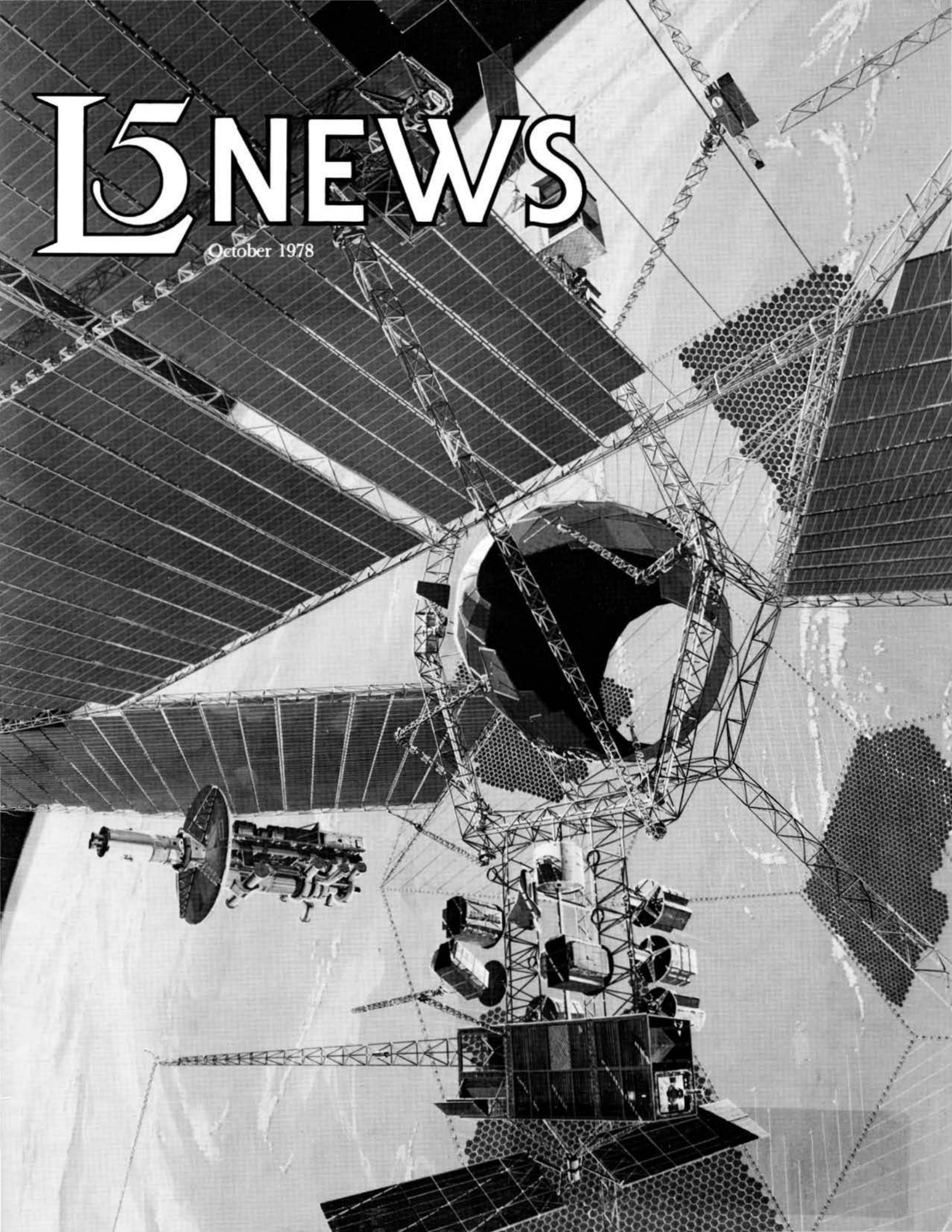
L5 NEWS

October 1978



L-5 NEWS

A PUBLICATION OF THE L-5 SOCIETY

VOL. 3 NUMBER 10 OCTOBER 1978

In this issue:

Publication office: the L-5 Society, 1060 E. Elm, Tucson, Arizona 85719. Published monthly. Subscription: $12.00 per year, included in dues ($20.00 per year, students $15.00 per year). Second class postage paid at Tucson, Arizona and additional offices.

Membership Services: L-5 Society, 1620 N. Park Avenue, Tucson, Arizona 85719. Telephone: 602/622-6351.

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

Cover: Construction of the heat cavity of a solar power satellite *(courtesy Boeing).*

An office at the Environmental Research Laboratory. The plants seen here produce about one kilogram of vegetables per day every day of the year. These intensive cultivation techniques may some day be applied to growing food in space.

NASA-Supported Study at the University of Arizona Selects Crops for Closed Habitats in Space

by Annita Harlan

What to eat and how to raise it during years of space habitation are issues being addressed by a team at the University of Arizona's Environmental Research Laboratory in Tucson. Under the direction of Research Associate John Phillips, a diverse group including library specialists, biologists, and a student of psychology are considering the literature on closed environment agriculture (CEA) in search of likely food sources for space pioneers and permanent inhabitants.

The study came into existence in order to cover gaps in knowledge uncovered at the 1977 NASA-Ames Space Settlement Study which was attended by two of the team members. It has centered on collection of published works which detail the methods used in growing crops and raising animals not under field, but under enclosed, conditions. Increased yields are usually realized by CEA, and economies can be made in materials, such as nutrients and water. Recycling in controlled loops, an imperative for space habitations, naturally derives from CEA practices.

With compilations of candidate species, their yields, needed feedstuffs and spatial requirements in hand, the ERL team will be making specific recommendations to NASA in several areas of RT&D. Among them will be: utilization of space shuttle to to study systems and components. Development of a dedicated long-duration exposure facility for life sciences research. Initiation of quantitative studies in earth-based phytotrons. Continuation of interdisciplinary forums to promote developmental interaction among industrial, governmental and university personnel interested in CEA. Expansion of the data base SIRS (Space Information Retrieval System) begun during the study.

The study will be in progress until November 30, 1978 and the participants would welcome input from interested individuals.

Children of Gaia

by Erik T. Paterson

Living creatures not only respond to their environment, but actively change it. This is the prime principle of ecology, and the details of the flows of energy, water and nutrients within the ecological system are secondary. It explains the interdependence of living things.

The "Gaia Hypothesis" was named by William Golding and elaborated by Lynn Margulis and James Lovelock as an extension of this principle. It suggest that the entire biomass of the Earth is a single living entity, able to control and direct the changes in its own environment to ensure its own survival. Every organism does this, from the lowest to the highest. A unicellular organism is a metastable co-operative collection of molecules which, in themselves, are constantly changing each other and their environments for the sake of the survival of the whole. Similarly, an organism as complex as a human being is an equally metastable co-operative of cells changing each other and their environments. The hypothesis cannot be proved, but it offers powerful insights that can guide would-be populators of Space.

Up until now Gaia has been unable to perform the one activity shared by all its component organisms. It has failed to reproduce itself. It cannot reproduce itself because it has not been able to evolve the necessary mechanisms to be able to move parts of itself off the surface of the Earth and into space, the only place into which it can divide without destroying itself by self-competition.

But now, in the shape of some derivatives of the hominids, Gaia may have developed just that mechanism by which, after 3½ billion years, it can reproduce itself. If we choose we can establish independent colonies in space. But those colonies cannot survive long unless we learn the lesson of Gaia. We have to take with us a sufficient variety and diversity of other organisms whose own interactions and modifications of their environment will permit us to live. But they, in their turn, will depend for survival on the modifications in the environment of space that only we, with our technological expertise, can bring about.

It is one of the chief ironies of our age, that we, who threaten Gaia's very survival, can be the means for the spread of Gaia's children across the Universe.

L-5 Symposium

by Tony Davis

What are the chances that your cozy little mecca in outer space will be destroyed by a terrorist attack? By a killer virus? By a flood of radiation? How will we get along up there? Will it be governed by the kind of social democracy, replete with trade unions and constitutional guarantees, that we know in the United States and Western Europe? Or will it be a less benign form of government, one that would make the Soviet Union seem humanistic by comparison, one in which the dregs of human existence would battle it out for survival?

These and other questions were explored last month in the L-5 Symposium held at the 36th annual World Science Fiction Convention in Phoenix, Ariz. Panelists were L-5 Society president Carolyn Henson and science fiction writers Mack Reynolds and Joe Haldeman, both of whom have novels in the works about space colonies.

In general, the outlook of the panelists was optimistic, and one of the reasons is the kind of people who are likely to settle in outer space. Comparing the colonizing of space with the colonizing of the Western Hemisphere, Reynolds noted that the immigrants from Europe throughout the ages were either some form of human scum — such as convicts or ne'er-do-wells — or refugees from an oppressive political atmosphere back home.

The crew that came over with Columbus, for instance, were not adventurers, said Reynolds. Instead, they were "the scum of Southern Spain who even were on the verge of mutiny. Columbus went over for money, you know."

The later Spanish settlers, led by Conquistadores such as Cortez and Pizarro, "were the most corrupt, depraved people you could find," said Reynolds. On North America, Georgia, for one, was settled by convicts. Many of its new residents — the slaves — didn't want to come to begin with.

Reynolds noted that the Irish who came to the U.S. to escape the potato famine in the 1840's were the lesser trained of their countrymen, while the better-equipped ones stayed on. Likewise, it was the poorer, less-trained Germans who fled Bismarck and Jews who fled the pogroms, he added, and the Italian immigrants mainly came from the poorer, rural areas of Sicily and Southern Italy.

The first space colonists, by contrast, are likely to be so intelligent, competent and well-trained that they could get a good job on Earth, said Reynolds.

But someone from the audience shot back that "the people who leave here — are they the ones who louse up to begin with?"

Henson, meanwhile, predicted that Earth will eventually become a giant park, maintained by space dwellers for their amusement — "the people will not be allowed to mess up their home planet.

"We can clean up Earth by leaving it. The only way out is up. We can't go back to our past ways."

What kind of government will we have up there? Again, it depends on who goes up first, according to Henson. Colonies that are largely corporate-dominated and founded primarily for the purpose of space industrialization — which is the most likely scenario for the early settlements— will probably resemble company towns, with the resulting corporate dominance over both politics and social life. A member of the audience suggested that the only way out of such a bleak future would be for the workers to buy controlling interest in the company, thus giving employees more control over their lives.

Asked about the possibility of a terrorist blowing a hole in a spaceship, Henson replied that on Earth, an offshore oil platform would be a much easier target, since it could be sabotaged by little more than a good monkey wrench. Yet terrorism has never struck one. She said security measures need not be more tight than on a nuclear submarine, where the only persons who are screened out before boarding are those who have been getting in trouble with the Navy.

"Most people are a heckuva lot more stable than social scientists would have you believe. Terrorism is not nearly as rampant as believed," she said.

Other suggestions from the audience for combatting terrorism in space included an "absolute death penalty for upsetting the system" and to "take precautions — Don't let any Italian politicians along".

As for the prospect of a disease-racked space colony, Henson argued that it isn't as likely as a plague striking a large city.

"New flus don't come out of Tahiti. They come out of China. You need a large body of host organisms to generate new diseases.

"On bases in Antarctica, for instance, they'll go nine months in the cold with no contact with the outside world and be healthy, then they'll get their first piece of mail and all catch colds and flus."

Reynolds, however, warned that a group of space colonists living a disease-free existence inside a rock shield could be easy targets for germs once they came back to Earth because they would never be able to build up any immunities. □

So you think, as Mack Reynolds does, that the days of prisoners as colonists are over? Lawrence Brozik, an inmate of the Florida Prison system, disagrees in . . .

The Prisoner and Space

"Today, one hundred of Florida's deathrow inmates were taken from their cells and were transferred to the KENNEDY SPACE CENTER (KSC) which is situated in southern Florida. Training under super maximum security conditions will take place, and each of these prisioners will be sent to the Lunar Service Station I site within the next twenty-four to thirty-six months." (Future news circa 1980.)

Such a scenario as the above is not absurd.

I think the facts will bring us to conclude that "THE PRISONER IS OUR MAN."

