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The grand vision of the space pioneers

by Marsha Freeman

Throughout the history of space technology development, the pioneers who produced operational weapons for war also laid the basis for man to fulfill his greatest dreams in peacetime. From the Peenemünde rockets in the second World War to the Atlas booster that both delivers ICBMs and has taken men into orbit around the Earth, these benefits of space technology have been intimately linked.

Today the greatest challenge facing the science, technology, and diplomacy of the United States is the speediest development of directed-energy space-based anti-ballistic missile weapons. The capabilities needed to bring space colonization to realization will be greatly enhanced by the military necessity the nation now faces.

Tsiolkovsky: 'Perfect human society'

In 1903, while the Wright brothers were demonstrating at Kitty Hawk that man could at least get off the ground, a nearly-deaf Russian schoolteacher published a document titled "Investigating Space With Rocket Devices." Konstantin E. Tsiolkovsky wrote, "At first the rocket can be used for circling the Earth; then a journey can be made in some other relation to the Sun, say to some planet; the rocket can come more or less close to the Sun, fall on it or escape from it into space and become a kind of comet flying for thousands of years among the stars, until it reaches one of them, which may become a new Sun for the travellers and their descendants."

He continued: "Mankind will establish a series of space bases around the Sun using, for this purpose, asteroids (small planets which are plentiful within the Solar System). Reaction devices will enable man to conquer infinite space and to receive 2,000,000,000 times the amount of solar energy humanity receives on the Earth."

Tsiolkovksy, who also worked on the design of metal dirigibles for flight, outlined in his 1903 work a fourteen-step program for evolution from the "aeroplane" to the rocket and for space development.

Point number eight in his program was that "ether suits are designed for leaving the rocket safely in the ether." The next point was that "special containers are invented for plants that are to produce oxygen and food and to purify the air within the rocket. . . . Man is no longer entirely dependent on the Earth, for he can produce the means of sustenance apart from it."

In step ten, "numerous space settlements are set up around the Earth," and then in step eleven "solar energy is utilized not only for obtaining food and other comforts, but also for locomotion throughout the Solar System."

Next "colonies appear on the asteroids and in other parts of the Solar System wherever there are small heavenly bodies." Then the "number of colonies grows with the development of industry," and finally, the last point, "Human society and its individuals become perfect."

Why should man venture beyond the Earth? To Tsiolkovky, that question had both a philosophical and practical answer. "This planet," he said, "is the cradle of the human mind, but one cannot spend all one's life in a cradle. Humanity will not always remain on Earth. In its desire to have more light and space it will first penetrate beyond the atmosphere and then will conquer all the immense space within the Solar System."

He saw the immense opportunities for science that his rocket devices could open up. "There was a time—not long past—when the idea of knowing the composition of heavenly bodies seemed hopeless to the best scientists and thinkers. Now that time is past and gone.

"But I think that today the idea of a closer, direct study of the universe would seem still more wild. To set one's foot on the soil of an asteroid, to lift with one's hand a stone on the Moon's surface, to establish orbital bases in space, to create inhabited rings around the Earth, Moon, and Sun, to observe Mars from a distance of a few miles, to alight on one of its satellites or even on the planet itself—can anything be more crazy? But the employment of rocket devices will open up a new era in astronomy—the era of a closer study of the sky."

Less than two years before his death, Tsiolkovsky gave a May Day speech in 1933, piped in to Red Square from his

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home in Kaluga. In it he described the progress of "humanity's daring dream—conquering space beyond the clouds.

"For 40 years I have been working on a rocket motor," he stated, "but I thought that a journey to Mars could take place hundreds of years later. Time, however, moves quicker and now I am sure many of you will be witness of the first trans-atmospheric flight." Undoubtedly, many who heard him that day did witness the first flight of an orbital satellite, Sputnik 1, two weeks after the one hundredth anniversary of Tsiolkovsky's birth, on October 4, 1957.

"Tsiolkovsky's dream," as his program is called, inspired a generation of Russian rocket designers and scientists to push ahead into the frontier to accomplish what the pioneer had laid out as the basis for perfecting human society.

Oberth: 'Extend life wherever possible'

By the time Hermann Oberth was writing his major work in 1923, the American rocket pioneer Robert Goddard had already demonstrated that liquid-propelled rockets could fly. Unlike Goddard, who was too sensitive to the derision and scepticism around him (particularly from the press), Oberth decided to be as bold as he could in order to capture the imagination of a generation of potential space enthusiasts in Germany.

