thickness quoted.
cost	\$0.20/W	\$0.50/W is ERDA goal for silicon in terrestrial application.
lifetime	30 years	High radiation damage (Van Allen, solar storm)
On-board power	20-40kV DC	Needs rotary joint development: high voltage, high amperage.
Microwave Energy Transmission		
Antenna size	1 km diameter	Must be phased flat to 1/4 wavelength (2.5 cm)
Frequency	2.45 GHz (10 cm)	Reserved for industrial, scientific, & medical use.
Pointing accuracy	1 arc min.	Requires active (upbeam) control
Amplifron module size	6 kW	Requires very accurate wave guides (over 2 × 10 <sup>6</sup> units).
Ground receiver (rectenna size)	10 × 14 km	Additional protected area required.
Beam flux	20 mW/cm <sup>2</sup> max. at center	Potential problem with microwave exposure standards; ionosphere interactions (23mW/cm <sup>2</sup> -HF, VHF communications VLF navigation interference.
Transportation		
Launch vehicle gross weight	7 × 10 <sup>6</sup> kg	Major launch complex required.
Payload	225,000 kg in low orbit	Payload density forces space fabrication and assembly
cost	\$44/kg in LEO	Requires order-of-magnitude reduction below shuttle; high reuse assumed; target cost.
Flight/year	500/SPS (10GW(e))	Sophisticated launch scenario
Launch complex	Off-shore lake style.	Rapid turnaround time; recovery; refurbishment; fuel supply; noise.
LEO/GE0	Cargo; personnel	Advanced technology orbital operations
Construction rate	1 SPS/year; automated space fabrication and assembly involving remote devices	Space manufacturing feasibility assumed: orbital assembly forced by low payload density; productivity of man in space; exceeds terrestrial production rates; maintenance.
Personnel rotation	13 weeks extra-vehicular activity; 26 weeks in space station	Personnel stay time: radiation-dose problems; industrial standards may not be feasible.

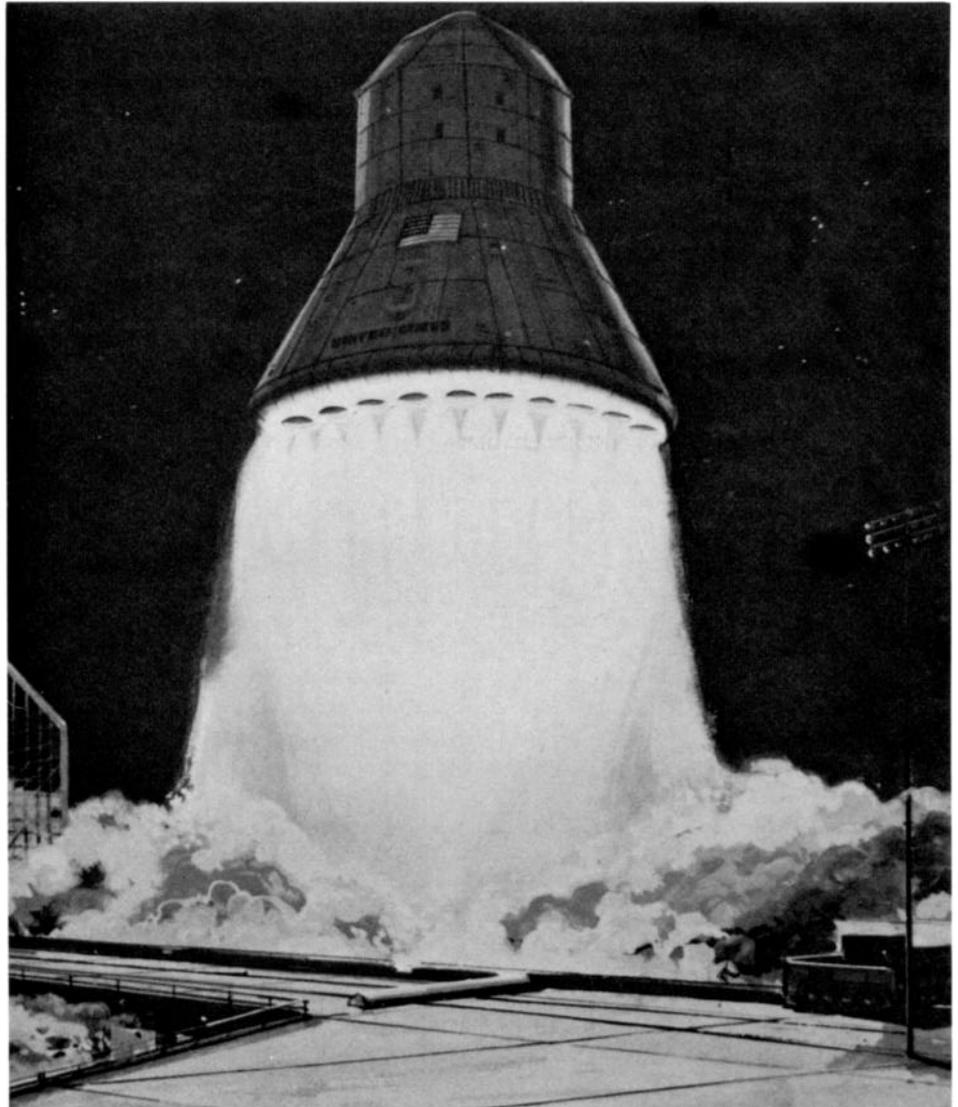
The achievements of NASA and its contractors, in developing the Space Shuttle, have been frequently noted. What has not been so noted is that the development has taken place entirely within the budget and schedule laid down in 1971-1972, excepting relatively minor cost increases and program stretchouts as mandated by the OMB. This achievement means that when key spacecraft designers propose advanced new launch systems, their assessments of cost and design feasibility must be regarded as of high credibility.

