From the Moon to Mars: The New Economics

This is the transcript of a half-hour video produced by the LaRouche Political Action Committee. The reader is strongly encouraged to watch it! This is Part 2 of a series.[1]

> Mankind is creative, instinctively. No animal is creative. Only mankind, only the human mind is creative. Living processes are creative; life is creative. But it's not consciously creative. Even the inanimate world, so-called, is creative. The evolution of the stars, the evolution of stellar systems is a creative process. But the difference is: Man, individually, is creative. And it's the willful creativity by Man, which is going to shape the future of the Solar System, and beyond.
>
> —Lyndon LaRouche, remarks to a conference, "Save Human Dignity for the Sake of Mankind," Moscow, Dec. 3-4, 2009 (recorded Nov. 18, 2009)

Lyndon LaRouche (interview): We're looking to that. In order to realize the objectives which stand before us now, we have to give mankind a new mission—mankind as a whole. The mission is typified by the idea of the Mars colonization.

This requires us to make the kinds of changes, in terms of scientific progress, which are needed for mankind's future existence.

We have many problems on this planet. And we can not solve those problems, extensively, without going into a development of the Solar System as a habitat of mankind. We're on the edge of doing that, scientifically. There are many scientific discoveries, yet to be made, which will make it possible to act for man's colonization of Mars.

That will be in some time to come. But we need now: We need the intention of accomplishing the Mars colonization. We need to educate and develop generations of young people, who will be oriented to that kind of mission. In the coming period, we will have the birth of young people, who will be part of the colonization of Mars, in one way or the other, before this century is out.

We need to give mankind a sense of purpose, developmental purpose, not only throughout the planet, but through the influence of Earth on the adjoining regions of the Solar System, and beyond.

1. http://archive.larouchepac.com/lpactv?nid=13468
Part 1 is at http://archive.larouchepac.com/lpactv?nid=11573

NASA

Artist's conception of astronauts exploring the Moon.

> Those objectives are feasible. There are, admittedly, many problems to be solved, scientific problems, which are not yet resolved. We have many questions. But, essentially, we know this is feasible. We know this should be feasible within two or three generations. What we have to do, is give to people, who will be the grandchildren, born now, to give them something to realize. When we're dead and gone, they will be there, three generations from now, four generations from now. They will be the people who actually colonize areas beyond Earth itself. We need to give them the opportunity to do so. We need to give society, in the meantime, the mission-orientation of achieving that colonization, for our descendants, three generations or so down the line.

As with basic economic infrastructure on Earth, the industrialization of space will be a central feature of long-term national economic planning in the years to come—if the United States expects to experience real economic growth again. Economist Lyndon LaRouche has proposed the goal of a manned mission to Mars with fusion-powered rockets, with a flight time of a week or less. Many steps will be needed along the way, like the industrialization of the Moon and the development of fusion power. But these will be markers of a more profound achievement, the transformation of human culture, from the idea of an Earth-bound species to one expanding its activity throughout the Solar System, and eventually the galaxy beyond. The purpose of space-exploration, is not conquering real estate or looting raw material for Earth; it is making a change in the existing relationship between Man and the universe, a change which is necessary for developing new principles essential to the improvement of life here on Earth.

Such a change requires a new understanding of the true meaning of "economics."

1. Measuring Economic Value

> When you look at the historic pictures of Aldrin and Armstrong beside their lunar craft, the concentration of energy in these two Humans is incredible, compared to the energy it took to build their vehicles and carry them to the shores of a New World. In 3 billion years our star had to dissipate 10 trillion trillion trillion kilowatt-hours into space-time to turn approximately 18 out of 92 elements into a system that is capable of reflecting upon the structure, the origin, and the destiny of itself and the universe. Yes, we are unbelievably expensive. At least one hundred billion trillion

A maglev train, the rail technology of the 21st Century, can travel up to 360 miles per hour.

kilowatt-hours have been expended on each of us, counting all Humans that walked the Earth since the *Homo Erectus*. Even at 1 cent per kilowatt-hour—a price as outdated as the 5 cent cigar—this adds up to an energy-worth of one billion trillion dollars per person—equal to the present U.S. Gross National Product for one billion years. Moreover, each year our star dissipates 900,000 trillion kilowatt-hours per capita, sustaining the Biosphere and our growth potential.