His scholarly 1923 work, *By Rocket Into Planetary Space,* was expanded and revised in 1929. In addition to duplicating, independently from the earlier work of Tsiolkovsky, the necessary physics for space travel, Oberth outlined a full array of space capabilities which would excite young thinkers and lay the basis for German and U.S. space programs for decades to come.

In his 1929 book, Oberth included a section called, "Stations in Interplanetary Space." He stated that spacecraft, on the largest scale, can be "put into orbit around the Earth. They then represent a small moon, so to speak."

These stations "could contribute to navigation by sending signals, photographing the Earth, having a strategic value in war, warning ships of icebergs," and could perform what we call today "search and rescue" missions. "The weather conditions of the whole Earth could constantly be kept in view, considerably promoting our knowledge of meterological processes. . . ."

Considering the use of space technology for Earth, Oberth described in detail the placement in orbit of a reflector, which would concentrate energy from the sun to be used to enhance agricultural production and influence the weather.

"By suitably adjusting the single facets, all of the solar energy reflected by the Sun could be concentrated on a single point on Earth or spread out over wide stretches of land as needed. . . . Wide stretches of land in the north could be made habitable by means of dispersed light . . . in our own latitude, the feared sudden drops in temperature in spring and the night frosts in fall and spring could be prevented, thus saving fruit and vegetable crops . . . for the southern hemisphere and the tropics there would only remain the illumination of large cities at night and . . . influencing the weather."

This idea of orbiting large solar reflectors to change the energy balance of Earth for agriculture, the weather and lighting, has been more fully developed by one of Hermann Oberth's students, Krafft Ehricke, who is currently the president of Space Global Company in California.

Another chapter of Oberth's 1929 work reflects the philosophy that he stated directly in an autobiographical article in 1957. "This is the goal: To make available for life every place where life is possible. To make inhabitable all worlds as yet uninhabitable, and all life purposeful."

This goal was made programmatic in the chapter titled "Trips to Strange Celestial Bodies." After providing all of the necessary calculations for a trip to the Moon, Oberth insisted: "I cannot agree with the view that strange celestial bodies should be visited only if living conditions similar to our own are found there. A visit to the Moon would have great scientific value. We are here dealing with a celestial body that, in the main, consists of the same substance as the Earth . . . but it has been preserved from the effects of air and water.

"By comparing the two, we can see what, on the surface of our Earth, is attributable to the effects of air and water, and what is not." Oberth outlined a program for deep drilling on the Moon to explore for metals, and for studying its geology as a way of better understanding our own.

"It is possible that the exploration of Mars will open up undreamt-of possibilities of development for human culture, technology, and science," he wrote. "It is also possible that the first expedition to Mars will be the last for centuries," but the purpose would be to "clean up the old points of controversy about Mars. Whether further trips have a purpose one will be able to say only after the first trip.

"In case Mars were uninhabited, it would be the task of the first expedition to make colonization attempts with organisms from similar climates on Earth . . . and see whether and how these living organisms acclimatize on Mars. . . . Its research would become of downright epoch-making importance to the biological sciences.

"Venus," he went on, "could be the most difficult but also the most rewarding celestial body for the space navigator to explore. Other planets can't be visited by rockets or landed on" by manned crews, Oberth posited, because of the amount of time it would take to reach them using chemical fuels.

Oberth was forced to defend his vision against critics who ridiculed the possibility or usefulness of space flight. In 1924, he reported, a mathemetician reviewed his 1923 book and stated, "It will not be possible to travel around in space because of the enormous wear of material. We think that the time has not yet come to deal with this problem and probably it will never arrive."

Oberth, living in Europe at the present time, has been proven right. To Oberth's students, the time had indeed arrived by the late 1930s to finish the designs and get on with the business of finally going into space.

Von Braun: 'To increase man's knowledge

Wernher von Braun met Hermann Oberth in 1931, became his student, and went on to head up the World War II German rocket project which laid the basis for all of the rocket developments in the post-war U.S. space program, from the first Explorer to the Saturn V.

By 1952, when von Braun began to write books on space exploration, it was clear that the technological difficulties could be solved—clear at least to von Braun and the one hundred-plus German rocket scientists then resettled in the United States.

