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Need worldwide mobilization for Moon-Mars mission

A new age of exploration would be a unifying focus for east European and U.S. high-technology industries facing shutdown. Marsha Freeman reports.

At present, an increasing number of nations around the world are facing catastrophic declines in basic health care, agricultural output, and overall economic production. At the same time, the scientific and technical manpower and capabilities which are the only solution to these problems are also contracting worldwide, at an alarming rate. There is no way to dramatically uplift the world's population to adequate levels of health care, nutrition, education, and energy consumption, without a worldwide mobilization on the frontiers of science. A linear extension of today's technologies could not possibly increase productivity fast enough to prevent genocide in many parts of the world.

Global threat to skilled manpower

There is no way to deal with the accumulated years of rot, obsolescence, and underinvestment in basic infrastructure, industry, and human services worldwide, except to mobilize the world's scientific community and resources to break through on the frontiers of science and give mankind new, more efficient solutions. But those precious resources are now under siege.

The threat to the second largest pool of scientific manpower and expertise in the world, in the former Soviet Union and its satellites, is the most dramatic. Independent republics are now faced with the responsibility of preserving world-class scientific capabilities which happen to be located on their soil, in the face of political and economic uncertainty. According to sources in the Union of Sovereign States (U.S.S.), the budgets for the research institute of the Academy of Sciences have not yet even been determined for this year. Even before the August attempted coup and resulting declarations of independence, the central Soviet government had announced that its civilian space program would be cut 50% over the next five years.

In a speech before the Extraordinary U.S.S. Congress of People's Deputies on Sept. 2, reported in *Izvestia,* the vice president of the Academy of Sciences, Academician Yevgeni Velikhov, pleaded with the deputies not to "break things so violently that the pieces cannot be put back together again." He addressed the fact that though each republic now has been given control over those scientific or R&D institutions that are on its territory, "we must understand that in the future . . . the republics in their own interests will always accept the idea that certain centralized functions must be exercised.

"We must understand," he continued, "that there is a whole series of structures which cannot be rebuilt afterwards at all. Science is a very delicate instrument, and it is now collapsing very quickly."

Aviation Week magazine has reported from Moscow that nearly half of the 5 million jobs in the aerospace industry of the former Soviet Union could be lost, depending upon how the industry is reorganized. The Soviet Ministry of Aviation Industry will be dissolved in 1992 and will probably be replaced by an interim Union agency, because, clearly, the aerospace industry cannot function without some kind of inter-republic coordination. Facilities, such as wind tunnels, have to be available to all research institutes, so preliminary agreements to maintain the same level of cooperation between the research and design bureaus and production facilities have been reached between several republics.

Fearing that their world-renowned research capabilities in the nuclear fission and fusion field could also be dismantled, Soviet scientists have issued new, urgent calls for the United States and the international community to join cooperative projects for next-stage fusion experiments.

In the United States, the downgrading of the Strategic Defense Initiative (SDI) over the past five years has slowed to a trickle the flow of new directed energy and laser technologies, which should have already been available from SDI research for medical and industrial applications. Due to the cutbacks in defense spending, the bankruptcy of the commercial airlines, and the slowdown of increases in the civilian space program, more than a year before President Bush's recent "disarmament" initiative, the aerospace-defense-aircraft industry in the U.S. began laying off more than 100,000 skilled workers and managers.

The current fracas over next year's budget for the National Aeronautics and Space Administration, where a tradeoff is being demanded between slowing down Space Station Freedom or eliminating the start of *any* new projects, will not have a satisfactory resolution. In a statement released Sept. 27, NASA Administrator Richard Truly lamented that this will be the first budget in many years which does not even keep up with inflation.

Crisis in eastern Europe

In eastern Europe, the picture is even more dramatic. There, the indigenous technical capabilities of each nation have been wholly integrated with and dependent upon the Soviet Union since the 1950s, either through the Warsaw Pact or the Council on Mutual Economic Assistance (Comecon). Therefore, as the Soviet research programs contract, and these countries try to realign with the West, premier research facilities are being held in limbo.

