What Is Our Future?

This is the edited transcript of a presentation by Ben Deniston, a member of the LaRouche PAC Science Research Team, to the LaRouche PAC's Manhattan Project meeting in New York City on October 27, 2018. Denniston's presentation followed that of Barbara Boyd, featured in the November 2 issue of EIR.

What will the future look like if we succeed? What can be done with a Four Powers Agreement—that is, if we can get the United States, Russia, China, India to come together to form an alliance to end geopolitics and thereby ensuring that the global community no longer has to worry about geopolitical conflicts, proxy wars, trade wars, all this crazy stuff, and focus on the common, shared advancement of mankind. This is embodied in the Schiller Institute's petition for a New Bretton Woods conference—calling on the leaders of these four powers to initiate that.

The Science to Colonize Moon, Mars

I was asked to discuss today mankind's future from the standpoint of mankind's future in space. I'll start by referencing an excellent 1986 paper by Lyndon LaRouche, "The Science and Technology Needed to Colonize Mars." [**Figure 1**] At that time, LaRouche was emphatically pushing a Moon-Mars colonization space program as the premier economic and science driver globally.

FIGURE 1

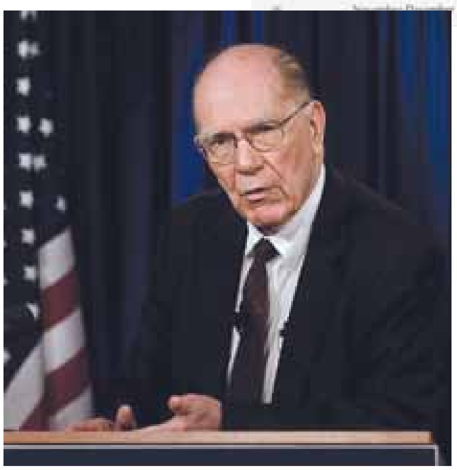

Making the combined efforts of the SDI and a Moon-Mars Mission the "science driver" for the nation will not only take us into space, but will give us a bonanza of new wealth.

The Science and Technology Needed to Colonize Mars

by Lyndon H. LaRouche, Jr.

Fusion magazine

Title page of 1986 article by Lyndon LaRouche (left).



He had picked up on this approach somewhat earlier but, coming out of his collaboration with Krafft Ehricke, and his work on the Strategic Defense Initiative, by the mid-1980s, he was really putting a lot of work into this. By the mid-1980s, LaRouche had realized that mankind had come to a point in its development for not just visiting space, but economically developing and colonizing nearby space, bringing man into becoming a controlling, active force in the Solar system. LaRouche was convinced that a Moon-Mars colonization effort would drive the greatest progress, the greatest technological development and would underpin new scientific revolutions.

Therefore, he wrote, Moon-Mars needed to be our mission driver. At the same time that we are developing the world, bringing infrastructure to all the formerly colonized nations, ending poverty, completing the World Land-Bridge, we need to simultaneously pursue space exploration and settlement, to continue to drive the frontiers farther. LaRouche's paper is an excellent presentation of his perspective. Some of the specifics may have changed to some degree, but the basic thesis he presents there is as accurate today as it was then.

I was always struck—and I think this is an important element to separate LaRouche's perspective on space from many others—by how he organizes his conception of the necessity of this Moon-Mars colonization program. In this paper, you'll see he discusses in significant detail how to get to the point of having human colonies on Mars.

He says that's going to require an industrialization of the Moon first. We'll begin by constructing space ships, electronics, advanced materials, physical infrastructure on the Moon from resources provided from the Moon and other places in space. We'll not try to lift everything we'll need for Mars from the Earth, but we'll utilize that which we can make on the Moon from lunar resources. That's the way we'll put together flotillas of fusion-powered spacecraft that will carry many people to Mars and back at constant acceleration—ideally at one-gravity acceleration—to negate the effects of zero gravity during space travel, and vastly increase the speed of these trips. That would provide the basis to then populate Mars with eventually thousands of people.

It's around a 40-year program that LaRouche lays out and breaks down into stages, bringing a rather interesting reasoning to the program. He says the basis of a Moon-Mars program needs to be sufficient to support a relatively small number of scientists who are able to live in space and on the surfaces of the Moon and of Mars, who will operate and maintain the largest and most advanced telescopic system ever devised by mankind.