In 1953 he authored the *Conquest of the Moon* which detailed precisely how a crew would effect a lunar landing, what they needed to take with them, and most importantly, what they would do when they got there.

"There have been many books written about journeys to the moon, but few of the writers seem to know what to do with their explorers once they get them there. . . . We will not go to the moon simply for the sake of getting there. True, man's curiosity and adventurous instincts will play a large part in the enthusiasm for the venture.

"But the primary reason will be scientific: to increase man's knowledge of the universe. . . . Throughout the ages, the nature, purpose, and movement of the moon have never ceased to fascinate man, and always he has had a yearning to reach its surface. Modern man is on the threshold of fulfilling that dream."

In 1952 von Braun wrote his book *The Mars Project*, in which he outlined in great detail the method for carrying out a successful manned mission to Mars. His plan has not yet been implemented, and stands as one of the great achievements that the second quarter-century of NASA work must accomplish.

"The expedition to Mars," he wrote, "should be considered the ultimate achievement of a gradual and often painful step-by-step development of manned space flight which may take many decades to accomplish." Von Braun projected an expedition of 12 men, two ships, and an effort that would take two years and 239 days.

"By the time the Mars expedition is in its preliminary planning stage, space stations will have been an accomplished fact for years, and there will be many—possibly as many as 1,000—men who will have spent some time on space-station duty. There will be at least one hundred rocket-ship pilots who have flown supply ships to the space station. . . ."

Wernher von Braun died just eight years after his Saturn V rocket took the first crew of astronauts to their lunar landing. His detailed engineering designs for the Mars project and space colonization are yet to be realized.

In a conversation with his friend and biographer Erik Bergaust in 1971, von Braun indicated where he saw the next set of problems man had to tackle: "Human travel beyond our own solar system . . . is a staggering concept. Even the most reckless of us do not expect it to come about for several generations. . . .

"To build a rocket powerful enough to travel that far [to the nearest star, Alpha Centauri, 4.3 light years away] we must contemplate an entirely new art. . . . To reduce travel time to other fixed stars to figures compatible with the life span of man, travel speeds must approach the speed of light. Not even nuclear fission or nuclear fusion processes are adequate to produce such speeds. . . . The problem is that nobody knows—yet—how to build a proton rocket. . . ."

Ehricke: 'The universe is man's field of activity'

In 1929, when Krafft Ehricke was 12 years old, he saw the motion picture, "The Girl in the Moon." Hermann Oberth, his future teacher, had been the film's technical advisor. According to Ehricke, his mind has been more in space than on the Earth ever since.

After his work on the German Peenemünde rocket project, Ehricke came to the United States and in the 1960s was responsible for the development of the liquid-hydrogen-fueled Centaur rocket. He has brought Hermann Oberth's ideas for orbiting mirrors into engineering reality in the form of Lunettas and Solettas and has developed a comprehensive five-phase program for industrializing the Moon.

In a presentation in New York City on November 28, 1981, after a tour of speaking engagements in Europe, Ehricke said, "With the urbanization of the Moon, we will see a third dimension of our civilization arise. Lunar industry will provide an unbelievable boost to industry on Earth. The heart of the lunar settlement will be fission reactors first, and then fusion reactors."

Ehricke has had to do battle with the full array of anti-nuclear environmentalists for the past fifteen years. As early as 1960 he stated in Congressional testimony that "The universe is run by nuclear energy. Space will be conquered only by manned nuclear powered vehicles. Planning anything else for the late 1960s is, in my opinion, flirting with obsolescence almost from the start. . . ."

In the November 1957 issue of *Astronautics* magazine, Ehricke laid out the philosophical basis for his commitment to the human development of space. He explained his "three laws" of astronautics:

"I. Nobody and nothing under the natural laws of this universe imposes any limitations on man except man himself.

"II. Not only the Earth, but the entire Solar System, and as much of the universe as he can reach under the laws of nature, are man's rightful field of activity.

"III. By expanding through the universe, man fulfills his destiny as an element of life, endowed with the power of reason and the wisdom of the moral law within himself."

Ehricke ended his 1981 lecture on lunar development by stating that "All this is thought out and developed to a point where a five-phase development program could begin under the Reagan administration, and we could have the first permanent circumlunar settlement in a lunar space station in 1992, the 500th anniversary of Columbus's discovery of the New World."