The SPS cost goal can be met for a larger class of vehicle such as has been proposed by Boeing. Such systems involve vertical landings on large artificial lagoons; they resemble giant Mercury capsules in shape. Payload is 227,000 kg. Such vehicles are of the type described and illustrated in Chapter 3 of my book, *Colonies in Space*. Such large spacecraft, with liftoff mass three times that of the Saturn V, appear to call for a developmental cost of \$9 B.

There now appears to be evolving a systematic approach to the conduct of space construction, and to the development of methods for assessing the optimal role of people in performing construction tasks.

For construction of SPS, the basic structural element is the beam. It is currently considered that beams are to be formed in space, possibly from graphite-composite materials<sup>2</sup>, using "beam-builders"<sup>2,3</sup> which are designed for a high level of automation. The role of people, then, would extend only to the joining of beams. The particular role requires further study, and it now appears possible to develop understanding of the optimum role on the basis of ground studies.

These studies involve experiments performed in the Neutral Buoyancy Tank of the Marshall Space Flight Center.<sup>3</sup> This facility is actually a large, deep swimming pool in which people, wearing pressure suits, swim under water in what for many purposes is a simulation of weightlessness.



The first tests of this type, involving simulated in-space assembly of beams, took place in March of 1977. These tests showed that the assembly task is greatly facilitated by using an automated manipulator to position a beam, to be joined to another beam.

Through such experiments, it will be possible to develop estimates of human productivity and of the rates at which structures can be assembled.

### Implications for Space Colonization

One cannot now say that the ground launched SPS is unknown in Washington. However, it is regarded as fraught with problems, and is regarded, for the near term, as a subject for detailed study rather than as an option which might be directly developed.

On the other hand, it appears that launch vehicle technology will not seriously limit the feasibility or economic attractiveness of SPS, in the time period of interest (post-1990). Thus, these SSTO developments undercut the claim of space-colonization advocates, that SPS would not be economically attractive unless built from lunar material in a space colony.

This does not mean that the Earth-built SPS will be as cost-competitive or as

technically desirable as the space-built SPS. It does mean that the SPS might be commercialized without space colonization.

Moreover, if the launch-vehicle problem is regarded as solvable, then the only major advantages of the space-colony approach lie in the areas of permitting more conservative designs (e.g. heavier SPS systems) and of environmental advantages (fewer rocket launchings). Balanced against them must be the very real difficulties of developing the lunar base, the mass-catcher, and the processing and construction facilities at the colony.

The advantages of the space-colonization approach, particularly in the economics, appear to be real, and would weigh with great significance in any major effort to supply the world with SPS-generated power. But in view of the twenty-year time before SSTO is available, and in view of the subsequent time for SPS development, this consideration can hardly be important before the next century.

Accordingly, the following scenario appears realistic:

1977-1985: Extensive studies on space construction, involving Earth-based and Shuttle-based tests and demonstrations. Detailed design studies on SPS, including evolution of firm, credible developmental schedules.

1985-1993: Development of a cheap

space transportation system. Development, in low Earth orbit, of a space-construction facility and its use in building satellites for use in communications, Earth observation, postal service, and the like. (These satellites are in the 100-1000 meter size class.) Conduct of an initial demonstration of satellite solar power, involving a subscale SPS.

1993-2000: Construction of the first commercial SPS systems.

By the 1990's, then, it is possible that the SPS will be considered a major energy source. And at that point, space colonization advocates will be able to step forward, offering the very attractive concept of a cheaper and environmentally kinder SPS. The technical and economic arguments then could very well put the nation in the space-colony business, with a firm technology base, a product (the SPS) which is well regarded, and with the idea of space colonies having been around twenty years and so having lost its gee-whiz aspect.

### REFERENCES

1. R.A. Summers, H.R. Blieden, C.E. Bloomquist. AIAA Paper 77-552
2. F.F.W. Krohn and D.L. Browning. AIAA Paper 77-543
3. R.L. Kline, AIAA Paper 77-544

---

# Soviets, Others Attack OTRAG Flight

Sharp criticism of the first flight of the OTRAG launch vehicle module (*Report*—September 1, 1977) has been leveled at both the company and West Germany. The attacks are coming from European sources as well as the Soviet Union and Africa.

