Celebrate Apollo moonshot by colonizing space

by Marsha Freeman

During the third week of July, millions of Americans, and people all over the world, will celebrate the twentieth anniversary of the first manned landing on the Moon. Events are being held to honor the men who laid their lives on the line and put years of hard work into missions which pushed mankind beyond the boundaries of Earth, and into a new era of exploration.

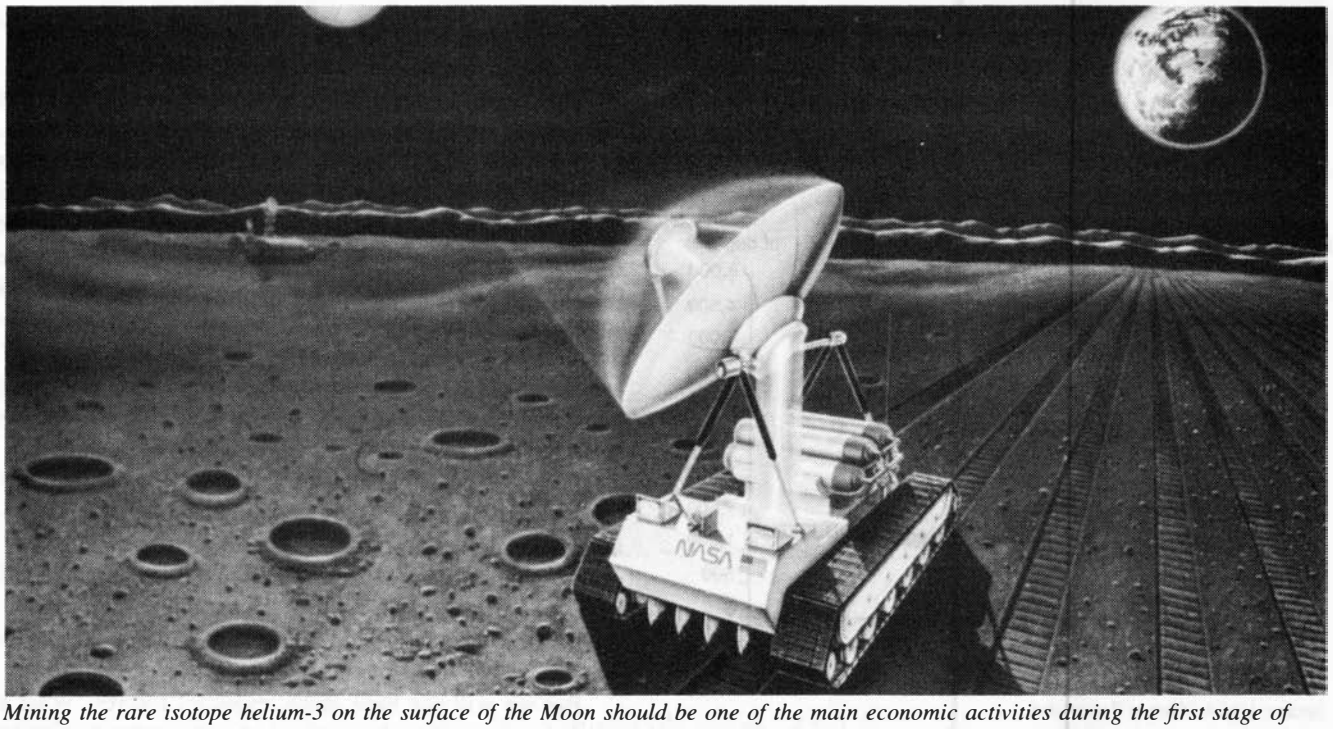
But this joyous occasion should also remind us of the days in the past when this nation saw as its goal a preeminent position in virtually all fields of science and technology. This Apollo anniversary should be the point of inflection, where the years of defining what we could do in space by how much money we could spend, ends; and the goals for the space program become defined by what is *necessary*.

"The present state of our economy is disturbing," a President of the United States has said. "We take office in the wake of seven months of recession, three and one-half years of slack, seven years of diminished growth, and nine years of falling farm income.

"Business bankruptcies have reached their highest level since the Great Depression," he continued. "Since 1951, farm income has been squeezed down by 25%. . . . Of some 5.5 million Americans who are without jobs, more than 1 million have been searching for work for more than four months. And during each month, some 150,000 workers are exhausting their already meager jobless benefit rights. . . .

"Our cities have been engulfed in squalor. . . . [W]e still have 25 million Americans living in substandard homes. . . .