—Krafft Ehricke, "The Heritage of Apollo," 1974

The science of physical economy begins by treating the development of an entire nation as a single physical process, taken over capital investment cycles of at least two generations. Economic planning begins with the question, "Where must we be in 50 years, and what must we do today to get there?"

Unlike financial statistics, a true notion of physical profit shows that Great Projects are actually a necessary part of the growth of a national economy. A similar phenomenon can even be seen in the Biosphere, whose growth has historically depended on relatively rapid, large-scale evolutionary upshifts.

As the biogeochemist Vladimir Vernadsky proved, in the early part of the 20th Century, the evolution of the Biosphere is governed, not on the Darwinian scale of random changes in individual organisms, but, on a planetary scale. The direction of evolution has been toward a constant planet-wide increase in the biogenic migration of atoms—the rate at which matter is consumed, transformed, and redistributed by living matter in the process of growth and development.

Although the total energy throughput of the Biosphere increases over time, it is not simply consumed by the multiplication of organisms.

The history of the Biosphere is punctuated by the increase of energy-flux density, through the evolution of more efficient technologies to concentrate and utilize such energy as a means to accomplish more biogeochemical work, as in the case of photosynthesis in plants, or the concentration of higher functions in a complex and energy-intensive central nervous system in mammals. Because creative reason has given mankind the ability to willfully direct our own evolution, we have superceded the Biosphere, measured by the increase of what Lyndon LaRouche has termed mankind's potential relative population density. Under the influence of a new geological force—human culture—the biogenic migration of atoms is intensified on the Earth itself, and potentially, throughout the Solar System as a whole.

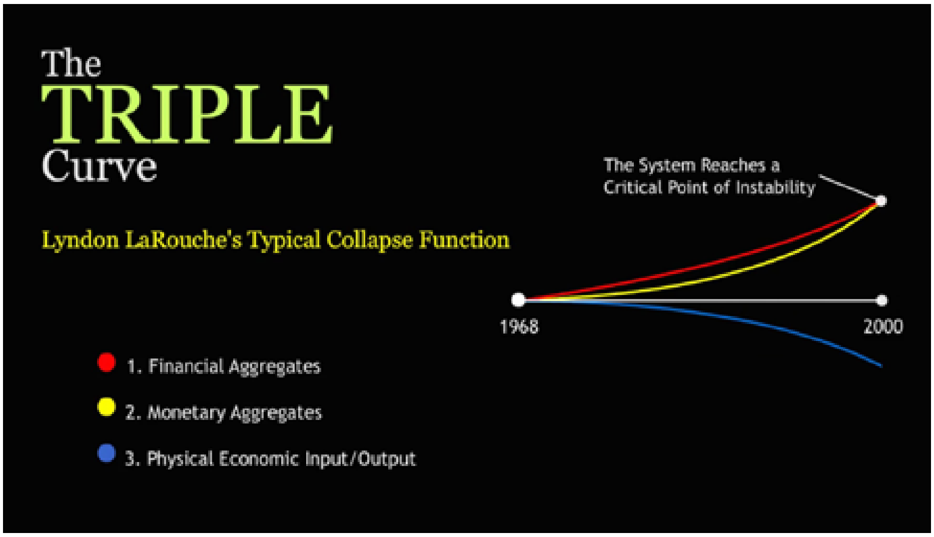
The material preconditions previously created by the Biosphere for the growth and improvement of the human population must be increasingly re-created through human activity. A growing ratio of total economic activity must therefore be devoted to long-term investments in science-driven production and infrastructure, long-term capital investments which secure the material preconditions needed by future generations.

The physical economy, like the Biosphere, is determined from the "top, down."