LaRouche lays out a fascinating proposal for populating the Mars orbit with a number of telescopic systems that can cover significant ranges of the electromagnetic spectrum. And that if you distribute them along the Mars orbit such that they orbit with Mars, but either before it or behind it, you will have in such an array an entire set of satellites orbiting around the Sun in the same orbit as Mars, but distributed out to make the full circle. You can then integrate all of those telescopic systems into effectively a single apparatus, and thereby give the coming generations of young scientists the most advanced, frontier capabilities to investigate the physical universe that they could ever dream of. That project should be the basis of the entire colonization of space; that goal should define the entire project.

So, potentially thousands of people living in space; thousands of engineers, construction workers, people growing crops, the lunar colonization, all of this activity to support a relatively small number of people to operate this particular type of telescopic apparatus. That's a rather provocative driver for the entire program. As to why this should be, and how we need to think about ordering mankind's colonization of space, LaRouche says:

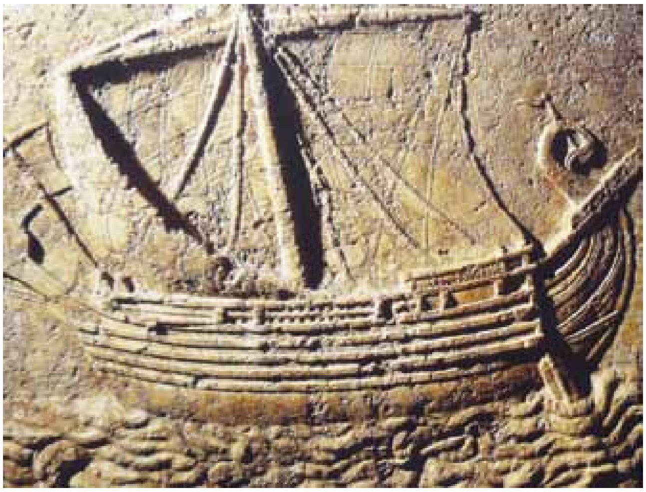
> As physical science progresses, what was accepted as the best physics yesterday, seems to break down around the edges. Usually, when this first occurs, the physicists mumble the ugliest curse word in their scientific vocabularies—'anomalous'. At first, they look at the embarrassing experimental results suspiciously, thinking someone must have played a mean prank upon them. Sooner or later, some physicists warn, 'It's no good calling these embarrassing experimental results anomalies. We have to face scientific facts. There is something wrong with our existing scientific textbooks.' The history of anomalies is the history of fundamental progress in science.

Needed: Revolutionary Transformations

You who are at all familiar with LaRouche's revolutionary work in economics, know where he's going with this line of thought: Fundamental revolutionary transformations in mankind's understanding of the organization of the universe, are the basis of humanity's advancement; it's the basis of technology. It's the basis of new infrastructure platforms; it's the basis for being able to increase the productive powers of labor; increasing living standards; its LaRouche's metric for economic growth—potential relative population-density. We may have a lot of technologies, a lot of infrastructure, advanced material sciences, all of these things, but it is all bounded by, at the most fundamental level, our scientific understanding of the nature of the universe in its deepest fundamentals. Our breakthroughs in getting ever closer to those fundamentals are what enable us to pursue the kind of development and progress that only mankind can achieve.

In his vision of the space program, LaRouche discusses the necessity to colonize space, industrialize the Moon, colonize Mars, really develop all the potential technologies available to us today: nuclear technologies, fusion technologies, magnetic levitation, and the

FIGURE 2



Phoenician ship bas-relief on a sarcophagus from the 2nd Century A.D.

most advanced processing of resources. Utilize those technologies to the fullest extent, to our fullest ability. All are within mankind's capability now today, really.

That effort, when fully realized, will give us the ability to develop the entire planet, bring mankind into space, and begin its colonization. As we engage in that effort we will encounter the clues, the anomalies, the paradoxes for our next steps that will in turn lead us to the next revolutions in science, that will lead to the next classes of technologies, to the next platform of civilization as we look not just to the Solar System, but I would say to the galaxy at large.

So, that's LaRouche's thesis on how you need to think about scientific advancement and mankind's conquest of space. I now want to take a parallel track—resituating how to think about space development from the standpoint of a natural historical progression [**Figure 2**] of human evolution and development.

Unfortunately, a lot of damage has been done to our imaginations and minds by science fiction and various popularized views, such that many people today view space and space travel as some weird sci-fi thing. A few people get excited, but it doesn't mean anything for the vast majority.