"Our classrooms contain 2 million more children than they can properly have room for, taught by 90,000 teachers not properly qualified to teach. One-third of our most promising high school graduates are financially unable to continue the development of their talents. . . . We lack the scientists, the engineers, and the teachers our world obligations require. We have neglected oceanography, saline



University of Wisconsin

Mining the rare isotope helium-3 on the surface of the Moon should be one of the main economic activities during the first stage of lunar industrial development. In this artist's conception, an unmanned robotic miner is using solar energy during the two-week lunar day, to process this valuable resource.

water conversion, and the basic research that lies at the root of all progress," the President went on.

"Medical research has achieved new wonders, but these wonders are too often beyond the reach of too many people, owing to a lack of income (particularly among the aged), a lack of hospital beds, a lack of nursing homes and a lack of doctors and dentists. . . .

"But all these problems pale when placed beside those which confront us around the world. . . . The first great obstacle is still our relations with the Soviet Union and Communist China. We must never be lulled into believing that either power has yielded its ambitions for world domination."

A speech which our current President could give today? It was delivered by John F. Kennedy on Jan. 26, 1961. Anyone who believes the Apollo program was started because there were no economic or political problems to contend with at the time, is not familiar with history. The Apollo program was the *solution* to these problems, posed by President Kennedy.

One look at the data in **Figure 1** answers the question as to why we need an Apollo-style commitment to space exploration today. Unlike recent years, in the 1960s the nation mobilized the best talents of its young people to accomplish great things. The graduation of doctorates in the sciences over the past 20 years has followed the same general curve as the spending on the space program, with an expected five-year lag between the time money is spent, and degrees are earned.

Four months after his State of the Union address, quoted above, Kennedy announced a program to be the means toward the end of restoring America, and his presidency, to greatness. In his talk before a joint session of Congress on May 25, 1961, Kennedy made absolutely clear that what became called the "Apollo program" was not just a budgetary line-item for the National Aeronautical and Space Administration, but the pathway to the future.

Who will lead?

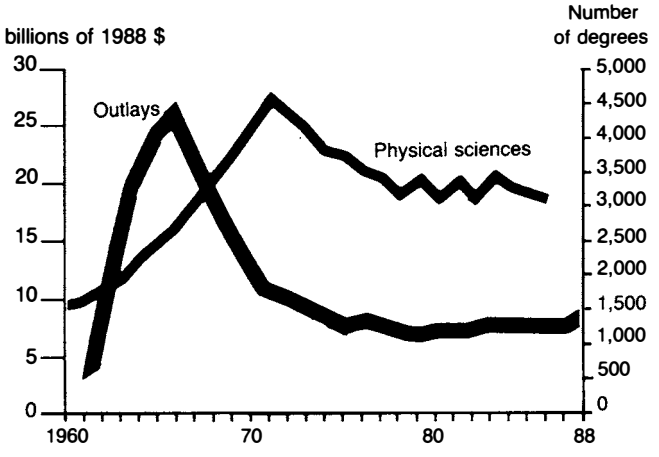
Only the President of the United States can commit the nation to a long-range program in space. But the Congress, by holding the purse strings, can prevent such an effort from succeeding. When Kennedy asked the nation through its elected representatives to make the commitment to "land a man on the Moon and return him safely to Earth" before the end of the decade of the 1960s, he knew that *even if he served two full terms in the White House*, he would not be president when the landing occurred.

Therefore he laid his cards on the table, and told the Congress what the project would require, and that if they would not see it through to the finish, it would not be worth doing at all.

In his "Special Message to the Congress on Urgent National Needs" on May 25, after outlining the broad array of programs he was proposing, Kennedy stated, "Let it be clear—and this is a judgment which the members of Congress must finally make—let it be clear that I am asking the Congress

FIGURE 1

NASA budget versus doctorates granted in the U.S.



Source: NASA Office of Exploration.

As the NASA budget peaked in 1966, the number of students graduating with doctorate degrees in the sciences took off. The curves have been similar ever since.

and the country to accept a firm commitment to a new course of action, a course which will last for many years and carry very heavy costs of $531 million in fiscal 1962, an estimated $7 billion to $9 billion over the next five years. If we are to go only halfway, or reduce our sights in the face of difficulty, in my judgment it would be better not to go at all. . . .

