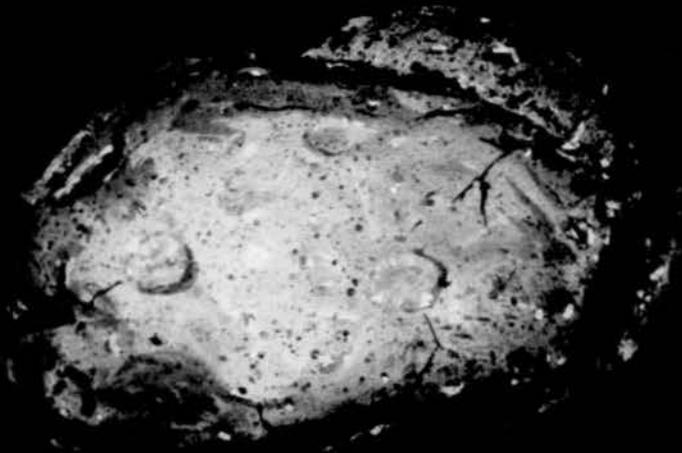


L5 NEWS

SEPTEMBER 1977



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In this issue:

- 2 **We're Going** *George Koopman reports on two milestones: the first Shuttle free flight, and Governor Brown's Space Day celebration.*
- 5 **Shuttle Milestones** *A report on progress with the Space Shuttle.*
- 8 **'77 NASA Summer Study** *A study team finds that an Apollo scale effort can bring solar power satellites, space cities on line by 1990.*
- 9 **More on Space Freeport** *Mark Frazier reports progress on a project to develop an international space port.*
- 10 **Space Spider** *NASA studies a new method to construct solar power satellites.*
- 11 **Inside the L-5 Society**
- 13 **Bibliography Update**
- 16 **L-5 Marketplace:**
 - O'Neill Fund Appeal**
 - Conference: The Industrialization of Space**
 - "Life Beyond Earth" Course**
 - Space Events Recordings**
 - Future Presentations**

Cover: A 10 million ton asteroid passing close to the Earth/Moon system. A few hundred of these flying mountains (future mines for space industries) are believed to exist.

The Shuttle is for scale only. A deep space vehicle would be required to match trajectories and return. (Cover artist is Bill Hartmann of the Planetary Sciences Institute, Tucson, Arizona).

WE'RE GOING

by George Koopman

On California's Space Day, her limits to growthish, "small is beautiful" Governor Brown turned and stepped squarely into the future.

Late Thursday evening, a few hours before the Enterprise came floating successfully down out of the desert sky, a friend and I stood in a quiet moment in his living room, grinning like two schoolkids, and shook hands. The species had done it: We were going to Space!

BROWN: "THE EVER-LASTING FRONTIER"

Our celebration was not premature. Earlier that day we'd sat in a large crowded hall at the Los Angeles Museum of Science and Industry and witnessed an event as important to the future of space as the milestone flight of the Shuttle itself. Jerry Brown, California's limits to growthish, "small is beautiful" Governor, turned and stepped squarely into the future. He opened Space Day, as the event was dubbed, by noting the continued need to respect certain limits here on Earth. But in space and the universe the governor saw no limits, and sensed "not only immediate benefits in a practical economic sense, but in a far more profound way for the people of this Earth." Taking an extraterrestrial viewpoint, he saw "the oneness of the human race," and observed that we were psychologically limited by the notion of closing frontiers, "jeopardizing the democratic fabric itself." The frontier, he emphasized, is certainly not closed: "It's just opening up in space."

"It's only a question of when and who and what kind of leadership will be taking us there. And I, for one, don't think we ought to just be looking down here below. If we look back in history, the human problems in Spain, when Isabella launched Columbus on his discovery, were greater than they are today. And after all those years, I'm not sure they've improved all that much. But you have to keep going. You have to keep pushing, because that is the human impulse. Instead of fighting it or ignoring it, we ought to develop it and respect it and encourage it and celebrate it.

And that's why we're here. Because the potential of this State and this Country and this species has just begun to be tapped. It's just a matter of courage, it's a matter of investment, it's a matter of work, it's a matter of collective effort and common purpose.

"That's been the destiny of California, of America, and it's going to be the destiny of this world as those of us in this room and those of us on this planet work together to push back the new frontier which is the everlasting frontier: Space. The Universe itself!"

There was loud applause: Jerry Brown had just swung his considerable weight, and to no small extent his political future, behind the new space movement. He introduced his Cabinet; they'd come down from Sacramento for Space Day, too. He gently reminded those assembled that California's burgeoning budget surplus was just shy of NASA's total budget, fueling rumors that California was ready to deal directly with NASA and loft its own satellite solar power station. And he made a special point of introducing his Special Assistant; ecologist, former Merry Prankster and Whole Earth cataloguer Stewart Brand, the man who turned Jerry Brown on to Space. Brand, the Governor said, had shown him that "Ecology and technology find a unity in space exploration." More applause.

Space Day was on. Luminaries abounded. Chaired by Astronaut Rusty Schweickart, now Ambassador plenipotentiary from NASA to California, the program was an impressive smorgasboard of space and its future. The recipe:

Take several hundred lean and hungry aerospace industry leaders and mix liberally with large contingents of NASA spaceocrats, government bureaucrats and media folk in an environment produced by the combined clout of the Governor's office and Rockwell's best. Fold in prominent futurists, environmentalists and a generous pinch of the military. Add a dash of Trekkies and assorted serious space freaks. Blend harmoniously in an appropriate California setting on the eve

of the first free flight of the Enterprise, seasoning well with the ideas of Gerry O'Neill, the results of the third NASA Summer Study and a large measure of good old-fashioned American excitement. Serve with evolutionary awareness.

FROSCH: IT'S EYES UPWARD

The next speaker was NASA's new Administrator, Dr. Robert Frosch, who reflected upon the was, is and can be of space in a talk entitled "Space: Which Way is Up?" Exploration is the "human cultural imperative," he proclaimed, and going to space "the continuation of something we've always done." He noted that the Stone Age builders of the observatory and computer at Stonehenge probably had to face the same questioning of resource use and priorities as the space explorers of today. And a few quick side calculations showed that the level of effort required to build Stonehenge would be roughly equivalent, in modern terms, to a planetary mission, say the Jupiter Orbiter Probe.

After a reasoned review of the near term prospects and benefits of the Shuttle, he commented on the origins of the ubiquitous technologies of our modern society. Looking back from Einstein to Newton, Kepler and Galileo he deduced "It all started with Astronomy."

Frosch pointed out that, for him, the main significance of the Shuttle was not merely to do the known better, but to find the new possibilities. He rang in clearly on the side of the pioneers: "The question of 'how can we afford to do it?' is backwards. Given history, and given the answers that the Stonehenge people gave to the questions they must have asked, is it really possible for the richest country in the world to say that right here and now we decide that the entire thrust of intellectual history that looked outward from Earth was wrong?"

He concluded that we can not stop "because of what this kind of thing has always meant to the human race. We are now in a period of consolidating and understanding what we have learned from

the first era, the First Age of Space, and preparing to see what it is we will do, and where it is we want to go, and how we want to go there, in the succeeding Ages of Space."

NASA's Administrator also fielded questions from a panel chaired by Stewart Brand, and sounded at times more like the Director of Marketing pitching the clients than a theoretical physicist turned manager. The image emerging from his remarks was clearly one of NASA in transition from a "because it's there" explorer to a robust serviceperson of the future.

SAGAN: COST OF A VIETNAM WAR?

Next up was Space's answer to Johnny Carson, explorer of the planets Dr. Carl Sagan. He echoed what was to be a central theme of the day; the line of human endeavor and exploration leading to space, and the parallels with the European voyages of discovery to the New World. "The fraction of the national budgets of Holland, Spain, England or France that were devoted to sailing ship journeys of exploration and discovery in those centuries was something like ten times the fraction that the NASA budget represents of the Federal budget in this country."

He went on to review the many deep practical reasons and justifications for planetary exploration, drawing examples from the cross-impact on a wide range of sciences, from climatology and geology to biology. Sagan also showed slides of the best returns from our extraterrestrial cameras, rhapsodizing about remarkable features on that planet and this, plugging his vision of how we will better know "the origin, nature and destiny of worlds."

Dr. Sagan did not, however, confine himself to planetary robotics. Without naming names, he took what some regarded as a cheap shot at the vision of space colonization, equating its cost to "one Vietnam War; between one and two hundred billion dollars." And he went on to say that "The initial cost of space colonization is so large that it's not obvious that it's the direction we should go."

He did not go unanswered.

O'NEILL: TIME TO STOP LETTING ARTOO DETOO HAVE ALL THE FUN

Dr. Gerard K. O'Neill came to the mike and wasted no time putting his colleague gently but firmly back on track: "First of all, for Carl's benefit, he hasn't been reading the literature recently. The last estimates on the costs of the kinds of things I'm talking about are a lot lower than he

mentioned." And for those who would save money and send robots, he noted that Darwin and Magellan and Armstrong, Mitchell and Schweikart had gone themselves:

"We're now in a tremendously useful and productive period of space exploration, which we must honestly describe as timid. Not because of the timidity of people within NASA, but because of the timidity of the people who give them money. These days we send robots into space instead of going ourselves. And much as we all love Artoo Detoo, I think it's about time we stopped letting him have all the fun. A byproduct of a vigorous thrust into space should be a direct human involvement again."

Gerry went on to prove that a picture is worth a thousand words by illustrating his talk with the many beautiful renderings of life on Island Threes and Bernal Spheres familiar to readers of the L-5 News. Point made.

Space Day also featured Dr. Robert Cooper, Director of the Goddard Spaceflight Center, speaking on applied space research; Dr. Chris Kraft, Jr., Director of the Johnson Space Center on satellite solar power; and Dr. Burt Edelson, Director of the Comsat Labs, on the future of satellite communications. Robert Anderson, President of the Shuttle's builder, Rockwell International, seconded the Governor's theme in a talk on California and Space; and Dr. Bruce Murray scanned the horizons of new techniques and technologies from his vantagepoint as Director of the Jet Propulsion Laboratories.

The universality of the appeal of space was brought home by the appearance on the platform of one of the planet's grand men of exploration, Captain Jacques Cousteau, who lent his enormous prestige and presence to the occasion. His remarks were to the point: We can save the oceans by providing invaluable information on their condition from remote sensors in space.

And lest we forget that this whole party was a joyful send-off for the Enterprise, astronaut Deke Slayton, NASA's Manager of the Approach and Landing Test, briefed us all on the events to take place the following day at Edwards Air Force Base.

The space celebration also included an elegantly catered luncheon for the thousand-plus guests served on trays, by the fountain of the Museum's spacious Rose Garden. Rockwell and several other aerospace concerns had large convention style booths, and solar heated coffee was available on the lawn. The famous M.I.T. mass driver model was on hand, and Gerry O'Neill's students demonstrated it with

showman-like flair. A new and stimulating movie, "Space Borne" was also shown at the beginning and end of Space Day.

BROWN: "IT'S ALL THERE JUST WAITING FOR YOU"

In his closing remarks Governor Brown emphasized the importance of the day. A remarkable collection of interests had been brought together, covering "the range of human potential" and representing the exciting possibilities of the shuttle for everyone on the planet. He reviewed the practical present applications of space technology, and equated the flight of the Enterprise to the driving of the Golden Spike on the first transcontinental railroad, predicting that we in the room would indeed see our dreams realized, "looking to the future with confidence, with expectation and collective purpose, to realize the common purpose of this whole species." He concluded: "It's all there just waiting for you and the rest of the people who stand behind you throughout this



About the author: George A. Koopman is President of INSGROUP, Inc. (INstructional Systems GROUP) of Huntington Beach, California, designers, developers and producers of audio-visual programs and products.

He is partner and Director of Future Presentations, a Los Angeles-based lecture bureau representing speakers on future-oriented topics such as space industrialization, extra-terrestrial intelligence and life extension.

Mr. Koopman is also the Executive Producer of "The Joyful Wisdom Program," a nationally syndicated weekly radio program with a futuristic outlook. His comments on space industrialization were carried in the recent "Shuttle" issue of Business Week.

world waiting to get into space, go into the oceans, to understand ourselves, and to create the quality of life that our evolutionary potential justifies. Thank you."

The feeling with which we left was simple and profound. For the women and men who had been running around the planet-face, regarded by many of our fellow humans as a little strange, talking about living and working in space, it was clear: We have achieved critical mass. It is really going to happen. The many elements necessary have been brought together, not the least of which is the personal political and economic weight of the state and its Governor.