The first charges were made in an article in the leftist publication *To The Point Internationale*, by a leader of the Katagan forces which attempted to overthrow the government of President Mobutu of Zaire this spring. It was claimed the Zaire government, with the help of OTRAG, was developing missiles which could carry nuclear warheads against other African states. The implication was the Katagan invasion helped to reveal this "secret" plot on the part of Zaire. The Katagans are heavily supported by Angola, which in turn derives most of its support from the Soviet Union and Cuba.

The Marxist government of Mozambique has reportedly protested the flight to the West German government.

Within the past six weeks, the Soviet paper *Pravda* has condemned the flight three times. The Soviets charge that the OTRAG operation is a demonstration of Germany's desire to re-arm with medium and long-range ballistic missiles which can carry nuclear warheads. No mention is made of the fact that the vehicle has been developed as a satellite launcher: however, there is reference to Kurt Debus, OTRAG's Chairman. Debus was involved in the V-2 development during the Second World War, and the Soviets have not forgotten this.

European aerospace officials have also made disparaging remarks in an article published in *Aviation Week and Space Technology* magazine September 12. However, these later comments seem to

stem from the potential embarrassment caused by the low cost OTRAG operation, and are not considered substantive or dangerous to OTRAG's continuation.

*Reprinted from the  
Foundation Institute Report  
85 E. Geranium, St. Paul, MN 55117*

---

## NOVA to Air Space Concepts

"One Small Step," a history of humanity's movement into space, will air the week of January 23rd. "The Final Frontier," a look at our future in space -- beginning with the space shuttle and including space settlements, is scheduled to air the following week, January 30th. Check your local PBS listings for the exact day and time NOVA is seen.

# Life In Space -- A Place In Your Future?

by Gordon Woodcock

Since about 1974, there has been rapidly developing a new direction in thought regarding the future of humanity. First widely espoused by Dr. G. K. O'Neill of Princeton in his 1974 article in *Physics Today*, this philosophy advocates large-scale human settlements in space and argues that the time to begin is now. The L-5 Society, among others, has been founded around this philosophical construct. Numerous technical meetings and conferences have been devoted to the idea, and many articles and news features have appeared. This new direction in thought has its devotees, its detractors, and the usual majority of agnostics. The goals of the L-5 Society are stated in part as "to have thousands of people living and working in space by the turn of the century." Contrariwise, Carl Sagan says (September 1977 L-5 News), "the colonization project would cost one Vietnam war--the initial cost is so large that it's not obvious that it's the direction we should go." Gerry O'Neill says (again quoted from the Sept. L-5 News), ". . . the first Shuttle flights carrying components of a space-manufacturing system could lift off by the mid 1980's, and significant amounts of clean electrical energy obtained from solar satellites in high orbit could begin to flow into our power lines on earth by the early 1990's."

But listen to an old hand at the space systems development business, A. V. Cleaver of Rolls Royce, a contemporary of von Braun, writing in the *JBIS* at the request of the British Interplanetary Society (his article was called "On the Realization of Projects" and is highly recommended reading):

"I am not a complete sceptic, in that I would not scoff at the possibility (of space colonization) . . . eventually.

"Nevertheless, I believe that much of what has been written on the subject is unmitigated nonsense: naive, unrealistic, and premature, and betraying an ignorance of the real world of project costs and motivation."

The discourse seems to have largely been cast along ideological lines, that is to say, those who believe in a fantastic future and

those who think these concepts are pure fantasy. Unfortunately, little communication takes place in such discussions.

The space colonization proposition is generally presented in an "all or nothing" manner. The lot is usually advanced as a sort of unified faith. Yet it consists of sub-propositions, each independently subject to rational analysis and discussion. There are at least four of these major sub-propositions that can be independently considered, and those in turn have sub-sub-propositions that merit examination. The four major sub-propositions are:

(1) The world needs solar power satellites as a nondepletable energy source.

(2) These satellites should be built from resources derived from space, e. g. the Moon, rather than from the surface of the Earth.

(3) The human work force in space (the construction crew) should be permanently based in space (i. e. in a settlement or colony) rather than exchanged from Earth

on a regular basis as, for example, the majority of workers on the Alaskan pipeline were exchanged on a regular basis, spending six to nine weeks on duty and a similar period off duty in the lower 48. The argument in favor of this permanent settlement proposition is based on crew transportation costs and on continuity of effort and skill retention.

(4) The human race needs to expand beyond the confining limits of its home planet in order to continue to thrive and develop. (Krafft Ehrlicke calls this notion "the extraterrestrial imperative." It was originally stated by Konstantin Tsiolkovski, who said "The Earth is the cradle of mankind. But one cannot live in the cradle forever.")

In this series of articles, I propose to examine each of these propositions separately in order to provide as much perspective as possible and to try to lead to a few tentative conclusions.

The first order of business will be to examine the potential value of solar power satellites. We must deal with at least four poles of opinion in addition to the ones generally favorable to solar power satellites or space colonization:

(1) We don't need any new sources of energy, at least not for a very long time. Oil, gas, and coal will last for several generations. This might be regarded by solar enthusiasts as the Archie Bunker viewpoint, but I have seen it expressed, for example, on the editorial page of the *Wall Street Journal*.