"I believe we should go to the Moon," Kennedy continued. "But I think every citizen as well as the members of Congress should consider the matter carefully in making their judgment, to which we have given attention over many weeks and months, because it is a heavy burden, and there is no sense in agreeing or desiring that the United States take an affirmative position in outer space, unless we are prepared to do the work and bear the burdens to make it successful. If we are not, we should decide today."

History might have taken a different turn, had President Reagan announced the new Strategic Defense Initiative program on March 23, 1983 with the same admonition to the Congress.

At the time of the Apollo announcement, the head of NASA, James Webb, estimated that the United States had only a 50-50 chance of beating the Russians to the Moon. Kennedy's science adviser, Jerome Wiesner, was dead-set against the program, and out of the entire cabinet, only Vice President Lyndon Johnson was an enthusiastic supporter.

No one familiar with the history of the turbulent first year of the Kennedy presidency, can make the claim that the aggressive goals he set for space emerged from a "consensus" of opinions of his advisors. The President has to lead.

The Apollo 11 mission to land the first men on the Moon was carried out and accomplished with five months to spare. But the other, even more long range projects in Kennedy's "Apollo" speech, such as developing nuclear propulsion to go further than the Moon, were sabotaged beginning in the Johnson administration, as the "left-wing" New Agers were determined to substitute the use of drugs to discover "inner space," for the exploration of "outer space." In later Republican administrations, "right-wing" and "small is beautiful" austerity ideologues stole the dreams of a generation of young people who had believed, along with Kennedy, that the sky is *not* the limit to what they and this nation can accomplish.

Today, the Bush administration and the nation are once again faced with a series of crippling economic, financial, and national security crises. Therefore, formulating long-range goals in space is once again on the agenda. We still have the technical skill, some of the basic industrial capability, and the people around with the experience to put the country on a "pathway to the planets."

But we will not have these resources forever. What is needed is the will to do what may be unpopular on Capitol Hill and at the budget office, but is absolutely necessary for the continued existence of this country as we know it. It is also true that a Moon/Mars mission for space will also win the support, and even the affection, of the great majority of the American people.

This time, build the infrastructure

The precursor to space travel was the rocket, and the precursor to the movement of human civilization throughout the Solar System will be the space station. In a recent publication by NASA on Space Station Freedom, it is reported that "serious space station thinking came to the United States in 1945," when Wernher von Braun "and other visionaries such as Krafft Ehricke left Germany at the war's end to work for the United States." The first technically serious design of an Earth-orbiting space station was published by Professor Herman Oberth in Germany in 1923.

In 1960, just two years after the establishment of NASA, a Manned Space Station Symposium was held in Los Angeles, bringing together space station advocates. After men proved they could survive at least a brief bout with space travel, planners assumed the next logical step would be a station so men could live and work in Earth orbit.

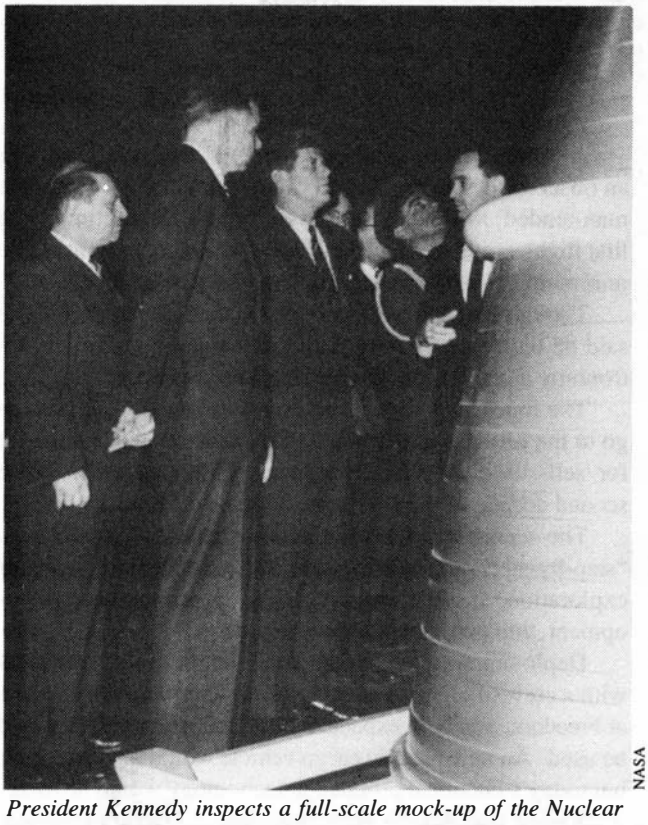
President Kennedy chose the goal of landing a man on the Moon to challenge the Russians, and guide Americans to do something very difficult, but obtainable. Though space visionary von Braun and others knew that the long-term colonization of space would require a base of operations, or station, in Earth orbit, there was not enough time to build that infrastructure and still meet Kennedy's deadline for the lunar landing.