Many of the world's pyramids were assembled by the prisoner of yesteryear. For much of the recovered art and anthropological data, we are indebted to their service. Thank you, prisoner.

When England was into the business of colonizing America, few Englishmen could be induced to venture away from "home", even when gold was offered as an inducement. So England turned to her dungeons and asked the prisoners (with death and life sentences) if they would consider going to America. England was "surprised" to find so many colonizers/explorers in various of her dungeons. The prisoners, it was learned, sought to be frontiersmen as opposed to being practice material for the executioner! Thank you, prisoner, for settling America.

When our forefathers were going west, once again the prisoner was used for building roads and bridges. Thank you, prisoner.

When the continent of Australia was in need of colonizing, the prisoner was used again. Thank you, prisoner.

There are cases upon cases where without the prisoner's contribution there would have been major lags in our development. The prisoner has contributed significantly to national expansionism, resource development, technological advancements and scientific contributions. The list is long. Thank you, prisoner.

Let us examine how the "free-person" thinks v.s. the prisoner.

A. The free-person has certain basic thoughts and ideas which make up his or her Gestalt. Examples:

I. Today is a special day and I wear a special color outfit of clothes. I do this because I am Irish.

II. It is Friday night and I must go to the discotheque to be with my friends.

III. This is my house and new car, I am very happy.

IV. I often have a spontaneous desire to go for a midnight walk down to the bay, and I enjoy it.

V. I don't want to go to a certain place, so I won't go.

VI. Linda Sue and/or John Paul will say they want some sex or love tonight.

VII. Space colonization and manufacturing facilities are pure hogwash! Furthermore, I am not leaving my house and friends for any longer than a few weeks. Let's make Earth happy first.

B. The prisoner has certain basic thoughts and ideas which make up his or her Gestalt. Examples:

I. There is nothing special about today and my clothes will be the same color as yesterday even if I am Irish.

II. It is Friday night and I will go nowhere that I didn't go last night. I will go to my cell. I have few, if any, friends. Anyhow, they usually represent a liability!

III. This cell is not my house, and I have no house. Nor do I have any car. I am not happy.

IV. I have no spontaneous desire to go for a midnight walk down to the bay, because I cannot go.

V. I may not want to go to a certain place, but I will go if I am told to go.

VI. Sex. Two guesses what's available.

VII. Space colonization and manufacturing facilities are TALLY HO! Yes, I will leave this cell to go to a place which offers more choice.

Due to the high cost of per kilogram of mass delivered to the Lunar surface, this discussion will use small dollar numbers. Although these are not meant to represent actual costs, these figures will, nonetheless, get us to our conclusion.

The free person, it has been learned, wants a round-trip ticket so that he/she can first go to the Moon to sort of "look it over." The whole space scenario is, to quote Gerard K. O'Neill in "Space Manufacturing Facilities" (**Space Colonies 1977**), ". . . a concept which is still, for many people, very rich in future shock." The prisoner, however, unequivocally says, "Yes, I will go, even if it is forever." This brings us to some real dollar considerations:

If the free person goes to the lunar surface with the Space Transportation System (STS) etc. pledged for his or her short duration return, the cost is phenomenal.

Let us suppose that the cost from the Earth's surface to the lunar's surface is exactly one dollar. Let the same stand for a return trip. Thus, we have a round-trip for the cost of two dollars. Let us also suppose that the free-person will go on the roundtrip at a wage scale double that of the Alaskan pipeline workers; wages, then equal about ten cents for his/her short duration venture. Also, for the same time period, society in general, has been housing and feeding a prisoner for a cost of five cents. Grand total cost to the tax-payer, then is two dollars and fifteen cents. And what we get is not much done on the lunar surface.

If, on the other hand, the prisoner goes and no Earth resources (H and O plus complex STS, etc.) are pledged for his/her return, the cost is much less.

For example, if the prisoner goes on the one-way venture, the cost is one dollar. If we subtract the housing and feeding costs if he/she had remained in prison, it brings the cost to ninety-five cents.

"They set up the Lunar Service Station I, fed lunar resources to the space manufacturing facility where the first space colony was built, which in turn built the solar power satellite (SPS) which now

powers New York." (Future news, circa 1995)

Could we thank the prisoner again?

IN CONCLUSION:

Sending the prisoner to space is proposed by reason of history, psychology and economics:

The prisoner has developed new frontiers in the past and will do it again. The lunar envionment is hostile and Florida's large death-row has prisoners who are willing to go.

(NOTE: Today, 1978, there are plus one hundred condemned prisoners on Florida's death list and these prisoners are housed close to KSC.)

Reader opinion on this paper is sought and all letters addressed to the author will be read as a source of feedback. Please address your letters to LAWRENCE BROZIK No. 040717, BOX 221, RAIFORD, FL 32083. Also, should you write your Congressperson, etc. on the use of prisoners in space, thank you.

ABOUT THE AUTHOR:

Lawrence Brozik is a prisoner in the Florida prison system, serving a fifteen year sentence for manslaughter. He is a graduate of the Associate of Arts degree at honors and a continuing student of psychology and psychiatry. He is to be released by 1981. He is a licensed commercial pilot with plus fifteen hundred hours of safe flight logged and a member of the L-5 Society.

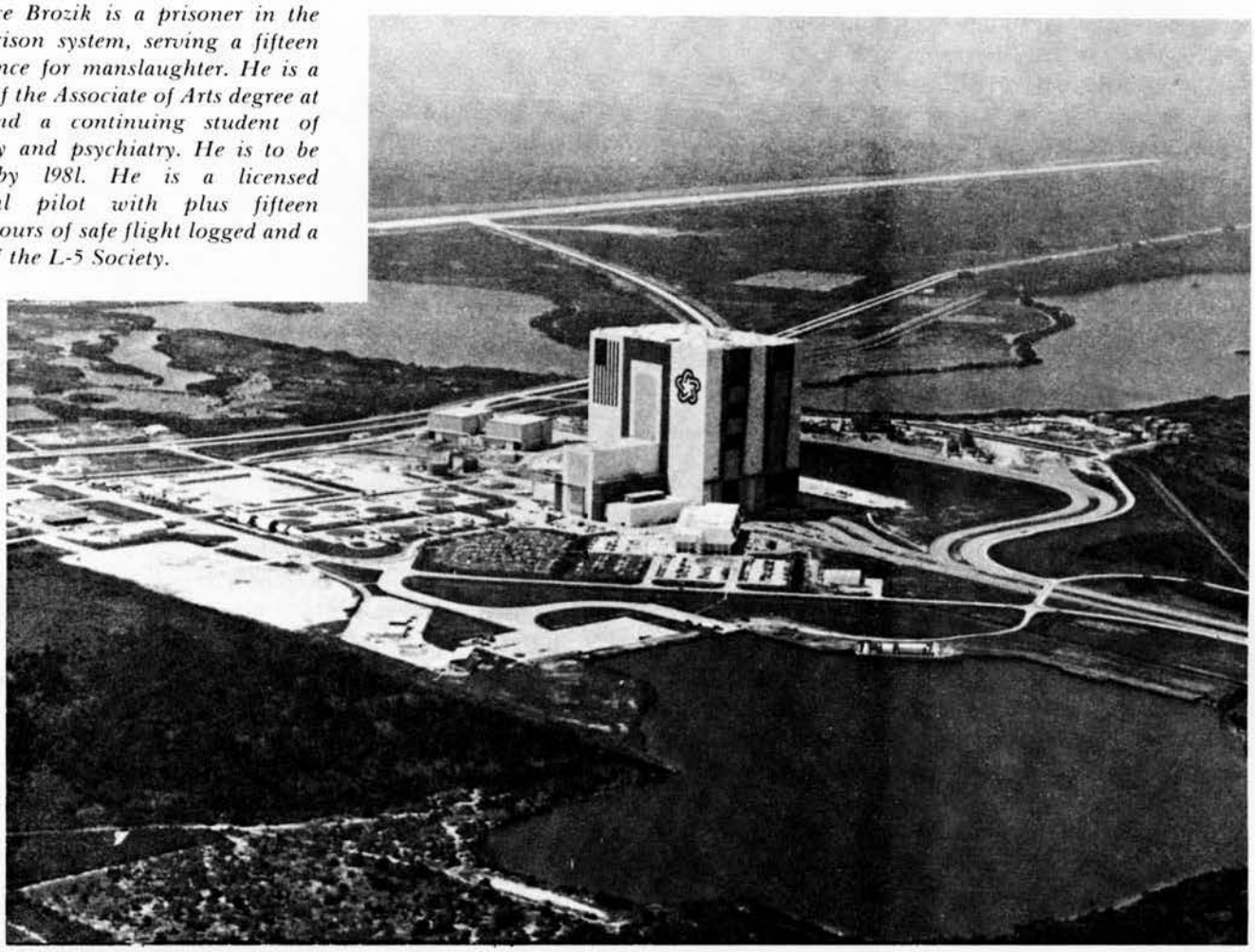
Immense Crawler Transporter—Massive loads will be carried on the top deck—the size of a baseball diamond—of this transporter. It will be used to move mobile launcher platforms with the assembled Space Shuttle between the VAB at the Kennedy center and two launch pads at complex 39.

Big Facelift at Kennedy Center

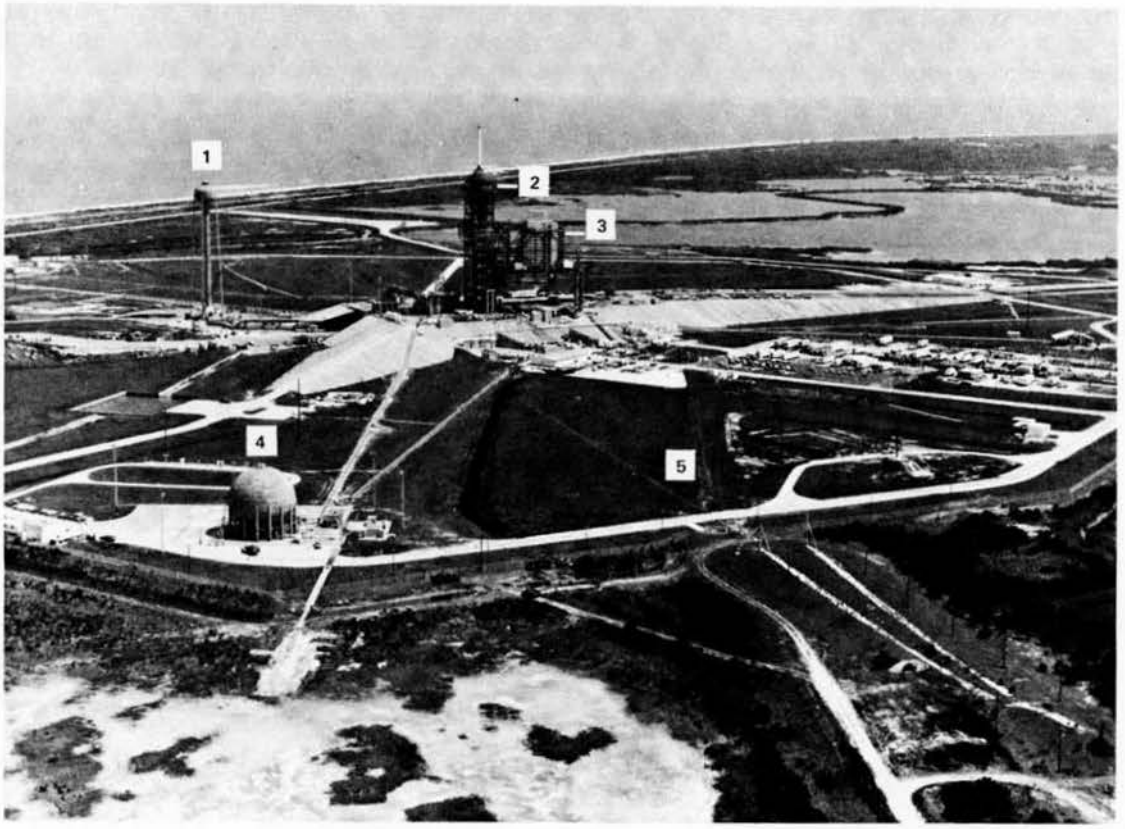
The changes, refurbishments and new construction going on at the Kennedy Space Center are many and varied as the center braces for a whole new era of space adventure following the arrival of the Space Shuttle next year. To accommodate the responsibilities involved, almost all the established facilities are being modified.

