Why Are We in Space?*

Neil P. Ruzic

HAD Columbus speculated on the future he might have envisioned bigger, faster sailing ships or even ships without sails, headed straight across the ocean sea. But they would have remained boats. A less conservative contemporary, Leonardo da Vinci, might have forecast a future including airplanes, for he was known to have designed flying machines modeled after birds.

But neither of these imaginative men nor even their third brilliant contemporary, Copernicus, who reasoned that the earth is a moving planet, could have speculated that ships might fly between the planets and beyond the solar system at speeds approaching the velocity of light. For one thing, these pioneers of the early Sixteenth Century had no appropriate engines, computers, or technology as we know it. For another, they did not know what space was composed of or how fast light traveled, if indeed it did.

Now that the space age is reality, our imaginations soar ahead of us from a broader base of knowledge. There is a new renaissance here for the partaking, an awakening from one-world thinking that has modeled our plans and our ambitions throughout history. Today we envision black holes, extraterrestrials, and even a healthier, happier life on earth.

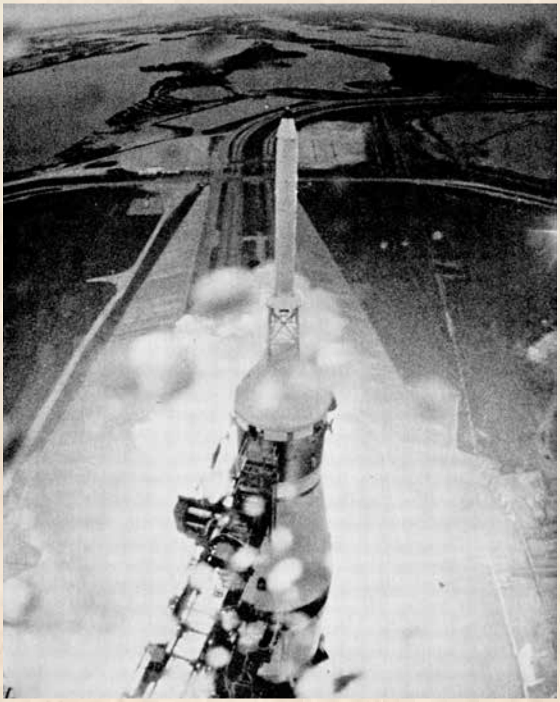
And we envision these exciting, worthwhile phenomena not as science fictioners did during the first half of this century, as impossible-but-fun playthings, ethereal maidens lingering in the jungle gardens of Venus, or a declining race of wise Martians roaming red deserts. Now that we know Venus is hot enough to

*Reprinted from *Air University Review* 31, no. 1 (November–December 1979): 34–48.

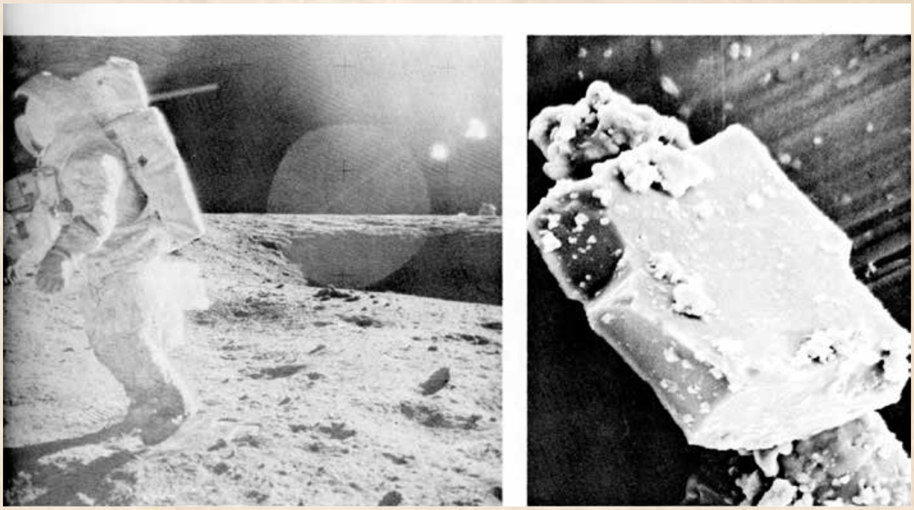
melt tin and that pockmarked Mars resembles the moon more than a living planet, we can set our sights for truer, more significant, even more exciting treasures. After all, while the important reasons why we are in space may have been understated, it should be obvious that if there were no space capability neither could we have sent satellites to orbit the earth, men to the moon, robots to the planets, nor could we seriously contemplate the next era of humanity spread across this and other solar systems. In other words, if there had been no space effort, we could not have gotten into space—a simplistic statement and yet one that, remarkably, often seems forgotten.