The night ride to Edwards was beautiful. An hour before dawn we were herded across a vast dusty mountainside with thousands of other cars, and parked all in a row to gaze down at the Shuttle and its mother 747 bathed in lights and surrounded by rustproof red scaffolding on the ramp far below. The overture was exceptional: In the East rose Jupiter, then Venus and the old sliver of the Moon. The high desert clouds reflected the sunlight before our home star made its appearance in a sunrise that was more than any director could have desired.

The scene of the mountainside was American! Campers, dogs, kids, hawkers selling commemorative T-shirts. Telescopes and monoculars and shortwave radios and cameras were set up and tried out. The old and the young were there, not a few of the latter aware that they could, in reality now, dream the dreams of future Star Fleet commanders. Hippies and aerospace engineers looking around to wonder if they were in the right place; or was this an Evel Knevel spectacular? The cars kept coming, and the radio informed us that traffic was backed up two miles waiting to get onto the base.

The scaffolding was pulled back now, and the most unlikely looking couple in aeronautical history moved slowly and grandly across in front of us, out towards the dry lake bed. Across the vast desert scurried cars and emergency vehicles, small dots positioning themselves out on the runways. Overhead flashed pairs of T-38's, the chase planes, white and light and orbiting the grand scene. Lower came the NASA and Air Force choppers; counting the crowd no doubt, worrying about traffic and filming it all.

The local radio station, which was supposed to be carrying the live command channel conversations between the Shuttle, 747, chase planes and the ground was earning the universal enmity of most everyone tuned in by running snatches of the conversations between great hunks of mediocre country western music and ads

for the local car dealers.

And far off, at the near end of on of the best and longest runways on the planet, they started to roll. Slowly and surely they lifted off. The command channel was finally coming in live, and the matter-of-fact tones of pilots and astronauts and Mission Control only sharpened the senses on the hillside, where a hundred thousand pairs of eyes watched as the Enterprise and her retinue climbed into the distance, slowly disappearing to a point. The wait was agonizing, till having traced a giant circle the ensemble reappeared, coming overhead at 20,000 feet. The jumbo jet was clearly visible, and the chase planes were tiny white dots; three on one side, one on the other. The command link was still except for the occasional professional comments reading off altitude, heading, requests for a chase plane to move in for a look at this or that, and the cool voice of Mission Control. Still reaching for altitude the planes bore on across the base and off to once again disappear from view.

It was getting hot on the ground; probably close to a hundred. Separation was coming up, and we couldn't see it. We didn't see it. The Enterprise was flying free, and the hillside was a mass of searching eyes and pointing hand. Where was she? Arms pointing to the Zenith. Two white dots. No. That was Jupiter and Venus, still visible. More than a minute since separation. Where was she? Planes overhead, way up. No, that was the 747, still with one chase plane.

"LIKE SOME FANTASTIC FLYING SHARK"

And then all the arms and eyes pointed together and out of the East, like some fantastic flying shark complete with three white pilot fish came the Enterprise; floating, flying, gliding down home smoothly in a curve that brought her cleanly and precisely over the end of the dry lake, and a joyful cheer from the mountainside, and quick silence again as her altitude became double digits and single digits and she was down in an



enormous cloud of dust that went on and on and she stopped rolling. Cheers and cheers again and not a few tears.

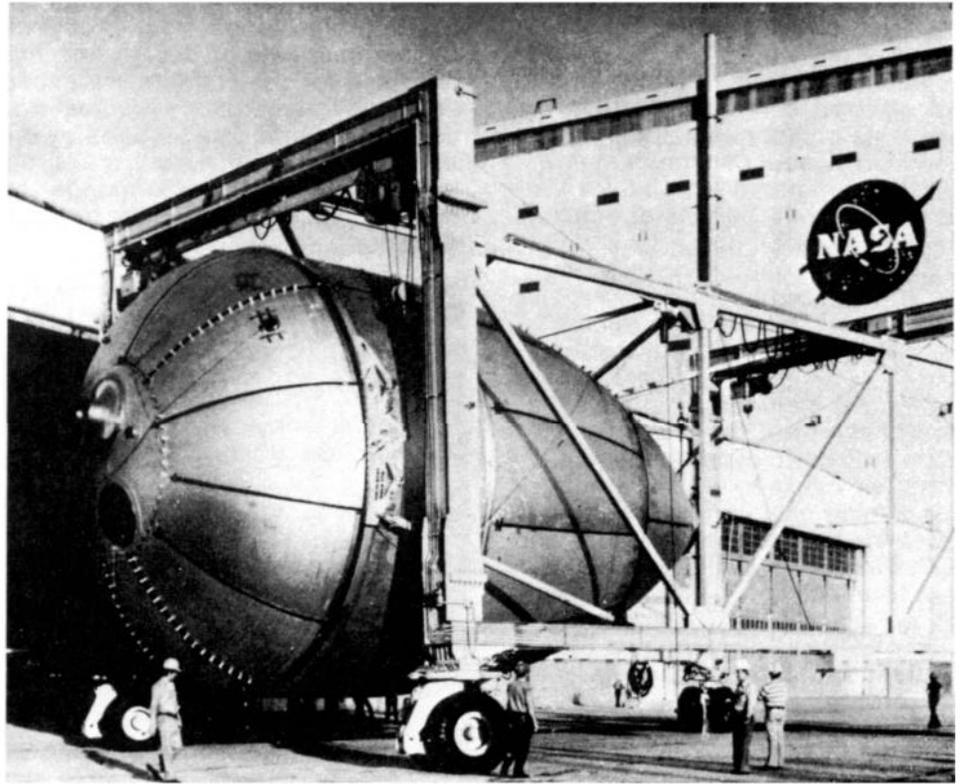
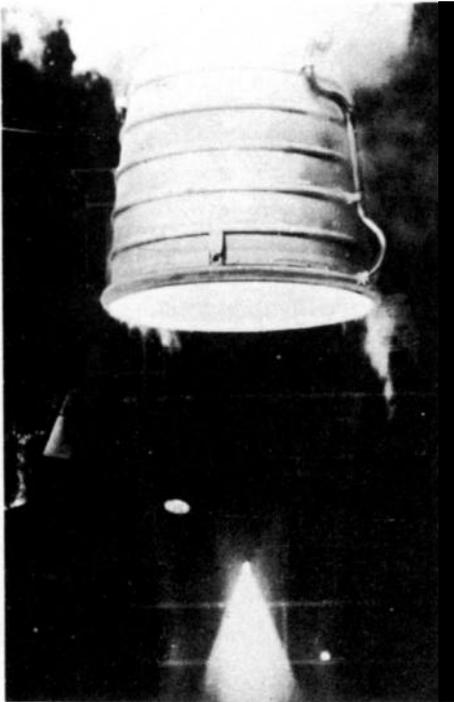
And so it was that in the summer of her two hundred and first year, America, with vision both revolutionary and evolutionary, gave birth to the Third Industrial Age, and she was called Enterprise, and it was good. The technological portion of this achievement was of course extraordinary, in the spirit of the best that this country can produce, unrivaled on the planet. But the vision evidenced in the human commitment to go to space as a species is an achievement transcending the technological, a spiritual undertaking as profound as any in recorded history. It means, quite literally, that we have consciously participated in the evolution of the race.

The New Worlds to be found on this voyage of discovery will, of course, include the not so unknown worlds of solar power, global communication, and generally better life on the home planet. But the real unknown is no longer unknown spaces and undiscovered natural resources, as it was for the European pioneers. Rather, it is that in returning to the universe from whence we were born, we will evolve into the next species, ourselves in the future and look back to see this important milestone not only in the technological but also in the humanistic frame of reference. •



Shuttle Milestones

The first completed liquid oxygen tank for the Space Shuttle's external tank moves toward the vertical test area at the Marshall center's Michoud facility in New Orleans, where it recently underwent proof pressure testing. The black strips along the sides are made of a special moisture sensing material that detects minute leaks at the weld joints. All tanks-manufactured by the Martin Marietta Corp.-will undergo similar proof testing before flight. This tank will be used in MSFC's main propulsion test program at the National Space Technology Laboratories (Miss.) starting in December 1977.



The first Space Shuttle main engine has been tested successfully at rated thrust conditions for 60 seconds with a total test duration of slightly more than 80 seconds. A major Shuttle project milestone, the firing was conducted by Rocketdyne Co. personnel under direction of the Marshall center at NASA's National Space Technology Laboratories. It was achieved on Engine 0003 in A-1 sea-level test position. This is the first rocket engine

designed for repeated use and the first engine controlled by computers. Operating at high combustion pressures, it is more powerful for its size than any rocket engine previously developed. Designed to provide 7½ hours of flight operation and 55 re-uses before overhaul, it will bum for approximately 8½ minutes during a nominal Shuttle mission. It produces 470,000 pounds of thrust at rated vacuum conditions.

ORBITER TESTS

TAXI TESTS: February 15, 1977

Three taxi tests assessed the mated capability of the Shuttle Orbiter piggyback atop the 747 in ground handling and control characteristics up to the flight takeoff speed. The tests also validated the 747 steering and braking.

Weight of the 747 at the start of 'the taxi tests was approximately 400,000 lbs. and the Orbiter weight was approximately 144,000 lbs. The nose of the mated Orbiter is at a +6 degree altitude atop the 747.

The taxi tests were performed incrementally at various speeds. Taxi Test #1 speed was 89 mph and the 747 brakes were applied at 27 mph; Taxi Test #2 speed was 140 mph with the 747 brakes applied at 23 mph; and Taxi Test #3 speed was 157 mph with 747 brakes applied between 57 and 46 mph.

Successful completion of the taxi tests permitted the "go" for the first inert Orbiter captive flight.

FLIGHT #1: February 18, 1977

Duration: 2 Hr. 5 Mins.
Maximum Speed: 287 MPH
Maximum Altitude: 16,000 Ft.

This flight obtained information on low-speed performance and handling qualities of the mated "crafts" and was accomplished almost exactly as planned. The 747 combined with the Orbiter handled much closer to the standard 747 than was anticipated. The 747 crew stated "they couldn't even tell the Orbiter was aboard." The 747 mated with the Orbiter totals a much lower gross weight than a fully-loaded commercial 747 traveling from Los Angeles to London.

FLIGHT #2: February 22, 1977

Duration: 3 Hr. 13 Mins.
Maximum Speed: 328 MPH
Maximum Altitude: 22,600 Ft.

Flight #2 accomplished a series of flutter and stability control tests. During this flight, the two right engines of the 747 were reduced to idle thrust. The flight was termed "super."

FLIGHT #3: February 25, 1977

Duration: 2 Hr. 28 Mins.
Maximum Speed: 425 MPH
Maximum Altitude: 26,600 Ft.

This flight concluded the flutter tests and concentrated on stability/control/flight evaluation and airspeed calibration. Stability and control were evaluated by idling the #4 engine of the 747 to simulate an engine failure.

At the completion of this flight, it was stated that if flights #4 and #5 follow the same successful pattern, flight #6 would not be necessary.

FLIGHT #4: February 28, 1977

Duration: 2 Hr. 11 Mins.
Maximum Speed: 425 MPH
Maximum Altitude: 28,565 Ft.

This flight simulated emergency descent of the mated vehicles and a missed landing approach, as well as maneuvers required of the 747 when the mated vehicles enter the separation flight phase.

The emergency descent was accomplished by reducing the four 747 engines to idle thrust. The missed approach was performed by flying the mated vehicles over the runway within several feet of the ground, then returning the 747's four engines to power and flown around for the final approach and landing.

Full braking of the 747 was used for the first time upon landing in a simulated "short" runway situation. 747 braked to stop in less than 6,000 ft.

FLIGHT #5: March 2, 1977

Duration: 1 Hr. 39 Mins.
Maximum Speed: 474 MPH
Maximum Altitude: 30,000 Ft.

This flight performed two simulations of the flight profiles which will be used when the Orbiter is separated from the 747 in the third and final test phase. The two simulation release flights were performed successfully. Because an altitude of 30,000 ft. was reached it was possible to simulate the separation at about 25,000 ft.

In addition, the short runway landing was again achieved. This simulated NASA Marshall Space Flight Center's 7,500 ft. runway at Huntsville, Alabama. The mated vehicle configuration will be utilized to ferry the Orbiter to the Marshall Space Flight Center next year where the Orbiter will undergo a vertical ground biration test program with the External Tank and Solid Rocket Boosters.

As a result of the success with the five flights, it was determined that the sixth flight was not required.

PHASE II APPROACH AND LANDING TESTS (Piloted Flights)

FLIGHT #1: June 18, 1977

SCA/Orbiter Brake Release: 8:06 A.M. (PDT)
SCA/Orbiter Landing: 9:01:46 A.M. (PDT)
SCA/Orbiter Weight: 263,088 Kilograms
(580,900 lbs.)