The only reason a permanently manned space station was not built soon after the lunar landing was accomplished, was that the "leadership" of the country convinced itself the U.S. could not "afford" an aggressive space program. During President Nixon's second term, all long-range goals for space were canceled, except the reusable Space Shuttle. As a result, since the late 1970s, we have had a shrinking base of scientists and engineers, dropping productivity, overall economic decline, moral indifference, and technological obsolesence in industry, agriculture, and defense.

Neil Armstrong's "giant leap" for mankind was the event for which President Kennedy, and likely the entire twentieth century, will rightfully be remembered. But decades before Apollo, American rocket pioneer Robert Goddard pointed out that, "Real progress is not a leap in the dark, but a succession of logical steps," and this has a great deal of truth to it.

Most Americans do not realize that today the United States currently has no way to transport astronauts to the Moon, even if we decided to do so. We will have to go back and build the infrastructure we did not build in the 1960s, in order for people to be able to live in space.

NASA's current plan is to start assembling Space Station Freedom in the first quarter of 1995. The most important aspect of this facility is not that it will be "finished" after 20 Shuttle flights bring up all the pieces, but that it has been designed and will be built so that it is *never* "finished," but can evolve. As the overall activity of the space program changes, so will Freedom.



NASA

President Kennedy inspects a full-scale mock-up of the Nuclear Engine for Rocket Vehicle Application, or NERVA engine. The development of NERVA, which was canceled in 1972, was central to Kennedy's plan to prepare the space program for the steps beyond Apollo.

Initially, the eight-man international crew will perform activities on the station which have been tested for short periods of time on the Shuttle, and Skylab before it. These include materials processing experiments, biomedical research, and astronomy.

But the station is being built with electronic and mechanical interfaces so that it can be expanded. Two vertical spines could be added to the original horizontal truss structure for additional laboratories and modules to accommodate a larger crew (**Figure 2**).

More unmanned attached payloads could be added to this additional framework, as well, accomodating telescopes and astronomy experiments, and studies of the effects of the space environment. More advanced solar energy systems are planned, to add 50 kilowatts (kW) of electrical power to the original 75 kW, as is a servicing bay for large payloads such as the Hubble Space Telescope and other Great Observatories telescopes.

In the next century, Freedom could include a quarantine facility for samples brought back from Mars, greenhouses to grow food before it is grown on the Moon, a variable gravity facility to prepare people to live on planets with less gravity than the Earth, and a depot to assemble, check out, and service large vehicles on their way to the Moon and Mars. The depot would become a "Kennedy Space Center" in orbit.

New propulsion systems could be tested at the station, along with technologies such as laser communications, and exceedingly complex robotic and automation equipment. As these requirements develop, Freedom will change its shape and capabilities, the same way a laboratory adds on new buildings and test stands, and updates equipment.

We will finally have the research, development, and testing facility for space technology, *in situ*.

'Pathway to the planets'

On May 31 the space agency presented a briefing with the above title, as a status report on the long-range plans being developed by the Office of Exploration. This office was established in August 1987, following the publication of the report of the National Commission on Space, and a study by former astronaut Dr. Sally Ride.

Both reports recommend a return to settle the Moon, preceding a series of manned missions to establish a settlement on Mars. Both reports also stress the need to build the infrastructure to enable these forays through the Solar System to lead to a permanent presence.

However, there has been political pressure on the space agency from space quack Carl Sagan, the Russians, and

others, to propose goals which can be accomplished "without spending so much money," or quickly so people (read: Congressmen) do not "lose interest" in funding the effort.

The Office of Exploration, therefore, has spent its first two years studying a variety of options for the twenty-first century in space. At the Pathway to the Planets conference, NASA Administrator designate and former astronaut Adm. Richard Truly stated, "I believe we're destined to become a multi-planet species, with both the Moon and Mars in our future."

Dr. Mark Albrecht, the director of the newly reconstituted National Space Council under Vice President Quayle, observed correctly, "Human exploration doesn't emerge from the bottom up, as a solution to some particular problem; it will never be a cost-beneficial solution."