Why do we go to space? Certainly not simply because it is there. Maggots in rotting meat are there, too, but few people feel an overwhelming urge to explore them. We want to go to space because it is man's finest nature to explore for potential beauty. Now that we already have explored the earth, we literally seek new worlds. What finer gift to leave for future generations than the legacy of exploration? If we improve our lot on the old world in the process of exploring space, as has been done, then these improvements should be regarded as a by-product and not the primary reason for spacefaring.

All of us have some of the lingering curiosity of Columbus or Copernicus within us. We are invigorated by exploration. We feel a churning in the pit of our stomachs when we consider stepping forth on another world. Will it be different from our own planet? How will it be similar? What is over the horizon? Some infuse that feeling of excitement by riding roller coasters, or gambling, or taking drugs, or in countless other ways. Scientists, explorers, and adventurers get it by extrapolating from the known, by reaching out and grabbing the unknown to render it better known. In the process they make it part of themselves, just as a loved one becomes part of yourself once love is shared.



If all this sounds like an emotional plea for space travel, then thank God we have emotions to shape our intellectual efforts. Without passion, we would be poor indeed, little better than nth-generation computers coldly calculating their calculations, endlessly answering endless questions. But while our motivator remains romantic, intellectual achievement becomes the tool of our passion. To go to space we first had to improve our science and technology. To improve our technology we had to pay for it, and to pay for it we had to explain it.



Moon exploration

During the sixties we first saw men land on the moon. Saturn V vehicle (previous page) lifted off from Launch Complex 39-A on the nation's second manned lunar landing mission. . . . The heavens became a part of man's world as we watched the space-suited men of Apollo 12. Astronaut Alan L. Bean (above, left) "floats" along the lunar surface. . . . A moon fragment, enlarged here 3300 times, was among the fine lunar material collected by the Apollo II astronauts on this first step onto the moon.

Unfortunately, the explanation was ill-considered. It was too shallow, too mechanistic. Now, after 20 years, at the very time when space goals should be broadened, we find ourselves with a declining budget for space and an apathetic public.

During the sixties when the aerospace industry was implementing the President's decision to land men on the moon by the end of the decade, it is doubtful whether anyone directing any important phase of the gigantic space program truly thought our entire technology was being improved just to go the Russians one better. Few space leaders bothered with such transient thoughts, but the public was not informed of their legitimate goals. There were those in government or in the space program who feared the public would not support a “moondoggle” that had as its purpose just getting to another world. There were others who had no time to explain and still others, probably, who had not themselves considered why. The mass media, so used to skin-deep explanations of anything remotely scientific or complex, gave the public the impression it should support the Apollo program because the Soviets might get to the moon first and shoot rockets at us or prevent us from landing, or worse, that the space program was justified on the basis of Teflon frying pans and better gadgets. There was talk from the military of “high ground” and intercontinental missiles. There was talk, closer to reality but still too amorphous to mean much, of total capability and technological leadership to earn the respect of the world.