The tasks are to build or modify buildings and apparatus; design, build and acquire equipment and ground support facilities; and then install, wire up and interconnect the thousands of complex systems. Dr. Robert Gray, manager of the Space Shuttle Projects Office at KSC, is responsible for completion of the massive job.

The accompanying pictures show only some of the activities underway in preparation for the first launch of the Shuttle, now scheduled for June 1979.



Long-range View—This picture shows most of the facilities that will provide both launch and return accommodations for the Space Shuttle missions. When ready for launch, the orbiter will travel from the Vehicle Assembly Building to its launch pad (beyond right margin of picture). Upon its return, the orbiter will land at the strip visible at top of photo.



Looking Down at Shuttle Facilities—Shown are the 87-meter tall water tank (1), which holds 1,025,500 liters of water, built to protect the orbiter and its delicate payloads from acoustical damage during launch; (2) the fixed service structure (lightning mast at top) with rotating service structure (3) nearby—to provide access to the orbiter for changeout and service of payloads at the launch pad; the liquid oxygen facility (4) which supplies one of the propellants (along with hydrogen) for the main engine; and the emergency egress system landing area (5), to be used in case of a mishap during launch procedures while the astronauts are in the orbiter. The system consists of a slide-wire running from the pad to the emergency landing site; should the need arise, the astronauts would move quickly into a small trolly-like device that would transport them to safety, traveling at high speed along the slidewire.

SPS Hearings

(Continued from last month.)

by Ken McCormick

The next witness to appear was Mr. Garry DeLoss, a professional lobbyist representing the Environmental Policy Center. Mr. Deloss testified that "The Environmental Policy Center opposes the SPS concept and this bill's commitment of funds to SPS technology development because we believe that (1) even if the SPS could be shown to technically feasible, it will never be economically and politically feasible, and, (2) the money which this bill would allocate to SPS technology development instead should be allocated to land-based, decentralized solar energy technologies.

"Several studies have purported to calculate the cost of producing dozens of solar power satellites over a period of many years beginning near the end of this century, and then compare that cost with projected costs for other possible sources of electricity. All of these studies of the economic feasibility of the SPS are flawed in major respects.

"The supposedly objective cost estimates for the SPS are being made by the corporations, NASA space flight centers, consulting firms, and academicians who have a vested interest in encouraging a massive government commitment to SPS. This leads to cost estimates that are mere self-fulfilling prophesies, or what one critic, Dr. John Cummings of the Electric Power Research Institute, calls 'legislating all the answers.' Richard Caputo, who directed a two-year Jet Propulsion Laboratory (JPL) study of the SPS recognized the same pattern of behavior, and characterizes the cost estimates he examined as based on 'assumptions of success' rather than a real data base. The SPS proponents appear to begin by calculating the cost goal which the total SPS system must meet to compete with other energy sources, and then allocate that cost goal among the various subsystems of the SPS. Hence, they tend to reach similar conclusions about the total cost of the SPS based on widely varying estimates about the costs of the sub-systems."

DeLoss also noted several of what he called "diseconomies of scale" in connection with the solar power satellite. First of all, he said, "A utility receiving electricity from an SPS would require a reserve of standby power capacity equal to or greater than the SPS power of five gigawatts" for use as a backup source in the event that power from the satellite should be interrupted without notice.

Second, the commitment of $60 billion required to develop the SPS to a commercial scale is much larger than the

commitment to develop other energy sources. "The cost of developing photovoltaic cells for land-based uses to a 10MW scale commercial demonstration powerplant by 1985, for example, will be from 0.2 to 0.4 billion dollars. In other words, the SPS would require 150 to 300 times more R&D dollars just to test its economic feasibility. Even the breeder reactor's proposed development cost of about ten billion dollars is dwarfed by the SPS proposal. The diseconomy of scale inherent in such a large development cost is that it can only be financed by preempting funds that could have been used to develop other energy technologies. In effect, the extremely large development cost requires a commitment in favor of the SPS technology versus competing energy technologies even before the economic feasibility of the SPS is demonstrated.

"A third diseconomy of scale of the SPS is that the projected costs depend on maintaining a specified rate of construction of new satellites. In other words, if electricity demand growth leveled off for a few years, as it did from 1974 to 1976, and consequently, the rate of SPS construction was slowed, costs per unit would rise sharply."

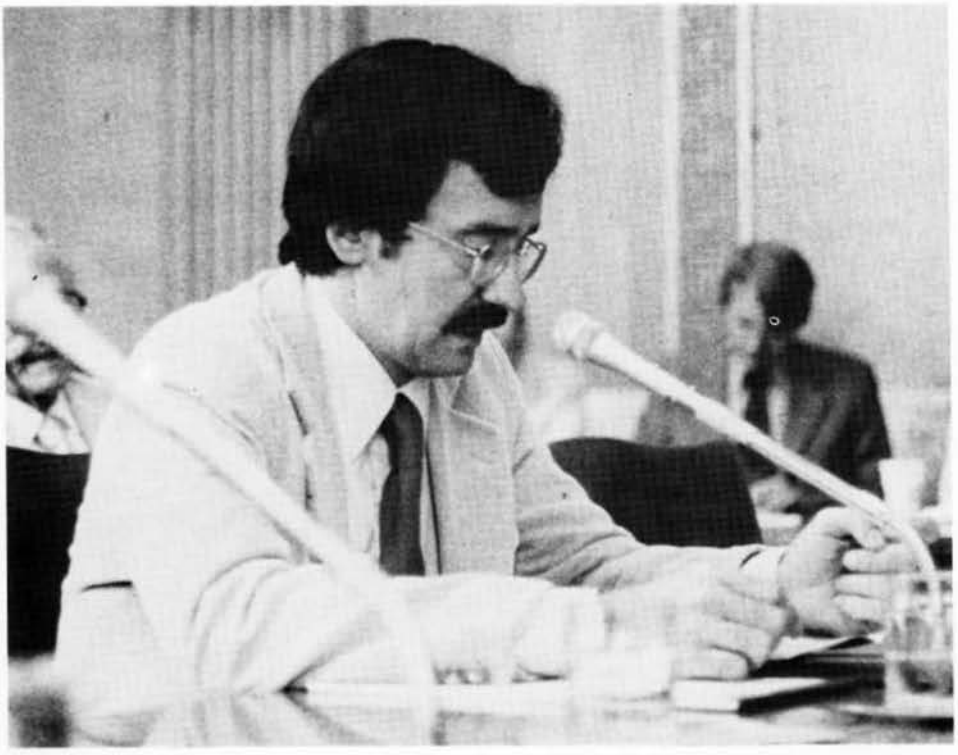
Unexpected variations in demand growth, coupled with the fact of the large power generating capacity of a single SPS, could lead to a mismatch between supply and demand, creating an idle investment for utility ratepayers or shareholders, said Mr. DeLoss.

"A fifth diseconomy of scale of the SPS is that the high cost and high risk of relying on the SPS means that the federal government is likely to be the only entity with the resources and, hence, ability to absorb the risk needed to finance the SPS. Utility companies would be relegated to the role of distributors of SPS power rather than producers."

A sixth "diseconomy of scale" noted was the vulnerability of SPS to attack by a foreign power. Powersats could be attacked in orbit with missiles or gound-based lasers. "Saboteurs," said DeLoss, "could attack the receiving antennae, which would have almost indefensible perimeters of many miles, or the high voltage transmission lines."

DeLoss turned, next, to what he called "the most obvious flaw in the existing studies" on SPS economics, "their failure to adequately consider the lowest cost alternatives to the SPS, which are, first efficiency improvements that will reduce our need for new energy supplies, including new electric generating capacity, and, second, land-based, decentralized solar energy technologies."

With regard to efficiency improvements, DeLoss complained that existing SPS studies "don't reflect the realistic possibility that we will use energy much more efficiently two or three decades from now, especially if resources were commited to energy conservation on the scale proposed for SPS development. No report on SPS economics that I have reviewed includes speculations on how much energy could be saved if the hundreds of billions of dollars proposed for SPS development and deployment were instead spent on improving energy efficiency."



Garry Deloss, testifying against the SPS bill. (Photo courtesy Charles Divine.)

"The SPS proponents prefer to set up the straw man of a centralized solar energy powerplant alternative and then knock it down by claiming high costs for land acquisition, electricity storage, and transmission lines up to 2,000 miles long from solar powerplants concentrated in the Southwestern states. Even the most objective of the SPS studies, the report by JPL, compared the SPS with what its director has described as the 'worst solar terrestrial options,' centralized solar energy powerplants at sites remote from their markets. . . The JPL study concluded that the SPS would cost more than a land-based, centralized solar energy powerplant using a solar thermal process and fossil fuel backup system, and about the same as a centralized photovoltaic solar energy system with a fossil fuel backup system.

"If the SPS costs were compared with decentralized solar electric systems using photovoltaic cells, the SPS would look even worse. Decentralized solar energy systems would be lower cost than centralized solar energy systems used in the JPL study because transmission costs can be eliminated, land acquistion costs can be reduced by using air spaces over rooftops and parking lots, and waste heat can be put to work near the generating site.

"Objections by SPS proponents that electricity storage costs are an insurmountable barrier to lowering the cost of land based solar energy. . .have to be taken with a grain of salt. The people who suggest that major reductions in the cost of electricity storage are not likely are the same people who are extremely optimistic that costs for the various subsystems of the SPS will fall drastically."

DeLoss conceded that SPS might be technically feasible, but pointed to increasing social pressures on the technology of energy production. "In the past," he said, "positive answers to the questions of technical and economic feasibility might have been sufficient to assure the development of a new energy source. But today our society is more crowded, competition for the use of finite resources such as minerals, air, water, and land has increased, and the social and environmental impacts of a new technology are major factors in determining whether it will be developed on a large scale. Hence, in a democratic society, a proposed energy producing technology such as the SPS must be acceptable to the public, or politically feasible, as well as technically and economically feasible."

On the question of the political feasibility of powersats, DeLoss first

Peter Glaser, inventor of the SPS, defending his work. (Photo courtesy Charles Divine.)

pointed out the need for many launches of a heavy-lift launch vehicle (HLLV): "Construction of a single SPS would require 50 to 500 flights of the HLLV at the rate of one to five launches per day. If the dozens of SPS's needed to achieve the claimed economies of scale are to be built, the launches would continue at this rate for decades. Indeed, eventual replacement of worn out SPS's (a 30 year life is predicted) would require such launches into the indefinite future . . . .

"An HLLV being launched would be louder than the less powerful Saturn rocket and an HLLV landing would be much louder than the SST." Because of the noise problem, DeLoss said he doubted that even Cape Canaveral could be an acceptable launch site, due to the fact that "Orlando, Florida and the Disneyworld amusement park are just a few miles away, and the nearby population is growing rapidly."

Another major political barrier to acceptance of SPS by the public which was cited by DeLoss was the public's desire for increased consumer control of the energy supply: "The public enthusiasm for solar energy is based on an interest in decentralized, or dispersed, solar energy systems, not highly centralized systems like the SPS, which must be owned by giant utility companies or the federal government. Solar energy enthusiasts are looking forward to development of solar energy systems scaled for use by individuals, neighborhoods, and communities. . . . Resistance to the SPS will grow as consumers become aware that the larger scale commitment required to make the SPS work would effectively foreclose consumer and public utility commision influence over electricity rates and construction decisions."

The final political obstacle mentioned was the problem of siting receiving antenna areas. DeLoss pointed to the recent controversies over the siting of both nuclear and fossil fuel plants, high voltage powerlines, nuclear waste disposal projects, and the Navy's Project Sanguine, a proposal to bury a huge grid of electric cables for low frequency communication with submerged submarines.