(2) We don't need any high technology energy systems. It can all be done with backyard technology. This is the "Small is Beautiful" or soft technology view.

(3) The world is coming to an end anyway, so why bother. This is the "Limits To Growth", or world dynamics view.

(4) We admittedly need some new sources of nondepletable energy. but there must be better ways to solve the problem than with solar power satellites. . . they would be prohibitively expensive.

The next article will attempt to present some facts and structure an economic perspective from which to examine the energy viewpoints expressed above.



# Human Settlements In Space

## Focus of Congressional Seminar

A special Congressional Futures Seminar to examine a new national goal in space was held on October 28th and 29th at the Rayburn Building.

Organized by futurist Barbara Marx Hubbard at the request of Representatives Barbara A. Mikulski (D.-Md.), Olin E. Teague (D.-Tex.), and Edward W. Pattison (D.-N.Y.), the seminar featured Dr. Gerard K. O'Neill of Princeton and Northrop Corporation President Dr. Thomas O. Paine, who was NASA administrator during the Apollo era.

The seminar was titled: THE HIGH FRONTIER: HUMAN SETTLEMENTS IN SPACE. Participants examined a goal to establish the first human settlement in space producing solar energy for Earth by 1992.

This historic dream of a human foothold in space on the 500th anniversary

of Columbus' discovery of the "New World" has brought together an unusual congressional sponsorship: Mikulski -- a young leader of human causes such as preventing violence in the family, and veteran space champion, head of the House Committee on Science and Technology, Olin "Tiger" Teague.

Mikulski said, "Those of us who are decision makers have to think of more than making global ends meet. I'm convinced we have to explore the infinite resources of space to learn to survive here on earth."

Teague said: "We've proven that we can get to outer space. Now we have a mandate to explore the ways in which the resources of space might benefit the future of mankind."

Mrs. Hubbard added, "Our remaining fossil fuels are dwindling rapidly. It is the height of irresponsibility for the U.S. not

to develop productive facilities in space while we have time and resources. Americans have historically been a people responsive to vision and hope. We must get a foothold on our new environment in space now."

Dr. O'Neill and Dr. Paine were joined as seminar speakers by civic leader Alex Parker. Parker is the developer of Space Square at One Times Square in New York.

Other speakers included: Dr. J. Peter Vajk and energy expert Gerald W. Driggers of Science Applications Inc.; Dr. Donald Tartar, Professor of Sociology, University of Alabama; Dr. Brian O'Leary, Professor of Astronomy and Science Policy, Princeton University; Lee Windheim, Architect and Senior V.P., Leo A. Daly Co.; and the Honorable Richard H. Nolte, Executive Director, Institute of Current World Affairs.

## US Public Supports NASA, Space Shuttle by Whopping Majority

A Trendex survey taken May 24-28 using a nationwide telephone poll of 1240 people gave the following results:

### U.S. SPACE PROGRAM ATTITUDE

Favorable	67%
Unfavorable	16%

### MAJOR REASONS FOR U.S. SPACE PROGRAM

Expand Knowledge	30%
International Leadership	23%
Practical Application of Technology	15%
Progress	14%
National Defense	10%

### VALUE OF SPACE SCIENCE PROJECTS

Very or Somewhat Important	85%
Unimportant	11%

### NASA MANAGEMENT OF SPACE PROJECTS

Very Good or Good	72%
Fair	12%
Poor	2%

### "YES" RESPONSE TO SPACE FOR SOLVING MAJOR PROBLEMS

Communications	82%
National Defense	77%
Education	74%
Natural Resources	61%
Energy	56%
Environmental Protection	55%
Medical Care	54%
Transportation	54%

### SPACE SHUTTLE PROGRAM AWARENESS

Yes	64%
No	36%

### KNOWLEDGE OF KEY SHUTTLE FEATURES

Space Transportation is Main Mission	30%
Reusability is Key to Low Cost	51%
Space Operations	

### NEED FOR SHUTTLE IN FUTURE SPACE OPERATIONS

Yes	78%
No	9%

However, before you space enthusiasts break any arms from the back patting these statistics may inspire, you'd better consider one last figure from that Trendex survey:

### FUNDING FOR SPACE PROGRAM

Increase	31%
Maintain Current Level	34%
Decrease	23%

Getting U.S. citizens to put their tax dollars where their opinions are has never been an easy task. But it is one that people who plan to live and work in space may have to learn.

# Inside the L-5 Society

## Industrialization of Space Conference

by H. K. Henson

The theme of the 1977 annual meeting of the American Astronautical Society held in San Francisco, October 18 to 22, was the Industrialization of Space.

Cosponsored by the L-5 Society (among others) over 600 people registered for the event. Over one third of them were L-5 members.

The papers delivered at the meeting were evenly split between hard technical and social-economic-political themes. A recurring conflict was between the "free enterprisers" and the "get-the-government-to-do-it" camps. An excellent example of the former was Robert Poole, Jr.'s paper, "Hidden Perils in Government Support of Space Activities."