Then, suddenly, we were there: almost half of all of us on earth, some 1.5 billion people, riveted to our television sets seeing men on the moon. Never before in history had so many human minds been concentrated at the same time on *any* activity. It was a fantastic, utterly unprecedented opportunity to explain why the space age was worthwhile and important and what our objectives were on the moon of tomorrow and beyond. Instead, we watched two space-suited figures take pictures of each other and of an aluminum American flag nonfluttering in the nonatmosphere. We sat fascinated while they loped around in the unearthly sixth gravity of our closest heavenly body. We learned in minute detail how they got there, the size of the rockets compared with the Washington Monument, the thrust of the great engines, and the return routing.

Not a word was heard about “why are we in space?”

Here on earth, when our political, social, and religious leaders saw our blue planet televised from the moon, the fact that it was finite, beautiful, and a single object instead of 145 distinct nations overpowered them. They said it forced them to realize that we are all in this spaceship earth together!

Had these political, social, and religious leaders never seen a model of the earth—a contour globe, perhaps—where the thin red lines between nations are gone? Couldn't they have gained those profound insights from their grammar-school geography lessons?

Meanwhile the Vietnam War continued. Neil, Buzz, and Mike were replaced by the regular prime time shows. People settled back and said how nice it was that our clean-cut American boys were the first to walk with a giant step on the moon. And the government slowly turned down the space effort to a simmer.

I do not blame the government. The failure of the space planners themselves and, by example, the press to explain the space program to the public or, worse, to explain it on the basis of either showing up the Russians or for military reasons or frying pans was the failure to trust the common American to spend a few of his tax pennies a year on something intellectually exciting.

The Reasons for Space

Many reasons exist for going to space—all of them better than what we are told. Put quite simply and roughly in order of chronology, they are the following:

- To orbit satellites for improved communications, weather forecasting, navigation, resource monitoring, and other such purposes.
- To reap the by-product of space technology by transferring innovations and methods to many areas of industry and medicine.
- To compare other planets with the earth and to study the sun so we can better understand the origin and workings of earth and its dwindling mineral reserves.
- To explore the universe to determine, among many other things, whether life or even other intelligences exist elsewhere.
- To create a focal point for a new intellectual renaissance that will improve the wealth, health, and happiness of all of the people on earth.

Could there be more worthwhile purposes for any human endeavor?

Even after a fledgling 20 years of space activities, we can point to significant accomplishments by considering what the world would be like if we were not in space. That is somewhat like imagining an alternate history if Columbus had not come along when he did. Wouldn't prosperity in Europe or Asia eventually have led to better oceangoing ships that would have discovered the new world as they roamed farther and farther from home? We can only surmise that such a sequence would have taken place at some point by someone.

Likewise, it is inconceivable that space will not be explored sooner or later by some nation. Thus, the benefits listed will accrue to the country that builds and utilizes its space capability.

Like it or not, civilization started down a new path with Columbus. Today the space age is carving out another new epoch, as significant at least as the Great Age of Exploration or the Renaissance or the Industrial Revolution. Implications of the spread of humanity across the galaxies, or the eventual contact with other sentient beings, or the understanding of man's purpose in the universe are not just exciting—they are staggering.

None of that has happened yet. But all of it is possible now, and impossible without a space effort. It has been five centuries since Columbus ventured forth toward his new destiny, but only two decades since the space age began. And yet there are already some profound benefits that this totally new age of exploration has brought to mankind. To understand these benefits more clearly, consider what our civilization would be like had there been no space program. In addition to the excitement of space exploration, consider the economy, computers, communications, weather forecasting, energy, food and water, housing, human health, science, and the alternate future of a simpler life.

consider money

Had there been no space effort, we would not have spent some $80 billion that might have gone for other purposes. But on the other hand, we would not have stimulated the economy and in so doing returned to it as much as $1 trillion over those 20 years! That is the astounding finding of several economists' studies of the space program. One researcher measured the results of specific, existing space-spawned industries such as cryogenics, gas turbines, and integrated circuits. Another made econometric models of the spreading effect of high-technology endeavors, of which the space program is clearly the largest.