"When I was speaking to a few members of the House, when this bill was progressing the House," said De Loss, "I just happened to contact the office of Congressman Obey, from Northern Wisconsin, and I learned that the congressman got elected to office by running against a 30-year incumbent who supported the siting of Project Sanguine in his district. Congressman Obey opposed the siting, and that won the election for him. So I just wonder, if we're to have a hundred or more of these antenna sites in the country, how many congressmen or senators would want to advocate the siting of maybe three or four of those antennae in his own district.

"SPS proponents are aware of the siting problem. A NASA study could find only 69 potential land sites, and some people have suggested that ocean sites could be used...Perhaps Boeing or the Arthur D. Little company should study the current controversy over a proposal to site nuclear powerplants off the coast of New Jersey."

Senator Melcher questioned Mr. DeLoss: "It has been stressed by Congressman Flippo and others that there are (congressional) checkpoints to the proposed bill.Do you think there ought to be, or you don't think it's necessary?"

"The checkpoints are only important if you believe that we ought to start down the road along which those checkpoints lie. I think that the existing study, which is approximately half finished, will possibly, if it's altered a little bit in some of those estimates, come up with a negative answer, and the first checkpoint is the end of that study. That's the checkpoint I'm interested in. I think that when we get to the end of that study, we should have an answer that says that this is not a good idea to continue."

"Then you envision the checkpoint (as) being administrative?"

"The checkpoint would be that if the study comes to a negative conclusion, it would be very difficult for the advocates of the SPS to come before the Congress and get authorizations on research and development of SPS."

'What if it's a positive conclusion?"

"Well, then, we'll still fight it . . ."

"You wouldn't object to' what Dr. Deutch and Dr. Koomanoff described on their experiment to determine whether or not there's danger from microwaves?" asked Senator Melcher.

Mr DeLoss replied: "We haven't objected to the existing study. In fact, as I said, I think if this study is changed somewhat, and we've already met with (DOE's SPS project management office head) Mr Koomanoff and some of his colleagues to discuss this, that the results of this study will probably be negative."

Senator Melcher persisted: "Well, let's make it a posed question: 'who wants, in their own state, antenna sites?' That doesn't mean much unless you say there is danger from the antenna site. Is that correct?"

"Well, there is at least a *perceived* danger, and that could be as important as a real danger."

Dr. Peter E. Glaser, the originator of the SPS concept, was the final witness to appear before the subcommittee. "We found it difficult, I think," said Dr. Glaser, "to make the linkage in our mind's eye between terrestrial power stations and orbiting solar collectors. Yet, the technology for constructing the latter is at least as well established as several terrestrial power generation methods now under development. There is growing consensus that: The SPS is technologically feasible; the basic research and experimental phases are now past, and

there remains what is essentially a challenging engineering task which is well within present capabilities."

Dr. Glaser addressed himself to a few of the objections that had been raised: "I believe I do not have to stand, either before this committee or the public, in explaining my support for solar enetgy of **all** types and applications over the last 25 years. This record speaks for itself.

"I would certainly urge that if funds are allocated (for SPS) that these (funds) do not come out of the solar budget, but, rather, that they come out of the budget for those energy sources which are called 'central power'."

Dr. Glaser recommended a funding level for a five-year technology advancement program that, would equal about 10% of present annual funding for each of the advanced nuclear energy options.

On the issue of microwave biological hazards, Dr. Glaser had this to say: "The microwave transmission system can be designed so that microwave exposure of the public at the perimeter of the receiving antenna site will be 100 times less than the present United States standard for continuous exposure to microwaves and will meet guidelines for microwave exposure adopted by the Eastern European countries."

Dr. Glaser expressed the belief that "thirty years, as was mentioned, is just the beginning of the life of the solar power satellite."

He then pointed to support and interest in SPS which he said exists in the general public, labor unions such as the International Association of Machinists, and foreign countries.

"I have recently visited Europe, and I know that, in Germany, several industries are very interested in it, because they do not have the options that we have. They do not have the type of sunshine that we get in Arizona.

"Furthermore, there is great interest in Japan. Japanese industries realize that their options are very limited....

"I had the opportunity to discuss this with representatives from India. The prime minister of India, so I am told, is greatly interested in solar power satellites. A recent article in the **Christian Science Monitor** quoted an Indian scientist explaining why they are greatly interested in solar power satellites... It would enable them to provide the power they so desperately need to meet the needs of their growing population.

"In Russia, work is progressing. I have met with several Russian representatives at various conferences who are well acquainted with our work."

Dr. Glaser said that he hopes that the scientific data from the ongoing Salyut operations will be freely available. "I think that they are doing a lot of the things that will shed more light on the kinds of things that we will have to do as we attempt to develop solar power satellites."

On the subject of international relations and SPS, Dr. Glaser had this to say: "I was priveleged to attend a conference organized by the American Bar Association . . . (where the) 1967 Space Treaty was being considered by both the NASA delegation and the Soviet delegation. I asked a very specific question: 'If you do construct a solar power satellite, would that fall under the 1967 Space Treaty?' The answer from the Soviet representatives was, 'Yes, it would.'

"The president of the United States...has made it very clear that any object in space should be considered to have the same right of ownership as any object on the surface of the Earth. And so the vulnerability of a solar power satellite is the same as the vulnerability of a ship at sea . . . .

"I believe that the solar power satellite must be considered an object that can be destroyed, but that very few objects now exsist in this world that could not be destroyed. It would be much harder to attack in geosynchronous orbit, and only a few nations would possess such an ability.

"Furthermore, I hold an expectation that solar power satellites would be utilized internationally, on a global basis, with many nations enjoying the benefits....

"I would like to comment on who would own the solar power satellite. The most unlikely owner would be the Boeing Company...I do not see the ownership by any one large company or utility, but rather, similar to the communications satellite, it would be a joint ownership between government, industry, and the public, like Comsat and like Intelsat . . . .

"A flight test program with the space shuttle will provide opportunities for SPS-related experiments to be performed by other nations which may wish to participate in the SPS development program. Such an involvement will set the stage for international cooperation which will be essential to the success of the SPS development program and subsequent commercialization."

"The SPS is obviously an enterprise which would stimulate the development of the nation's capabilities in high technology. As has been noted by Dr. Frank Press: "High technology industries have grown almost three times as fast, increased their productivity twice as fast, expanded their enployment nine times as fast, and at the same time raised their prices only one-sixth as much as low-technology industries.' The SPS is especially remarkable, however, in that its need for high technology is complemented by a need for mass production of very large numbers of repetitive elements (solar cells, microwave power amplifiers, dipole rectifiers, etc.) so that it can provide an important stimulus to employment at the level of skills required for operation of a production line or in the construction industries as well as at the professional engineering level.

"The SPS can also be of very great benefit to the U.S. balance of payments, making our nation again an energy exporter rather than an energy importer. The export trade created by the SPS might involve the sale or lease of power stations in orbit, sale of services such as launch, construction and maintenance for SPS's, or export of microwave power to receiving antennas (perhaps locally built) in other countries....

"Because of its dramatic character and profound implications, the SPS development program can help engender positive attitudes towards the future in a way that could not be expected from, say, a commitment to coal gastification.

"Moreover, a prerequisite for deployment of the SPS is development of a truly economical capability for transportation to orbit and for large-scale construction in space; the possibility therefore arises of other forms of space industrialization and, eventually, of human settlement off Earth.

"The SPS development program will focus development efforts on space processing, fabrication, assembly and maintenance; human habitations in orbit; space transportation efficiency, and the possible uses of extraterrestrial resources, thus setting the stage for achievements which may transcend anything that heretofore has been accomplished by the human species . . . .

"I believe that we are here on the verge of a new evolution—an evolution that can take us into space in ways which we have dreamed about for many years."

Geosynch Best

NASA Marshall and NASA Johnson have now decided that satellite solar power generation can best be accomplished in 24-hour orbit rather than near-earth orbit. The reason is weight. Such large structures in space are subjected to Earth tides, which are 225 times more feeble in the higher orbit and give a weight advantage because less material is needed.

Construction of such satellites will require a high-orbit work force of 500 and a completely reusable space freighter.

Facts and Fallacies of Space Warfare

by James Oberg

This article is not an advocacy of any particular space warfare system, nor an indication of the existence of any particular system. Any opinions expressed are purely those of the author.

Few space images are as spectacular as those of space combat, al la **Star Wars** or **Star Trek**. Death rays and photon torpedoes zap across the vacuum of deep space, seeking targets. Stricken spaceships tumble from the sky in flames.

Closer to our modern world, newspaper headlines scream about Soviet killer satellites. "Seize the high ground," cry the traditionalist military thinkers, and surely nothing is higher than space. Critics denounce civilian space projects as secret attempts by the Pentagon to build space weapons with which to threaten the world below. And H-bombs in orbit could become a real Damocles Sword hanging over humanity's head.

The vulnerability of giant space power satellites to enemy action has become another key argument in the arsenal of those who oppose such systems. They paint grim scenarios where America's electricity supply is crippled by an enemy's space hand grenade.

As usual with highly technical questions of space flight, most of the printed material about 'space war' is garbage. Basic concepts of astrodynamics and space operations are ignored by ignorant but attention-getting spokespeople of a dozen different clamoring pressure groups.

What are the facts and fictions of war in space? What are the basic operational considerations which make many of the most common ideas about space war utterly impossible? And if military operations ever are conducted in space, what form might they take?

First off, readers must realize that it is impossible to "shoot down" a space satellite. It cannot be done. No way, no matter how big the bomb or how fast the anti-satellite missile or how devastating the radiation beam.

Here's why: space satellites are kept in orbit not by virtue of their wings or their rockets or their solar power panels, but purely by virtue of their momentum, or their velocity through space. Over a matter of days or weeks, most satellites are little slowed by the very thin air drag at orbital altitudes.

So if a satellite is hit by a weapon, the spacecraft may be crippled or punched full of holes or broken into pieces, but the debris continues in orbit. It remains in space.

But military tacticians do not need to 'shoot a satellite down' to be successful in their military objectives. They can cripple it, confuse it, or even kidnap it. They can cut its communication links with the Earth. They can destroy the effectiveness of its equipment, or they can kill the crew or destroy the intelligence of the onboard control computers.

How? Space is very different from Earth in this regard, and two of the major distinctive features are speed and vacuum. Both make major changes in 'common sense' military actions.

Take speed, for example. The closing rates of enemy spacecraft can usually be measured in the tens of thousands of miles per hour, maybe up to ten miles per second. Obviously there is no reaction time for a pushbutton response to the 'whites of their eyes'. Weapons are deployed seconds in advance, at a range of hundreds of miles. Even the tremendous velocities of dead metal can cause terrible damage if it hits another vehicle, so explosive warheads are hardly necessary. Hot metal could be even more deadly.

One simple anti-satellite weapon considered in the 1960's was a cheap solid-fuel rocket like a Scout or an Aerobee, which simply tossed a few hundred pounds of ordinary sand and gravel up into the path of an on-coming satellite. Zip zap! the target satellite is peppered by celestial buckshot at five miles per second. Perhaps holes are punched in its skin. At the very least, its windows and solar panels are sandblasted to ruin.

Setting off a high-explosive charge nearby a space target will, of course, have no direct effect, because there is no air to conduct the concussion; the only possible damage is through shrapnel, and that is why the Soviet anti-satellite system seems to call for the explosion of the **hunter** satellite, while the target satellite continues in orbit, slowly tumbling and dead. Evidently the Russians have built a cosmic "Claymore Mine", an explosive device which directs the majority of its fragment grenade shards in a set direction. Woe to the spacecraft in the swath of these human-made meteorites!

The alternative to impact weapons are radiation weapons, and here is where the vacuum of space becomes important. There are no clouds, and rays of energy can cross thousands of miles, spreading out only as much as the generating optics of the weapon allow.

Lasers have been called 'death rays', but such a use within Earth's atmosphere may be marginal. In space, a laser system powered by giant electric generators or by chemical reactions could beam energy across twenty thousand miles, to melt an enemy vehicle, or at least blind its cameras and the eyes of its pilots, or maybe nudge it off course.

More insidious than lasers is the radiation generated by nuclear detonation. On Earth, many of the wavelengths of radiation are absorbed in the atmosphere, but in space they fly out to infinity. Take X-rays, for example, which on Earth are absorbed by the first few hundred feet of air around the detonation, forming the characteristic super-heated fireball. In space there is no fireball, but the X-rays zap directly into the walls of the target spacecraft.