Gerard K. O'Neill gave an excellent presentation. He ended on a sour note, telling the audience that under the current administration the chances of government support are scant. (Round 1 to the "free enterprisers" by default.) Two other technical papers of unusual interest were, "A Non-Synchronous Orbital Skyhook," by Hans Moravec, accompanied by a fantastic computer-generated movie, and "Space Habitats at the Earth-Moon Lagrange Points," by B. E. Schultz, which

examined the stability of certain classes of orbits about L-5.

The last day of the conference included a talk by T. A. Heppenheimer emphasizing an evolutionary approach to space development, requiring many years and starting with Earth-launched SPS. This was followed by an exciting talk by Christian O. Basler on a possible way to privately finance a large scale space development project by means of a "staging company," making it possible to start work soon. (A "staging company" would be a special closed-end investment management company which spends income on R & D and converts to an operating company when the risk has been reduced to a reasonable level.)

Copies of Basler's paper are available from L-5 for \$2.10 each, plus the usual \$2.00 postage and handling fee. (The one fee is charged, regardless of quantity of order. You may elect to order other items at the same time, thus reducing your postage and handling charge per item.) More details on Basler's concept will appear in the next L-5 News. Many of the other papers from the AAS will be available from L-5.

## AAA Convention

The preliminary program for the American Anthropological Association Meeting in Houston has come out. The Symposium on *Extraterrestrial Community Design* is scheduled on December 1, Thursday, 9:00 - 11:20 A.M. In the preliminary program the speakers are listed in alphabetical order. The actual sequential order of the presentations will be as follows:

1. Wolfgang Hilbertz, University of Texas School of Architecture.
2. Magoroh Maruyama, Psychology, University of Missouri, Kansas City.
3. Wolfgang Preiser, Architecture, University of New Mexico.
4. Vidvuds Beldavs, Cummins Engine Company.
5. Jib Fowles, Studies of the Future, University of Houston, Clear Lake City.

6. Dan Koski-Karell, Karell Institute.

The room number is not yet known. It will be either at Hyatt Regency or at Sheraton Houston. The reservation form for these two and a few other hotels is available in *Anthropology Newsletter*, September 1977. Elizabeth Bjornen has offered her suite in Sheraton Houston for a get-together meeting, which is planned for the evening before the day of the symposium. The tentative schedule is 8:30-10:00 P.M., Wednesday November 30.

In addition, an informal discussion session for the purpose of exchange of ideas between Lunar Science Institute, NASA and interested anthropologists is scheduled Friday afternoon, December 2, 5:00 to 7:00 P.M. This will be also either at Hyatt Regency or Sheraton Houston. All interested persons are invited.

L-5 members Howard Gluckman, Steve Miszencin, Alan Katz, and friends will be presenting programs relating to space colonization at the Science Fiction, Horror, and Fantasy Convention at the LA Airport Marriot over Thanksgiving weekend.

Also anyone interested in getting onto a charter flight to see the first Space Shuttle launch in March, 1979, should contact Howard Gluckman, 5400 Newcastle Ave. #69, Encino, CA 91316.

## Smithsonian Seminar

Washington, D.C. (Sept. 17, 1977)

Dr. Gerard K. O'Neill headlined an impressive panel of speakers at a day-long seminar sponsored by the Smithsonian Institution. Dean T. Stephen Cheston of Georgetown University and Jesco Von Puttkamer of the NASA Office of Space Flight rounded out the program, which focused on human, technical and economic aspects of space colonization.

Dr. O'Neill's wide-ranging presentation included updates on technical progress, media coverage and available literature, film clips of the building and demonstration of the scale model mass driver (from footage for an up coming NOVA PBS television special) and a detailed discussion of the possible sources of and prerequisites for private investment in space manufacturing/SSPS facilities.

Dean Cheston's detailed analysis of the social aspects of space colonization emphasized the need to maximize flexibility in all space social activities and to provide for informed consent of inhabitants confronting the new and (legally) unknown environments.

Mr. Von Puttkamer provided a comprehensive audio-visual account of NASA plans and programs for the industrialization and/or exploitation of space.

Two local L-5 members, Harrell Graham and Charles Chafer, secured a reduction in admission prices of 50% for L-5 members. Graham and Chafer also arranged radio and television interviews with local members and Dr. O'Neill. Fully 35 of the 150 attending took advantage of the L-5 reduced rates. The seminar also served as a take-off point for the formation of an active local L-5 organization. Other interested Washington area members should contact either Harrell Graham (202-547-8253) or Charles Chafer (703-354-6233).

## Sunny Outlook For Space Colonies

Space industrialization is on its way, although not as quickly as optimists such as Gerald O'Neill, originator of the space colony concept, would have hoped. This was the message from the first European meeting held last week at Queen Mary College, London, of the L-5 Society, a grass-roots organization for furthering the cause of space colonization. In the keynote address, John Disher, NASA's Director of Advanced Programs, noted that the market for power from space is worth "trillions of dollars" over the next 50 years.