Flight Duration: 55 Mins. 46 Secs.
Maximum Speed: 181 KEAS (208 MPH)
Maximum Altitude: 4562 Meters (14,970 Ft.)

Spacecraft Commander Fred Haise and Pilot Gordon Fullerton were at the controls of the Space Shuttle Orbiter during this first manned captive flight. This flight was a once around a racetrack-like flight path which measured approximately 125 kilometers (78 statute miles) on the "straight-a-ways" with 16 kilometer (10 statute mile) curves.

The Orbiter's onboard electrical power (fuel cells), auxiliary power units, hydraulic and coolant systems were activated prior to takeoff.

During the initial climb-out, low-speed flight control system tests were performed. When the mated craft reached approximately 4,562 meters (14,970 ft.), the SCA flaps were positioned to 10 degrees and speed was maintained at approximately 181 KEAS (knots equivalent airspeed -- statute mph).

After the first turn of the racetrack-like trajectory, a flutter test was performed by the actuation of the orbiter's flight control surfaces, then the SCA flight control surfaces; the Orbiter's speedbrake was opened to 60, 80, and 100 per cent; a test of the Orbiter's gyros was

performed, and the Orbiter's flight control system and surface deflection were checked.

This first manned captive flight was originally scheduled 24 hours earlier; however, during pre-flight checkout, three of the onboard computers "voted out" a fourth. This "rejected" computer was replaced. There are four onboard computers which operate redundantly to provide commands to the various orbiter systems. According to mission rules, the Orbiter may be flown with three computers operating, but program officials decided to postpone the flight one day. There is a fifth computer onboard which operates a back-up flight control system independent of the other four for additional redundancy.

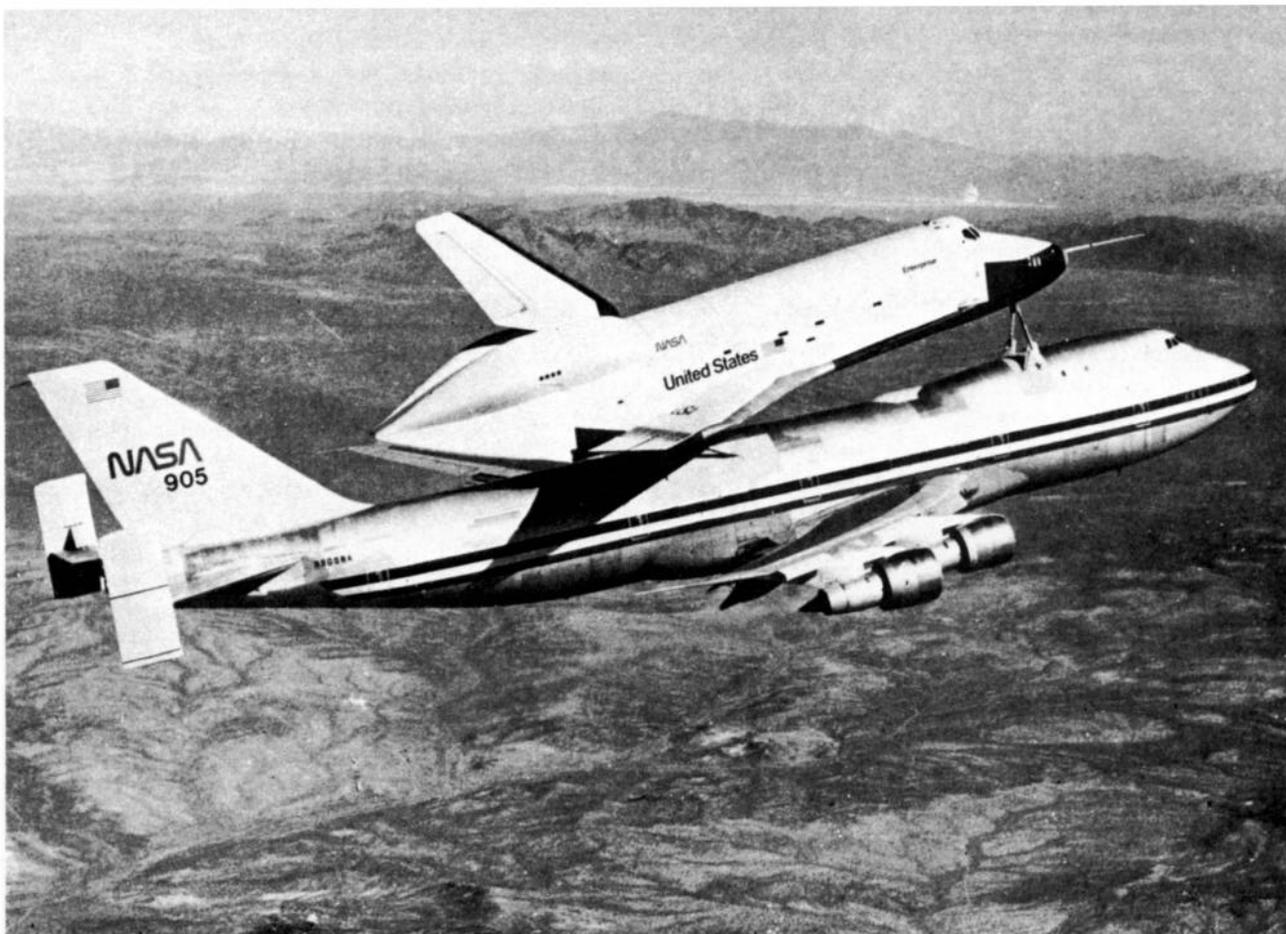
FLIGHT #2: June 28, 1977

SCA/Orbiter Brake Release: 7:49:50 A.M. (PDT)
SCA/Orbiter Landing: 8:52 A.M. (PDT)
SCA/Orbiter Weight: 253,018 Kilograms
(557,800 lbs.)

Flight Duration: 1 Hr. 2 Mins.
Maximum Speed: 270 KEAS (310 MPH)
Maximum Altitude: 6714 Meters (22,030 ft.)

Spacecraft Commander Joe Engle and Pilot Dick Truly were at the controls of the Space Shuttle Orbiter during this second manned captive flight. This flight consisted of a modified racetrack-like trajectory as well as a "Grand Prix" roadrace-like trajectory.

The Orbiter's onboard electrical power (fuel cells), auxiliary power units, hydraulic and



A totally successful first flight of the mated Boeing 747 carrier jet and orbiter, Enterprise, took place at the Dryden Flight Research Center on Feb. 18.

coolant systems were activated prior to takeoff.

During the initial climb-out, low-speed flight control system tests were performed. This low-speed flutter test was performed with the Orbiter's flight control surfaces activated first, then the 747 SCA's control surfaces were operated with the mated craft at a speed of approximately 225 KEAS (259 mph). Following the low-speed flutter test, the Orbiter's speedbrake was opened to a 60, 80, and 100 per cent deployment.

The SCA crew then applied Special Rated Thrust (SRT) to the 747 engines for the climb, a pushover, and acceleration of the mated craft to approximately 270 KEAS (310 mph). The Orbiter and SCA crews again applied inputs to their respective craft control surfaces for a high-speed flutter test followed again by the deployment of the Orbiter's speedbrake at a 60, 80, and 100 per cent deployment. The low and high speed flutter tests assessed the accuracy of predicted control surface responses and structural characteristics with respect to aerodynamic vibration.

The mated craft then climbed again to an altitude of approximately 6,187 meters (20,300 ft.) for a separation maneuver test. The 747 crew accomplished a pushover and acceleration of the mated craft to approximately 270 KEAS (310 mph), with a descent rate of approximately 914 meters (3,000 ft.) per minute. The Orbiter's elevons and ailerons were positioned to provide the optimum Orbiter control surface positioning for the actual release maneuver in Phase III ALT.

Following the separation trajectory test, the mated Orbiter/SCA climbed again to approximately 5,882 meters (19,300 ft.), accomplished a pushover and established a 747 glide slope of approximately six degrees for an Orbiter AUTOLAND made fly-through. At this time the Orbiter crew monitored the Orbiter's Horizontal Situation Indicators which operated in conjunction with the MSBLS (Microwave Scan Beam Landing System). The combined craft then established a normal approach for landing.

The results of the flutter, separation maneuver and AUTOLAND tests were well within the tolerances expected by program officials.

FLIGHT #3: July 26, 1977

SCA/Orbiter Weight: 565,000 lbs.

Duration: 59 Mins. 53 Sec.

Maximum Speed: 312 mph

Maximum Altitude: 27,992 ft. (AGL)

Spacecraft Commander Hise and Pilot Fullerton were at the controls of Enterprise during this third and final captive flight, a full dress rehearsal of the planned August 12 free flight. The SCA/Orbiter reached a maximum altitude of 27,992 ft. (AGL) at which time pitch over was performed. The carrier aircraft landing gear was deployed to simulate the free flight approach and landing profile. A practice separation run was normal and "abort separation" was performed one minute after pushover. Enterprise landing gear was deployed for the first time after the SCA landed on runway 22. The final approach profile was identical to that planned for the first free flight.

Shuttle Free Flight

Technical Details

Shuttle Orbiter *Enterprise*, with astronauts Fred W. Haise and C. Gordon Fullerton at the controls, was released from atop a 747 carrier aircraft for the first free flight approach and landing test (ALT) at NASA's Dryden Flight Research Center, Edwards, California, August 12, 1977.

Haise and Fullerton flew the 75-ton Orbiter to an unpowered landing on a dry lake runway after explosive bolts released the Orbiter from its 747 carrier aircraft at an altitude of about 6,738 meters (22,100 feet) above ground level. The free flight of the Orbiter took about five minutes.

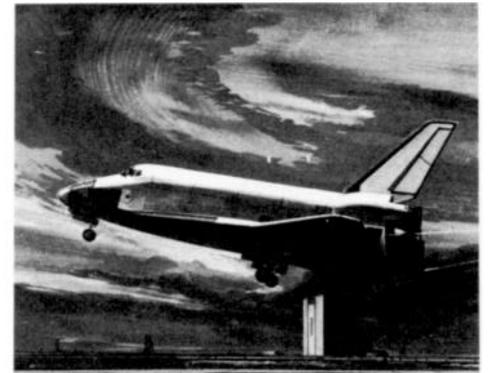
This initial solo flight followed a series of unpowered and piloted captive test flights conducted at Dryden which began in mid-February. The Orbiter was carried aloft for a series of five "inert" flights (Orbiter systems inoperative) before astronauts Haise and Fullerton and fellow ALT crew members Joe Engle and Richard Truly flew subsequent captive flights.

The captive flights verified the aerodynamic and handling capabilities of the 747/Orbiter combination as well as Orbiter systems and crew procedures.

Astronauts Engle and Truly will pilot *Enterprise* during the second flight, tentatively scheduled for about three to four weeks later.

A series of free flights is currently scheduled with the Shuttle Carrier Aircraft (SCA-747) serving as the airborne platform from which the Orbiter will be launched. These flights, with NASA astronauts at the controls of the unpowered Orbiter, are designed to verify the Orbiter's subsonic air-worthiness, integrated systems operations and pilot-guided and automatic approach and landing capabilities.

The Orbiter, workhorse of the Space Shuttle program, is designed to be used a minimum of 100 times. It is as big as a commercial jetliner (DC-9); its empty weight is 68,000 kg. (150,000 lb.); it is 37.2 m (122 ft.) in length and it has a wingspan of 23.8 m (78 ft.). The Orbiter is to be launched into low Earth orbit in 1979 with its three main engines augmented by a pair of solid rocket boosters.



The Space Shuttle is composed of the Orbiter, the two solid rocket boosters and an external fuel tank which feeds the Orbiter's three engines.

The Orbiter is attached to the back of the fuel tank and the solid boosters are attached to each side of the external tank. The solid boosters will be recovered, refurbished and reused. The external tank will be jettisoned but not recovered.

Enterprise, the first Orbiter (101) to be used in the Dryden flight test program, is the first development article of the Shuttle program to come off the assembly line. Under construction since June 19, 1974, Enterprise's main parts come from numerous aerospace contractors throughout the country. The crew module and aft fuselage were fabricated by the prime contractor, Rockwell International's Space Division, Downey, California; the mid-fuselage (cargo bay) by General Dynamics, San Diego, California; wings by Grumman Aerospace Corp. of Bethpage, N.Y.; and its tail assembly by Fairchild Republic Co., Farmingdale, N.Y.

The Orbiter's three main engines, each of which provide 2.1 million newtons (470,000 lb.) of thrust at launch, are being built by the Rocketdyne Division, Rockwell International, Canoga Park, California.