When gigantic bursts of X-rays hit a solid object, their energy is instantly absorbed, causing the outer skin to expand suddenly. This expansion is slight but sharp, and sets off a hypersonic shock wave which propagates through the skin of the vehicle to the inner wall. This energy of the shock wave does not peacefully transfer itself to the air inside, but instead tears off fragments of the inner wall (it's called 'spallation') and shoots these fragments into the interior of the spacecraft at supersonic speed. The whole wall facing the nuclear burst thus becomes a giant shotgun shell, tearing the guts out of any electronics (and humans) inside.

Not far behind the X-rays are the neutrons and other particles. They could pass harmlessly through the soft body of an astronaut, but for one catch. Before they reach the tissues of the astronaut, they strike metal atoms in the skin of the spaceship, and knock off atomic fragments which go careening through space. And these 'secondary' particles are not at all harmless when they pierce a human body.

Depending on energy dosage, the astronauts or cosmonauts might receive survivable doses (measured in **rems**, either whole-body dose or skin dose), or might receive second or third degree skin burns, or might be instantly instantly incapacitated like a spider dropped on a hot skillet. It depends on range and power.

Naturally, too, there is the thermal pulse and visible light pulse of the nuclear detonation. But compared to the damage of the earlier effects, they are not too important.

Lastly is yet another devasting effect of space bursts of nuclear weapons. It is called "electro-magnetic pulse", or EMP.

We've all heard bursts of static on radios and TVs when a lightning bolt flashes nearby. That's EMP, but on a tremendously tinier scale than that associated with nuclear detonations in space.

The magnetic pulse near (that is, within a few tens of miles) a large thermonuclear blast is so powerful that it induces electric power surges in every metal conductor within reach. Walls, wires, pipes, teeth braces, everything develops a high voltage which burns out electric circuits and sparks across gaps, setting off fires and filling the air with the smell of ozone.

How can a spacecraft defend itself against such vicious energies?

Well, in a moment we'll discuss the first, best defense: hide. If they can't find you they can't blast you.

But there is also a range of active defenses, and again, they are based on the two unique features of space: high speeds and hard vacuum. They can be used for defense as well as offense.

First, an enemy weapon can be zapped itself before it gets to bite, by hitting it with sand clouds launched a few moments earler. Particularly vulnerable are nuclear weapons, which are complex devices prone to glitches and easily damaged. So hit first — or set up barriers of "space sand traps".

How about beam weapons? They work in space because it's a vacuum. The defending ship might deploy a gas cloud between itself and the attacker to absorb much of the beam's energy. Lasers can be counteracted in space with highly reflecting three-corner mirrors which beam the radiation back in precisely the direction from whence it came, zapping the attacking laser. "Hoist on its own petard" is an expression rooted in just such a parallel tactic from the wars of the Middle Ages (a petard was an explosive charge).

"Even if Babylon could climb to the sky and build a strong fortress there, I would still send people there to destroy it . . ." — Jehova makes first space war threat, 566 BC (**Jeremiah** 51:53).

Protective measures can be taken against some effects of nuclear blasts. Interior walls can be lined with materials such as cork to contain the 'spallation' shotgun shell effect. Electronic circuits can be shielded in 'EMP cages' which divert the electromagnetic pulses around the circuits; the circuits can also be built with surge resistors to contain less-than-lethal EMP pulses. And crews can be protected to an extent by appropriate shielding, such as a tiny "storm cellar" in the heart of the ship, perhaps surrounded with the dense fuel and water tanks.

But the best tactic is to avoid fighting at all, and to elude the senses of the hunters. Space is so vast and our ships are so small . . . .

Powerful Earth-based radars scan orbits near the Earth and can, with effort and ingenuity, track objects out to about two thousand miles. The limiting factor in using radar is that the outgoing beam diminishes by the famous "inverse square law", and the returning echo **also** diminishes by another inverse square. This means that an object only twice as far away will return an echo **sixteen** times (two squared and squared again) as weak.

Space-based radars will for the forseeable future be much weaker, with ranges of less than a few hundred miles for combat spacecraft detection. Besides, blasting nearby space with a questing wave of energy is the loudest way to attract attention to oneself, attention of other predators lurking silently nearby ("near", say, two hundred miles, closing at two miles per second—you have less than two minutes to live or die).

One trick to avoid these problems is to emit the detection beam from a powerful and protected Earth-based site, and let the space-based fighter craft listen for the echo. In space, giant receiving antennas can be deployed, hundreds of yards across, from a spacecraft, to receive the tiny whispers which betray the locations **and** velocities (via Doppler shift) of silent neighbors who would not even realize they had been detected.

An alternative sensor is only an extension of our first space exploratory sense: sight. Powerful telescope cameras on mountain tops (or, later, in low earth orbit) could watch for spacecraft tens of thousands of miles away.

Neither optical nor radar sensors help much when the prey releases decoys, corner reflectors for radar and balloons to fool the probing telescopes. So for each move there is a counter-move, and a counter-counter-move . . . as always.

Another way of detecting spacecraft is with ion sensors to sniff out their expended propellants. The background readings might disguise any but the most gross enemy rocket firings, but any vehicle attempting a surreptitious rendezvous **must** fire braking rockets which could scatter a tell-tale hail of ions ahead of the hunter, alerting a keen-nosed quarry.

Yet another way spacecraft betray their presence is via their communication activity, responding to commands and advice from earth, or other space-based colleagues. One way to avoid this is to communicate along thin low-power laser beams aimed directly at the calculated position of the target. The chance of interception is very small, as is the chance of detection . . .

Unless, of course, the hunter sows a cloud of dust across the spaces within which the quarry is suspected to be hiding, and sensitive infra-red sensors wait to see the laser communications beam unsuspectingly light up a line through this cloud, pointing its accusing finger both to the secret sender and the secret receiver . . .

Unless, of course, the beam was bounced off a mirror left floating in space by the foxy quarry, suspecting such a trap. The hunters find only the mirror while the fox flees safely ten million miles away.

We cannot yet speak of millions of miles, since space combat of the next few decades would happen in some rather restricted arenas. Space, while unmarked and boundless, has certain dynamic regions of varying importance. They are called Low Earth Orbit (or LEO), Geo-Synchronous Orbit (GEO, and its half cousin SEMI-GEO), and Cislunar Space (CLS), as well as Lunar Space and Trans-Lunar Space (TLS).

LEO is within a few thousand miles of Earth, in which earth-based sensors and weapons can assist the spacecraft, and in which spacecraft can hide from others (and from blast effects) by flying in close to the Earth and ducking over the horizon.

GEO is a band around the equator, some twenty two thousand miles high, at which objects orbit at the same speed as the turning Earth below. It is a valuable ring of space real estate, now being filled with communications and warning satellites,

and future home of power satellites.

Semi-GEO orbits are only twelve hours long, or twice per day, rising out to GEO altitude at high point but falling back to only a few hundred miles above the atmosphere at low point. It is a favorite orbit for many Soviet and American military satellites, as the spacecraft alternately swings high over North America, then twelve hours later high over Eurasia.

Military spacecraft are even farther ranging, even today. VELA monitors skim out sixty thousand miles to watch for secret nuclear blasts taking place anywhere in the solar system, even behind the moon.

War in space, or at least combat in space, is a chilling possibility of the near future. Some observers find the concept abhorrent, hoping to maintain space a zone of peace. Others would welcome such a development, emphasizing as it would high technology devices in which the United States excels. Further, these latter observers claim, where better to fight a future war than in bleak emptiness far from any civilians?

But if history is any lesson, concepts and notions of combat seem to lag a generation behind. So it seems to be happening with the idea of 'space war', which teems with modern misinformation and misconceptions.

A Space Solar Power Satellite (SSPS) presents unique military problems. It is too big to hide, but on the other hand it is too high for anyone to sneak up on it from behind the Earth's horizon. It has a tremendous potential of power for both detection (via radar) and defense (via IR lasers).

Its size is so large that little short of a megaton-sized nuclear detonation is likely to harm it. Notions that it could secretly be 'killed' by some Soviet weapon system, in such a way that the Earth would not be able to tell that it had been attacked and had not been the victim of a natural catastrophe, are extremely far fetched. Sandblasting of the solar cells might be marginally effective over the long run, but this could not occur instantaneously nor could it be done in secret.

In the stable 24-hour orbit over the equator, the SSPS could deploy its own defense systems as needed, including 'space ramparts' of sand or pellets. This material, drifting in nearby orbits, would not be dangerous to the SSPS or to visiting spacecraft due to the low speed of their rendezvous orbits, nor would the particles interfere with light or microwave emissions. But they could destroy any fast-moving attack satellites which ran into them.

The electrical energy could power radar pulses which could track attacker-sized vehicles tens of thousands of miles away, thus giving hours of warning. For protection, a high-energy laser beam could be used, but a laser beam whose frequency was deliberately selected so as to be absorbed completely in air. Thus it would by its very structure not be a threat to any ground target.

The radiation protection needed normally for the onboard personnel (due to the high altitude above the magnetosphere, open to direct solar radiation) would add extra protection in the event of hostile action.

So the SSPS is far from a helpless, vulnerable space target, as some critics would like us to imagine. It can take punishment, cannot be shot down, and can detect and swat enemy vehicles more easily than they can take action against it.

One last example: who has not heard of the notion of putting "bombs in orbit", to threaten the Earth below with instant annihilation?

The idea is absurd. It's not that it would not be a friendly thing to do: it doesn't make sense and it can't be done at all effectively.

Here's why: as the weapon orbits the earth, it passes over locations below—but at most, only twice a day, and often many hundreds of miles east or west of a potential target. In the event of war it could take many hours before it could be lined up for attack. During that time, far simpler devices on ships at sea or launched from high-flying jet aircraft could cripple it.

And of course, while the bombs are orbiting, there is always the chance of failure, or capture, or secret disabling by covert attacks one by one. And the potential target nations always know where the bombs are and when it would be possible for them to be a threat, and when not.

Missiles in silos or submarines are more accurate, better protected, and can reach targets within half an hour, simultaneously. From a military point of view, they make far more sense.

The logic of space flight has had only twenty years to sink into the consciousness of the population. Its application to military activities is still veiled in mystery and mistakes. Wars seem to spring from miscalculations and bad estimates, of which there is an overabundance today. A summary of the 'facts of space war' will help keep space war forever a figment of our imaginations.

DOE Appoints New Spokesmen In Four Regions

New DOE representatives have been named for Region I (Boston), Region II (New York), Region V (Chicago), and Region IX (San Francisco).

As chief spokesmen for the Department, the four will administer the Department's regional programs and will provide overall direction for DOE's regional dealings with the public, state and local officials, business and labor and others concerned with energy policy and planning.

Harold J. Keohane, 40, chairman of the Massachusetts Department of Public Utilities has been named DOE chief for Region I which includes Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island.

Robert A. Low, 58, will head up DOE activities for Region II which includes New York and New Jersey. He was formerly head of New York City's Environmental Protection Administration and director of the city's energy office.

The Manager of DOE's Chicago Operations, Robert H. Bauer, 50, will be DOE's chief spokesman in the states of Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin. He will continue his role as Chicago Operations Manager, a post he has held since 1972.

William C. Arntz, 52, who has been Acting Regional Representative for Region IX since DOE was activated, heads up the area of Arizona, California, Hawaii and Nevada. He was Regional Administrator for the former Federal Energy Administration from 1973 until DOE was activated.

Solar Energy Calendar

23-25 OCT 1978: Los Angeles, CA. Solar Energy, seminar sponsored by New York University's School of Continuing Education. Contact: New York Management Center, Inc. 360 Lexington Ave., New York, NY 10017 (212) 953-7272.

13-15 NOV 1978: New York, NY. Solar Energy, seminar sponsored by New York University's School of Continuing Education. Contact: New York Management Center, Inc., 360 Lexington Ave., New York, NY 10017 (212) 953-7272.