Bob Piland, Assistant Director for Program Development at Johnson Space Center, Houston, announced that NASA and ERDA hope to join together for a three-year study of the space solar power station concept. He sketched the results of NASA's thinking to date on solar power satellites, which could lead to power from space in 20 years. The plans involve development of a heavy shuttle for launches, but by-pass the need for an O'Neill type space colony. Even on the basis of materials lifted from Earth rather than mined from the Moon, Piland regards solar power satellites as competitive with other energy systems.

Cliff Singer of Princeton underlined that asteroids present better building material than the Moon, because of their plentiful carbon, nitrogen, and hydrogen, which the Moon almost entirely lacks. His conclusion was that space industrialization would be better based in the asteroid belt.

--Reprinted from the New Scientist.

---

The John Muir High School Chapter of the L-5 Society in Pasadena, California, was established in September and has already attracted over 35 members and organized a number of activities.

Founders of this chapter are President Taylor Dark III and Vice-President Daren Nigsarian. Other officers are Secretary Ann Tamashiro and Treasurer Natasa Prurac.

This chapter has an advantage in its adjacency to the Jet Propulsion Laboratory and the California Institute of Technology. Activities scheduled include a slide presentation by JPL Scientist Tom McDonough, a special tour of JPL, and viewing of the next Space Shuttle test flight at Edwards Air Force Base. They also hope to organize an all-school lecture by George A. Koopman, Executive Producer of "The Joyful Wisdom Program" radio broadcast and partner and director of Future Presentations. They are also working on an L-5 Society T-Shirt for sale

to members of the international Society.

Any interested L-5ers in the vicinity of Pasadena are encouraged to contact this chapter to lend them help or ideas. For further information write or phone:

Taylor Dark III  
1385 Chamberlain Rd.  
Pasadena, CA 91103  
Phone: 213-449-3257

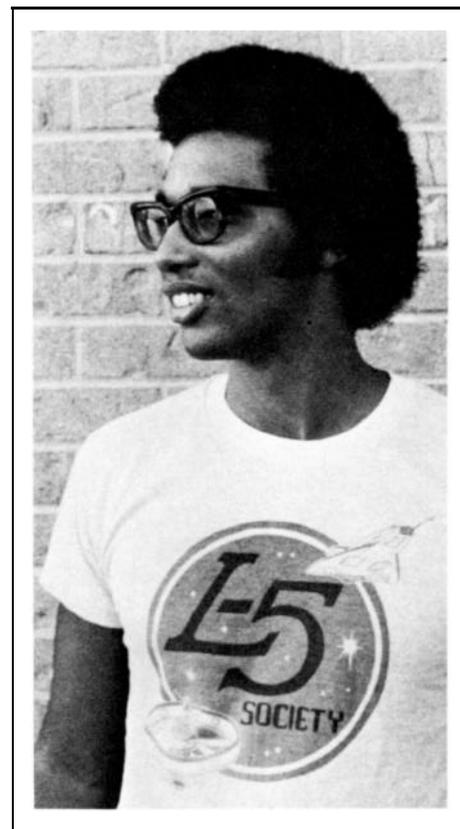
---

Please note that we have just formed an L-5 chapter at the University of Maryland. The headquarters for now will be located at my house, which is a short walk from campus. The forms required by the University are being registered and filed tonight (Tuesday, Oct. 15); copies of the Constitution will be sent to you soon. The name of the chapter will be Maryland Alliance for Space Colonization. We have an executive committee of five now set up, including two undergraduates, one graduate student in biochemistry, one graduate student who also works for the state government and was Student Government Association President for the University of Maryland Baltimore Campus when he was an undergraduate, and, myself.

You might be interested in a copy of my paper "Strategic Planning for Global Survival" which strongly defends the space program in the context of suggesting new methods for assessing technology and cost/benefit trade-offs. If you can tell me who I should send it to, I can get you a copy quickly.

Paul J. Werbos  
8411 48th Avenue  
Berwyn, MD 20740  
301/474-1465

Raymond L. Robert of Denver, Colorado, thinks it's time to get together a local L-5 group, suggesting that "the next edition of the Society News could plug it (in the advertising, not the Western sense)." Those interested can contact him at 3600 S. Yosemite #960. Denver. CO 80237, (303) 773-3272.



## Austin L-5 T-Shirts

The Austin, Texas L-5 chapter is offering the T-shirt depicted above for \$4.50 each (includes postage and handling). The color is dark blue and brown on a light blue background. Sizes available are small, medium, large and extra large. The artist who created it, John Delano, explains the symbolism:

"The use of the United Nations identification on the shuttle is an expression of the hope that the colonization of space will be an international effort. The von Braun space station is a familiar symbol of space colonization. The African continent was chosen as it is considered the true cradle of humanity."

Send orders to:

**L-5 Society**  
**University of Texas, Austin**  
**P. O. Box 8213**  
**Austin, TX 78712**

Please allow 2 to 3 weeks for delivery.