LaRouche's Triple Curve

As the level of the nation's physical economy—the production and distribution of physical goods and infrastructure—has been subordinated to the increasingly fictitious moment-to-moment values of monetary and financial instruments over the last 40 years, their relative rates of growth diverged more and more [**Figure 1**]. A production-oriented economy was replaced by the myth of a consumer-driven economy. Under this system, the profitability of monetary and financial values depended on the reduction in the physical costs associated with infrastrucuture, production, and scientific research and development. Without the necessary inputs represented by such physical investment costs, which create the potential for future growth, the system has collapsed.

FIGURE 1



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Cost-cutting policies which aim to save money turn out to be the most costly.

Yet, as a sovereign nation, the United States has the authority to issue long-term credit against the expected value of future gains in national wealth. This means that the proper context for measuring economic value extends beyond the apparent conditions of the moment, at least one to two generations in the future—a future which must govern our decisions in the present.

But how can real economic value be measured?

Under the crude plusses and minuses of the monetarist accounting of British free-trade theory, money is treated as what is known in physics as a scalar number: Its value only changes by "more" or "less," despite the fact that new discoveries qualitatively change the physical-economic values being measured. Thus, dollars spent in a casino are treated as no different than dollars spent in a steel mill, or on the space program.

The American System of political economy is based on the foundation of physical economy, placing national priority on agriculture, industry, and infrastructure.

David Lilienthal headed the Franklin Roosevelt Administration's Tennesee Valley Authority, a major public works project for water management and power generation built during the Great Depression. He wrote about the importance of the TVA for raising the productivity of the region and the country through the new economic dynamic it created:

> The cost of such development work is recorded on TVA's books, in the accounting terminology, as "net expense"; but the benefits appear on the balance sheet of the region and of the nation. And, as with public improvement expenditures generally the country over, since the days of Henry Clay, it was anticipated that such expenditures would be repaid to the taxpayers not directly in dollars, but indirectly in benefits.
>
> —David E. Lilienthal, *TVA: Democracy on the March* (1944)

Today, the nation's space program is potentially the most powerful engine for producing such benefits. A fusion-powered Moon-Mars colonization program will involve major long-term national investments, drawing on a skilled labor force that has largely disappeared, technologies that don't yet exist, and knowledge that has yet to be gained. Rather than an incremental approach, this points to a science-driver mission to rapidly develop the needed skills and technologies to tackle multiple problems at once: problems which touch on fundamental areas of knowledge. What will we need to perfect manufacturing and food production in space? What are the biological effects of extended missions beyond Earth's gravitational and magnetic field? How rapidly can we bring thermonuclear fusion on line?

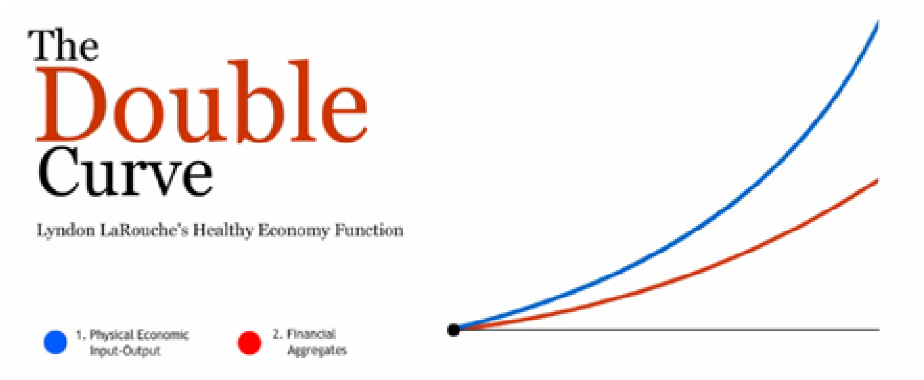
A science-driver crash program, in the words of John F. Kennedy, "serves to organize and measure the best of our energies and skills."

Where those skills are lacking or nonexistent, we will create them.