Enterprise was transferred from the Rockwell International assembly plant at Palmdale, California, to the Dryden Center January 31, 1977. At completion of ALT, this first Orbiter will be ferried atop the SCA to NASA's Marshall Space Flight Center, Huntsville, Ala., where it will undergo extensive ground vibration tests. Subsequent to these tests it will return to the Rockwell facility at Palmdale and be prepared for orbital flight sometime in the early 1980's.

The second Orbiter (102), currently under construction, will be the first vehicle to be used in the Shuttle Orbital Flight Test (OFT) program which is scheduled to begin in 1979. Six OFT flights are planned to demonstrate the Orbiter's capabilities in Earth orbit before the Shuttle becomes operational in 1980.

'77 NASA SUMMER STUDY: No Show Stoppers!

Study Team Finds Apollo Scale Effort Can Bring Solar Power Satellites, Space Cities on Line by 1990

by Carolyn Henson

Will the 1977 Summer Study on Space Manufacturing Facilities (SMF) be the last of its kind? This year's team, like those who had worked on the concept in the summers of 1975 and 1976, concluded that there were no insurmountable technical barriers and that the economics were promising. But, at a briefing given August 2, study leader Gerard K. O'Neill advised the reporters, industry representatives, NASA officials and spectators packing the Ames Research Center auditorium that "We need to go to a continuous effort." He revealed that all 5 of the subgroups in this year's study hoped to continue working on the SMF concept, adding that "bandaid funding won't be enough for long."

According to O'Neill, NASA is trying to scrape up additional SMF funds from its already lean budget. But NASA watchers agree that the hard-pressed agency will have to go to Congress next January (if Office of Management and Budget Director Bert Lance will permit them) to ask for a line item in the fiscal year '79 budget for the SMF approach to solar power satellites (SPS) in order to be able to mount the full-time research effort O'Neill proposes.

O'Neill told the crowded auditorium that "by 1980 we could begin a Shuttle flight test program for SMF." He predicted the first liftoff for construction of the SMF -- given a go-ahead by Carter in '78 -- would occur in 1985, and that energy would be delivered from space by 1991. "The first solar power satellite," explained O'Neill, "would provide enough electricity to power all of Los Angeles."

John Shettler, on loan to the study team from General Motors, described the study's proposed scenario in detail. The pricetag? "Comparable to Apollo -- about \$66 billion." The schedule? Proposing a hypothetical "Space Gateway Corporation." Shettler outlined their production schedule. By March, 1987, the lunar mining base, source of the SMF's raw materials, would be established. By November, 1989, the SMF, located in a circular orbit 50,000 km from the Earth's surface (partisans of the 2:1 resonant and



Exterior of a space-habitat for some 10,000 people. The inhabitants, members of the workforce of a space manufacturing complex, would return after work to homes on the inner surface of a large sphere, nearly a mile in circumference, rotating to provide them with gravity comparable to that of the Earth. Their habitat would be fully shielded against cosmic rays and solar flares by a non-rotating spherical shell, accumulated from the slag of industrial processes carried out on lunar surface material. Outside the shielded area agricultural crops, far less sensitive to radiation than are humans, would be grown in the intense sunlight of space.

L-5 orbits, take note!), would boast 3,000 workers. The first SPS would roll off the production line in December of 1990; the second, in December, 1991, and the third in April 1992. By the year 2004 Space Gateway Corp., with 50,000 SPS space construction workers, would be supplying the electrical needs of the entire world.

After his talk, people crowded around Shettler, asking him where they could buy stock in Space Gateway. Shettler gently explained to the disappointed investors that Space Gateway was merely a rhetorical device; and, as O'Neill pointed out later in the briefing, "They (corporations) only go ahead when the technical risk has been cut down to 1%."

So, it looks as if at present the major thrust of the SMF project will remain in the hands of the U.S. government and researcher's hopes are fixed on the possibility Congress and Carter will choose to fund them.

O'Neill Summer Study Notes

by Gerard O'Neill

The 1977 NASA-Ames Summer Study was the largest yet conducted on the subject of space manufacturing and space settlements. More than fifty people took part, from universities, government, and private industry. The study addressed several short-term technical issues vital for the achievement of a low-cost, high return program of manufacturing in space from non-terrestrial materials. The goal in those studies was the production of satellite solar power stations to send clean energy to the earth within the next two decades.

Details of solar satellite design were not addressed, because these have been covered by other NASA studies. Instead, the summer study looked at ways to use the Space Shuttle system, beginning in the 1980's to set up a small mining and transport base on the surface of the moon, shipping materials out to a precise point in free space. From there many thousands of tons of lunar materials could be transported to a high orbit above the earth to be processed with solar energy into metals, glass, silicon and oxygen. These pure elements would then be used to construct satellite solar power stations, each weighing as much as an ocean liner.

Several of the study groups worked on problems of great importance, but not on the "critical path" for the first years of space manufacturing. One group worked out a plan for the necessary research to insure that crops can be grown and farm animals raised in space, using the results of the latest work done on greenhouse-agriculture on the earth.

Another group looked at the most efficient designs for space habitats and

calculated the costs of providing earth-normal gravity for the workers in space by habitat rotation. Still another group found ingenious ways to return nearby asteroids to high orbit, using gravity-assist "swingby" methods worked out during previous space missions.

The study concludes that no "show stoppers" have been found, and that with the recent hard work many problems now look easier than they did earlier. At the same time, a great program of research and development, comparable to that of the Apollo project, lies ahead if space manufacturing is to be realized.

We feel that further research at a much more intensive level *is* needed, as soon as possible, both to find whether such "show-stoppers" exist at a deeper level, or if not, exactly how best and most efficiently to design the many components of a space-manufacturing system.

If the necessary research is done quickly, we feel that the first Shuttle flights carrying components of a space-manufacturing system could lift off by the mid 1980's, and that significant amounts of clean electrical energy obtained from solar satellites in high orbit could begin to flow into our power lines on earth by the early 1990's. By the turn of the century most of our new electric generating capacity could be in the form of solar satellites, rather than coal or nuclear plants. Alternatively, a less aggressive program, taking plenty of time to explore alternatives, and conducted at the deliberate pace of government decisions in this decade rather than with the sense of urgency we felt during the Apollo Project, might give the same benefits, but five or ten years later.

Our suggested program would make heavy use of the Space Shuttle, due to make its first free flight this month. We would use the Shuttle to lift to low orbit all the components needed for the first space-manufacturing system, and all the people needed to operate it. We would use the Shuttle's external tanks to make modular living-quarters for use in low and high orbit and on the lunar surface. Other tanks of that kind would be pelletized to form reaction-mass, expelled by mass-drivers to lift Shuttle payloads to lunar orbit. Though we would begin our program by carrying up from the earth all the food needed by workers in space, eventually we would switch to space-agriculture, using the unlimited solar energy available in high orbit.

From our six weeks of intensive study by fifty people, we feel that it is time to augment our efforts by an intensive, hard-driving program of research and development on a most attractive option.

More On Space Freeport

by Mark Frazier

The space freeport project is beginning to move. In recent weeks the following developments have occurred:

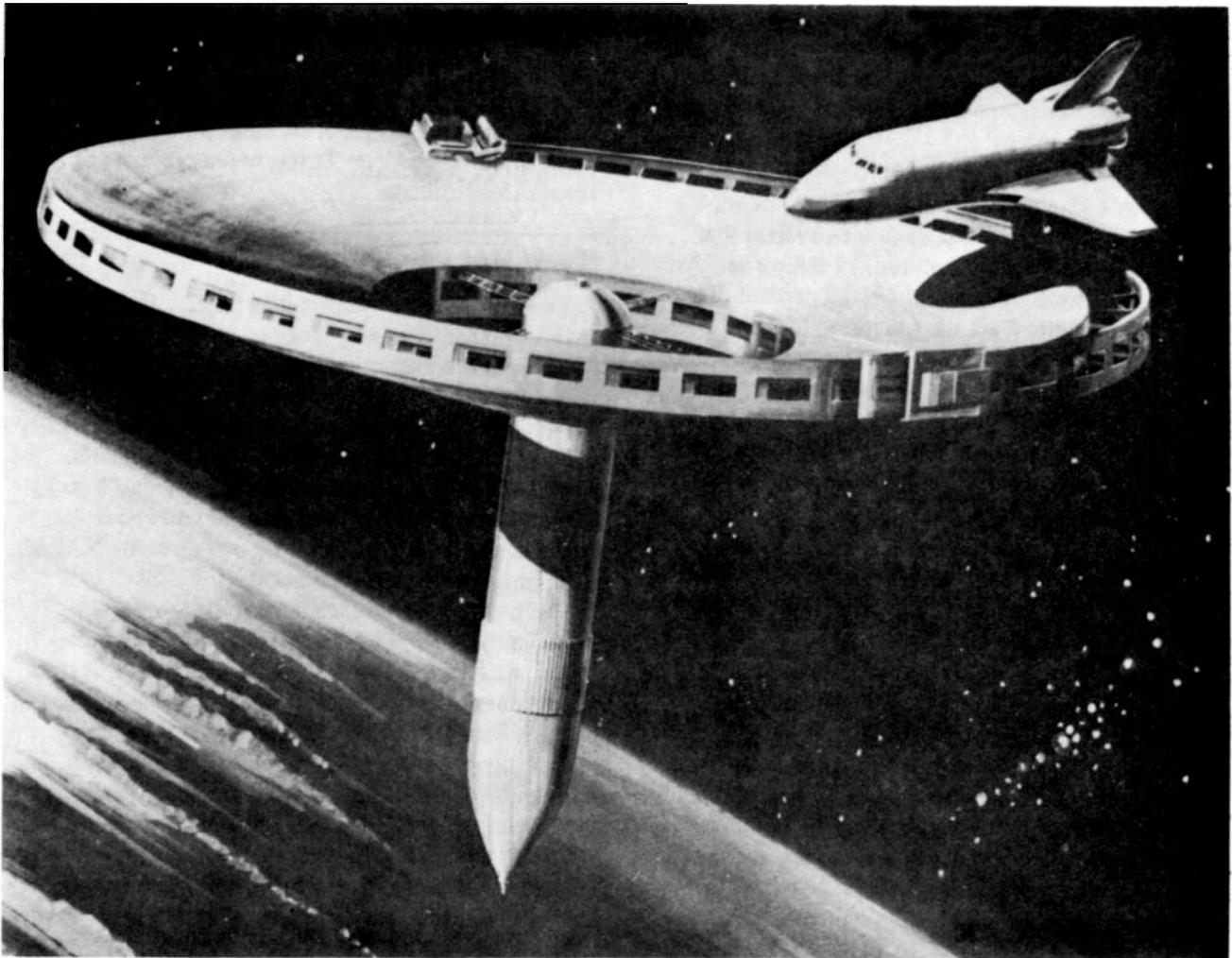
1. *Funding.* OTRAG, A West German company, has indicated that it will make a contribution to the study. OTRAG became the first corporation in space this May, when it lofted the first of a series of rockets from an equatorial launch site. It expects orbital capability by next year. Headed by Dr. Kurt Debus, former head of NASA's Manned Space Flight Center at Canaveral, OTRAG has raised millions of dollars to date from investors in Europe.

2. *New advisors.* We are pleased to announce that Dr. Marcel Barrere, head of the International Astronautical Federation, has joined our advisory board, as had Ed Finch, chairman of the aerospace law committee of the American Bar Association and former ambassador to Panama. Both will bring welcome ideas and experience to the project.

3. *Upcoming conferences.* Earthport project members are organizing, or appearing in, a number of aerospace-related conferences in the future. Art Dula, chairman of our government launch activities committee, is director of the American Bar Association conference on science and technology from Aug. 4-10 in Chicago, featuring business in space: Paul Siegler, a member of our private users committee and a consultant to NASA, is organizing a conference on the industrialization of space, sponsored by the American Astronautical Society and the American Institute of Aeronautics and Astronautics. Earthport study director Mark Frazier and private users committee chairman Bob Poole will deliver papers at the conference, to be held in San Francisco beginning October 18.

4. *Contact with equatorial governments.* Translations of a letter to 43 heads of equatorial nations have been completed, and were in the mail by mid-August. The letter asks whether the nations wish to be considered as potential sites for an international free trade zone/space launch area. Dr. Irwin Pikus, acting head of the State Department's space division, has helped us in preparations for a simultaneous, similar letter to heads of telecommunications ministries in these countries. We anticipate replies during late August, September, and October.

More bulletins will follow as things progress.



“Space Spider”

“Spiders” Build in Space -- This artist’s concept depicts two proposed Teleoperator Space Spiders building a structure for a solar power satellite onto a Space Shuttle external tank. On completion of such a structure, the external tank could become a control center for space operations, a crew habitat for Shuttle astronauts and a focal point for various space missions. The Shuttle orbiter is shown at right hovering over the solar power satellite.