One example is the recent trauma of the Carl Zeiss optical facility in Jena, east Germany. Zeiss Optical has built more optical telescopes in the 1-2 meter range, mainly for Comecon institutes, than any other company in the world. In the Soviet Union and many developing nations, Zeiss had the monopoly on precision optical equipment. As of 1989, there were 70,000 highly skilled people working at its facility in Jena, manufacturing cameras, computer chips, and eyeglasses, in addition to its core business of microscopes, telescopes, and optical devices.

Nature magazine reported last April that Zeiss became "unprofitable" almost overnight after German reunification and the currency reform was put into place, because the East German subsidy to Zeiss, largely through the guaranteed market for its product, was stopped. The other former Comecon countries, which had made up 65% of Zeiss's market, could no longer buy its products with transfer rubles. In response, the company laid off *43,000 workers,* and reportedly has a plan to reduce employment to 10,000. Once this pool of highly skilled manpower is lost, it will be impossible to replace.

For years, the Soviet space program has depended upon the capabilities of the former Comecon nations, all members of Intercosmos, for the most advanced new technologies. In turn, the skills developed abroad were captive to Soviet requirements. Most of them began space programs when Intercosmos was formed, in 1967. By that time much of the Soviet leadership realized that the United States would soon surpass the Soviet space program, when the Apollo program achieved a manned Moon landing, the "space race" was over, and the Soviet Union needed a larger pool of technical manpower for its high-tech space-military programs.

Budapest, Hungary has been home to two major centers of space instrumentation for scientific satellites. All of the electronics for the Soviet Vega mission to Halley's Comet was manufactured in Hungary, and the integration of the spacecraft with the instruments was done there as well. Hungary also participated in three plasma-measuring experiments aboard Vega, and handled the central data acquisition.

According to Karoly Szego of the Central Research Institute for Physics in Hungary, the computer and one experiment aboard the Soviet Phobos spacecraft to Mars were developed at his institute, and the image-processing system aboard the Mir space station, used for remote sensing, is a derivative of computer systems developed there, as well.

Last year Hungary began formal negotiations with NASA and the European Space Agency (ESA), as have other former communist countries. On April 10 of this year, ESA's director general and Hungary's minister without portfolio Erno Pungor signed an agreement for cooperation in the peaceful exploration of outer space. The agreement covers joint projects, as well as the exchange of experts, training courses, and access to ESA's European Space Information System.

But while the positive impulse of the western Europeans is to try to preserve and integrate as much as possible of the fine technical expertise in the east, ESA ministers will be meeting on Nov. 18 in Munich to decide how much to delay crucial European space projects, as member states insist they cannot continue to increase space spending. Recently *Space News* reported that ESA has proposed putting off the first flight of the small reusable spaceplane, Hermes, to the year 2002, with the first manned flight two years after that.

The most pressure for cuts in ESA's long-range programs has come from Italy and Germany, which want to limit annual spending increases to 10%, because of other strains on their budgets. Substantial increases are needed to keep Hermes, the Columbus Space Station Module, and the Ariane rocket program on schedule.

Thus, a significant part of the world's scientific, technical, engineering, and skilled manpower is facing virtual extinction. There is no overall plan, at least in the public domain, which proposes how to stop and reverse this, and there will be virtually no way to quickly reconstitute it, once it is gone.

Why a Moon-Mars colonization mission?

The argument is often made that if a nation has a goal to accomplish a specific task, such as curing a disease, large amounts of funding and resources should be put into that specific project. The serendipitous nature of creative scientific research, however, has often demonstrated that many of the most important discoveries have *not* been made because a researcher was given a grant to answer a specific question. In general, a large-scale effort at the frontiers of man's knowledge, engaging the abilities of a large number of creative minds, will produce a cornucopia of new science and technology, little of which could have been written up in a grant proposal.