As Franklin Roosevelt proved with the Depression-era Civilian Conservation Corps, legions of unskilled, poorly educated young people can be inspired to a national mission, and trained with the means to accomplish it.

To put it in the words of Alexander Hamilton, writing in his 1791 “Report on Manufactures”: “To cherish and stimulate the activity of the human mind by multiplying the objects of enterprise, is not among the least considerable of the expedients by which the wealth of a nation may be promoted.”

FIGURE 2



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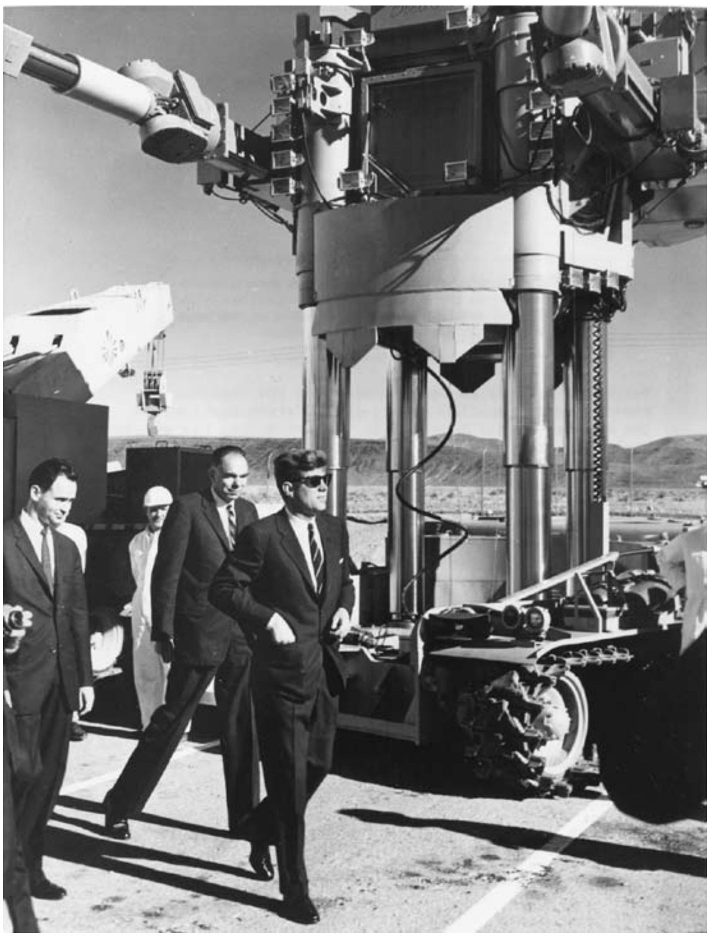
During recent years, rocket scientists were hired by Wall Street to design the complex financial instruments that we now call “toxic waste.” Under the Moon-Mars mission, rocket scientists can go back to designing rockets.



NASA

President John Kennedy inspects the Nuclear Rocket Development Station in Nevada, Nov. 8, 1962.

Raising national expenditures in education, research and development, and high-technology infrastructure raises the total physical cost to the economy; but, concentrating those costs in investments in the improvement of the productive process, through new skills and higher technologies—through a higher capital intensity—reduces the physical cost per capita, and leads to a greater physical profit for society as a whole—the only form of true profit in economics [**Figure 2**].

The general mission assignment, is to drive astrophysics, microphysics, biological science, and human knowledge, to far beyond their presently forseeable limits for the coming century. By working in space, and on Earth, simultaneously, for these coordinated breakthroughs in discovery of new principles, by the time we establish the first science-city colony on Mars, we will have revolutionized science and economy on Earth many times over.

Because of the physical-economic payback to the nation, such a seemingly expensive project actually costs nothing.