# What's Available from the L-5 Society?

WATCH FOR NEW ITEMS MARKED WITH . . .

## Books:

<i>The Hunger of Eve, A Woman's Odyssey Toward the Future</i> , Barbara Marx Hubbard Stackpole Books, Hardbound. 1976	B1	\$ 8.00	(.10)
<i>The High Frontier: Human Colonies in Space</i> , Gerard K. O'Neill William Morrow & Co., Hardbound. 1977	B2	\$ 8.00	(.10)
<i>Colonies in Space</i> , T.A. Heppenheimer Stackpole Books, Hardbound. 1977	B3	\$12.00	(.10)
<i>The Fourth Kingdom</i> , William J. Sauber	B4	\$ 6.00	(.10)
<i>War and Space</i> , Robert Salkeld Prentice-Hall, Inc.. Unbound copy. 1970	B5	\$ 7.00	(.10)
<i>Exopsychology</i> , Timothy Leary Peace Press, Paperback. 1977	B6	\$ 8.00	(.10)
<i>Colonies in Space</i> , Fredric Golden Harcourt Brace Jovanovich, Hardbound. 1977	B7	\$ 8.00	(.10)
••• <i>House in Space</i> , Henry Cooper Holt. Rinehart, Winston, Hardbound. 1977	B8	\$ 8.95	(.10)
<i>Paperback Bantam Books</i>	PB8	\$ 2.95	(.10)
••• <i>Space Colonies</i> , Edited by Stewart Brand Penguin Books, Paperback	PB9	\$ 5.00	(.10)



## Otherwise Unpublished Papers:

"Space Resources and the Human Race" W.L. Hurd, Jr.	22pp.	UP2	\$ 1.54	(.10)
"The Nature of Space Law" Scofield and Morgan	123pp.	UP4	\$ 8.61	(.15)
••• "Space Industrialization, the Challenge to Private Enterprise Capitalism," Christian O. Basler	18pp.	UP6	\$ 2.10	(.10)
NEW FROM THE OCT. 77 INDUSTRIALIZATION OF SPACE CONFERENCE				

## Reprints:

"Satellite Power Stations," William C. Brown,	PI	\$ 1.30	(.15)	"Space Colonies and Energy Supply to the Earth." Gerard K. O'Neill, <i>Science</i> , December 5, 1975	P9	\$ .80	(.10)
"Colonies in Space," <i>Time</i> , June 3, 1974.	P2	\$ .40	(.15)	"Wireless Power Transmission," John F. Mason, <i>Electronic Design</i> , December 6, 1975.	P10	\$ .50	(.10)
"Colonization of Space," Richard M. Reiss, <i>Mercury</i> , July/August, 1974.	P3	\$ 1.10	(.15)	"Colonies in Space," Ron Chernow, <i>Smithsonian</i> , February, 1976.	P11	\$ 1.10	(.15)
"The Colonization of Space," Gerard K. O'Neill, <i>Physics Today</i> , September, 1974.	P4	\$ 1.20	(.15)	"Moon Mines, Space Factories, and Colony L-5," Michael Guillen. <i>Science News</i> , August 21, 1976.	P12	\$ .50	(.10)
"Lagrangia: Pioneering in Space," Gerard K. O'Neill, <i>Science News</i> , September 21, 1974	P5	\$ .40	(.10)	"Engineering a Space Manufacturing Center" Gerard K. O'Neill, <i>Astronautics and Aeronautics</i> , October, 1976.	P13	\$ 1.30	(.15)
"An Orbiting Solar Power Station," <i>Sky and Telescope</i> , April, 1975.	P6	\$ .60	(.10)	"The Impact of Space Colonization on World Dynamics," J. Peter Vajk. <i>Technological Forecasting and Social Change</i> , 1976.	P14	\$ 3.10	(.15)
"Colonizing the Heavens," Isaac Asimov, <i>Saturday Review</i> , June 28, 1975.	P7	\$ .80	(.10)	Complete set of reprinted articles.	CP15	\$14.00	(1.50)
"The Garden of Feasibility," Gwyneth Cravens, <i>Harper's Magazine</i> , August, 1975.	P8	\$ 1.00	(.10)				

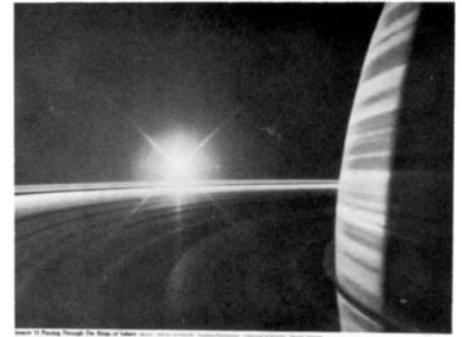
Prices in parentheses apply to overseas orders only, to help defray the additional shipping costs.  
Will be shipped surface, unless additional monies accompanies order to cover air postage.