Physical-Economic Platforms

That view and that attitude could not be more wrong. We're talking here about the natural future of mankind, if we are to progress. I think that's best understood, again, in terms of LaRouche's work, and in particular his work on what he calls physical-economic platforms. If you want to understand human progress, if you want to understand economic development, you have to understand the role of infrastructure. If you want to understand the role of infrastructure and how that allows mankind to change his relation to the natural world, then we want to look at certain discrete phases of qualitative shifts in how mankind transformed his relationship to the natural world.

Let's begin by looking at the very ancient era, of the earliest times of trans-oceanic navigation; the very earliest of maritime cultures. The earliest seafaring cultures that could navigate the seas, depended upon certain fundamental discoveries about the stars and the star map; they depended upon an understanding of the stellar night-time sky. They mapped their position on the water, based on their readings of the positions and changes in the sky during both the daylight and night-time hours. LaRouche says that was really man's first infrastructure platform; those discoveries constituted the beginning of our being able to expand our natural environment, so to speak; to expand the domain in which societies could exist and develop coastal territories all over the planet. Our civilization was fundamentally transformed by our understanding of trans-oceanic navigation.

The next revolutionary steps [**Figure 3**] came with the development of inland river systems, and eventually by the construction of man-made canals and water-

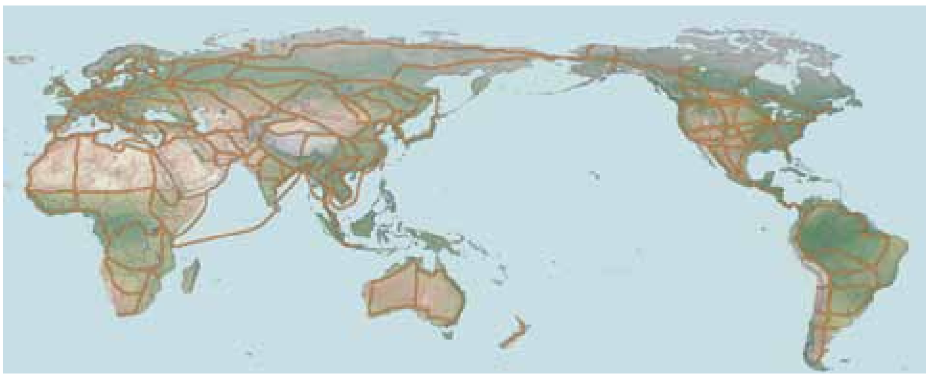
FIGURE 3

River systems and canals enable development.

FIGURE 4

Map of the U.S. transcontinental railroad.

FIGURE 5



Map projecting the extent of the future World Land-Bridge.

ways to interconnect naturally existing river systems, allowing us to bring cities, society, and general economic development further inland along these waterways and river systems, and canals. These activities allowed mankind to begin populating completely new non-coastal territories. Again, this is mankind at work here, this is what's natural about human beings.

We go from the stage where we existed in certain parts of the planet, certain parts of the natural world, and through these kinds of creative advances and revolutions, we begin to exist and develop and populate completely new areas, which were inaccessible before, were undevelopable before, or unlivable before. Now, all of a sudden, they become livable, they become territories of regular habitation and development, as a function of mankind's activity and creative advancement.

We progressed further with the development of the initial transcontinental rail systems, [**Figure 4**] again, bringing new territories into economic access to the point that what we're approaching today, is in a certain sense the full realization of global development based on the most advanced infrastructure available today: [**Figure 5**] the World Land-Bridge, as defined by Lyndon LaRouche and Helga Zepp-LaRouche, which will bring the entire territory of the planet up to the most advanced living standards and conditions of life, through the utilization of the most advanced infrastructure and technology systems available.

Take the case of California: Go back 100 years in California, before all the major irrigation systems were built. What do you think the potential population-density of California was, especially Southern California, the Central Valley regions? It was hardly anything. With the construction of initial transportation systems and the water management systems, we turned a region that was prior to mankind's intervention scarcely habitable, into one of the most productive regions on the face of the planet, actually one of the most agriculturally productive on the planet. That's just one, small example.

Taken to a global scale, that's the World Land-Bridge, especially when more advanced transportation systems are deployed, such as magnetic levitation technology, and even larger water management systems, such the Transaqua project to refill Lake Chad in Central Africa with water from the Congo River tributaries or the South Water North Project in China, or the North American Water and Power Alliance project for North America. These are the types of transformative programs that can make the potential of the entire territory of the planet—especially many of the interior regions of the continents where the population density and economic productivity is low—to be as productive, as capable, and as supportive as even the most advanced regions are today. Here we have mankind, shaping the potential of the entire territory of the planet.