2. The Science-Driver Crash Program

A curious breed of individual seems to be making a place for himself in this ordeal of emerging from the pupal state into the space age. This is the man who, technically speaking, appears to be willing or able to think more than

> 10 years ahead. A few years ago, people of his type were called crackpots.... Terraforming planets is a topic of discussion among the less inhibited Washington space policy men nowadays.
>
> —Tom Alexander, *Project Apollo*, 1964

The lessons of America's 1960s Apollo Project should not be forgotten. As a technological feat, it surpassed anything in human history. But its greatest impact was in the domain of the imagination—the ultimate source of physical wealth.

In 1961, against the wishes of many of his own advisors, President Kennedy challenged the nation to a manned Moon landing by the end of the decade. In order to accomplish the monumental task which he laid out, new rocket engines would have to be developed, *ten* times more powerful than any which then existed.

New spacecraft would have to be created, more complex than any machines ever built, capable of linking up in space, maintaining communication with Earth over a distance of 240,000 miles, and safely returning crew members through re-entry into the atmosphere at speeds higher and temperatures hotter than had ever been experienced. It was not yet known if human beings could even function in space for days at a time; little was known about conditions on the Moon, or whether the lunar surface could even support a landing ship without being swallowed whole by the lunar dust. Out of seven American attempts to send unmanned probes to the Moon, up to that point, all had failed.

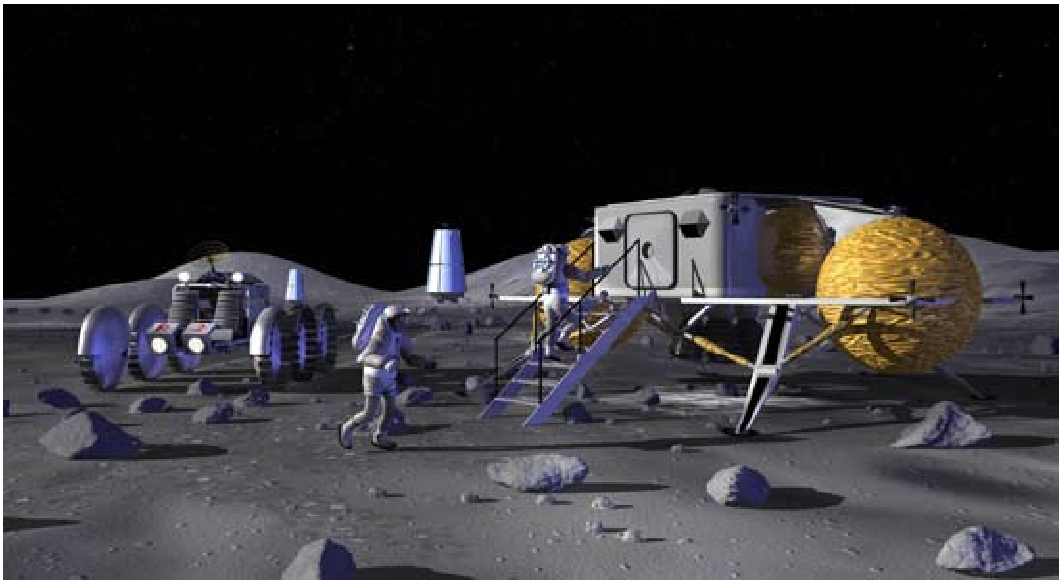
NASA

Buzz Aldrin of the Apollo 11 mission, the second man on the Moon, July 20, 1969.

At the time that President Kennedy committed the nation to landing a man on the Moon, the United States had not yet put a man in orbit around the Earth.

Yet, with a clearly defined mission, the nation was mobilized. At its peak, over 400,000 people were working directly on Apollo, 90% of them in industry. Thousands of skilled scientists, engineers, and technicians were mobilized under the leadership of NASA, which funnelled millions of dollars of grants to educational institutions to produce thousands more. The excitement of space created an entire generation of scientists and engineers. Almost every aspect of the program presented entirely new types of challenges that had to be solved on an urgent time schedule.