The investment in space has such an enormous payoff because it spreads to a wide variety of industries. Achieving higher industrial output—and lower inflation—is inevitable through space technology, according to the econometric division of Chase Manhattan Bank, because of the growth of labor productivity.

Productivity growth means that less labor is needed per unit of output. As less labor is required, costs decline. As costs decline, prices decrease and consumers' real income rises, which then leads to greater purchases of goods and services and improved mass production that lowers unit costs still further. The size of the labor force can then increase through greater job opportunities and spread across many businesses in many industries, old and new.

These economic spin-offs do not occur right away, though. They become significant after about five years. The U.S. growth in output per man-hour actually has dropped behind that of other industrial countries because of a slowdown in the last 25 years of investment in new U.S. technology. A revitalized space investment is part of a larger emphasis on industrial growth that must be made if the U.S. is to solve its economic problems of inflation, balance of payments, and dwindling technological leadership.

consider computers

So quickly, yet so subtly, have computers of all kinds entered our lives that it is difficult to imagine what the world would be like without them. If we assume that population growth remained at least as great without a space program as it has been, our entire banking and credit system would be bogged down under a morass of detail. Without the integrated circuits pioneered for the space program, millions of clerks would work at slow hand calculators, laboriously figuring individual invoices and other business forms. Management information, such as inventory or production control data, which now is flashed from retail stores to warehouses, would be the costly guesswork of yesteryear. Printing, especially typesetting, would be far slower. The lack of instantaneous coast-to-coast reservation systems would have retarded the dramatic growth of the airline industry.

Engineers would take hundreds of hours to perform tasks that today take minutes. The great scientific discoveries of the past two decades, in antibiotics and contraceptives, in pulsars and astrophysics, in the chemistry of new materials, in the fundamental knowledge that, in turn, spurs tomorrow's progress—all would have proceeded, if at all, on a much lower level of awareness.

Largely as a result of the space stimulus to computer technology, computers are taking over more and more jobs. Computers have even entered the household with some 150,000 microcomputers already sold for home use. "Someday they'll be as standard as the telephone," according to one of the firms that makes them.

That may be exaggerated, but sales of microcomputers are expected to exceed three times that number in the next 12 months. They are being used to answer personal correspondence, cross-index journals, keep a log of people talked to on ham radio, dim and brighten living room lights, open and close the drapes, balance the checkbook, keep track of investment portfolios, update the Christmas card list, collate menus, play electronic games, report on water seepage in the basement, and lock the front door at night!

consider communications

Space is a legitimate goal not only for finding new worlds but also for satellites to improve communications here on earth. We would not see Olympic games live from overseas, the Pope's coronation at the Vatican, or President Carter's European visits. International television by satellite may seem of small importance, but remember that other countries also see what we are doing and how our society works. Overseas news broadcasts exert an educational pressure, a force toward international understanding.

More specific education by satellite is offered by the Applications Technology and the new Communications Technology satellites that broadcast directly from orbit to TV sets in rural communities. Experimental direct-broadcast satellites have televised emergency medical treatment to Eskimos and similarly isolated peoples. Hundreds of millions of others leading substandard existences in Africa and elsewhere can become educated through this unique mechanism. In fact, the Indian government, after participating in an experiment in which the broadcast satellites beamed instructional television programs to some 5,000 villages, viewed satellite education as the *only* way to conquer India's widespread illiteracy.

In advanced nations, especially the United States, business efficiency would suffer without the extraordinary capacity and economy of overseas satellite telephone circuits and space-spawned computers. As a result, we probably would be more nationalistic and isolated in business than we are today. It follows, then, that there would be less of an opportunity to progress beyond the limits of our shores either in terms of world trade or world harmony.

consider weather forecasting

Due to weather satellites and numerical weather prediction, the 24-hour forecasts of today are as accurate as the 12-hour forecasts issued 15 years ago—correct 84 percent of the time. The prognosis for 15 years hence is for five-day average forecasts with similar accuracy. A five-day forecast that is 84 percent accurate would save $5.5 billion a year in the U.S. alone and about $15 billion annually over the entire world.