NASA’s Marshall Space Flight Center has issued a request for quotations to industry for a “Design Study of the Teleoperator Space Spider for Building Large Space Structures.”

The “Space Spider” concept formulated by Marshall engineers involves a device that would be capable of constructing large structures such as satellite power systems and antennas in space. Carrying a roll of prestamped material, the Spider would attach itself to the rim of an established core and, traveling by means of a crawler-type drive, would spin a newly formed ribbon of material around the rim. The action would continue until a particular diameter was reached.

The Teleoperator Space Spider has been proposed for flight aboard the Space Shuttle in the 1980’s.

Notes From USRA

USRA is no longer providing liaison and coordination in relation to experiments for the Long Duration Exposure Facility (LDEF) and potential experimenters should communicate directly with:

Mr. John DiBattista
LDEF Project Officer
Mail Stop 158B
NASA/Langley Research Center
Hampton, VA 23665
Telephone: (804) 827-3704

There are still a number of options available to experimenters under the NASA Announcement of Opportunity.

Moreover, there are still opportunities for flight on the first LDEF missions. An additional Announcement of Opportunity is planned for late 1977.

If the research you contemplate is better suited to Spacelab, which is of shorter duration and carries people, or to other shuttle programs, please contact:

Dr. Noel Hinners
Office of Space Science
Mail Stop F 5131
NASA Headquarters
Washington, D.C. 20546
Telephone: (202) 755-2320, Ext. 53672



Treasurer's Report

by Bill Weigle

Treasurer, Board of Directors

In the last fiscal year (July 1, 1976 to June 30, 1977) the Society had an income of \$47,047.87.

Of this amount memberships (regular, student, institutional and renewals) brought in \$15,583.00 or just over one-third. The largest category was, however, \$17,298.19 in donations. This includes money donated by William O'Boyle and Barbara Marx Hubbard during the Society's times of need, as well as donations earmarked for particular projects (paying reporter's traveling expenses, production of the color pictures in the May '77 L-5 News, etc.) from George Litwin, George Koopman and the Koopman Foundation, Jay Levey, Timothy Leary, Bill O'Boyle, Jack Hopkins and Barbara Marx Hubbard. Special thanks goes to Larry Friesan who, although not wealthy, has sent in a donation every few months for the last two years, and to all the people too numerous to list who have sent in an extra five or ten dollars from time to time.

The remainder of our income came from sales of publications, books, posters, slides and back issues.

In fiscal year '77 the Society disbursed \$48,899.35 placing us \$1851.48 in the red as of July 1. The largest expenditure was in labor. Management services cost \$10,344.09 and wages totaled \$4,359.38 for a total of \$14,703.47. Printing ranked next at \$12,775.17. This includes L-5 News printing and special mailings. Photocopy services cost \$4,230.62. (This expense should drop as the Society has just acquired its own machine and is also standardising printing to avoid tons of "rush" printing done by photocopier.)

Postage and handling excluding labor cost \$3,103.18 in order to get books, slides, posters, publications and the L-5 News to you. The phone bill to get the "news" to us ran \$2539.89.

Please note we paid \$970 to a number of outstanding artists and writers for work in the L-5 news. We pay for some-but remember, volunteerism is still the word.

We are here! The Ann Arbor L-5 Society officially came into being last March 23. Anyone in the southeastern Michigan area who is interested in joining our rapidly growing clique may write us at Box 126, Michigan Union, Ann Arbor, MI 48109.

Report from the Annual Meeting

by Carolyn Henson, Secretary,
Board of Directors

At the annual meeting, after voting down a motion by Daniel Lomax that the election for the Board of Directors be invalidated, the ballots' were counted. Lomax, who, as a member of the nominating committee, counted the ballots, wanted it made clear that he did so under protest. All candidates for the Board were elected. We appreciate Vid Beldavs of Columbus, Indiana, for chairing the meeting from 2 to 3:30 p.m. (when he had to catch a plane) and Marc Boone of Ann Arbor who chaired it from 3:30 to 8 p.m. Special thanks to the folks who voted to adjourn before we starved, and our condolences go to those who gave up and walked out!

The Board of Directors now has the following members: Gordon Woodcock, Harlan Smith, and Carol Motts (new members); H. Keith Henson, Carolyn Meinel Henson, William H. Weigle, Norie Huddle, Konrad K. Dannenberg, Hon. Edward R. Finch, Jr., Leonard David, Jim Oberg, Barbara Marx Hubbard, J. Peter Vajk, Magoroh Maruyama, Jack Salmon, Phillip Parker, David M. Fradin, Romualdas Sviedries, and Mark Myron Hopkins (previous board members).

Mark D. Grover of Evanston, Illinois wrote in saying, "I have become more than a bit curious about the cryptic lines concerning recent 'major changes in the management of the Society.' For those of us who aren't able to 'see it happen' in Tucson, I think an explanation is in order."

June 11 the Society's administrator, Daniel Lomax, resigned leaving behind a badly "overcommitted" checking account and hundreds of unshipped orders.

These problems, which developed over some months, were not entirely his fault. Among other things, they stemmed from over ambitious projects (May '77 L-5 News) and procedures and personnel which could not keep up with the increasing work load. We do appreciate the good things accomplished by CDS (Daniel Lomax's company) for the Society over the last year.

Thanks to a heroic effort on the part of nineteen volunteers (see credits in the August L-5 News), a top notch secretary from Kelly Services, and loans and donations, we were able to keep any checks from bouncing, catch up on unshipped orders, and set up a new office in a month's time. The August L-5 News was the first issue put out by the new staff-in our spare

time, at that!

So who's running the Society now? Every month you can check the lineup in the masthead on page 1. Membership services are handled by Doris Cooper (the Shipping Hot Line Lady) and Eileen Asher; Bill Weigle is administrative assistant, and I am editor. Who's the administrator? We're looking for a good business manager fill the slot.

Mark Grover had another question: ". . . as the L-5 News has gotten larger and slicker every month, the bylines are getting fewer and far between. There are several markedly different styles in the various articles, and I'd strongly suggest that someone take the credit (or blame) for each."

Articles without bylines are written by me using press releases, State Department telegrams, government agency notices, etc. Their style is markedly different from my bylined articles because, let's face it, "ERDA Issues National Energy R&D Plan" doesn't really get my juices flowing, whereas "NASA Nixes Algae Burgers"-to cite my favorite literary opus-gives me something to really sink my teeth into. So, next time you read a dreadfully boring article about some government contract, you know who to blame.

One article in the August L-5 News is an exception to the above rule. I guess it's really unfair to keep you in suspense about who coauthored "What to Remember When Reading A Study Report." They are Stella Calvert and Ray Sperber.

A EUROPEAN CONFERENCE ON SPACE SETTLEMENTS AND INDUSTRIES

Sponsored by the L-5 West European Branch

20th September 1977 9.15 am - 18.00

Provisional list of papers to be presented

1. "Results of Recent Studies of the Space Solar Power Concept"
by Robert O. Piland
Assistant Director for Program Development
NASA Johnson Space Center
2. "Space Production of Satellite Solar Power Stations"
by William N. Agosto
Electronics Engineer
New Jersey, USA
3. "Biological Effects As A Factor Affecting A High Power Microwave Transmission-Reception System"
by Adrian Cowderoy
University of London
4. "Design Principles for Space Settlements"
by Peter R. Voke
British Aerospace, Electronic & Space Systems Division

Volunteer's Notebook

5. "Sources of Volatile Materials for a Space Manufacturing Facility"
by Dr. C.E. Singer
University of London
6. "Area Requirements for Food Production on Space Colonies"
by Dr. I. Richards
L-5 Society (West Europe)
7. "Anchored Lunar Halo Satellites for Cis-Lunar Transportation and Communication"
by Jerome Pearson
USAF Flight Dynamics Laboratory
Wright-Patterson Air Force Base, Ohio
8. "The Role of Selenostationary Orbits in Cislunar Settlements"
by Peter R. Voke
British Aerospace, Electronic and Space Systems Division
9. "The Role of Nonweiler Waverider Spacecraft in Exploring and Colonising the Solar System"
by Duncan Lunan
ASTRA

For further details write:

The Director
L-5 Society
40 Lamb Street
Kidsgrove, Stoke on Trent
England, U.K.

Philadelphia, Pennsylvania now has a meeting place for L-5 members who live in the Delaware Valley and South Jersey area.

The meetings will be every Saturday morning from 9:30 a.m. to 1 p.m. at the Central Library, Logan Square, 19th and Benjamin Franklin Parkway, Phila., Pa.

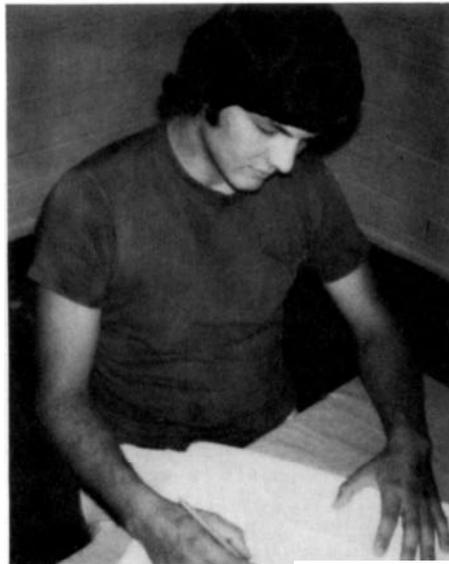
The first meeting will be 9:30 a.m., August 13 and every Saturday thereafter for at least 12 weeks before we have to rotate to another Phila. city library or can renew our lease. For further information contact:

Mr. Richard W. Bowers
3059 Cedar St.
Phila., Pa. 19134
Phone: (215) 739-7780

Volunteers this month included Howard Gluckman of Los Angeles, Neil Rest of Chicago, Marc Boone of Ann Arbor, and Tucsonans Jim Anderson, Mara Anzuina, Elizabeth Martin, Michelle Branch and Gale and Windy Henson.

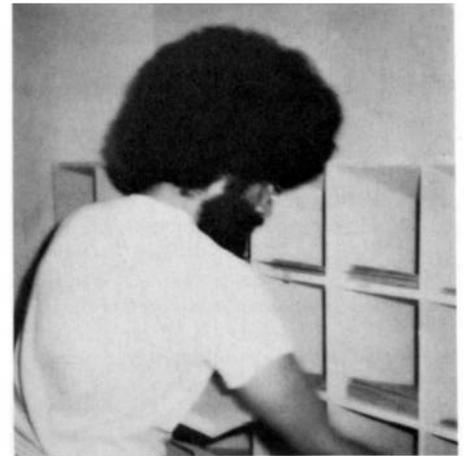
You can get free room and board for your next vacation in Tucson, America's winter playground, in exchange for working a mere 12 hours per day in the L-5 office. (Remember, folks, that's only half the hours in a day!) Take advantage of this special offer today by writing:

Carolyn Henson
Director, Volunteer Labor Gang
L-5 Society
1620 N. Park
Tucson. AZ 85719



My vacation.

-Marc Boone



If I got a paying job doing this I could afford to eat better than they're feeding me.
-Neil Rest



Listen to side two of Abbey Road as one piece. Here comes the Sun. -- Jim Anderson

In a recent letter, I said I would "put the final nails in the coffin of L-5 as a place for the colony." Keith responded with, "Can we put a little colony at L-5 just for sentimental reasons?"

My mathematical results do, indeed, show that under the best-understood method of lunar mass transport, L-5 is a lousy place. But in response to the overwhelming public interest in L-5, I have devised an alternate approach, which may indeed permit a good case to be made for L-5. Moreover, this approach would allow us to say that L-5 is to be preferred over L-4, if that is indeed the case.

I hope to have preliminary mathematical results, pertinent to this problem, early in September; definitive results would then be available by the end of the year, after I return from a lengthy trip Stateside. So, all friends of L-5 are advised to watch closely for developments.

T.A. Heppenheimer
Heidelberg, West Germany



Up in space I want to float. If you want to float in space, call 602/622-6351.

Mara Anzuina
Age 10

BIBLIOGRAPHY UPDATE

by Conrad Schneiker

"The Safe Shuttle"

Nelson E. Brown

Technology Review, March-April 1977

If you like disaster movies, you're sure to enjoy reading about the endless number of things that could turn a routine shuttle flight into a waking nightmare. If in addition, you're planning to ride the shuttle, you'll be somewhat relieved to find out how most of these contingencies have been planned for using a "fail-operational" philosophy ("bring 'em back alive!").