And that is what's being pursued now—the completion of a new physical-economic platform that we're in the middle of developing.

What's Next?

So, what's next? What comes as the next natural step? This is what makes mankind unique; it is our very nature, our destiny as a species, to continually pursue new types of creative development and expansion into the universe, whether it's the territories of the planet Earth, or now, as we're looking, beyond. [**Figure 6**] Space is not just a fantasy of some small section of science-fiction geeks. It is the natural future destiny of all mankind to navigate and settle, and it should be thought of as nothing less. The fact that every child today in the United States is not assuming that space exploration and settlement will become a regular part of life by the end of his or her life, is a tragedy. Because it should be and needs to be.

FIGURE 6

NASA

Near side of the Moon, imaged by Lunar Reconnaissance Orbiter, December 2010.

When you speak about space, again, think infrastructure, infrastructure platforms: What are the revolutionary changes in our infrastructure systems that will transform our relationship to space, as these prior infrastructure platforms transformed our relations to different regions of the planet? Think back again to the history of the United States. Travelling from the East Coast to the West Coast prior to the Transcontinental Railroad was an incredibly difficult, troublesome, harrowing experience, taking a covered wagon across the entire territory of the continent. Very few people attempted it, and fewer still got there alive; it was a huge expense; it was incredibly difficult and dangerous. What changed? Infrastructure: Rail systems.

Today, millions of people do it on a regular basis. What was, prior to a certain infrastructure platform, incredibly difficult, limited, if not impossible, has become a regular, everyday experience. With an infrastructure platform for space, space travel is similarly transformed. **Figure 7** is an image of a document that Kesha Rogers and I collaborated on a couple of years ago now, the "Solar System Economic Platform," takes off from the same thesis of LaRouche's 1986 paper, which I cited at the beginning of this presentation. Rogers and I reviewed LaRouche's thesis from the standpoint of some of the developments that had happened since he wrote it.

FIGURE 7

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LaRouchePAC.com

PRINCIPLES AND BOUNDARY CONDITIONS OF A NEW SPACE PROGRAM

A SOLAR SYSTEM ECONOMIC PLATFORM

by Kesha Rogers & Ben Deniston

The commitment to space exploration must be based on the defense of the creative identity of the human mind. Human beings are a space-faring species, not meant to be confined to Earth: a species with a mission to discover and come to understand who we are as mankind in the Universe. We must bring about a unified human mission that establishes a completely new view of the Solar System, defined not by the compartmentalization of space, but by a unified galactic system.

Visionary leaders like space pioneer Krafft Ehricke and President John F. Kennedy understood that the industrial development of the Moon and beyond is not just a worthwhile undertaking, but an extra-terrestrial imperative. Today, China is leading the advance toward this extraterrestrial imperative with the steady progress of its lunar program.

For the last six years I have led a national campaign to defend our U.S. manned space program, which is fundamental to the progress of our nation's economic development, and provides the basis for peaceful relations among all nations. Our manned space program, and the future of our nation, have been under brutal attack since 2010, with the egregious cuts and dismantling of our space program, starting with Obama's cancellation of the Constellation program, and the cuts to a fusion science driver program, important for the development of fusion propulsion technology, which is absolutely essential for the exploration of space. We must restore our commitment to a unified national mission dedicated to the exploration of space, starting with the development of the moon (including its unique fusion resource, helium-3).

This will lay the basis for a much greater expansion of mankind throughout the Solar System, with Mars as the next target for human exploration and development. America needs a robust space exploration and development program to draw our nation's attention away from petty problems on Earth and to refocus it once more on the excitement of exploration of the Universe, the thrill of discovery, and the conquest of new frontiers. This passion for adventure and yearning to stretch our horizons will surely drive the next generation of space explorers and inspire our nation for the next 100 years in space.