Exemplary of the American System of economics, first established by Alexander Hamilton, it was the ingenuity of a scientifically oriented industrial sector, combined with a mission-orientation provided by the Federal government through NASA, that made the Moon landing a success, and drove a nationwide dynamic of real economic growth. With industry, university, and government working simultaneously on scientific and technical problems, breakthroughs in one area spread quickly to another. With the tight interconnection between basic manufacturing and advanced re-



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Artist's rendition of a lunar outpost.

search and development, major advancements occurred "upstream" in the machine-tool section of the production process, affecting whole sections of the civilian economy "downstream."

New commercial industries in microelectronics, communications, and advanced materials provided not only new jobs, but increased the division of productive labor for the economy as a whole. Kennedy's investment tax-credit during this period further stimulated industry by rewarding capital investments in plant and machinery.

Under the optimism of Apollo, private investments often preceded government contracts, as companies spent their own funds on research and development, in expectation of long-term government commitment to the promise of space. Contrary to the failed market theory of supply and demand, it is productive investment which generates "demand."

Instead of a one-shot stunt, many of the leaders of Apollo envisioned it as only the first step in mankind's necessary expansion into the Solar System—what NASA's Administrator James Webb called "the mastery of space and its utilization for the benefit of mankind." The vast human and technical infrastructure built for Apollo would serve as the foundation for a follow-on space station, lunar outpost, and manned Mars mission.

In the same speech in which Kennedy announced the Moon shot, he proposed simultaneous acceleration of the nation's nuclear rocket program: "This gives us promise of some day providing a means for even more exciting and ambitious exploration of space, perhaps beyond the Moon, perhaps to the very end of the Solar System itself."

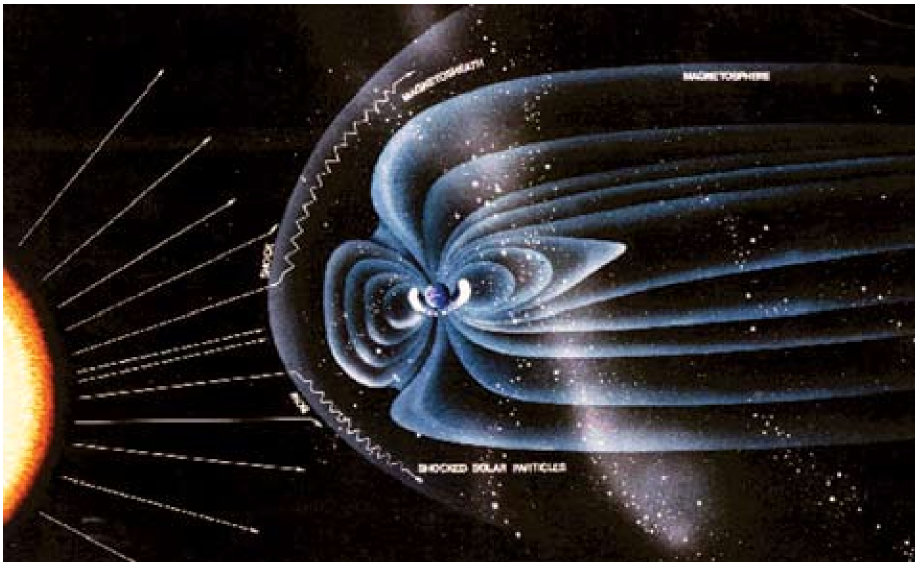
The nuclear fission rocket was the space program's most advanced reseach and development project. Designed to use fission to heat liquid hydrogen for the upper stage of a rocket for travel beyond Earth orbit, it would have been the natural bridge technology leading towards fusion rockets—the key to interplanetary flight beyond the Moon, planned for post-Apollo missions.

The reason for nuclear rockets was simple: once in space, chemical fuels can only go so fast and so far. The principle of energy-flux density applies as much to rockets as to every part of an economy's productive process, from electricity production to machine-tool design.

In first approximation, energy-flux density refers to the energy density measured by the amount of useful work that can be accomplished from a given mass of the fuel. With the discovery of an entirely new physical principle, in the form of nuclear fission, we gained not only an increase in energy density, but a change in the transformative power of the process itself. Nuclear fusion is the next, necessary step in mankind's mastery of nature.