Exploration Office head Dr. Franklin Martin reviewed the various scenarios which have been proposed to NASA and considered by his office, indicating that only developing a permanent human presence beyond Earth, not just visits, should be the goal for the future.

One such proposal has been for a trip to the Martian moon, Phobos, which supposedly would be easier than a manned mission to Mars, because such a small body, about the size of Manhattan Island, has very little gravity. This means it requires less energy to land there. The manned mission to Phobos would get humans near Mars at the earliest possible date, with a targeted year 2003 landing. The four-man crew would go there using an expendable launch vehicle, as there would not be enough time to develop new reusable ones.

But as Martin pointed out, "it's like taking your kids to Orlando [Florida] and not going to Disney World—Mars is the real target."

A second scenario considered was an "Apollo mission to Mars." It would entail three expeditions at the earliest possible date, which could be the year 2007. No permanent infrastructure would be built on the planet, but the American flag would be planted and samples of Martian soil and rocks brought back to Earth.

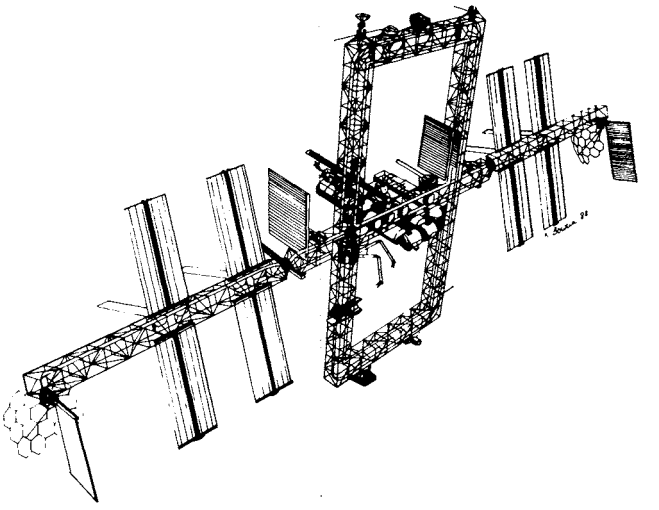
Martin reported that preliminary engineering studies indicated that having to take all you need with you because no mid-way facilities have been built before you go, would require placing millions and millions of pounds of payload in Earth orbit, which is "too massive from a common sense standpoint."

Martin stated that people propose "taking the Apollo program to Mars," because they have "oldtimers' disease," and think we should do things "like we did them before." A more aggressive approach should be taken, he remarked.

He reported also that his sense from a press conference held recently by the Apollo 11 crew was that, "these gentlemen would have built a space station and stayed on the Moon," if they had had their choice. "The next time around," Martin said, we need a "longer-term commitment."

FIGURE 2

The future expanded space station Freedom



Source: NASA.

The basic Freedom space station, which will be completed before the turn of the century, is centered along the horizontal truss structure seen here. This drawing represents an evolved design, where two vertical trusses have been added completing a rectangular central portion of the station.

A third scenario examined involved the goal of placing an observatory on the Moon. This "lunar outpost" would be man-tended, without people living there all the time. The first flight would be in the year 2004 with a crew of four. The minimum human support infrastructure would be built.

Though Martin stated that this would be "attractive," he said he didn't see how to "sell" this lunar program "on astronomy alone." More ambitious goals are needed.

The fourth and clearly only sensible long-term goal is to go to the Moon, "live off the land," to develop technologies for self-sufficiency, and use it as "a staging area, in the second decade of the 21st century, to go off to Mars."

The scenario for "evolutionary expansion" would be a "step-by-step program to open the inner solar system for exploration, space science research, *in situ* resource development, and permanent human presence."

Deployment to the Moon would begin in the year 2004 with a crew of eight. Assembly of vehicles would take place at Freedom, and both expendable and reusable systems would be used. An new electric cargo vehicle would be developed, but today's chemical propulsion technology would be used.

Viking and Apollo were "missions," Martin explained. Now we have "operational capabilities, like the Shuttle." A long-range plan should be based on the use of all of the infrastructure of the space program. He summarized the stud-

ies so far by stating that he personally is not happy with any of the scenarios, yet.

What the Office of Exploration has learned from all of the studies conducted, Martin reported, is that a heavy lift launch vehicle is needed for the future, and if possible, by the mid-1990s. This kind of rocket could deliver up to 200,000 pounds to Earth orbit. One design is the Shuttle-C, with the "C" standing for cargo (**Figure 3**).