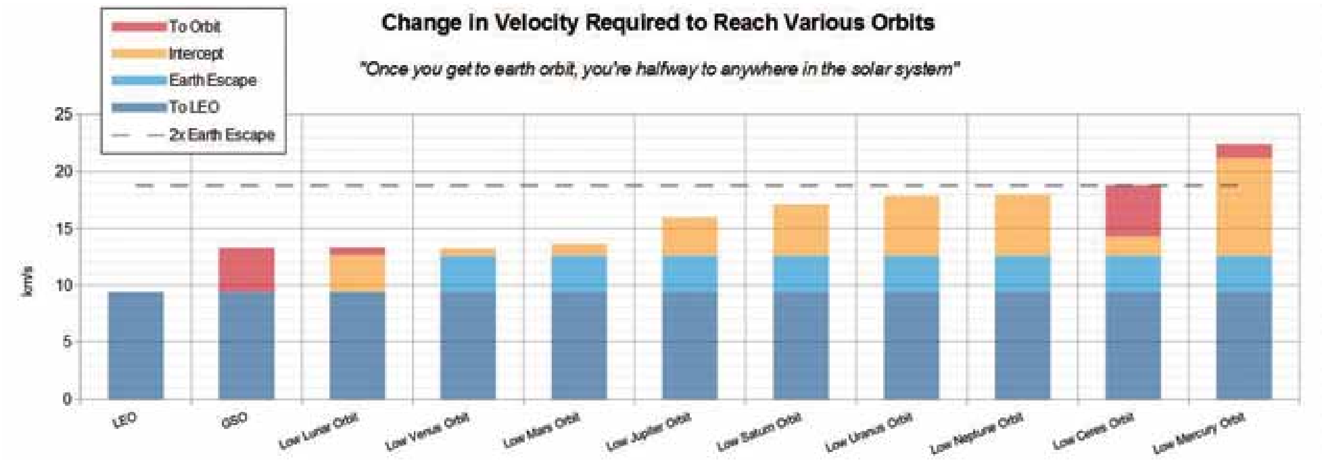
— Kesha Rogers

Four Pillars of a Solar System Platform

The title of our 2016 paper, "The Principles and Boundary Conditions of a New Space Program: A Solar System Economic Platform," looks at the boundary conditions that we're coming up against to create a new platform. We defined a few broad categories that should be distinguished, identified and pursued, if we're going to create a platform that will give mankind a completely new relation to the Solar System. Those included:

- **Access to Space.** Getting from the Earth's surface to Earth orbit. That's a huge part of any kind of human activity in space. We'll get into that in a little more detail.
- **Travel in Space.** Once in orbit, getting across vast distances, to the Moon, to Mars, to other bodies—travelling around in space.
- **Space Resource Development.** Creating the goods we need from the resources available in space, instead of having to bring up from Earth's surface everything we will need—a very difficult and energy-intensive process. What can we source from the Moon, from near-Earth asteroids, from other bodies as we get farther and farther out? LaRouche discusses this in his 1986 paper, the industrialization of space—producing goods from the resources available to you in the Solar system.
- **Life Beyond the Biosphere.** More recently I've added a fourth point, which is not actually addressed in this article, but I think it's also worth identifying, which is the broad category of life and biology beyond Earth's biosphere—

FIGURE 8



certainly a very in-depth and involved topic, with many fascinating, exciting and important aspects, which are a little bit beyond what we can get into today.

These are the categories, then—the basic pillars of a Solar system platform that Rogers and I identify in our paper, plus one.

Pillar 1: Access to Space

How many of you know how far away space is, from us here on Earth? I'll assume everyone guessed the exact right answer, because everyone at our events is incredibly intelligent. It's around some 200 km up, about 125 miles. That's what people say is the beginning of space. So, for a rough figure, I'll say about 125 miles—that's not that far. That's significantly closer, in simple distance terms, than I am to you in New Jersey right now. If you take a straight distance measurement from me to you, versus you to space, you are significantly closer to space than you are to me, right now.

How far is the Moon from Earth, then? Well, if the edge of space is less than a Washington to New York trip, less than half of that, really—how far away is the Moon? Well, the Moon is significantly farther, averaging almost 400,000 km (about 250,000 miles) in its elliptical orbit, about 2,000 times as far as the distance to space itself. How about to Mars? That's even a larger jump: about 150 times farther than the Moon at its closest distance, or around 1,000 times farther than the Moon at its greatest distance. Going from Earth to space, and then going from Earth orbit to the Moon, and then going from the Moon to Mars—those are vast, vast distances, vast leaps in distance.

But this is significantly misleading. Because, getting into space is not simply about "getting up" 200 km. If you go up 200 km, straight up, what happens? You just fall straight back down. It doesn't bring you into space. The action that's needed is what people in science call "change in velocity," or *delta v*—"delta" meaning change and "v" meaning velocity.