15-16 NOV 1978: Miami Beach, FL. Solar Energy Applications, conference sponsored by the American Institute of Chemical Engineers, 345 E. 47th Street, New York, NY 10017 (212) 644-7526.

BIBLIOGRAPHY UPDATE

by Conrad Schneiker

"Astronaut Special Issue"
Space World, July 1978

A series of articles on who's going to fly in the shuttle and how they are (and will be) selected and trained.

"Space Colony Debate Issue"
Space World, June 1978

A collection of articles presenting pro and con views on space colonization, reminiscent of the "debates" printed in the Coevolution Quarterly Space Colony book.

Looking Beyond The Space Shuttle
Dave Dooling
Spaceflight, October 1977

Reports on a study of single-stage-to-orbit vehicles. This study was recently completed at NASA's Langley Research Center. The study found the use of dual-fuel engines may make possible single-stage-to-orbit launch vehicles that are little bigger than the space shuttle and weigh far less. This would result in greatly reduced launch costs.

Space Factories In 1977 -- Part 1
Dave Dooling
Spaceflight, October 1977

Gives brief history of space processing experiments, listing the more interesting results. Planned and proposed developments in space transportation and space habitation that may lead to a space factory are discussed.

"Achromatic Trajectories and Lunar Material Transport For Space Colonization", T.A. Heppenheimer
Journal of Spacecraft And Rockets, May/June 1978

Derives trajectories for launching mass from the moon to L-2. The discovery of trajectories tending to be relatively insensitive to launch velocity errors is reported. Optimal lunar mass driver siting and aim direction is discussed. Finally the equations describing mass catcher motion in the vicinity of L-2 are presented.

"Soviet Shuttle Tested"
"Soviet Update"
National Space Institute Newsletter, June 1978

Very short notes claiming the Soviets have tested a shuttle (kosmolyot) and are also considering a lunar polar orbiter.

"Will Iceland Sell Heat Via Microwaves?"
Microwave System News, May, 1978

Iceland could become "The geothermal Middle East of the North Atlantic" if studies in progress there lead to a geostationery power relay satellite system. Using Iceland's abundant geothermal energy, the system could relay energy to the eastern coast of North America and most of South America, Africa, and Western Europe. Among other things, Iceland's incidence of earth quakes has kept venture capitalists away for the time being.

"Space Junk Menance"
Richard F. Dempewolff
Popular Mechanics, Aug. 1978

Half of some 10,500 objects launched since 1957 have re-entered — falling in backyards, crashing into highways, striking ships and even killing a cow. It may get to the point where advanced SST's need special radars and computers to avoid junk in decaying orbits. This article also discusses the SKYLAB menance, noting the NASA-NORAD discrepancies in predicted re-entry dates, but overlooking NASA's well-know political motivations for issueing a bad prediction. DOD's plans for complete tracking coverage of the skies to 20,000 nautical miles and beyond are given brief mention.

"A Mass-Catcher For Large-Scale Lunar Material Transport"
T.A. Heppenheimer
Journal of Spacecraft and Rockets, July-August, 1978

This technical report demonstrates the possibility of positioning the lunar mass catcher across achromatic trajectories, yet maintaining modest propellent requirements and low impact velocities. More good, solid research supporting the "high frontier" concept; more significantly, it was not supported by NASA, but by a West German foundation.

"Low Cost Transportation is the Key to Space"
Tom Broz
Foundation Report, August 1978

Reports design studies on low cost launch vehicles conducted by Foundation, Inc. These vehicles, had they been built and lived up to their expectations, would have cost much less to build and operate than the Space Shuttle. The designs tried to maximize off-the-shelf technology and built on the pioneering work of Phil Bono, the McDonell-Douglas engineer who advanced single-stage shuttles in the 1960's. This kind of work done during the last decade is now being duplicated by aeorspace and government studies.

Air Et Cosmos, March 11, 1978

Contains an interesting collection of articles on the European Space Agency's Ariane launcher. (We're reviewing a reprint with English translations). The news: immediate construction of 5 Ariane launchers plus one backup has been approved by ESA. Four test launchers are already in production. The Ariane is aimed at the geostationery market, competing head-on with the space shuttle for uncommitted customers such as Canada and INTELSAT. The article "Ariane vs. Shuttle: The State of Competition" compares the respective launches on numerious points and the shuttle comes out the loser. Where the shuttle does have advantages, they arouse little interest among potential users. In fairness to the shuttle, the author notes, it will be useful for developing human presence in space.

"Possibility of Utilizing Higher Plants in a Life-Support System on the Moon"
Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Vol. 12, No. 3 (May-June), 1978, pp. 63-67
by Terskov, I. A., G.M. Lisovskiy, S.A. Ushakova, O. V. Parshina, L. P. Moiseyenko

The possibility is examined for the repeated interruption of plant vegetation by long-term darkness corresponding to the "night" on the Moon. This may prove useful for incorporating a unit of higher plants into a life-support system on lunar bases in the event of using the sun as an illumination source. To this end, cultures of vegetables (Bordeaux beets, Petrovskaya turnips, Chantanet carrots, dill, and Virovskiy white radish) and wheat (Sonora variety) were cultivated during a "lunar" photoperiod, i.e., the light and dark periods equal 15 terrestrial days. The tests convincingly showed the basic possibility of obtaining traditional plant products under conditions of the "lunar" photoperiod. It was also proven possible to use grain from wheat grown during the "lunar" photoperiod as seed material for further cultivation of these plants during this photoperiod. [Author's Abstract]

Spinoff

Scientists working for America's aerospace program have made many far-reaching technological discoveries and

advances in the course of their efforts to provide vehicles for space exploration. Only now, as their voluminous findings are examined for possible reapplication to other technologies, is the full impact of their pioneering research being widely recognized. These reapplications or "spinoffs" are beginning to assume major proportions, touching most of our lives, directly or indirectly, every day.

Spinoff 1978 selcts, from thousands of examples, those technology transfers representing important advances of significant public benefit, discussing their new-found uses and their development from the original aerospace applications. These spinoffs range from designs for more efficient aircraft to increased-resonance guitars, from capsize-proof life rafts to burglar alarms, from body-building equipment to a jet propulsion system for boats, from foam filters for cars to five-year flashlights, from a device for extending lightbulb life to "foil" wall paper, from heat resistant paint to metallized food packaging, and many, many more. Copiously illustrated with color photographs, **Spinoff 1978** is an an attractive and fascinating appreciation of the many truly "space age" aspects of our contemporary lifestlyle. 178. 124 p. il.
NAS 1.1/4:978
S/N 033-000-00712-4 $3.25

NASA Tech House

Tech House (Technology Utilization House) consumes only about one-third the electricity and one-half the water of comparably-sized homes. It incorporates solar heating, central air conditioning, a super efficient fireplace, roll-down thermal shutters, a complete interior and exterior intruder alarm system, fire resistant construction, a waste water recycler, evergency power-failure lights, three bedrooms, two bathrooms, and a garage into a design that can be built for approximately $50,000 (in 1977 dollars).

NASA constructed and is currently evaluating Tech House in order to demonstrate the extent to which some of the space program's many scientific breakthroughs can aid in the construction of more efficient, more comfortable, safer, and less expensive homes in the near future. This booklet discusses and illustrates the many innovative features of Tech House in non-technical language and examines the promise they hold for all homeowners, present and prospective. 1977. 19 p. il.
NAS 1.19:149
S/N 033-000-00704-3 $1.10

Apollo Expeditions to the Moon

A dazzling color book about the entire 15-year Apollo space program, written by 18 key members of the team that successfully planned and carried out the enormous national effort to land Americans on the moon. Its 15 chapters tell the dramatic story of what are perhaps the most exciting and challenging scientific voyages in modern history, voyages that symbolize the triumph of mankind and technology over seemingly impossible odds.

The 18 contributors include current and former key NASA officials, astronauts, engineers, and scientists. Among the famous names are Vernher Von Braun, Buzz Aldrin, Michael Collins, Charles Conrad, Alan Shepard, James Lovell and Chris Kraft. Each describes his role in helping to make the complex Apollo missions successful, providing broad insight into the US civilian space program from its inception to the present. These accounts are accompanied by full color photos that appear on almost every page, some of which have rarely been seen by the public.

Bringing together the momentous events that were witnessed by millions and the little-known and unreported experiences of the people responsible for them in a single detailed pictorial volume, **Apollo Expeditions to the Moon** is one of the finest and most complete space-exploration accounts ever published.
Available from the U.S. Government Printing Office, Washington, DC 20402, cloth cover, $8.90.

Hearings Reports

Senator Howard W. Cannon (D-Nev.), Chairman of the Senate Committee on Commerce, Science and Transportation, announced the availability of the following hearings in the area of science, technology and space:

—Nasa Authorization for Fiscal Year 1979, parts 1, 2, and 3, February 21, 22, and 28, March 1, 7, 8, and 16, Serial No. 95-86 (Part 4, Index, to be printed at a later date).
—Oversight of Science and Technology Policy, Parts 1 and 2, February 10, 14, and April 26, 1978, Serial No. 95-77.
—Export Policy, Joint hearing between Committee on Banking, Housing and Urban Affairs and Committee on Commerce, Science and Transportation, Part 7, Oversight on U.S. High Technology Exports, May 16, 1978.
—Committee Print — Recombinant DNA Research and its Applications, Oversight report, together with minority views, August 1978.
—Authorization of the Standard Reference Data Act and Review of the National Bureau of Standards, February 15 and April 6, 1978, Serial No. 95-72.
—Nuclear Waste Disposal and Utilization, March 31, 1978, Serial No. 95-92.

A limited supply of these hearings is available. Requests will be filled in the order received. Interested persons should send a self-addressed mailing label to the Senate Committee on Commerce, Science and Transportation, Subcommittee on Science, Technology and Space, Room 5202, Dirksen Senate Office Bldg., Washington, D.C. 20510. Please specify which of the above publications you are requesting.

Terraforming

"Terraforming — the conversion of dead planets, asteroids, and moons into habitable biospheres". That definition may be familiar to SF readers and other futurists, but it's not in any dictionary. Soon, however, **Terraforming** will be the title of a book I'm writing. Science Fiction ideas, climate modication, planetology, energy and materials resources, and clever tricks to convert Mars into another Imperial Valley and Venus into an African savannah will be discussed, as well as why, who, when, and how.

I wrote a long lead article on terraforming in the May issue of **Astronomy**. Now the material to be published must be increased ten-fold.

So I'm asking for help: references to SF stories from Stapledon to Anderson to Benford to Clarke; weather and climate modification clippings; publishable ideas, speculations, critiques (all properly credited). Where does terraforming tie in with SPACE COLONIES, via competition or complement? Please write me with suggestions.

James Oberg
Rt. 2 Box 1813
Dickinson, TX 77539

Energy Progress?

A small step for man, a small step for energy. Undaunted by conference committee battles, the House Energy and Power Subcommittee staff floated some fuel-saving compromises of their own last week. Among the suggestions outlined in a memo: Postpone going metric until "a three-foot meter can be developed," thereby reducing "nationwide, the commuting distance by almost 10 percent"; Lower the boiling point of water so that it takes less energy to run the turbines in powerplants.

"The Future United States Space Program"

by Carolyn Henson

October 30 through November 2 "The Future United States Space Program" will attempt to top "The Industrialization of Space" as the largest, most exciting space conference ever held.

The conference kicks off Monday afternoon with two concurrent sessions: "Space: the Arena for Change" and "Optimization and Numerical Methods". The former features a talk by Chuck Hewitt, executive director of the National Space Institute, and three talks which examine opportunities for students and small-scale investigators to use the shuttle. The latter is intended for people whose work causes them to dream about Riemann surfaces.