Even now the weather watchers help prevent crop failures, lost construction time, and ship and airplane accidents. Today's satellite system of weather watchers provides pictures of cloud cover over the globe both day and night. Satellites contribute significantly to our ability to discover and track hurricanes, thus helping save lives and property.

If we had no satellites, a storm could begin unobserved in the tropical seas and sweep into an inhabited coastal zone without warning. That used to happen regularly. At the turn of the century, a hurricane took 5,000 lives in Texas; another killed 4,000 in the Caribbean in 1928. Some 1,500 lives were lost in 1959 when a hurricane ravished Mexico. Contrast those figures with the satellite-watched storm that became Hurricane Agnes in 1972: 118 persons died, most from flooding after the storm subsided.

Another example is the recent Hurricane David. One of the most persistent storms to hit North America in modern times, David was spotted in embryo stage by satellite. Its erratic progress up the chain of the Antilles to Puerto Rico was tracked until a clear path toward the Florida coast was established. Since the affected areas received warnings well in advance of impact, loss of life was comparatively minimal despite 150-mile-per-hour winds.

Similar stories can be told of forest fires and floods, whose devastation has been reduced significantly both by satellite watch and space-spawned scientific monitoring instruments.

It is true that you could do much of this with airplanes instead of satellites. You also could conduct business without duplicating machines or computers or build large buildings by hand as the pyramids were built. But *would* you do so to the same extent? Technological innovation not only satisfies the needs of the time but also creates new needs that existed before only in miniature. Thus, electrostatic copying has transformed the business habits of millions, and the introduction of cranes and bulldozers has made highways, bridges, and giant dams feasible. In the case of weather observations, constantly piecing together aircraft weather photos to form a hemisphere-wide mosaic every few hours would be prohibitively expensive.

Perhaps the greatest contribution that the new space age has brought is the understanding and capability that we can now handle global problems on a global scale. Accurate long-range weather forecasting, much less weather control, is feasible only when the planet is viewed as a whole. The same global approach is beginning to help solve mankind's pressing problems in food, pollution, communications, education, and energy.

consider energy

Earth is not a closed system in which everything is recycled, like water falling as rain and evaporated to clouds. The earth is open to space and, therefore, fueled by the sun. Space technology, not surprisingly, has made its greatest contribution to alternate energy sources in the field of solar energy.

Solar photovoltaic cells routinely provide electric power aboard spacecraft. These cells that convert sunlight directly to electricity are now being introduced, along with solar collectors to heat water, in uses that range from providing energy in remote areas to heating and cooling homes.

Solar cells are also seriously being considered for "powersats," giant solar power satellites from which energy in the form of microwaves would be beamed to subscribing nations and reconverted to electricity on the ground. Solar power is an alternative long-range answer to the energy shortage because it cannot spill, explode, contaminate, irradiate, strip the ground cover, or pollute—and it is inexhaustible.

Space technology also has contributed to conventional energy sources. Without many of the 750 satellites now operational around the globe—of which 375 are U.S.—oil exploration would be more limited, air and water pollution more difficult to monitor, and population censuses harder to make.

The Alaskan pipeline might still be in the courts as environmentalists sought ways to protect the tundra from pipe ruptures that seemed inevitable. It was the heat pipe, first pioneered aboard spacecraft, that finally settled the problem and led to the law permitting construction of the oil pipeline. Heat pipes, thin vertical tubes along the length of the oil line, keep the permafrost frozen to prevent frost-heaving from breaking the big pipeline and spewing oil over the countryside. Similar heat pipes also transfer waste heat from chimney flues in homes and factories.

consider food and water

Crop planning would have remained a primitive pursuit without space technology. Land satellites (or "landsats") today carry crop-imaging sensors designed to discriminate among various types of vegetation. For instance, the satellite can "see" wheat and measure its extent and condition, including disease. Worldwide food and timber resources thus can be predicted with the accuracy necessary to feed and house a hungry, growing world.