"Mining Outer Space"

Michael J. Gaffey, Thomas B. McCord

Technology Review, June 1977

"Asteroids contain many of the minerals in short supply on earth. Detecting and recovering these minerals could be technically feasible and financially rewarding." This article takes a look at these technical and financial possibilities.

"An Electromagnetic 'Slingshot' For Space Propulsion"

Henry Kolm

Technology Review, June 1977

Describes the lunar mass driver, which "for all practical purposes makes the colonization of space as inevitable as was colonization of the western hemisphere."

"Gravitationally Stabilized Satellite Solar Power Stations Orbit"

V.A. Chobotov

Journal of Spacecraft & Rockets, April 1977

"A concept for a gravitationally stabilized satellite solar power station in orbit [is] described." "The principal advantages of this concept are that 1) no excessively large structural subassemblies are required and 2) passive, long-life attitude control for the array is used." "Rolling motion prevents the mutual shading of the array elements at the equinoxes."

"Plsetsk -- Russia's Top Secret Military Space Center"

James E. Oberg

Space World, March 1977

A brief article on this center and how its location was pinpointed and layout became public knowledge. This was accomplished through the efforts of a science teacher and his English grammar school students who observed ground tracks. Then a few enterprising science reporters filed requests for LANDSAT photos, specifying latitude and longitude, but omitting the country in question.

"Solar Power From Satellites"

Peter E. Glaser

Physics Today, February 1977

Discusses the SSPS proposal in detail. There is a long discussion of microwave power transmission and the environmental implications of SSPS are reviewed. For safety,

the author notes that rectennas may be placed off shore and that beams will be adjusted so the "Beyond 10 km from the beam center the microwave power density would meet the LOWEST INTERNATIONAL STANDARDS for continued exposure to microwaves." (Emphasis added)

"Weightless Perfection"

Physics Bulletin, March 1977

Reports on the NASA space processing programme (which uses the Black Brant VC sounding rocket). The experiments discussed "reinforce the belief that better materials can be produced in space than on earth."

"Soviet Space Shuttle"

Spaceflight, June 1977

Reports new information on Soviet plans for a recoverable 2 stage "Kosmolyot" (spaceplane). "Serious design development appears to have begun in the early 1970's . . ." "There is, as yet, no firm indication when the Russians expect to put their spaceplane into service."

"How Do U.S. Companies View Space Industrialization?"

Arthur M. Dula

Astronautics & Aeronautics, April 1977

"This article briefly describes results from a carefully prepared questionnaire on space industrialization sent to chief executive officers of 378 companies selected from among the Fortune 500 list of American industries and the Fortune 300 list of American service industries." Some results: "A majority of the respondents felt space industrialization would have a significant effect on the gross national product sometime between 1996 and 2010." "Some 30% of the respondents were aware of and interested in the possibility of solar-power satellites and communication satellites." "Many [companies] know nothing about potential profit centers, but about half that do expect to become involved in the Eighties if they may retain patent rights."

"Toward Large Space Systems"

Charles J. Daros, Robert F. Freitag, Richard L. Kline

Astronautics & Aeronautics, May 1977

Discusses potential requirements for large space structures and space construction bases.

"The Promise Of The Space Factory"

Donald M. Waltz

Technology Review, May 1977

"An enormous range of commercial products, from electronic components to medicines, could be manufactured in space. The economics looks promising, but some hard-nosed research will be needed." In the late 1980's, such common items as computer circuits, medicines and laser glass may be manufactured in space. This article looks at these and other candidate products for space manufacture, space factory requirements, and that all-important and presently "blank bottom line."

"Perspectives on Satellite Solar Power"

P.E. Glaser

Journal of Energy

March-April 1977, p. 75

P.E. Glaser originated the SSPS concept in 1968 with a pioneering paper titled "The Future of Power From the Sun." In the present article he presents a comprehensive review of SSPS concept development from that time to the present. He concludes "Since the SSPS concept was first proposed in 1968, considerable work has been done on its various aspects. It is now considered an option which deserves serious evaluation. Its potential for meeting energy demands beyond 1995 is being recognized and plans for its development are being studied. Assessments of SSPS technical and economic feasibility, environmental impacts and legal implications are being carried out by academic, industrial, and government groups in the United States and abroad. These assessments indicate that: there is increasing confidence in SSPS, technical, and economic feasibility; SSPS technology uncertainties and risks are being better defined; terrestrial solar energy developments, and near-term space construction base and advanced space transportation systems studies are supportive of SSPS development; a continuing SSPS technology development program can be economically justified on the basis of our present knowledge; and environmental impacts have not emerged as a major constraint on SSPS operation."

"Alternative Approaches to Space-Based Power Generation"

D.L. Gregory

Journal of Energy, March-April 1977, p. 85

Eight power systems (solar and nuclear) for satellite power stations are described and compared, followed by a report on their evaluation. The total cost of a complete program implementing each system is optimized and calculated. This information is then used to calculate the required ground busbar costs of SPS electric power. Four of the systems are judged viable. The net result is "that 'power from space' is not dependent upon a single power generation concept. Analyses of the exhaust emission quantities of the associated launch systems, rectenna land use, etc. indicate that the environmental impact associated with the SPS concept is extremely low. The baseline program would produce the first commercial power from space in 1996. This would be by no means an 'accelerated' program: SPS operation could probably be achieved at a much earlier date."

"The VTOVL Shuttle"

Philip Bono

Spaceflight, May 1977, p. 197

This very noteworthy letter should have been published as an article in its own right. It is prompted by the Boeing Powersat article (Spaceflight, February 1977, p. 52) reviewed here

last month. The Boeing concept is based on a single-stage VTOVL rocket transport, which in turn grew out of Philip Bono's design for a similar transport using a plug aerospike engine. Two NASA patents were taken out on his behalf for the previous design. He states that "14 years have passed since the first engineering paper was publically presented to an AIAA conference in Los Angeles." In addition he coauthored a book with Ken Gatland (Frontiers of Space) which "devotes most of its discussion (and colour illustrations) to a detailed examination of the VTOVL 'Shuttle' concept." It has been translated into 5 languages. Mr. Bono notes that his concept "has met with opposition and skepticism within the US technical community" and that until recent years it was "completely ignored, even as a second (or third) generation Shuttle." He proceeds to note recent studies "requiring huge payloads in the order of 500,000 to 1,000,000 lb. have revived the VTOVL, the enormous weights of such heavy-lift single-stage devices would be virtually impracticable to land horizontally (with wings)" He adds "From the beginning the Interplanetary Society [publishers of Spaceflight] recognized the approach as at least one viable solution to the reusable launch vehicle problem." It's good to see Boeing now realizes this as well.

"Project Columbus 1992"

Brian O'Leary, The Bulletin of the Atomic Scientists, March 3, 1977, p. 4

A call is made for Project Columbus, "the name applied to the entire umbrella made possible by building the first space factory which could process lunar or asteroidal materials by 1992." Neat idea but why wait 'til '92?

"On The Feasibility Of Small Power Satellites"

K. E. Drexler, T.A. Heppenhaimer
Journal of Energy, May-June 1977

The transmitting antenna of a powersat will not function correctly if scaled down. This results in two problems: building a small demonstration powersat (using the space shuttle) and feeding power into the national energy grid (which is designed for one Gw blocks of power, whereas the most economical powersat system yields a 10 Gw block). This article demonstrates that the use of a power relay satellite overcomes these obstacles.

"Will The Next War Be Fought In Space?"

Edward Hymoff
Popular Mechanics, July 1977

A sneak preview of DOD preparations for the "Star Wars" of the 1980's. Filled with discussions of suicide satellites, mine fields laid down by "mine-layer" satellites, hunter-killer satellites, decoy satellites, "dark" satellites (i.e. invisible to conventional radar) lurking in deep space (two were launched last March), and recoilless space weapons (lasers and particle beams).

"Energy From Outer Space"

Richard F. Dempewolff
Popular Mechanics, June 1977

An excellent introduction to "big booster earth launched" powersat concepts for the lay reader. Very well illustrated with some striking paintings.

The papers reviewed below are from the 1977 Princeton Space Manufacturing Facilities Conference. They will be available in book form this October and can be ordered from:

Jerry Grey
AIAA
1290 Avenue of the Americas
New York, NY 10019

"Mass Driver Theory and History"
Frank Chilton

Presents historical highlights of linear induction and synchronous motors and an overview of their theory of operation. This paper serves as an introduction to the mass driver papers below. Of interest is the brief discussion of a coaxial mass driver geometry, potentially a factor of three times less massive than the "standard" double-sided-rectangular geometry. It is noted that "Accelerations of the order of 100 g's are easy and over 100 g's are possible if desired." In conclusion, the mass driver "promises to be extraordinarily useful for space industrialization."

"The Long Duration Exposure Facility (LDEF) -- A Test Bed for Space Technology Development"

John D. DiBattista, Lenwood G. Clark

"There are significant limitations to simulation of the space environment in laboratories." These difficulties are described. The role of the LDEF program is space technology testing is presented. It will study "the synergistic effects of space vacuum, plasma, radiation, thermal cycling, and reduced gravity.

"In situ testing in space is usually important to obtain engineering and design data on new technologies (i.e., materials [such as adhesives, seals, lubricants, thin films for solar sails], coatings, etc.) which will be necessary for the success of future NASA and DOD programs involving very large space structures which must have useful lifetimes in space of several decades."

"Space Solar Power-The Transportation Challenge"

Hubert P. Davis

The role of space transportation in the SPS concept has been identified as a potential "show stopper" based on doubts that it can operate at an acceptable cost. This paper explores the role of Shuttle derived vehicles and two stage HLLVs in SPS prototype construction and in the overall concept. I'm somewhat disappointed that single-stage-to-orbit vehicles were not discussed.

"Advanced Technology and Future Earth-To-Orbit Transportation Systems"

B.Z. Henry, C.H. Eldred

A study with the emphasis on single-stage-to-orbit vehicles has shown advanced technology to be essential for more economical earth-orbit transportation. In connection with such vehicles, a surprising result emerged. "The much cleaner recovery offered by the aircraft-type landing appears achievable at no greater cost and risk than the ballistic recovery. Accelerated technology appears to pay off in either case."

"The Space Manufacturing Facility As A Base For Exploration"

Larry Jay Friesen

Discusses the advantages of "slingshot launches" from the 2:1 resonant orbit for planetary/asteroid missions as opposed to low earth orbit launches.

"Cost-Benefit Analysis of Space Manufacturing Facilities"

Mark Myron Hopkins

"This paper updates the author's previously published economic model by incorporating the results of the 1976 NASA/Ames summer study of space manufacturing facilities (SMF's) as well as other data which have recently become available. The analysis reveals that the economics of SMF's are substantially better than the favorable results found for space settlements (colonies) using this model in previous studies." In contrast to a rather common assumption, "It is found that the SMF option for producing SPS's may be less risky than building them on and launching them from earth."

"Lunar Resource Surveys From Orbit"

James Arnold

A brief summary of the Apollo findings on lunar chemical composition and how the planned lunar polar orbiter experiments will help fill in the existing gaps of knowledge by, among other things, "producing a chemical map of the entire moon."

"Lunar Resources and Their Utilization"

W.C. Phinney, D. Criswell, E. Drexler, J. Garmirian

Lunar surface materials are characterized, significant compositional differences between maria and highlands soil are discussed, a conservative processing plant design for these materials is presented and the rationale for not locating such a plant on the lunar surface is given.

"Basic Coaxial Mass Driver Reference Design"

Henry Kolm

A detailed exposition of coaxial geometry mass driver design principles with HP-67 & HP-25 program listings for performance computations. The original coaxial design was originated by the author. Its "superiority stems from the fact that inductive coupling between bucket and propulsion coils is inherently tighter, which permits more effective utilization of conductor mass, and both the bucket and guideway structures are subjected only to pure tension forces, which permit higher acceleration before structural limits are reached."

"Mass Driver Retrieval of Earth-Approaching Asteroids"

Brian O'Leary

Discusses mechanics and tradeoffs for mass driver tugs "designed to move Apollo and Amor asteroids at opportunities of low velocity increment to the vicinity of the Earth." (Apollo asteroids cross Earth's orbit, Amor asteroids approach Earth's orbit.) The author demonstrates that this source of material for high orbit use may be an order of magnitude less expensive than lunar materials. Thus "the total investment of a space manufacturing program

could be reduced twofold by using asteroidal instead of lunar resources; such a program could begin several years sooner with minimal concurrent development if asteroidal search programs and mass driver development are immediately accelerated."