"Social Aspects of Space" and "Space Guidance" run concurrently the second half of the afternoon. The former features talks on "The Possible Socio-Politico Nature of Early Space Colonies" where sociologist Robert McWilliams examines a number of isolated Earth communities and draws parallels to space habitats; "Constructing Space Communities: A Critical Look at the Paradigms" where sociologist B.J. Bluth considers utopian v.s. facilitative organizational development v.s. synergistic organizational development, drawing from her experience with a summer-long course she organized on space colonies. In "Space War" Soviet space program expert James Oberg reveals the facts and fallacies of space war; "Lunar Base Habitat Explorations Design Study" details a complete habitat design by a twelve person team at the Lunar and Planetary Sciences Institute. "Financial/Management Scenarios for a Solar Power Satellite Program", will be presented by a team from Science Applications. They reveal the results of their study for the Department of Energy. (Chris Basler fans will find this talk to be a valuable update on his "Staging Company" concept.) "Developing Closed Life Support Systems for Large Space Habitats", by agronomist John Phillips and anthropologist/plant ecologist Annita Harlan will show that research under way at the Environmental Research Lab not only promises a psychologically satisfying diet for space settlers; it may also go a long way towards solving the problem of hunger on Earth.

Tuesday begins with "Projected Space Applications" where researchers cover solar power satellites, possible human exploration of Mars, and laser aircraft propulsion. "Frontiers of Space Law" runs concurrently, featuring papers on communications satellites, the shuttle, remote sensing, solar power satellites, and military use of space. Later in the morning, "Economics" covers the approaches whereby cost of space activities is determined.

Tuesday afternoon "Projected Space Applications II" covers the defense program, interactions with Congress, technology transfer, Earth resources programs, and the role of non-aerospace companies. The other afternoon session is "Space Medicine". A highlight of the session is SPS inventor Peter Glaser's paper on "Health Maintenance and Health Surveillance Considerations for an SPS Space Construction Community".

Wednesday begins with "Future Programs and Prospects I", covering communications, the shuttle, Earth observation and future programs; and continues in the afternoon as "Future Programs and Prospects II".

Thursday morning has sessions on "Space Science Programs" and "Engineering in the 21st Century".

Other conference events include an awards luncheon Tuesday and a banquet Wednesday featuring House Science and Technology Committee chairman Olin ("Tiger") Teague.

This conference is the 25th annual meeting of the American Astronautical Society. Cosponsors are the American Institute of Aeronautics and Astronautics, the Aerospace Medical Association, Deutsche Gesellshaft fur Luftunde Raumfahrt eV (the German space agency), the Federation for the Advancement of Students in Science and Technology, International Institute of Space Law, L-5 Society, National Energy Resources Organization, and Science Fiction Writers of America.

Advance Conference Registration

TO: The American Astronautical Society
1830 NASA Road 1 LEC Mail Code D-01
Houston, Texas 77058

ADVANCE REGISTRATION:

(Members)	☐	$20.00 one day	(Student)	☐	$ 5.00 one day
	☐	$50.00 four days		☐	$10.00 four days
(Non-members)	☐	$25.00 one day	(Banquet)	☐	$15.00
	☐	$70.00 four days	(Awards Luncheon)	☐	$10.00

NAME_____ POSITION_____ DEPT._____

COMPANY_____

ADDRESS_____
(Street) (City) (State-Zip)

Inside the L-5 Society

Space Day

In the last few years there has been a low-keyed effort to have July 20, the anniversary of the Apollo 11 moon landing, proclaimed a national holiday. Up to the present, however, we know of only four states: California, Massachusetts, Alabama and Texas, which have had any sort of space awareness days.

A Space Awareness Day for Massachusetts was one of the goals of S.P.A.C.E., a Boston-based group. Although momentum in achieving this goal was slow in developing, the effort eventually required a minimum of time and was surprisingly easy.

We were initially operating under one major misconception: that legislative action would be required to have a holiday of this nature enacted. However, states typically proclaim a number of such special days: Dairy Day, Indian Heritage Day, etc. There was even a Saxophone Day proclaimed this year in Massachusetts. It is apparently customary for governors to make such proclamations, and it is within the discretionary powers of governors to do so without legislative involvement.

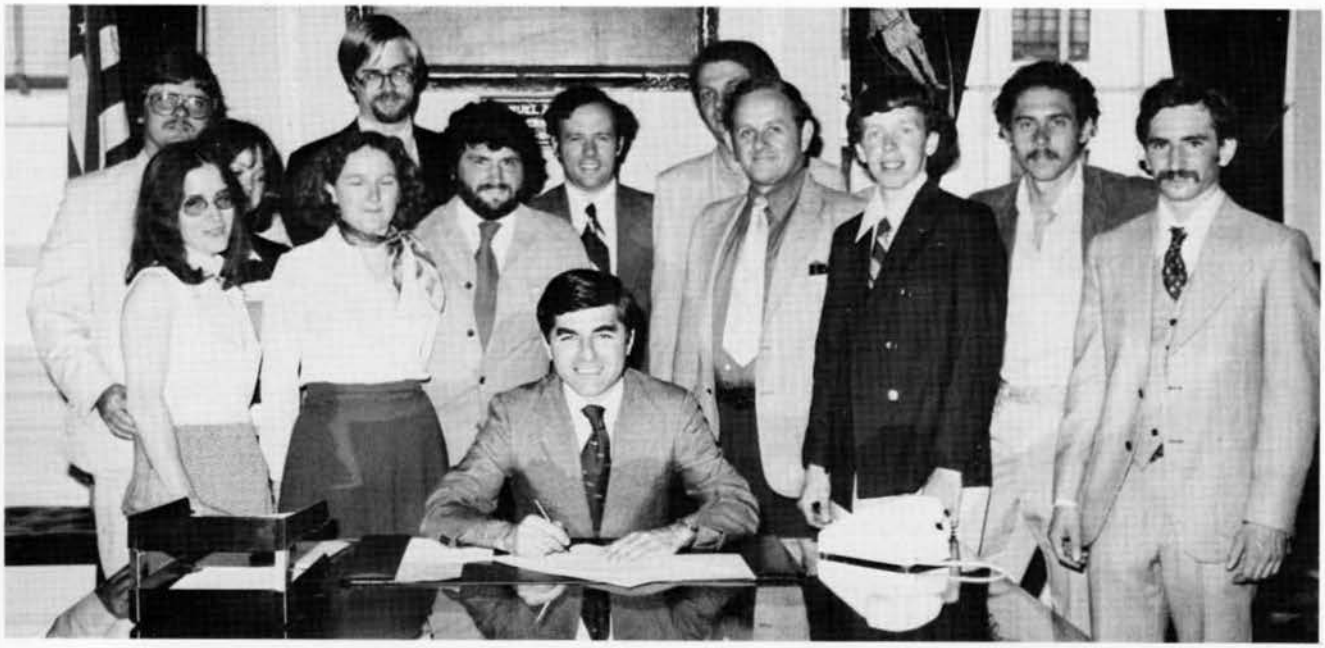
Finding this out disabused us of the false information that our efforts could only be undertaken with the help of a lawyer. The sum total of my efforts to have July 20 proclaimed Massachusetts Space Awareness Day amounted to the following:

1) In late May I approached the private secretary of Massachusetts' Governor, Michael Dukakis. This required no appointment, and in the short space of ten minutes I had explained my intentions, informed her that a local organization was sponsoring it, and received the news that the Governor routinely signed such proclamations. The personal secretary gave me a copy of a recent proclamation, Massachusetts Indian Heritage Day, and told me to submit a draft in the same form.
2) In early June I submitted the proclamation to the Governor's office and was told that we would be contacted within ten days as to the date that the Governor would sign it.
3) Two weeks later we were notified that the proclamation would be signed on June 26 at 11 AM.
4) On June 26 approximately 12 members of both S.P.A.C.E. and Boston L-5 collected in Governor Dukakis' outer office. In attendance were former astronaut Philip Chapman, Kevin Fine, Mark Hopkins, Wade Nivison, Marcia Allen, Robert Nichols (Director of Boston L-5), Beverly Bugos, Kathleen Prestwood, Bill Rudow, Frank Crehan, Ron Russell and myself. The signing, with posing for publicity photographs, took no longer than 10 minutes.

If all of this sounds easy, it's because it was. L-5 and S.P.A.C.E. members in other states should adopt as a goal for the upcoming year getting the governors of their own states to proclaim July 20 a state holiday. Perhaps, if we can get each state to proclaim a Space Awareness Day, it will be easy to make July 20 a permanent national holiday.

We are including a copy of the proclamation, for members in other states to use as a model .

Whereas:
The achievements in space by many nations have enriched the lives of Earth's inhabitants, from expanded employment in many fields and through the development in many fields and through the development of new technologies; and
Whereas:
The Apollo lunar missions, and present and future activities in space demonstrate that our planet is part of a vast and expanding system, rich in opportunities, a "High Frontier" which will renew the spiritual qualities that built the United States; and
Whereas:
Many citizens and industries of Massachusetts have participated in and contributed greatly to these historic activities in space; and
Whereas:
July 20 is the anniversary of the Apollo 11 lunar landing mission, when two Americans became the first men of our planet to walk on another world, saying, "We came in peace for all Mankind,"
Now, therefore, I Michael S. Dukakis, Governor of the Commonwealth of Massachusetts, in accordance with Chapter 124 of the Acts of 1972, do



The signing of the Space Day proclamation: Massachusetts Governor Michael Dukakis is seated at the desk. Behind him, from left to right, are W. Jefferson, B. Bugos, K. Prestwood, M. Allen, M. Hopkins, R. Nichols, R. Russell, W. Nivison, P. Chapman, F. Crehan, K. Fine, W. Rudow.

hereby proclaim that July 20 shall be known as Massachusetts Space Awareness Day, and urge the citizens of the Commonwealth to take cognizance of this event and to participate fittingly in its observance. —*Wayne Jefferson*

L-5 Chapters

Ashland L-5
Box 1420
Randolph-Macon College
Ashland, VA 23005

Austin L-5
P.O. Box 8213
Austin, TX 78712

Bay Area L-5
c/o David Brandt-Erichsen
814 Miramar Ave.
Berkeley, CA 94707
(415) 526-9346 or (415) 645-5990
(Has newsletter)

Boston L-5
c/o Eric Drexler
WI-518A MIT
Cambridge, MA 02139

Fresno L-5
c/o Gale Smith
36874 Cressman Road
Auberry, CA 93602

Genesee L-5
c/o Wendy or Bruce Voris
78 Lattimore Rd.
Rochester, NY 14620
716/461-5620

Houston L-5
c/o Larry Friesen
502 S. Austin No. 17
Webster, TX 77598

Jacksonville L-5
c/o Penny Stombock
Star Route 1 Box 1208
Yulee, FL 32097

Maryland Alliance for Space Colonization
c/o Gary Barnhard
4323 East-West Highway
Bethesda, MD 20742
(Has Newsletter)

Melbourne L-5
c/o Mike Dalton
650 E. Dixon Blvd. No. 3C
Cocoa, FL 32922

Michigan L-5
Box 126
Michigan Union
Ann Arbor, MI 48109
(Has newsletter)

Mississippi L-5
c/o Robert McWilliams
Box 5563
University, MS 38677

John Muir High School L-5
1905 Lincoln Avenue
Pasadena, CA 91103

Niagara Frontier L-5
c/o Elissa Wynn
40 Kings Trail
Williamsville, NY 12122
716/689-9140
or Michael Cooper
716/691-4584

North Carolina State L-5
c/o Robert Baldwin
Rt. 4 Box 121A
Waxhaw, NC 28173

OASIS
c/o Terry Savage
P.O. Box 704
Santa Monica, CA 90406
(213) 374-1381 or (213) 536-3209
(Has newsletter)

Put It In Orbit Society
c/o George Timothy Bigham
Rt. 2 Box 82
Huntsville, TX 77340

Reno L-5
c/o Ray Bryan
1071 Glen Meadow Dr.
Sparks, NV 89431

Tulsa L-5
c/o Tom Huffman
3424 E. 41st
Tulsa, OK 74135

UCLA L-5
c/o John Blanton
Box 77206
Los Angeles, CA 90007

University of Houston L-5
c/o Physics Dept.
University of Houston
Houston, TX 77004

Urbana L-5
c/o Steve Vetter
168 Townsend, U.R.H.
Urbana, IL 61801

Virginia Tech L-5
c/o Kimber Smith
4016 W. Pritchard, VPI & SU
Blacksburg, VA 24061

West European L-5
c/o Roger Sansom
45 Wedgwood Dr.
Lilliput, Poole, Dorset
BH14 8ES England
(Has newsletter)

Williamsburg L-5
Box 1795
Williamsburg, VA 23185

Space settlement oriented groups—cooperating with but not affiliated with L-5.