Today's experimental fusion reactors are designed to use powerful magnets or lasers to fuse deuterium and tritium, the heavy isotopes of the lightest element, hydrogen. When fused at temperature equivalents of 100 million degrees, most of the energy produced is in the form of electrically neutral neutrons which cannot be directly controlled. But in a reaction of helium-3, which can be mined on the Moon, and deuterium, which is abundant in seawater, almost all of the energy is produced in the form of highly energized, electrically charged particles which can be controlled with magnetic fields, meaning almost all of it can be utilized. This makes helium-3 the "holy grail" of fusion fuels, and the key to opening the entire Solar System to mankind.

The shift from chemical to nuclear fission is a necessary leap upwards in energy-flux density for the human species. The shift from nuclear fission to thermonuclear fusion will be as important as the discovery of fire to ancient man.



NASA

Interaction of the Solar wind and the Earth's magnetosphere.

Serious manned Mars planning within NASA coincided with the nuclear rocket program, since it was widely recognized that any manned flights to Mars would require nuclear propulsion. What had been mere dreams only a few years before, now seemed to be a rapidly approaching reality. If we could get to the Moon in less than a decade, Mars suddenly seemed a little less distant. A number of official studies examined various options for the earliest possible fly-bys and landings on the Red Planet by the early 1980s, with the most conservative projections putting Humans on Mars by the year 2000.

Here was NASA's program for the mastery of space, running across a broad front of American government, industry, and university research, with the attitude that doing the impossible was a national imperative.

> **President Kennedy:** . . . not because it is easy, but because it is hard.

Most of the major investments in Apollo were made within five years of Kennedy's Moon landing challenge. By the time that challenge was fully met, eight years later, much of the human and technological infrastructure that got us to the Moon had already been jettisoned, along with advanced projects like the nuclear rocket.

Despite that, every major economic study on Apollo since the 1970s has pointed to major multiplier effects for the whole economy through the new technologies and new skills developed through the space program. Simply put: The rate of return from the space program was greater than any other form of legal activity in the economy.

Was Apollo "unsustainable," as some have argued—an anomaly made possible only under the conditions of the Cold War? The basic facts of physical economy tell a different story: It was the space-related investments of Apollo, combined with President Kennedy's investment tax-credit, which spurred the last wave of actual growth in the physical economy of the United States.

Slightly less than 40 years since Apollo came to an end, it is the post-industrial economy of cost-cutting, privatization, and deregulation, promoted as the model of "sustainability," which has collapsed.

> But listen to the tale
> Of human sufferings, and how at first,
> Senseless as beasts, I gave men sense, and
> possessed them
> Of mind. I speak not in contempt of man;
> I do but tell of good gifts I conferred.
> —Aeschylus, *Prometheus Bound*

Breakthroughs of the Future

There has been almost no case in which an observatory or probe sent into space has not provoked the dis-

GSFC/Dominique Dierick and Dirk De la Marche

The North America Nebula.

covery of some new paradox in our understanding of the universe. Observations in the course of just one year have redefined our knowledge of the shape of the heliosphere that shrouds the Solar System; the nature of Earth's magnetosphere; and confirmed the presence of water on our Moon. Is it any surprise that space exploration will give us the most important discoveries of the future?

The Solar System, let alone the whole universe, is crowded with astrophysical and other anomalies just waiting for our prying minds to engage them. On this basis, alone, the number of new, fundamental discoveries awaiting mankind, from even the preliminary next steps toward Mars colonization, would assure us of major scientific breakthroughs in the practice of science upon Earth.

Were fusion research linked to a mission for interplanetary manned travel, it would lead to the very forefront of science, pointing to fundamental principles of matter at the microphysical scale, as well as their connection to phenomena at the scale of astrophysics—stars are, after all, powered by fusion. Fusion-powered flight will also open up an entirely new experimental domain, by making possible a phenomenon which has never yet occurred in the known universe: the creation of an artificial gravitational field by constant acceleration through cosmic space.