The basic Shuttle solid rocket boosters and liquid fuel tank would be used, but instead of an orbiter to ferry people to orbit, an unmanned cargo carrier would be attached to the external tank and it would only carry payload. This class of vehicle would be the enabling technology for settling the Moon, but in Martin's estimation, an even larger vehicle would be needed to bring freight to Earth orbit for the trips to Mars.

The engines on the Shuttle-C would be used first, three or four times on manned flights, and then transferred to the unmanned vehicle. With two engines, Shuttle-C could carry 100,000 pounds into orbit, and with three engines, about 150,000 pounds. High-energy Centaur upper stages on the Shuttle-C could send unmanned robotic probes off to the planets, giving them a higher-energy boost, and therefore shorter trip time, than is available now with expendable rockets.

A more advanced Shuttle-Z is being examined, which could transport up to 500,000 pounds to Earth orbit, by using more advanced solid rocket boosters and Shuttle main engines, with the ability to attach up to seven solid boosters around the fuel tank and main engines. This approach is similar to the one used by the Russians, who add more boosters to mass-produced rockets in order to increase their payload capability.

Martin confirmed that from the standpoint of long-range planning, Space Station Freedom "is compatible with both lunar and Mars" missions. "The design of an airport is not driven by the destination of the planes, and neither is the station," he remarked.

What will it take to go from planning to doing? "We need a 'get ready to go' decision from the President," Martin explained, then a "go" decision, and then a "launch" decision. At the current level of planning activity, the Office of Exploration will have a program to present to President Bush in the early 1990s. But, Martin stressed, the decision is purely political, and they have to be ready to come forward with recommendations at any time.

A group described by Martin as The Lunar Energy Enterprise Case Studies is examining the possible commercial opportunities of a Moon-Mars mission. Chaired by a member of the Edison Electric Institute and including participation from former astronaut and former Senator Harrison Schmitt (R-N.M.), the group is looking into the potential of mining the rare isotope helium-3 on the surface of the Moon, to fuel fusion power plants there, and on Earth.

Martin stressed that any and all options require "an Apollo-type commitment." The Office of Exploration will be doing a study to estimate the manpower requirements for such an initiative. He reminded the participants that at the peak of the Apollo program, NASA had over 36,000 employees, but is now down to just over 23,000. "If they'd fund programs the way they used to, NASA could do it," Martin stressed.

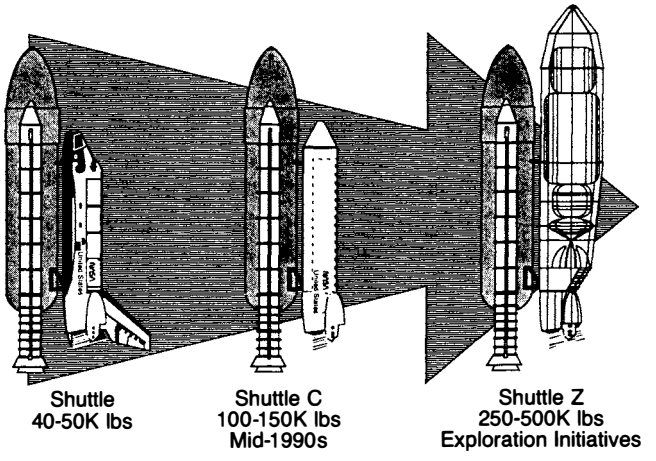
During this year, NASA is focusing studies on the role of artifical gravity on future manned missions, the scientific and unmanned precursor missions all of the scenarios require, the assembly and check-out of large vehicles at Freedom using the minimum crew, and the extraterrestrial resource processing and other technologies needed on any other planetary body.

When could the decision be made? "There are a number of initiative points," Martin stated. If a President needed an excuse, there's the Apollo anniversary in July; the thirtieth anniversary of the announcement of the Apollo program in May, 1991; the 500th anniversary of Columbus's discovery of America in 1992, etc. In other words, there is no lack of occasions that could be used to announce a decision to get on the "pathway to the planets." It's a purely political decision.

Actually, since things will only get worse as we delay the decision, there's no better time than the present.

The author is an associate editor of 21st Century Science & Technology *magazine.*

FIGURE 3
Shuttle cargo vehicle evolution



Source: NASA Office of Exploration.

Any manned planetary exploration will require the evolution of new cargo vehicles, greater than the 40-50,000 pound capacity of today's Space Shuttle. The Shuttle-C simply replaces the orbiter with a cargo carrier. The larger Shuttle-Z would take capacity up to a half-million pounds.