Mankato Space Society
Box 58 Activities Office
Mankato State University
Mankato, MN 56001
or Dan Lundquist (507) 345-3624

The Chicago Society for Space Settlement
4 N. 186 Walter Drive
Addison, IL 60101

Spaceworks
c/o Robert Topple
1930 Quince Street
Denver, CO 80020

Space Futures Society
c/o Richard Bowers
3059 Cedar Street
Philadelphia, PA 19134
(215) 739-7780

S.P.A.C.E.
6th Floor
575 Boylston St.
Boston, MA 02116

Bay Area L-5

The Bay Area L-5 Chapter is sponsoring a major public address by J. Peter Vajk at U.C. Berkeley on Friday, November 3rd at 8:00 pm (room to be announced). Those who have not heard Dr. Vajk before are urged to bring friends and to help publicize this speech as widely as possible.

We publish a monthly newsletter which announces our meetings and other space-related events around the Bay Area. Chapter supporter dues are $5 per year; newsletter subscription only is $2.50. Anyone interested in participating with us please contact David Brandt-Erichsen (President), 814 Miramar Ave., Berkeley, CA 94707, 526-9346 (home), 645-5990 (work), or Ross Millikan (Vice-President) or Jess Millikan (Secretary) at 223-2463.

South Bay people can also contact the National Action Committee for Space (Northern California Chapter) at P.O. Box 11343, Palo Alto, CA 94306, or call Ron Jones at 969-1115.

Astronomers' Note

The Astronomical Society of the Pacific is presently compiling a set of regional astronomy directories, listing planetariums, observatories, amateur astronomy groups, astronomy courses (which are open to the general public), lecture series, and stores carrying astronomy equipment. Anyone involved with such activity who has not yet been contacted is asked to send for a questionaire to the address below.

Please send all correspondence to:
Directories
Astronomical Society of the Pacific
1290 24th Avenue
San Francisco, CA 94122

Texas L-5

The local Texas chapters of the L-5 Society wish to announce the formation of a new, statewide organization known as the "L-5 Society of Texas". The chartering convention for this group was held on August 26th, 1978, at 21st Street College House co-operative dormitory, Austin, Texas. A constitution was adopted and officers elected for the Society.

The functions of the L-5 Society of Texas are to promote unity of aim and effort among local Society chapters in Texas and to provide a focus for concerted undertakings on a scale not previously possible with the divided status of the various local chapter. The L-5 Socity of Texas is in all respects subordinate to the national L-5 Society and wholeheartedly wishes to further its aims. It is to be hoped that our Texas Society will not retain its position as the only regional branch of the L-5 Society for long, and that others will follow our example and create similar organizations across the country. We in Texas feel that such a network of unified regional Societies would give the national L-5 Society a more solid underpinning and allow endeavors of considerable scope and size to be undertaken by the L-5 Society with a greater expectation of an influence and success.

We invite correspondence from any local L-5 Societies who desire to form a similar regional Society branch or are willing to consider such a step. A newsletter will also be published by Texas L-5.

Officers elected at the L-5 Society of Texas state convention were:

PRESIDENT: Ron Nickel
VICE-PRESIDENT: John Strickland
SECRETARY: Joseph Vissers
TEASURER: R. J. Howe
COMMUNICATION OFFICER: Claudia Crowley

Address all correspondence to:

L-5 Society of Texas
Box 8213
UT Station, Austin, TX 78712

Letters

May I be permitted to respond to Richard Stutzke's letter (**L-5 News**, May 1978, pp. 16-17) about the possible Soviet shuttle?

In July 1977 the L-5 Society, West European Branch, **'L-5 WE Newsletter'** carried an exclusive article of mine that discussed the possible design of a Soviet Shuttle—long before **Aviation Week & Space Technology** carried their article! In my article, written in June 1977, I suggested that the Soviet Shuttle would be a modified delta wing shape with two main propulsion engines and with a low cross range capability. It was suggested that it would have a glide-back capability only. I suggested a payload bay of 15 metres length by 5 metres diameter with a cargo payload weight of 18,000 kg, into a 210 by 250 kilometre orbit with inclination of 55 . I suggested a crew complement of up to four persons. I further suggested that the launch vehicle would be a modified Proton booster with side boosters being recoverable by parachute.

I believe that the reported recent drop tests will have been of one of a number of possible candidate designs of a Soviet shuttle and would have been a scaled down model. I believe that we are still some years away from seeing a Soviet Shuttle in orbit and that the USA will be first in June 1979. I think that the Soviets are more intent in accumulating practical experience with their Salyut space station—both in terms of longevity of flight, experimental data processing, resupply missions, international crews and multiple dockings. In this area, they are overtaking the USA and, I believe, it is the permanent manned space platform that is the key to space industrialization and that the Soviet Union, like the United States, has recognized this.

Phillip J. Parker, AFBIS, AMDPMA
Director, L-5 Society (West Europe)

This isn't entirely my idea; I first saw it mentioned in the June 1977 issue of **Analog** magazine, but I think it would be worth it to pass on to members.

I'm sure everyone has heard rumors that either we or the Soviets are designing laser or particle beam weapons which, mounted on satellites, would provide an effective defense against enemy ballistic missiles. So, if we can convince Congress that this would be feasible, we could urge that it would be safer and cheaper to manufacture the satellites at L-5. The Department of Defense should be quite enthusiastic, since building L-5 would only take about one-tenth of their budget . . . quite a small fraction of what our current network of anti-missile missiles costs.

True, I don't think we could entice the Pentagon into building the colony *just* for the satellites in the ABM network; but, when combined with SSPS, it makes an excellent "extra added attraction."

Robert K. Rose
Lakewood, CA

Hans Moravec's spinning skyhook (**L-5 News**, August '78) is clearly meant to remain straight. But a skyhook that is a simple cable will offer no resistance to the bending tidal forces that the skyhook will feel when nonvertical. To stay rigid, the skyhook should be a triangular lattice of cables, with a maximum width of perhaps 10% of the length. Because cable strength is diverted to retain rigidity, the performance parameters for a Kevlar skyhook may be more like those Moravec gives for fiberglass.

Also because of tidal torques, the angular velocity of the skyhook about its center will not be uniform. The peak will occur when the skyhook is vertical. This means that a skyhook that touches down precisely six times per orbit will have a radius slightly less than a third of the planet's radius.

Another point: no material is perfectly rigid. A skyhook in operation must be viewed as a very long spring with longitudinal vibrations. Periods would be on the order of several minutes, and amplitudes could reach a kilometer. Some kind of damping system is obviously needed.

Is anybody making plans to mine Jupiter for metallic hydrogen (which may be a room temperature superconductor)?

Kenneth A. Brakke
Math Dept.
Purdue University
West Lafayette, IN

The rotational velocity of Jupiter at the equator exceeds the escape velocity of Earth. Even without its dense atmosphere, escaping Jupiter's gravity is well beyond our technology. Perhaps a better approach would be to manufacture metallic hydrogen with the use of heavy pressure. I expect, however, that metallic hydrogen would change state if the pressure were taken off. — CH

I have not yet had an opportunity to read the article on SPS dangers in **Mother Jones.** However, it seems that the arguments in Matthew Swass's letter (August '78 **L-5 News**) are as full as holes as any supposedly reasoned critique could be.

A solar power satellite does not need to outrun an attacking missile in order to protect itself. With high power radar and lasers or charged particle beam projectors it would have ample time to detect and destroy any rocket as it made the long climb to geosynchronous orbit. Further, I seriously doubt that a rocket capable of destroying an SPS could be launched for a "few million dollars". Just look at the balance sheets of OTRAG.

In the final analysis it is necessary to depict the SPS for what it is, a source of

immense power. How it is used will depend on how it is constructed and managed, and that depends on us.

Anthony Weiner
Findlay, OH

SPS is a great idea but the idea of cities in space will **never** be accepted by the public. Your philosophy should change. Shoot for SPS first and then when that works, talk about cities in space. Otherwise Proxmire, will veto **all** your ideas. When you folks become more realistic in your goals-write me and I'll sign up again. Remember, as far as Congress is concerned, when you ask for too much, you usually get nothing!

Joseph Lanza
Reading, MA

Thank heavens Goddard and Von Braun didn't have that philosophy!—CH

I just want to let you know that there will be a letter campaign to save the shuttle Enterprise. It will demand that the Enterprise not be scrapped, but be allowed to fly with the other shuttles. This letter campaign will begin in October. It will mostly involve Star Trek fans and should be fairly large. I am sure that L-5 members would be interested. Please tell them about this campaign; I want to ask them to write to their congressmen.

John P. Hedstrom
University, AL

While I am for the goals of space settlements, I take exception to some of the articles in the newsletter as to the reasons and means by which this is assumed to be accomplished.

First, in the area of electric energy. There is no shortage of electricity. In the future electricity can be generated by means of the known nuclear technology.

Second, the value of "space mining" is greatly overestimated. There is no real shortage of chrome, nickel, manganese, iron, silicon (quartz) and so on. For example, along the coast of northern California and southern Oregon are huge beach sand deposits containing Cr, Ni, Pt, Au, and Fe. These deposits are about 100 miles long, average 20 miles wide, and are of unknown depth, but have been tested to depths in places of at least several hundred feet. Off the southern coast of California within only a few miles of the beach lies a huge deposit of manganese nodules in only a few hundred feet of water. Easily reachable by ocean going dredges. I have been a prospector for most of my 60 years and I know what I am talking about.

James A. Reese
Glendale, OR

Help! Is anyone there? Anyone working on or interested in the habitat interior design problems of overcrowding, isolation, and artificiality? I would like to correspond with others concerning these and the related city planning issues. I am working on a master's thesis dealing with these subjects and any information, ideas, or papers would be a great help. If you have written material or would just like to exchange insights and ideas on interior design, please write me:

Bev Isbell
Rt 3 Box 231 Rd 21
Orland, CA 95963

The column "Careers In Space" (August, 1978 issue, page 9) has prompted this note to you. I am currently looking for a PhD program in Clinical Psychology with an emphasis in Space Medicine—Space Psychology—whatever it might be called.

The usual "Guide to Graduate Study" lists no such program. I wrote to the American Psychological Association who suggested writing to NASA. NASA has not answered.

Some school in this country must have a program for space related Clinical Psychology. Do you have any idea or suggestions? Any help will be **greatly** appreciated.

Mary Snell
Bay Area
Chapter Member
Berkeley, CA

Space Studies Institute

Dear Friend:

It gives me great pleasure to announce the establishment of the Space Studies Institute located here in Princeton, New Jersey.

The goals of SSI are to support and engage in research which will develop the "High Frontier" and the application of existing technology to open for human benefit the virtually unlimited resources of energy and materials now existing beyond the biosphere of the Earth.

SSI is the outgrowth of a rising interest in the High Frontier concept. Its highest priority at the present time is the purchase of equipment and materials for experiments proving and demonstrating vital components needed in order to bring the High Frontier concept into reality.

SSI is a nonprofit organization and maintains a small staff — its officers serve without compensation. The Institute relies mainly on tax-deductible contributions and gifts for its support.

Historically it has been a special characteristic of America to naturally form private voluntary associations to carry out tasks for the benefit of society. SSI is an example of such a voluntary organization.

The Space Studies Institute depends for its existence on your help. We welcome your support in the High Frontier adventure and ask you to take a moment fo fill out the coupon below and return it to us with your donation or subscription which entitles you to a free subscription to our Newsletter.

Sincerely,

Gerard K. O'Neill

Gerard K. O'Neill
President

Space Studies Institute
P.O. Box 82
Princeton, New Jersey 08540

I am interested in becoming (please circle) a Subscriber ($10) and/or Contributor ($_____) to this nonprofit Institute and understand that my tax-deductible gift is toward support of one year's equipment purchases and administrative work of SSI.

(BLOCK LETTERS, PLEASE)

NAME _____

ADDRESS _____

_____

ZIP CODE _____