# More Available from the L-5 Society

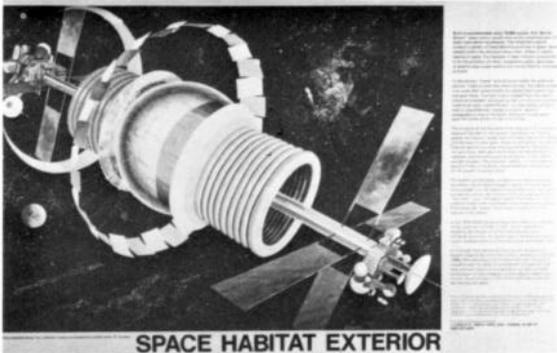
## Posters:



Pioneer XI in the Rings of Saturn, Adolph Schaller  
17" x 22", full color  
PO3 \$3.00 (.10)



Bernal Sphere Interior  
14" x 22", full color  
PO1 \$2.00 (.10)



Bernal Sphere Exterior  
14" x 22"  
full color  
PO2 \$2.00 (.10)

••• Caption:  
"Er-Suppose  
Isabella Had Said  
"No!"  
17" x 22" high  
by Kelly Freas  
3 ships on sea; with  
moon & rocket, on a  
black background.  
The impact of color &  
message is striking!  
PO5 \$2.00 (.10)



## Postcards:

Bernal Sphere Interior	PCL	\$ .15
••• package of 25	PPCL	\$1.75 (.05)
package of 50	BPCL	\$3.00 (.10)
Bernal Sphere Exterior	PC2	\$ .15
••• package of 25	PPC2	\$1.75 (.05)
package of 50	BPC2	\$3.00 (.10)

## ••• Bumper Sticker:

Message: SPACE POWER: L-5 (Blue on White)  
ST1 \$ .60 each  
3 for \$1.50



## T-Shirt Transfer:

Four color process T-Shirt Transfer, 8 x 11. Actually dyes into the material as it is ironed-on. Won't peel off! This is a full color reproduction of a NASA photograph, with the continent of Africa, the Red Sea and Saudi Arabia clearly visible.  
TT1 \$1.75 (.10)  
2 or more \$1.50 ea. (.15)

L-5 News,  
Volume 1:1-16  
Volume 2:1-6  
B1 # (indicate Vol. #)  
\$1.00 per Vol. ordered  
(.10 per Vol.)  
Complete Set of Back  
Issues,  
Sept. '75 - Oct. '77  
B1A \$25.00 (\$1.50)



## ••• Ballpoint Pens:

Microjet writing point, fine, blue ink, blue barrel, with ink eraser. Pencil style with imprint:  
SPACE IS SURVIVAL  
WE NEED SPACE TO LIVE IN  
L-5 IS THE PLACE  
BP1 \$ .50 each (.05 each)

Prices in parentheses apply to overseas orders only. to help defray the additional shipping costs.  
Will be shipped surface, unless additional monies accompanies order to cover air postage.



# SHOULD WE COLONIZE SPACE?

## NO!

“... I regard space colonies as another pathological manifestation of the culture that has spent all of its resources on expanding the nuclear means for exterminating the human race. Such proposals are only technological disguises for infantile fantasies.”

--Lewis Mumford, author of the *PENTAGON OF POWER*

“From an energy standpoint, there is no compelling need to demonstrate solar energy in space. Solar radiation reaching the earth’s surface is ample in most areas of human habitation to provide essential energy needs, at far less cost than a space system.”

--Wilson Clark, author of *ENERGY FOR SURVIVAL*

“A lot of people who want to get into space never got into the earth. It’s James Bond. It’s a turning away from the juiciness of stuff. That’s something that’s lost its appeal for me.”

--Ken Kesey

“As for those who would take the whole world to tinker with as they see fit, I observe that they never succeed.”

--Lao Tzu

“We can’t have us poor crazy late-twentieth-century hopheads going up there -- no way. This calls for a level of rationality and sanity that we haven’t begun to approach.”

--John Holt, author of *HOW CHILDREN LEARN*

## YES!

“Space exploration is probably the most dramatic example of human adventure made possible by science, but currently it is almost entirely monopolized on a competitive basis by the U.S. and the Soviet Union. The pooling of Western European, Japanese, and American resources for a specific joint undertaking would do much to accelerate international cooperation.”

--Zbigniew Brzezinski, Head of the National Security Council

“Satellite systems could provide vast quantities of electricity on earth without damaging the environment, and even offer the potential for this country to be an exporter of energy in the next century. The space colony concept is interesting and imaginative and one that NASA should be studying.”

--Senator Wendell Ford, Chairman of the Space Subcommittee

“We can. . . build space colonies which would fulfill functions that are now fulfilled by cities on the surface of the earth.”

--Isaac Asimov

“We can build colonies in space, as pleasant as we want and productive enough to markedly improve humanity’s chances of survival. And, we can begin to do this anytime we please.”

--T.A. Heppenheimer, author of *COLONIES IN SPACE*

“Colonies in space? The question really shouldn’t be raised. For me, anyway, it is self-answering. Yes, of course. Why not? Let’s move. Let’s go there. Let’s do the job.

--Ray Bradbury