To actually enter orbit, that is, to stay in space and not fall back to Earth, to get into low Earth orbit—this closest point of space accessible to us—you don't just need to go up to 200 km, you also need to increase your speed from your resting speed on Earth to a speed of 34,000 km/hour. That's pretty fast. For comparison, there are many pistols with a muzzle velocity of 1,500 feet per second—a little over 1,000 mph. To achieve low Earth orbit, therefore, requires accelerating to over 20 times the rate of a speeding bullet from a handgun.

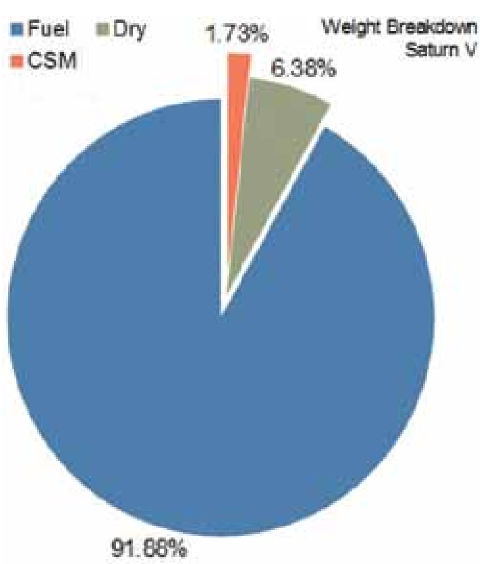
To sum up, getting from Earth's surface to low Earth orbit is not just about traversing a certain a distance, you actually have to change your velocity, such that you achieve orbit, and that requires you to move fast enough to maintain your position above the Earth in orbit.

In terms of distance, then, the Moon is 2,000 times farther away than "space"; in terms of action. To get from Earth's surface to Earth orbit, you need to achieve a velocity of 34,000 km/hr.

To reach orbit around the Moon, if you're thinking only in terms of distances, getting there represents a 2,000-fold increase; however, to traverse that distance requires achieving a velocity of 48,000 km/hr, only 30% greater. So, if you're talking about action, the energy requirement is really what it comes down to. Once you're in low Earth orbit, you're already more than two-thirds of the way (in energy requirements) to what it takes to get to lunar orbit. And as we'll see, Mars itself is not that much "farther"—just 54,000 km/hr (about 33,500 mph).

Figure 8 is a graphic representation of a number of

FIGURE 9



NASA

Saturn V and its launch weight breakdown.

planetary bodies in the Solar system, and the change in velocity, as we looked at the speed requirements to get to these orbits. Sometimes people say that once you reach Earth orbit, you're halfway to anywhere in the Solar system. The energy requirement to get from Earth's surface to Earth orbit is actually half the requirement for getting pretty much anywhere else in the Solar system, aside from maybe getting to Mercury, which happens to be one of the most difficult cases.

So, this first issue of our physical-economic space platform—getting from Earth's surface to Earth orbit—is really a major, major bottleneck for mankind's access to space.

One other very quick illustration: [**Figure 9**] is a breakdown of the weight of the Saturn V rocket, the rocket that took mankind to the Moon. The pie chart shows that almost 92% of the entire weight of that rocket, was fuel. And most of that fuel was used just to lift off from the surface of the Earth and enter orbit around the Earth. About 6.5% of the total weight was the rocket itself (not counting the fuel), and less than 2% of the entire weight of that gigantic rocket was the tiny Lunar Module that landed on the Moon and the Command Module that brought our astronauts back to Earth. So, this is just another illustration of the challenges and difficulties involved in this first pillar, the first basis of mankind having access to space.

This is an area we need to tackle and overcome. A vast array of technologies currently exist or are being developed that can dramatically lower the cost, dramatically lower the energy requirements, and increase the ease of getting people into space: [**Figure 10**] NASA has looked at scramjet (supersonic combustion ramjet) technologies, and space planes, as some people call them—engines that can continue burning atmospheric oxygen while accelerating to the extremely high speeds required to achieve orbit. These types of technologies are being pursued in the United States and in Europe; [**Figure 11**] China has had some recent breakthroughs in such technologies. Everyone knows that significantly increasing the thrust-to-weight ratio is a major advance that would, by any estimate, drop the cost by one to two orders of magnitude for putting payload and people into orbit.

So, this would be a huge game-changer in mankind's access to space.