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Throughout the 1960s, the mobilization in the United States to put a man on the Moon and return him safely to the Earth produced more scientists and engineers than the Department of Education has ever produced, more revolutionary health care technology than the National Institutes of Health, and more new energy technology than the Department of Energy. In order for men to live in the hostile environments of the Moon and Mars, there will have to be breakthroughs in medical technology, basic biology, data processing and computers, fission and fusion energy for power and propulsion, robotics and automated systems, materials, communications, and every aspect of growing food and industrial manufacturing.

No single country today has the scientific and technical capability, much less the advanced-technology manufacturing base, to carry out the Moon-Mars mission. Every study over the past six years proposing this as the long-range goal for the U.S. space program has recognized that some form of international collaboration will be necessary.

However, depending upon who was proposing the cooperation, numerous political agendas were really being put forward, not space exploration. Joint U.S.-Soviet Mars missions were put forward by kooks like Carl "Nuclear Winter" Sagan to foster a closer relationship to President Gorbachov. Republican "science advisers" like George Keyworth pushed international cooperation in space and other places as a way to ease pressure on the U.S. budget deficit. Neither of these are reasons to go to Mars.

There will be no Moon-Mars mission, if the United States does not lead it. The U.S. still has the largest pool of scientific manpower available to be deployed for this effort. Only two nations in the world have any experience in putting men into space, and only the United States has sent men beyond Earth orbit. Though the Japanese space program is impressive in its scope and plans, without manned space experience, and with a total program still an order of magnitude smaller than that of the United States, it would take decades longer for the Japanese, even with the Soviets and Europeans, to develop what could be conjointly done with the United States. Many studies have been done in this country describing how, when, and where to go in space. No matter which specific scenario is chosen, the Moon is the only sensible next step after Space Station Freedom, and capabilities will be needed to allow astronauts to live and work on the Moon, which were not necessary under Apollo.

Mars is a different story, altogether. Because of its great distance from the Earth, averaging 50 million miles, compared to the quarter million miles for the Moon, life on Mars will have to be independent from Earth. Activities which are done almost without thinking on Earth will take the most minute planning for Mars colonists. Energy is an excellent example of the kinds of quantum leaps that will be necessary, first in science, and then translated into new technology. For these missions, orders-of-magnitude increases in the energy intensity required to keep each person alive, healthy, fed, and working will be necessary.

Growing food in space colonies

Growing food presents another challenge. On Earth, the lion's share of energy used by plants comes from the Sun and is independent of man. On the Moon, where there is no atmosphere to protect against deadly radiation, and where night cycles last two weeks, food will be grown in protected, shielded, closed environments. On Mars, solar radiation is half that which reaches the Earth, the thin atmosphere is not an adequate shield against radiation, and the average temperature is dozens of degrees below zero. Most of the energy will have to be man made.

Scientists have estimated that the light and other energy inputs to intensive agriculture which will provide man's nourishment on the Moon and Mars could reach 600 watts per square meter of crop area. That means about 7.2 kilowatts per person of available electrical energy, for example, or 7.2 gigawatts (GW) per million population. Compare that to the gross estimate of 1 GW per million population for the United States, which includes not only agriculture, but manufacturing, all industry, commercial, and residential use.

There is no possibility of providing that large quantity of energy for space cities through a simple extension of today's technologies. Even nuclear fission power plants are too inefficient in terms of their operating temperatures, depend upon water coolants which will be unavailable on the Moon and Mars, and cannot be scaled up to economically produce the huge amounts of energy required. More energy-dense, compact, efficient energy production and conversion technologies are required, and will consist largely of plasma-based techniques from fusion reactions. The recent exciting developments in cold fusion may provide technologies for space not yet even considered.

The fusion of various light nuclei of hydrogen and helium will produce copious energy, not only in the form of heat, but also in charged particles and coherent electromagnetic energy. This energy array will be available for direct processing of materials, producing electricity, the propulsion of spacecraft, and other applications.