Among the myriad purposes of our landsats is the monitoring of freshwater supplies. Man currently extracts fresh water from only about a hundredth of one percent of the total global supply. Satellites not only help find thousands of temporary small lakes in the Southwest U.S., but they make it possible to locate subsurface water supplies near cities or areas in need of irrigation. Recently, a satellite tracked a freshwater iceberg as big as Rhode Island from its Antarctic home along the east coast of South America.

By necessity, the satellite food and water watch also becomes a watch for the conditions in which destructive insects breed. For instance, in order to eradicate the livestock-devastating screwworm in the U.S. and now in Mexico, billions of the sterile male insects are dropped in the infested regions to mate with females, thereby eliminating offspring. Satellites pinpoint precise locations within the vast geographical areas involved; without them, thousands of additional communication links would have to be constructed to do the same job. In fact, the task would be so enormous that it probably would not have been undertaken if it were not for satellites.

consider housing

Many household products and the construction of homes have been improved through the deliberate attempt to transfer space technology. For instance, thin, flat electric wires originally devised for spacecraft are replacing between-the-wall bulky cables in several demonstration buildings. Both baseboard flat wires for homes and under-the-carpet wires are being tested in an attempt to lower costs through reduced installation time.

Wall panels for some prefab homes are also a space spin-off. They resulted from high-performance plastics developed for rocket casings and liquid-hydrogen containers. The plastic panels now save more than 15 percent of the cost of conventional prefab panels.

A fireproof "tripolymer" plastic first developed to protect spacecraft fuel lines and tanks has been adapted for home insulation. The material forms a charred crust when burned and extinguishes flame.

These and other materials and techniques have been employed by the National Aeronautics and Space Administration in The Energy Conservation House (TECH) now on display at the Langley Research Center in Virginia. The house also partially reclaims waste water, utilizes the emergency electrical system that lighted Skylab, and has a security system spun off from an ultrasonic, pen-sized transmitter. Heating is supplied by solar collectors and a nighttime radiator using a heat pump. A computer-directed system heats or cools only the rooms actually in use at any given time.

While many of these devices have not yet reached the general market, a surprising number of well-known household products also are space spin-offs. For instance, if it were not for the space program, we would not have those high-energy, button-sized batteries for cameras and hearing aids or the larger nickel-cadmium batteries that power portable tools and sports equipment. Nor would we have a variety of new fire-retardant materials now finding their way into clothing, curtains, and carpets. Electric motors in our vacuum cleaners, electric shavers, and movie cameras would burn out quicker without the dry space lubricants they contain, lubricants devised first to work in the vacuum of space. Digital quartz-crystal clocks and light-emitting-diode watches, which have the accuracy of a minute a year, would not be here either without space technology—they were developed originally for the Apollo moon missions.

consider health

Without a space program, we would be poorer by several thousand medical instruments, ranging from cardiac pacemakers to devices for the detection of drug overdose.

Most medical research prior to the space effort focused on curing illnesses; comparatively little work was done on studying the healthy human body. Innovations in space medicine began with remote acquisition, monitoring, and interpretation of physiological processes during flight. As such, the space effort has given the medical profession a better understanding of how a healthy man functions as well as the tools for studying the human body.

With that beginning, numerous transfers of space technology to medical devices and health-care systems have been deliberately made. Probably the best known space spin-off to health is the cardiac pacemaker, an outgrowth of miniaturized solid-state circuitry developed for spacecraft where a multitude of instruments and devices had to be crammed into small volumes. Until recently some 30,000 Americans who wear pacemakers had to undergo surgery about every 22 months when their batteries ran down. But now a new NASA-assisted innovation of the original space-spawned pacemaker recharges the instrument's batteries through the skin by inductance. A patient simply wears a charger vest for an hour or so a week to recharge his pacemaker.