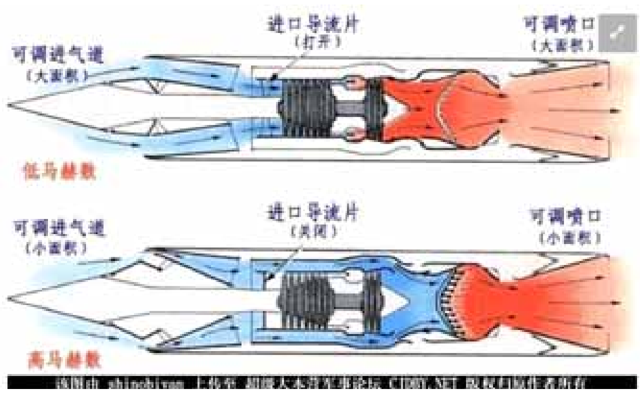
Let's take one step further and look at technologies like vacuum tube magnetic levitation systems [**Figure**

FIGURE 10

NASA

NASA's X-43A hypersonic scramjet demonstrator in 2004.

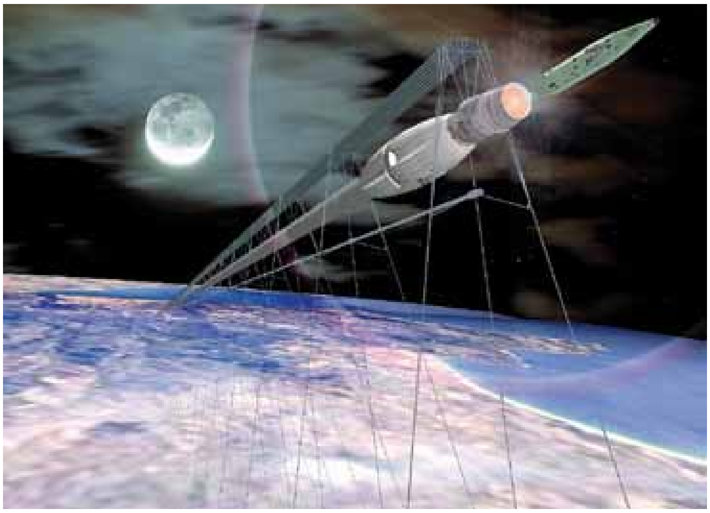
FIGURE 11



Chinese Aerospace Science and Technology Corporation

Chinese blueprint for a combined cycle engine.

FIGURE 12



NASA

Artist's impression of a StarTram Gen. 2 mag-lev space launcher.

FIGURE 13

NASA/Pat Rawlings (SAIC)

Artist's conception of a fusion rocket orbiting Mars.

12] that are being researched and developed to launch cargo, and potentially even people (eventually) into orbit. Such technologies completely eliminate the need to carry fuel, and therefore the weight of fuel, to get you into orbit, because all of the energy requirement can be provided by the launch system itself.

To you give a sense of this, under NASA's Space Shuttle program, it's estimated that it cost around $10,000 to put each pound of cargo into orbit. That's a lot of money! Some advances would lower it a little bit, but never by orders of magnitude.

Magnetic-levitation vacuum tube space launch technology is something many people have studied as a feasible option. People in China are looking at it, people in the United States at our national labs have looked at this. With a mag-lev launcher, it may be possible to lower the cost to insert cargo into low Earth orbit to around $20/kg—a three orders of magnitude cost reduction—thereby dramatically increasing mankind's access to the Solar system.

This is similar to the role played by the railroad for the early transcontinental traveler. Making breakthroughs here will open up new potentials for much more efficient, much quicker, much easier, much larger access to the entire Solar system.

Pillar 2: Travel in Space

Once in space, once in orbit, we'll need fusion propulsion. We need nuclear fission propulsion for certain cases, but if we want to really get around the Solar system, we'll need fusion propulsion. [**Figure 13**] This would revolutionize our access. Getting to Mars, for example, would be a matter of weeks, compared to well over half a year with the current technologies. People could soon be ferrying back and forth from Mars—a complete revolution in our access to the Solar system. We'll need nuclear propulsion in space.

Pillar 3: Space Resource Development

As to the development of resources—as LaRouche discussed in his article—probably the most important driving program for it would be mining the surface of the Moon for helium-3, [**Figure 14**] a fuel for fusion reactions that provides probably the best basis for sustained, long-term, advanced fusion power. Helium-3 is rare on Earth. You're not going to find any significant quantities on the Earth. But it covers the Moon. And mining the Moon for helium-3 could be the basis for an advanced fusion economy that could tackle all kinds of challenges in mankind's access to space, and in activities on Earth.