The requirements for the colonization of space will finally push mankind out of the hundred-year-old era of steam turbines, and into the age of directed, coherent energy.

Similarly in the biological and life sciences. Scientists who have reached a dead end in understanding, much less treating, debilitating diseases, will obtain a new "window" on human physiology and medicine from space. It has been found that the abnormal symptoms developed by space travelers, described as space adaptation syndrome, mimics the symptoms of certain diseases in Earth. Since these problems in space, such as the demineralization of bone, reduction in reactivity of the immune system, and cardiovascular changes, occur in otherwise healthy people, the mechanisms which produce such disorders can readily be studied from a unique standpoint.

Treating diseases and all manner of inevitable medical emergencies in space will require entirely new medical technologies. Even the short-duration Space Shuttle missions that have included extensive medical experimentation have already produced new diagnostic techniques, which will improve medical care on Earth.

Handling vast quantities of information quickly, handling dangerous or difficult operations robotically, and making hostile and lethal "natural" environments livable, will be the science-driver which will produce the earthly technologies that can uplift the human condition of all of those of us who participate in the colonization of space, from Earth.

Worldwide contributions to effort

There must be a worldwide division of labor to accomplish the movement of human civilization into space. Nearly every nation in the world has some area of expertise which will be crucial for this mobilization, and nations which do not now, must develop them as soon as possible.

The Soviets, for example, have the world's only flight-tested, heavy-lift launch vehicle, the Energia rocket, which could be used to carry large payloads to orbit. It is not man-rated, that is, reliable enough for human cargo, but could be an important addition to the stable of launch vehicles which will be required for a colonization effort. The Soviets have an impressive, in-depth space infrastructure, with the ability to launch spacecraft frequently, and quickly process payloads, which must also be brought into service.

Soviet scientists have done decades of work in propulsion systems using nuclear fission and probably also fusion, as has the United States. These programs in the Union have now been opened up for international collaboration, and must be integrated into a program to develop and use them.

The special capabilities of each of the formerly communist nations, all of which have contributed to the Intercosmos space program, should immediately be preserved. They will be required. The growing number of developing nations struggling to develop space capabilities must be brought into the Moon-Mars effort. Those with geographies favorable to the construction of astronomical observatories, such as Chile and Mexico, must act as foci for the education of the next generation of astronomers and other scientists, who will, perhaps, ultimately carry out their research from Mars orbit.

The United States excels in many areas, including life support systems, reusable transport to Earth orbit (the Space Shuttle), and leading the effort for the permanent manned presence in the Space Station, requiring the integration of large space systems. With 30 years of experience in manned space programs, the U.S. must help organize the global effort to carry out a 40-year Moon-Mars colonization program.

The second age of exploration

When President Kennedy announced the Apollo program, he described space as "this new ocean." Every Space Shuttle orbiter is named after a sailing ship. And the Europeans named their laboratory for Space Station Freedom, "Columbus," because those who have provided the vision for the space program have always thought of this era as the "second age of exploration."

In his introduction to the report prepared by a group of experts constituted to provide an array of scenarios for the Moon-Mars mission, former Apollo astronaut Gen. Tom Stafford recalled: "In 1433, a fleet of Chinese ships sailed all the way to Africa, trading, exploring, and advancing Chinese culture. But the Ming Empire had other priorities—problems at home, pressing needs elsewhere. They recalled the fleet—and then they burned it. . . .

"At about the same that China was burning its fleet, a small European nation's far-sighted leader, Prince Henry of Portugal—now known as Henry the Navigator—sent ships up and down the coast of Africa. Soon another European nation, Spain—just emerging from centuries of war and turmoil—also began an exploration program."

General Stafford drew the lesson: "Nations lose their leadership position when they give up the role of exploration. The question now facing the United States is which path to take with regard to 'oceans' of the 21st century."