Another heart disease benefit from the space program is the "Telecare" emergency system. Since more than 60 percent of deaths resulting from heart attacks occur within an hour after the attack, it makes sense to utilize the ambulance time for diagnosis and treatment. What better way to do this than to adapt the system originally designed to monitor the astronauts' heart actions? The principal Telecare component is an electrocardiogram display and telemetry system. The unit allows firemen or others trained as paramedics to send vital heart data to the hospital in seconds so doctors can begin treatment even before the patient arrives.

consider science

While the foregoing benefits of our space effort are tangible, dramatic progress can come only from an improvement in our understanding of nature. Copernicus, Newton, Lavoisier, Faraday, Einstein, and the other great explorers of the unknown throughout the ages knew this. But a reverse current has begun to flow into our modern world—to which science has contributed so much—and many people often lose sight of the benefits to be gained by unraveling nature's secrets. Instead, they turn to false values, such as astrology (now enjoying its greatest popularity), or denigrate science for the havoc it has reaped on the world. These people forget that science and technology are neutral. It is the use to which we put them that is suspect.

For thousands of years man behaved as though he would forever remain on the surface of this planet. Suddenly, in the brief geologic span of a few decades, airplanes and then spacecraft irrevocably altered the need for such behavior. The famous Club of Rome's study of world dynamics at the Massachusetts Institute of Technology (MIT), "The Limits to Growth," projected catastrophic collapse based on that now archaic trendline. But what the MIT study really reveals is that we cannot continue forever without seeking raw materials from beyond the planet earth. "The Limits to Growth" thus becomes the best argument yet advanced for why we are in space.

Not only do infinite sources of raw materials and infinite worlds await man's expansion into space, but the corollary pursuit of space goals generates innovations in virtually all fields of science and technology. Without the space program our understanding of new alloys, plastics, pure metals, and composites would be stilted. Vacuum technology, the science of ultracold called "cryogenics," superconductivity in which electrons seem to flow in a circuit forever, and the physics of "plasmas," the fourth state of matter besides solids, liquids, and gases—all would be in their infancy. Instead, they are viable disciplines already contributing to human progress.

Without the space effort, our knowledge of the earth and other planets would have remained limited. The six manned lunar missions, supplemented by robot probes to the planets, have advanced the earth sciences through a new field of "comparative planetology." As our planet runs out of oil and other minerals, the new knowledge of how the earth functions as compared with other planets could not come at a better time.

Man's view of creation has been altered significantly as a result of both space astronomy and the Apollo flights. We have seen "super-clusters" of galaxies bound together by a hot and tenuous gas. We have proved Einstein's theories that radio signals between earth and spacecraft will be slowed as they pass the sun. We have discovered a disc-star in the process of forming its own planets and have altered our theories of how planets are born.

Closer to home, we now know that the old theories of the moon's being captured by the earth or formed by a splitting of the protoearth are too simple. A new theory of atmospheric fission is emerging, in which the moon was formed from a hot earth atmosphere many times more massive than the moon. The surprising revelations that anorthosite, an igneous rock rare on earth, is one of the principal lunar rocks, that the moon is layered, that both meteoritic impact and volcanism formed the craters, that the moon contains a small liquid core of molten rock that magnetized surface stones brought back by the astronauts—all these and countless other discoveries about our closest neighbor in space would have remained unknown and hardly guessed at if man had not grabbed at his chance to leave the earth.

Similarly, planetary probes now have stretched mankind's influence through the asteroid belt beyond Mars and across the billion miles from Jupiter to Saturn. The Pioneers are continuing out to the orbit of Pluto and then, beyond the solar system, to interstellar space. Without the Mariners, Pioneers, Vikings, and now the Voyagers, we would not know that the polar caps of Mars are simple ice instead of frozen carbon dioxide, that great dust storms sweep a cratered surface, or that real riverbeds are etched into the now-dry ground. We would not know that the magnetic field of Jupiter, unlike the earth's, is created by currents deep within the starlike planet or that Jupiter's magnetic tail extends to Saturn. We would not have discovered the five or more rings of Uranus.