"Mineralogical Characterization of Asteroid Surface Materials from Reflectance Spectroscopy: A Review"

M. J. Gaffey and T.B. McCord

Opens with a helpful definition of terms "For those individuals not conversant with the terminology of planetary astronomy, remote sensing or mineralogy." I encourage all authors of technical articles to follow this example where appropriate in order to make the literature on space manufacturing/space habitation comprehensible to those whose area of specialization does not match the author's. The growing public interest in this field and its interdisciplinary nature make this a desirable goal. The interpretation of asteroidal spectra and the underlying theoretical basis for such interpretation is discussed at length. Indrawing out implications for space industrialization efforts, the authors conclude that "The Inner Belt, with several tens of thousands of objects to select from and with volatile-rich minerals in abundance, may prove to be the cheapest (with regard to energy) source of much of the needed raw materials." How? Solar sails "may make even relatively distant asteroidal sources competitive with Lunar surface."

"A Factory Concept For Processing And Manufacturing With Lunar Materials"

Gerald W. Driggers

"A conceptual design for an orbital factory sized to process 1.5×10^6 metric tons per year of raw lunar fines into 3.0×10^5 metric tons of manufacturing materials is presented. A conservative approach involving application of present Earth based technology leads to a design devoid of new inventions." For the system described, it is found that "By Earth based standards the individual plants and segments are not highly efficient. Taken as a whole and coupled to efficient automated assembly outside the facility, the concept is very efficient in terms of manpower, mass and volume. The key is end-to-end, raw material to finished product system integration. The realization of this type of facility may represent the next plateau of industrial development."

"Systems Analysis of a Potential Space Manufacturing Facility"

Gerald W. Driggers

"Results of a preliminary design study of the system elements comprising a manufacturing facility in earth orbit are presented. The elements discussed include cis-lunar transportation, lunar base, materials transport, factory, living facilities, construction support and energy supply. An evolutionary path of development, production and deployment is presented and step-wise interrelationships discussed." The author makes the interesting observation that "The level of detail allowed by the constraints of this study was sufficient to illustrate the intriguing potential for manufacture of products in space from lunar materials at high production rates."

1. Readers of L-5 News are encouraged to send to L-5 Society reprints of articles by them or by others relevant to space industrialization and extraterrestrial community design.
2. L-5 News will publish abstracts of relevant publications provided:
 - a. An abstract of *not more than 200 words* is provided by the author or by the person sending the reprint to L-5 Society, and *is accompanied by a copy of the entire article or book.*
 - b. The abstracts are subject to editing or rejection by the editor of the L-5 News.

Many literature-followers may not know what a goldmine the Government Printing Office is. They send out a free monthly bulletin of Selected Publications.

The April issue has, among a hundred other things, books on population psychology, ecosystem impacts of urbanization, and waste management technology; and a pamphlet, "What's New on the Moon?"

Just write Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, to get on the mailing list.

Neil Rest

Chicago, Illinois

Time Out For Tomorrow

Norman Avery

by *Conrad Schneider*

The cover of this futurism book sports a painting of O'Neill type III space colonies with glued-on reflectors. In the foreword, the author says "great depth will not be given to the various ideas presented herein . . ." Unfortunately he succeeded a little too well in that respect. For example, there are just 5 pages of text (yet 7 pages of illustrations) on the topic of space colonization. This book touches on many other interesting subjects: communication, computers, lasers, energy, transportation, etc. However, just after a new and interesting item is introduced, the subject is changed. The result is a "gee whiz" book that is somewhat frustrating if you want to know some of the hows and why behind all the neat prophecies. On the plus side, this book is packed with sketches, paintings, and photographs. It is an enjoyable book to look through. I hope there will be a revised second edition with smaller print that gets more into the "guts" of its subject.

Colonies In Space

T.A. Heppenheimer.

Introduction by Ray Bradbury.

Stackpole Books \$12.95

To skeptics concerned with economic and social priorities, aerospace engineer Heppenheimer has a ready reply. The space colonies which he and other scientists envision-and which may one day be on NASA's drawing boards-incorporate power satellites beaming back sufficient solar energy to

ease the world energy crisis. Whatever lingering doubts may remain Heppenheimer attempts to sweep away in a rosy scenario of lushly verdant, pollution-free space colonies complete with swimming pools, movies and zero-gravity sex. But space boosterism or no, space colonies could be a not-so-distant reality, so we'd better pay attention. More than 100 photos and line drawings (eight pages in color) give a startling immediacy to vivid descriptions of space shuttles, moon and asteroid mining and manned observatories which loom in our future. *BOMC alternate, Natural History Book club alternate [June 15]*

Reprinted from *Publishers Weekly*

Even the non-space fans have something good to say about Heps book -- K.H.

Colonies In Space, by T.A. Heppenheimer is being offered by the following book clubs:

Book-of-the-Month

Natural History

Explorers

Playboy

Aesthetic Implications of the Crystal Palace Space Habitat

Marjorie L. Stuart

Review by *Stella Calvert*

Gerard O'Neill's 1976 Crystal Palace Space Habitat is examined by a stage magician hoping to solve the chief problem with this structure. The Crystal Palace design provides significantly more living space per unit of mass than does the Bernal Sphere; however, the Sphere does provide considerably more visual space. Marjorie Stuart, a practicing stage magician from New York State, has spent her thoughts on optimization of visual space within the Crystal Palace design. As she says, "A magician does not care what is true. He is only interested in what appears to be true."

She recommends, for example, that roads along the circumference may well be straight, since the edge of the colony is not visible, but that the side to side roads ought to curve to avoid reminding the inhabitants at every step that theirs is an extremely small closed system. In addition, she suggests that the forest of longerons and risers be camouflaged both by hanging gardens and by pressing them into double duty as structural supports for the buildings. Also of interest is the suggestion that buildings be facaded on both sides, allowing for an alternation of residential and commercial streets and a much greater visual variety.

This paper once more proves that there is a need for people of all disciplines and specialties to be involved in the design of space colonies; conventional architecture may not be equal to the challenge of the space city, even as conventional fabrication techniques are too limited. However, with input from magicians, artists and poets; painters, stage designers and perhaps even smugglers, viable and beautiful cities in space can and will be designed.

Additional information on Ms. Stuart's work can be obtained from

Marjorie L. Stuart, Partner

Marburger Publications

31 Westgate Blvd.

Plandome, New York 11030

L-5 Marketplace

O'NEILL FUND APPEAL

(Reprinted from O'Neill's newsletter)

by G.K. O'Neill

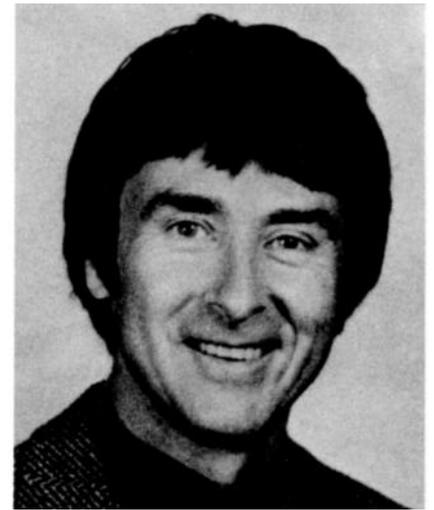
The first five months of 1977 have been a time of rapid progress in the work of Dr. Brian O'Leary, myself and our co-workers in many locations. Concluding a most pleasant and productive sabbatical year as Hunsaker Professor at M.I.T., in the Spring I gave there a seminar series titled "Spaceflight via Maxwell's Equations." This series went into research-monograph detail on the subject of electromagnetic mass-drivers, covering acceleration, guidance, mass-optimization and applications. The seminar-series is the basis for a technical book now in preparation.

During these months a working model of a mass-driver, with two-meter acceleration length, was built by a volunteer group at M.I.T. with the guidance of Dr. Henry Kolm and myself. The model was tested successfully at the 1977 Princeton Conference. An initial research grant to Princeton and M.I.T. was given in April by the Propulsion and Power Division of the Office of Aeronautics and Space Technology (OAST) at NASA Headquarters. A considerably larger grant, from NASA HQ in cooperation with NASA-Lewis Research Center (LeRC) is in an advanced stage of discussion for the year beginning Sept. 1977. The goal of that research program is a spaceflight-qualified mass-driver reaction engine, to be assembled in space from the Shuttle in the 1980's. Given funding, the intermediate goal will be a 10-meter, synchrotron-mode driver, in vacuum with a superconducting carrier, targeted for 1,000 gravities acceleration and a peak velocity of 1,000 kilometers/hour. The end-products of this line of research are intended to be mass-

driver reaction engines able to lift 850-ton payloads from low earth orbit to lunar orbit, using surplus Shuttle external tankage as reaction mass, mass-drivers as asteroidal transfer engines, and as lunar materials launchers. One job opening in this program is expected to exist at Princeton as of Sept. '77, for a fresh Ph.D. with strong EE, Physics and Aerospace preparation.

Television crews from WGBH-NOVA, planning a one-hour special in January 1978. and from BBC-TV, planning three one-hour specials for the Spring of 1978, attended the Conference and thoroughly documented the mass-driver tests. Our keynote speaker this year was Congressman Donald Fuqua. and Ambassador Peter Jankowitsch, Chairman of the United Nations Committee on the Peaceful Uses of Outer Space, delivered an important address at the Conference. With the continued cooperation of AIAA, it is expected that the next (1979) Princeton Conference will be explicitly international in character.

During these months Dr. O'Leary, Dean Stephen Cheston of Georgetown and I have completed the assembly of the Advisory Panel for the U.S.R.A. (Universities Space Research Association) Task Group on Large Space Structures, which I chair. This advisory panel combines representation from a number of constituencies, including engineering, natural sciences, life sciences, humanities, organized labor, the electric utility industry and the investment community. The first meeting of the Panel will be held July 25-26 in California, timed for briefing on the results of the 1977 NASA Study (see below).



Dr. O'Neill's main research area is high-energy particle physics. In 1956 he invented the storage-ring technique for colliding particle beams, a method which is now the basis for nearly every new high-energy machine. His studies on the humanization of space began in 1969 as a result of undergraduate teaching at Princeton, and were first published in 1974.

He is a pilot with ratings for gliders, land aircraft and instrument flight, and as a sailplane pilot holds an International Diamond Badge in soaring. On most of his travels in connection with research and lectures he pilots a small airplane.

Dr. O'Neill was selected by the editors of Aviation Week as one of the 25 Americans who contributed most to the development of the Aerospace field in the year 1975. He is a member of the Advisory Board of the National Air and Space Museum of the Smithsonian Institution, and serves regularly on advisory boards and panels related to advanced developments in space.

To support the development of space manufacturing/space habitats in a number of ways, a non-profit corporation, the Institute of Space Studies, Inc., is being formed in Princeton, separate from the University. Its title is not yet final, and a separate announcement of the establishment of the Institute will be made within the next months.

To: G. K. O'Neill
Institute of Space Studies, Inc.
Box 82
Princeton, N. J. 08540

Enclosed is a contribution of \$ _____ to a non-profit tax-deductible institution, toward support of one year's secretarial work or equipment needs of the Princeton space-studies group, not obtainable from University or Government sources.

(Block letters please) Name: _____
Address: _____

more **MARKETPLACE**

Conference: The Industrialization of Space

San Francisco

October 18, 19, and 20

SELECTED PAPERS (PRELIMINARY)

(TECHNICAL ASPECTS OF LARGE SPACE STRUCTURES)

"Freedoms and Constraints in Solar Power Satellite Designs;" Sperber and Zipursky; MIT. "Automated Space Fabrication of Structural Elements;" Engler; NASA/MSFC. "A Near Term Space Demonstration for Large Structures;" Nathan; Grumman Aerospace. "Space Construction-Near-Term Initiatives;" Woodcock; Boeing. "Space Construction of Large Space Structures;" Milton; Lockheed Missiles & Space.

(HISTORICAL PRECURSORS AND ANALOGS)

"Space for People;" Sklarew; Science Applications, Inc. "Hidden Perils in Government Support of Space Activities;" Poole; Space Freeport Project. "Man and the Stars: A Summary;" Gilson; Consultant. "Governmental and Industrial Roles in Initiation of Space Industrialization;" Stine; Consultant. "Expanding NASA's Charter to Facilitate Space Utilization;" Grodzka; Lockheed Missiles. "Energy Crisis, A History Lesson;" Sviedrys; Polytechnic Institute of New York. "Two Lessons from the Past: An Analysis of Government's Role in Developing Super-Economies;" DeMandel; Consultant.