It would probably revolutionize our capabilities for

FIGURE 14

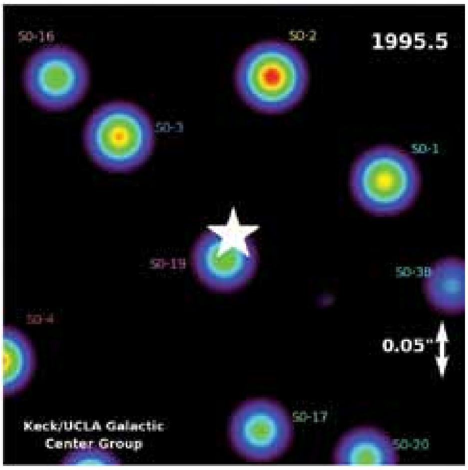
University of Wisconsin

Design concept for a robot to extract helium-3 from the lunar soil.

mining and resource processing here on Earth. The ability to take something as dispersed and unconcentrated as the lunar soil, or regolith as it's called, and pull out the resources needed—helium-3 being one, but also oxygen, water, metals, all kinds of materials—to develop the technologies to process those resources on the Moon, will create a wide variety of spinoff technologies back here on Earth, as will all of these stages of development.

I will conclude with the same concept that LaRouche called for in his basic thesis: Creating a Solar system platform to provide mankind with the beginnings of the economic development and industrialization of space, must be the basis for pursuing the new revolutions in all areas of science. Doing so will not only transform and upgrade our understanding of the universe, but also transform our relationship to it.

FIGURE 15



UCLA Galactic Center Group

A still shot from an animation showing stars orbiting the center of the Milky Way Galaxy.

An Outstanding Anomaly

Figure 15 illustrates just one of many anomalies that are fascinating and call for much more work. I know it looks a little cartoonish, but this is actual data; these are representations of actual observations of entire stars—stars the size of our own Sun, orbiting around some point at the very center of our galaxy. Now, Earth, along with our entire Solar system, orbits the center of the Milky Way Galaxy on a scale estimated to be between 225 and 250 million Earth years. That's one galactic year for us—we're farther out in the outskirts of the Solar system.

But the stars in this figure are orbiting near the very center of our galaxy on a scale of decades! They're making entire orbits around this single, tiny location on the scale of decades. They're orbiting this point in space as if they were planets orbiting a star, but they themselves are stars. And what can be deduced from these orbits is that, obviously, an incredible amount of mass would be required at the center to cause entire stars to orbit it, with these nice, very clean ellipses, very clean Keplerian elliptical orbits. And it's been calculated to require, I believe, something on the order of 4 million times the mass of our Sun, concentrated in that small point in the center, in order to cause these stars to orbit around it at the rate they do.

The question is, when we observe that point around which all these stars are orbiting, what do we see? Nothing! We don't see an incredibly massive star, we don't see some huge energetic object. We don't see anything! There's literally nothing that we can see. All that we have detected, so far, is a massive gravitational effect that's causing these entire stars to orbit as if they were planets.

This is one example of evidence for what some people call "black holes," which really is just a name for a place where our current understanding of physics completely breaks down. Here we have direct empirical evidence of phenomena in the universe for which we have no understanding, that we don't currently understand at all. And there are all kinds of fascinating connections between these types of super-massive objects at the centers of galaxies, and some of the most energetic and intense activity that we see in the entire universe. These things seem to play a role regarding the structure and the nature of galaxies as whole.

Prologue

Much more could be said about these frontier areas of science. I hope I have given you a taste of the sense that, as mankind pursues the colonization of space, the industrialization of the Moon, the Solar system platform, as I've been discussing it here, these technologies will transform mankind's relation to space, such that the space environment becomes just a regular, everyday part of the experience and activity of a growing proportion, and eventually of a majority of the human population.

As we pursue those technologies and our conquest of the Solar system, which is within our reach in the next couple of generations, we will also look beyond our Solar system to the farthest reaches of our galaxy, and the trillions of galaxies and galactic systems beyond, for the anomalies that will lead to ever new domains of science, of physics. The understandings of each of generation provide the basis for the next. Looking to 2100 to beyond, future generations will supersede what we have learned, with new arrays of technologies based on a completely new era of science.

That's the future! That's natural human progress! That's what we will inaugurate with the New Bretton Woods system and the Four Powers agreement.