The most basic part of a manned mission to Mars is also the most difficult: getting Humans there alive. It has long been known that there are deteriorative physiological effects associated with prolonged weightlessness in space. Loss of bone density, loss of muscle tone, heart problems, etc., are all known problems, which involve many paradoxical elements. Initially, it was believed that the loss of bone density and muscle tone were the results of simple "unloading" effects, attributed simply to atrophy, from disuse in microgravity. Experiments have shown, however, that there are more factors involved than simple unloading. For instance: The artificial unloading of Humans and mice on Earth does not fully recreate this effect [mice dangling from tails], and the forced loading of astronauts during spaceflight does not counter it.

There are a number of hypotheses for this to be explored. The most interesting, will be those concerning the electromagnetic properties of living matter, and its response to changes in the radiative environment, as well as isotopic ratios. It is known, for instance, that completely shielding organisms from normal environmental radiation causes developmental damage.

Conversely, pelvic bone loss in women is known to occur during radiation treatment for cervical cancer. Further, successful research has been performed on applying electromagnetic fields to speed the repair of broken bones. Very likely, similar processes are at play in the case of extended stays outside of Earth's gravitational field. All of this indicates a potentially very great role for electromagnetic and nuclear phenomena in space biology—as well as their significance for life on Earth.

This is all to be expected from the standpoint of a

NASA

NASA

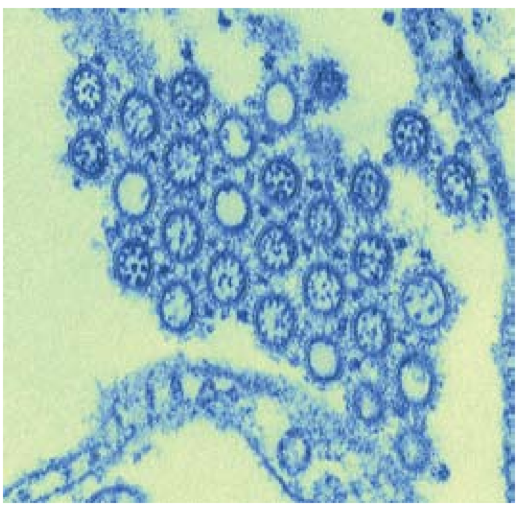
Left: Astronaut Sunni Williams exercising on the International Space Station. Problems resulting from zero-gravity conditions are complex and paradoxical. Above: Astronaut Salizhan Sharipov soars, weightless, through the International Space Station's Destiny Laboratory.

unified field theory: After all, is there such a thing as electromagnetism apart from gravitation? What are we actually creating when we create the artificial gravitational field associated with 1-G acceleration? If artificial gravity is actually gravity, what will be its effects on matter? What will be its electromagnetic component? What will be its effect on living tissue? What will be its effects on space-time itself?

Mastery of these questions will require a whole new battery of experiments, subjecting both carefully constructed instruments, as well as samples of living matter, to constant acceleration to and from the Earth. The new knowledge gained from answering these questions will undoubtedly lead to massive breakthroughs and new approaches to, minimally, AIDS, cancer, and virology in general, all of which are known to involve little studied electromagnetic, gravitational, nuclear, and quantum phenomena.

The questions at stake in manned interplanetary travel by fusion-powered acceleration are of a much more fundamental nature, and point to more profound economic and technolgical spillover than even the Apollo program of the 1960s.

This brings us to the domain of economics and policy: the organization of human society. The human species, beginning with the American population, must be educated with the understanding that the various steps toward becoming a spacefaring species—the industrialization of the Moon, the development of fusion power, and the colonization of Mars, are not optional ones. The problems here on Earth are not local ones. The fundamental scientific breakthroughs required to address these problems, lie, along with the answer to their origins, in the stars.



CDC/Cynthia Goldsmith

Study of the effects of electromagnetism on living tissue will open the way to breakthroughs in virology and other biological domains.