Solar, x-ray, and above-atmosphere astronomy would be virtually nonexistent without the space program. We would not know about the Van Allen belts or the wind of protons streaming from the sun. Nor would we now be devising self-propelled spaceships powered with gigantic solar sails. We would not be launching sounding rockets to probe the northern lights. We may have found the quasars and pulsars—the ultradense starlike bodies that are the most revolutionary astronomical discoveries since Kepler—but our attempts to explain them would be even more difficult.

Obviously, if we were not in space, we would have no chance of encountering life beyond the earth. And we would not have seen the awakening of scientific interest, the space-bought second Renaissance that inevitably must change and integrate our sciences, our philosophies, and even our religions. This, too, is why we are in space.

ONE VIEW of history is that all of the benefits brought by the space program in improved communications, health, and so on would have occurred anyway but in a different time sequence. We will never know the answer to that, but it seems reasonable, at least for terrestrial benefits. Yet even here it is important to realize that the space program has helped to shorten the time lag between invention and its application. Whereas we once went through a protracted 10- to 15-year testing and development period—for instance, for hybrid corn or penicillin—the time lag has shrunk now to only a few years.

Another, more widely held opinion is that a simpler kind of life—one without the consideration of men from other worlds, satellites, computers, integrated circuits, astronomical discoveries, better transportation, longer healthier lives, or more advanced science—would be all right and that space technology is just another gadget making our lives and neuroses more complex.

The desire to resist the disorder of change is an understandable human aspiration, but to attempt to resolve the disorder by returning to "the simple life" is ostrichlike in the extreme. First of all, lower standards of living create societal pressures that lead to dissatisfaction and economic imbalances such as depression, riots, or even war. Our money spent on space technology has been returned many times over by the benefits and spin-offs discussed—so much so that space research is probably the best large-scale financial investment ever made.

Another reason for choosing technological progress over reduced complexity of life is the reality that you are always better off knowing something—be it an enlarging Sahara desert or the fact that pulsars exist in space—than not knowing it. You can cope only with the known.

The knowledge brought by the space program has fostered an attitude that we no longer have to put up with major world problems such as energy or food shortages, widespread epidemics, or masses of uneducated people. In this sense, space technology is helping to end provincialism, even as it opens the doors to a literal cosmopolitanism. For, ultimately, the only way to extend man's knowledge of the universe is to venture forth from the earth. And the only way to do that is in a spaceship. This is true both for the observational knowledge to be gained of distant stars through orbital telescopes and the exploratory knowledge of the objects in our own solar system.

LIFE without a space program would deny our civilization and future generations the most effective of all mechanisms to accumulate and apply new knowledge on a vast scale. Do not assume that life *without* a space program would be merely the same as life *before* the space program. Overpopulation pressures would continue to push against the sides of our finite earth. The need for national defense would be at least as great. Illness and starvation, earthquakes and hurricanes would recur, possibly with even greater devastation. All of these and the other afflictions mankind suffers would be with us still and doubtless would be worse but with one important difference. Without the space program we would have neither the intellectual resources nor the technological base to deal with them.

National Space Institute
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Neil P. Ruzic, a writer-entrepreneur, is starting the Island for Science in the Bahamas, to raise shrimp and seaweed, desalinate water with solar energy, screen marine organisms for pharmaceuticals, generate electricity by delta-wing windmills, and explore other applications of science. He holds the first U.S. patent for a device to be used only on the moon and has written seven books on science applications. Mr. Ruzic is founder of *Industrial Research* and other magazines and helped Wernher von Braun start the National Space Institute. He holds degrees in science, psychology, and journalism from Northwestern University.