(ADVANCED TRANSPORTATION SYSTEMS)

"The Space Shuttle, Status and Utilization;" Thompson; NASA/JSC. "Advanced Launch Vehicle and Technologies;" Bell; Rockwell International. "Ground Operations and Concepts for Future Space Activities;"

McCoy; NASA/KSC. "A Hybrid Chemical-Nuclear Space Freighter Concept;" Kingsbury; McGill University. "The Interim Upper Stage;" Downey; Boeing. "Solar-Electric Propulsion and Inter-Orbital Transportation;" Austin; NASA/MSFC. "Space Flight with Magnetic Acceleration;" O'Neill; Princeton University. "A Non-Synchronous Orbital Skyhook;" Moravec; Stanford University.

(ECONOMIC REALITIES)

"Space Industrialization and the Long Term Prospects for Terrestrial Civilization;" Vajk; Science Applications, Inc. "Commercial Manufacturing on a Space Station;" Geschwind; Grumman Aerospace. "The Space Power Economy;" Beldavs; Cummins Engine. "A Free Enterprise Model for the Operation of Industrial Facilities in Space;" Sanders; International Investors' Research and Technology. "Space Industrialization -- The Long Range View and the near and Intermediate Steps;" Gould; Rockwell International. "The Space Industrialization Study at Science Applications, Inc.;" Sklarew; Science Applications. "Marketing Techniques and Space Industrialization;" Stine; Consultant.

(SPACE COMMUNITY PLANNING)

"Space Community Planning on a Down-to-Earth Context;" Mack and Esdale; SRI International. "If We Can Get Along at Idaho State, We Can Get Along in Space;" Mead et al; Idaho State U. "Design Principles and Cultures;" Maruyama; University of Illinois. "Alternative Social Structures in a Vacuum;" Bluth; California State University at Northridge. "Weather or Not-Meteorology in a Space Cylinder;" Ziegler; Polytechnic Institute of NY. "Aesthetic Implications of the Crystal Palace Space Habitat;" Stuart; Consultant. "Entrepreneurial Opportunity in the Provision of Community Services in Space;" MacCallum. "Kids in Capsules -- A Children's Eye Perspective on Being Spaced Out;" Cullinan. "Public

Perceptions of the Space Community Program;" Rudoff; San Jose State University. "Space Community Planning from a Viewpoint of Experience;" Heppenheimer; Max Planck Institut; "From the Hilton to the Heavens;" Cullinan; SRI.

(PSYCHO-SOCIAL AND BIOLOGICAL CONSIDERATIONS)

"A Layman Looks at Life in Space;" Damren; Consultant. "Personal Growth Education for Space Colony Inhabitants;" Cutler; Lockheed Missiles & Space. "Military Uses of Outer Space;" David; FASST. "Cultural Implications of Extraterrestrial contact and Space Colonization;" Urbanowicz; California State University at Chico. "The Psychological Effects of High Orbital Migration;" Leary; Lecturer.

(TECHNICAL ASPECTS OF SPACE HABITATION)

"Habitats in Space-An Update;" Shettler, General Motors. "Technology Requirements for Closed-Ecology Life Support Systems Applicable to Space Habitats;" Spurlock; Georgia Institute of Technology. "Magnetic Radiation Shielding for Permanent Space Habitats;" Paluszek; MIT. "Space Habitats at the Earth-Moon LaGrange Points;" Schutz; University of Texas. "Requirements of Orbiting Facilities for Industrial Space Processing;" Alvarado; GE. "Concept for a Lunar/Orbital Logistics Support Station and Training Facility;" Fedor.

(COMMUNICATIONS AND NAVIGATION)

"NAVSTAR Global Positioning System Program Overview;" Meston; Rockwell International. "The industrialization of Space;" Bekey; Aerospace Corporation. "Public Service Satellite Communications, Where We Are and Where We Are Going;" Lipke; Comsat General. "Space Industrialization: Education;" Joels; NASA/Ames. "Assembly in Space of Large Communication Structures;" Zylus and Ehrlich; Rockwell International

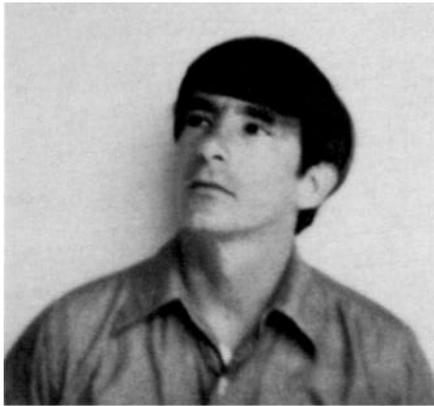
O'Neill Fund appeal (continued)

As our work has grown, though, a serious problem has grown with it. We devote practically all of our research grant money, considerably as it has grown, to materials, labor and other costs directly connected with the technical research. Departmental restrictions prevent our increasing our staff beyond one very overworked secretary, and as a result I

devote considerable time to typing nearly all my own letters myself, and to other secretarial and clerical work. Possibly through the mechanism of the new Institute now being formed, I would very much like by September '77 to bring in a full-time secretarial assistant. We cannot ask government funding for such a position, and I would like to find whether there is a broad-based support for providing the necessary salary through

small or larger tax-deductible contributions

I acknowledge with particular gratitude the contributions made in support of our work during the past several months by Mr. William O'Boyle and Mr. David Hannah. It is indeed a great pleasure to report so much progress, and there is every reason to believe that our cooperative effort will be equally exciting in the months ahead.



Paul Siegler

CONFERENCE TACKLES "PEOPLE PROBLEMS"

The "people problems" of space settlements will be delved into in detail for the first time in this conference. Following is the abstract for one of the papers in the Psycho-Social and Biological Considerations session:

THE PSYCHOLOGICAL EFFECTS OF HIGH ORBITAL MIGRATION

by Timothy Leary

In the 16th Century the Old World faced the challenging opportunity of colonizing a vast and rich New World.

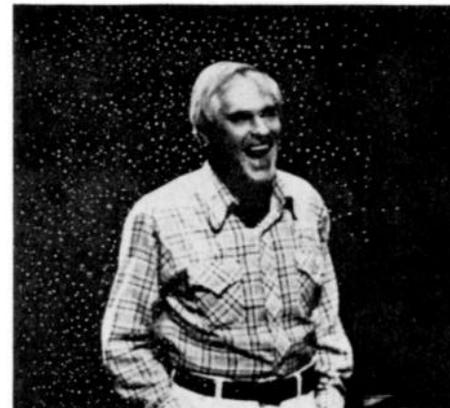
Two psycho-social systems-which we shall call the Anglo-Celtic and the Mediterranean-set up civilizations in North America and South America respectively. The differences between these two experiments provide interesting perspectives for anticipating what will happen in the next few decades as the limitless riches of post-terrestrial space attract Old World social competition.

1. The Anglo-Celtic psycho-social model is based upon individualism, democratic rule, open communication, free mobility, plurality of lifestyle, personal growth, tolerance of difference, competition, encouragement of invention, experimentation and creativity, decentralization, distrust of military authority, private enterprise and free-market exchange.

2. The Mediterranean model (derived from Oriental and Middle-eastern philosophies) emphasized: subordination of the individual to authoritarian rule, restriction of communication (censorship), restriction of movement, controlled uniformity of life-style, discouragement of personal growth, rigid maintenance of tradition, state monopoly, distrust of the inventive experimental approach, glorification of military control, centralization. collective enterprise, obedience to bureaucracy, suppression of difference.

A brief examination of the evolution of these two social models in South and North America provides instructive suggestions for the future of Space Colonization.

The technological and economic challenges for permanent High Orbital Mini-Earths appear to have been adequately met. The future of post-terrestrial colonization now depends on



resolving the software issues: mobilization of public opinion supporting the migration; economic access to resources available; political and cultural control; the psycho-social models and metaphors to guide life in the New Worlds.

It will be suggested that the best way to avoid the South Americanization of Space (i.e. the emergence of civil-service bureaucracies, military dictatorships, class struggle, centralized monopolies, imposition of standardized life-styles) is to re-examine the specific factors which led to the success of the North American model. We shall reexamine the emphasis of individuality, the open invitation to migrants from every continent, the open communication which made possible a United States-as well as a review of the obvious mistakes made by the North American pioneers.

The Space Settlement program will most gracefully harness the American imagination (and the aspirations of freedom loving people throughout the planet) if a deliberate attempt is made to recall, renew, reinvigorate and repeat the successful aspects of the Jeffersonian-Edisonian model. Among these factors are the frontier expansive spirit, the western hero-heroine, the small group seeking to live out a new vision, the need for adventure and calculated risk, the genetic imperative, the melting-pot open society mystique.

Simple and effective ways of countering centralized bureaucratic rule will also be reviewed.

The "Industrialization of Space" will be the biggest, most exciting conference held on solar power satellites, space industries and settlements. The speakers and topics discussed will be remarkably eclectic. Organizer Siegler, a free enterprise buff, Harvard Business School graduate and founder of Earth/Space, Inc., has pulled together NASA officials, corporation executives, college professors and mavericks, all of whom are working on a constellation of space projects.

Siegler promises audience interaction with all the speakers in lengthy question and answer sessions, as well as informal get-togethers where those of us in the New Space Program can meet and get to know each other.

As anthropologist Magoroh Maruyama has observed, "As members of L-5 Society get to know one another at various conferences and meetings, it has become clear that L-5 Society has a colorful assortment of different personalities." (Colorful Personalities, August '77, L-5 News.) People attending this conference can meet fascinating personalities ranging from the cultured and articulate Gerard O'Neill, the boisterous T.A. Heppenheimer (get him to sing "The High Frontier" for you!) to the legendary Tim Leary -- not to mention your beloved L-5 News editor, me. Hope to meet you there.

-Carolyn Henson

P.S. Don't forget to take the L-5 member's discount when filling out your application.

The Summer 1977 AIAA Student Journal features -- you guessed it -- space settlements. It includes articles by Jerry Grey, Gerard O'Neill, Leonard David, Brian O'Leary, and Rusty Schweickart. Copies are available for \$1.00 for members of the AIAA; \$5.00 for nonmembers, from:

J. Jeffrey Irons

Director of Student Programs

AIAA

1290 Avenue of the Americas

New York, N.Y. 10019

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L-5/AIAA/AAS CONFERENCE ON THE INDUSTRIALIZATION OF SPACE

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* * * * *

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What's Available from the L-5 Society?

Books:

<i>The Hunger of Eve, A Woman's Odyssey</i> Toward the Future, Barbara Marx Hubbard Stackpole Books, Hardbound. 1976	B1	\$ 8.00
<i>The High Frontier: Human Colonies in Space,</i> Gerard K. O'Neill William Morrow & Co., Hardbound. 1977	B2	\$ 8.00
<i>Colonies in Space,</i> T. A. Heppenheimer Stackpole Books, Hardbound. 1977	B3	\$12.00
<i>The Fourth Kingdom,</i> William J. Sauber Aquari Corp., Hardbound. 1975	B4	\$ 6.00
<i>War and Space,</i> Robert Salkeld Prentice-Hall, Inc., Unbound copy, 1970	B5	\$ 7.00
<i>Exopsychology,</i> Timothy Leary Peace Press, Paperback. 1977	B6	\$ 8.00
<i>Colonies in Space,</i> Frederic Golden Harcourt Brace Jovanovich, Hardbound. 1977	B7	\$ 8.00

Back Issues:

L-5 News, Volume 1:1-16, Volume 2:1-6	BI #	\$ 1.00
Complete set of back issues	BIA	\$22.00

Posters:

Bernal Sphere Interior 14" x 22" full color	PO1	\$ 2.00
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Pioneer XI in the Rings of Saturn
Adolph Schaller
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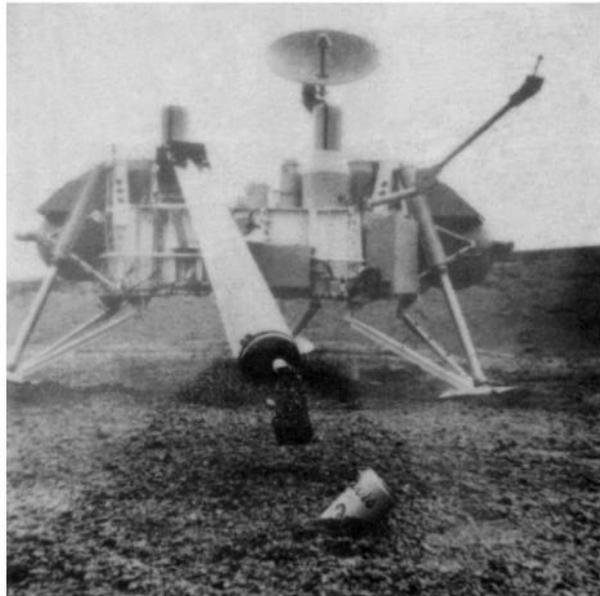
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