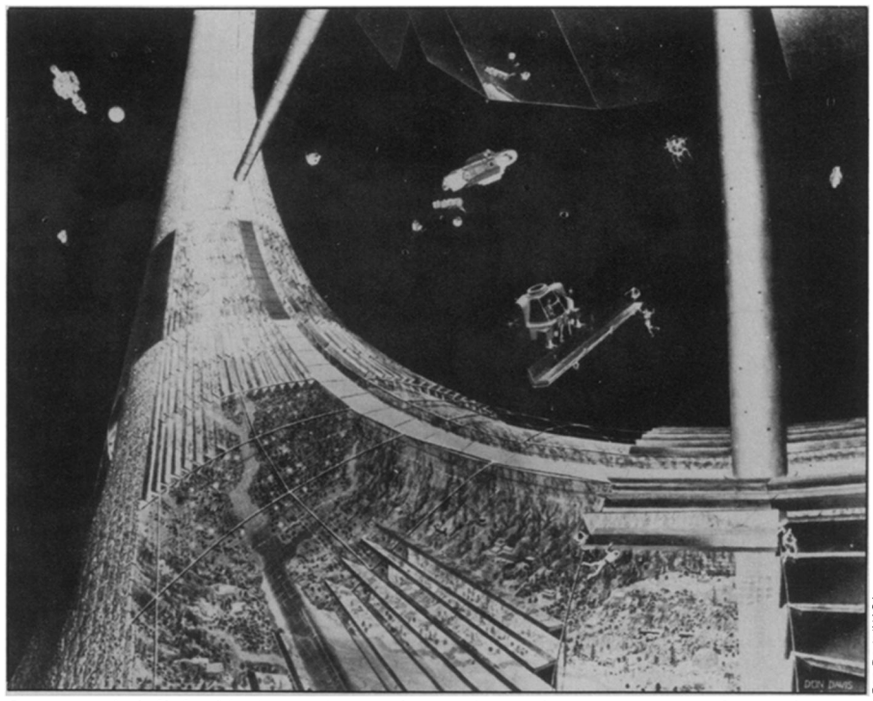
Space colonies: Home, home on Lagrange



Don Davis/NASA

Louvers admit light, block cosmic rays from colony's farm region, complete with river.

The huge wheel, more than a mile across, turns slowly on its axis, poised in space 240,000 miles from both earth and the moon. Nearby, a cluster of tiny utility vehicles jet back and forth, gnatlike, servicing a free-floating factory module within which a team of engineers and technicians are inspecting a fresh-grown batch of flawless semiconductor crystals the size of hen's eggs. On the far side of the wheel, docking personnel are preparing for the arrival of a raw-materials cargo shuttle from the asteroid belt, following the departure of a service tug carrying a newly resurfaced dish for one of the SECAR (Solar Energy Collection And Relay) satellites that are providing inexpensive power to the earth via microwave relay. And meanwhile, aboard the wheel itself, the rest of the 10,000 residents continue business as usual, working, studying and playing, monitoring the all-important life-support equipment, harvesting crops and conducting the myriad affairs that make up life on this vast, manmade colony in space.

But the idea itself is not the point. It has been a recurring theme in science-fiction for decades. Nor is it the point that Princeton physicist Gerard K. O'Neill made the idea respectable by presenting it at various scientific meetings and publishing it in respected journals such as PHYSICS TODAY and NATURE. It is rather that after 10 weeks of concentrated brainstorming and calculation, a team of engineers, economists, physicists, architects, astronomers, chemists, psychologists, biologists and management consultants has not only concluded the idea to be eminently feasible and largely within existing technology, but recommended "that the United States, possibly in cooperation with other nations, take specific steps toward the goal of space colonization."

The 28-member study group met at the National Aeronautics and Space Administration's Ames Research Center in Mountain View, Calif., specifically to work out what problems—and solutions—would be encountered in translating such a concept into reality. Their conclusions, based in part on gleanings from past and near-future projects such as Apollo and the space shuttle, seem surprisingly un-farfetched and more than a little fetching.

The obvious question is, why bother? One reason would be to take advantage of the potential of weightless manufacturing, as suggested by Skylab and the Apollo-Soyuz mission and scheduled for broader study aboard the space shuttle in the 1980's. The study group suggests that a major commercial activity of such a facility would be to build and emplace huge solar-power stations to hover in synchronous orbits around the earth to collect the sun's energy and beam it planetward as a virtually inexhaustable source of inexpensive electricity. Metals, silicon and oxygen for such endeavors would be mined on the moon and launched into space, where they would be gathered and ferried to the waiting colonies. (Carbon, nitrogen and hydrogen would initially have to be sent up from earth, but the development of low-cost production and transport systems would ultimately transfer this activity to eligible asteroids in the belt between Mars and Jupiter.) "In contrast to Apollo, though," says a summary version of the group's hefty report, "it appears that space colonization might be a paying proposition, with a benefit/cost ratio greater than one."

More important to many of the participants, however, was "a strong sense . . . that space colonization appears to offer a way out from the sense of closure and of limits which is now oppressive to many people on earth. . . . The possibility of cooperation among nations . . . may be far more important in the long run than the immediate return of energy to the earth. So, too, may be the sense of hope and of new options and opportunities which space colonization can bring to a world which has lost its frontiers."

The substantial technical difficulties were, of course, a major part of the study. Given, for example, the nearly 24-hour-a-day sunlight and optimized concentrations of carbon dioxide and water vapor in agricultural areas of the habitats, "vegetables, cereals, poultry, ham and dairy products for a North American population of 10,000 could be grown on a total area of about 450,000 square meters (111 acres)." About 10 million tons of shielding, necessary to keep out cosmic radiation in the absence of earth's protective magnetic field, would come from the slag left from processed lunar ores. The whole wheel and its contents would have a mass of about 500,000 tons, roughly equivalent, the group estimated, to the largest supertanker ship.

But the study group concerned itself also with subtler and more subjective issues. "Some concern was expressed," for example, "that the offering of very high wages to the initial construction workers might not attract the type of people best suited to long-term habitation in space; rather, it may be preferable to offer certain rights of settlement, perhaps in combination with subsidies for family transport." Psychological factors were considered in the overall design, which was envisioned to allow half-mile lines of sight, a feeling of spaciousness and proximity to growing things. The population would include some children, though most of the initial residents would be "young and vigorous men and women in their prime working years."

Although 10 weeks was barely enough to run through the idea once, let alone go back for a detailed systems analysis, the members found time to look beyond a single, pioneering colony to groups of closely interacting facilities, possibly with diverse governments and social structures, depending on their evolution. "Within the materials limits of ordinary civil engineering," the group envisioned spherical habitats up to 20 kilometers across, with 800 square kilometers of habitable land area. The development and construction of the initial colony would cost about $100 billion by the team's estimate, two to three times the cost (in 1975 dollars) of the Apollo project. □