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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).
By popular demand presenting

### 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 Love
110908 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
Milwaukee, 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 preceded, 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.


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 development 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 assessment 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.

<table>
<thead>
<tr>
<th>Investment unit cost, $1kW(e)</th>
<th>$1kW(e)</th>
<th>$1kW(e)</th>
<th>$1kW(e)</th>
<th>$1kW(e)</th>
<th>$1kW(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial solar electric</td>
<td>1300</td>
<td>1100</td>
<td>750</td>
<td>1200</td>
<td>1500</td>
</tr>
<tr>
<td>Solar photovoltaic</td>
<td>750</td>
<td>1200</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
</tr>
<tr>
<td>Wind</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ocean thermal</td>
<td>0.33</td>
<td>0.33</td>
<td>0.9</td>
<td>0.95</td>
<td>0.66</td>
</tr>
<tr>
<td>Solar SPS</td>
<td>0.33</td>
<td>0.33</td>
<td>0.9</td>
<td>0.95</td>
<td>0.66</td>
</tr>
<tr>
<td>LMFBR*</td>
<td>0.33</td>
<td>0.33</td>
<td>0.9</td>
<td>0.95</td>
<td>0.66</td>
</tr>
<tr>
<td>Fusion†</td>
<td>0.33</td>
<td>0.33</td>
<td>0.9</td>
<td>0.95</td>
<td>0.66</td>
</tr>
</tbody>
</table>

†Speculative; Division of Magnetic Fusion Energy.
§18% cost of money.

### TABLE 2. NASA's estimates of key parameters for the cost-effective development of the SPS.

<table>
<thead>
<tr>
<th>Key development problems</th>
<th>Approx. Development cost</th>
<th>Operational date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heliostat</td>
<td>11B</td>
<td>1985</td>
</tr>
<tr>
<td>Materials</td>
<td>500M</td>
<td>1990</td>
</tr>
<tr>
<td>Rotor</td>
<td>$1B</td>
<td>1983</td>
</tr>
<tr>
<td>Heat exchanger</td>
<td>$60B</td>
<td>1985</td>
</tr>
<tr>
<td>Launch vehicle and tug</td>
<td>$11B</td>
<td>2000+</td>
</tr>
<tr>
<td>Launch complex, orbital</td>
<td>$15B</td>
<td>1993</td>
</tr>
<tr>
<td>Operations</td>
<td></td>
<td>2000+</td>
</tr>
</tbody>
</table>

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3
TABLE 2. Assessment of key issues.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NASA initial assumption</th>
<th>Task Group comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Satellite System</td>
<td>5.10 GWe(e)</td>
<td>very large for utility integration</td>
</tr>
<tr>
<td>Gross weight</td>
<td>65 to 66 × 10^6 kg (10GW(e))</td>
<td>Over 500 heavy lift launch vehicle launches required per SPS</td>
</tr>
<tr>
<td>Life</td>
<td>30 years</td>
<td>Must be maintained in space with reliability equal to ground station</td>
</tr>
<tr>
<td>Size</td>
<td>Up to 10 × 20 km</td>
<td>No previous experience, limited ground demonstration feasible</td>
</tr>
<tr>
<td>Overall Efficiency</td>
<td>57%</td>
<td>Not yet demonstrated</td>
</tr>
<tr>
<td>Solar Array Material</td>
<td>Silicon</td>
<td>GaAs would permit greater concentration ratio</td>
</tr>
<tr>
<td>Thickness</td>
<td>50-100 pm</td>
<td>Not a “natural” thin-film material</td>
</tr>
<tr>
<td>Efficiency</td>
<td>16%</td>
<td>Not consistent with thickness quoted</td>
</tr>
<tr>
<td>cost</td>
<td>$0.20/W</td>
<td>$0.50/W is ERDA goal for silicon in terrestrial application</td>
</tr>
<tr>
<td>lifetime</td>
<td>30 years</td>
<td>High radiation damage (Van Allen, solar storm)</td>
</tr>
<tr>
<td>On-board power</td>
<td>20-40kV DC</td>
<td>Needs rotary joint development: high voltage, high amperage</td>
</tr>
</tbody>
</table>

Microwave Energy Transmission

| Antenna size | 1 km diameter | Must be phased flat to 1/4 wavelength (2.5 cm) |
| Frequency (10 cm) | 2.45 GHz | Reserved for industrial, scientific, & medical use |
| Pointing accuracy | 1 arc min. | Requires active (upbeam) control |
| Amplotron module size | 6 kW | Requires very accurate wave guides (over 2 × 10^6 units) |
| Ground receiver (rectenna size) | 10 × 14 km | Additional protected area required |
| Beam flux | 20 mW/cm^2 max. at center | Potential problem with microwave exposure standards; ionosphere interactions (23mW/cm^2) |

Transportation

| Launch vehicle gross weight | 7×10^6 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 | Advanced technology orbital operations |
| Construction rate | 1 SPS/year; automated space fabrication and assembly involving remote devices |
| 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.

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, using “beam-builders” 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. 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 SST0 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 SST0 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.


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.

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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.
4. We admittedly need some new perspective as possible and to try to lead to a few tentative conclusions.

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.
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: 49%

**NEED FOR SHUTTLE IN FUTURE SPACE OPERATIONS**

- Yes: 78%
- No: 9%

**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.
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.
5. Jib Fowles, Studies of the Future, University of Houston, Clear Lake City.

The room number is not yet known. It will be either at Hyatt Regency or at Sheraton Houston. The reservation form 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.

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 (703-354-6235).
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. Wrobos
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:
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Please allow 2 to 3 weeks for delivery.
# What’s Available from the L-5 Society?

**WATCH FOR NEW ITEMS MARKED WITH . . .**

## Books:

- **The Hunger of Eve, A Woman’s Odyssey**
  - Toward the Future, Barbara Marx Hubbard
  - Stackpole Books, Hardcover. 1976
  - B1 $8.00 (.10)

- **The High Frontier: Human Colonies in Space,**
  - Gerard K. O’Neill
  - William Morrow & Co., Hardcover. 1977
  - B2 $8.00 (.10)

- **Colonies in Space,** T.A. Heppenheimer
  - Stackpole Books, Hardcover. 1977
  - B3 $12.00 (.10)

- **The Fourth Kingdom,** William J. Sauber
  - Stackpole Books, Hardcover. 1977
  - B4 $6.00 (.10)

- **War and Space,** Robert Salkeld
  - B5 $7.00 (.10)

- **Exopsychology,** Timothy Leary
  - Peace Press, Paperback. 1977
  - B6 $8.00 (.10)

- **Colonies in Space,** Fredric Golden
  - Harcourt Brace Jovanovich, Hardcover. 1977
  - B7 $8.00 (.10)

- **House in Space,** Henry Cooper
  - Holt, Rinehart, Winston, Hardcover. 1977
  - B8 $8.95 (.10)

- **Space Colonies,** Edited by Stewart Brand
  - Penguin Books, Paperback
  - PB8 $2.95 (.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.
  - P1 $1.30 (.15)

  - P2 $40 (.15)

  - P3 $1.10 (.15)

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  - P5 $40 (.10)

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- **“Engineering a Space Manufacturing Center”**
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**Complete set of reprinted articles.**

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ST1 $ .60 each
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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.
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Please enroll me as a member of L-5 Society ($20 per year regular, $10 per year for students). A check or money order is enclosed. (Membership includes L-5 News, $3 to members; the balance – $17 or $7 – is a tax-deductible donation.)

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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