China's Lunar Far-Side Mission Has Made History

by Marsha Freeman

Jan. 20—On January 3, at 10:26 a.m. Beijing time, China's Chang'e-4 spacecraft landed in the south polar region on the far side of the Moon. This high-risk mission has opened the previously unexplored, scientifically unique, and potentially highly valuable hemisphere of the Moon, which is never seen from Earth. Prior to Chang'e-4, the far side of the Moon was only seen in glances from orbit by the Apollo astronauts and robotic spacecraft. The Chang'e-4 lander and rover are the first to study the far side *in situ*.

JPL/NASA

Moon's far side.

For years, political commentators have ridiculed the Chinese space program as merely doing what the United States did in the 1960s (the which it can no longer do).

Now China has done something that has never been done before! This should jolt Americans out of their stupor of recent years, which allowed the shuttering of our manned space program. And it has been done not to gain publicity or because there is a "space race," but because it is a crucial aspect of China's national commitment to contribute breakthroughs in new universal principles in science. China's space program is a science driver for its own economy and for those along the Belt and Road. The transfer of space technology to the economy is aimed at increasing economic productivity and people's standard of living in China, and in the dozens of countries that are participating in the "great projects" that are underway.

U.S. responses to this Chinese space advance run the political gamut. Former NASA Administrator Charlie Bolden has called for removing Congressional obstacles to enable U.S. space cooperation with China, while the genetically anti-China think tanks see the lunar mission as a further provocation by China, which is supposedly preparing for military action against the United States from space.

On Jan. 19, NASA issued a statement proposing new areas of cooperation with China on lunar exploration, offering to help analyze the imagery of Chang'e-4's landing plume (dust that is ejected upward when a spacecraft lands), as well as offering close collaboration with NASA's counterpart in China, the China National Space Administration (CNSA) in exchanging, collecting and analyzing data to be able to have the Lunar Reconnaissance Orbiter (LRO) go over the Chang'e-4 site to take high-definition pictures; the LRO will be in an ideal position to do so on Jan. 31.

America, too, used to have a lunar exploration program. This coming July, the entire world will celebrate

China Lunar Exploration Program

China's Chang'e-4 rover, Yutu-2, gets to work on the far side of the Moon.

NASA/Paul E. Alers

Former NASA Administrator Charles Bolden at the Kennedy Space Center in Cape Canaveral, Florida on July 21, 2011.

the 50th anniversary of the Apollo 11 mission—man's first steps on the Moon. It is remarkable—and tragic—that, in five decades, the United States has not returned to the Moon, and this failure has contributed to the cultural pessimism of our youth.

What has increasingly gripped the United States since the assassinations of President John F. Kennedy, Bobby Kennedy and Dr. Martin Luther King, is the British oligarchy-centered financial strangulation of investment in the productive economy, replaced by financial resources being transferred to highly speculative and worthless paper. While bankrupt financial institutions are bailed out to the tune of tens of trillions of dollars, there is "not enough money" in the federal budget for the space program, fusion energy, or breakthrough areas of science.

Even more deadly than the financial cuts and destruction of infrastructure, was the injection—as if with a virus—of the "rock-drug-sex counterculture" in the aftermath of the Kennedy and King assassinations. The primary vector of this intellectual and moral decay of American culture was the anti-science and anti-human "environmentalist" movement.

As Henry Ford aptly put it, "Whether you think you can, or you think you can't—you're right." If you believe that man is simply a beast and that the world is overpopulated (particularly among darker-skinned people), then why go to the Moon at all?

LaRouche on the Spirit of Inquiry

China has surpassed the United States in some aspects of lunar exploration. But, America can overthrow the ever-increasing insanity of the post-JFK era and uniquely take a critically important, leading role because of our historical mission as a nation. It was America that defeated the British Empire; it was FDR who opposed the Empire after WWII; and we were the first nation to land a man on the Moon and bring him safely back to Earth. That Moon mission was an accomplishment for all mankind.

We can "leapfrog" over these obstacles, by re-igniting the idea of mission—not just a return of Man to the Moon, but an intensive "crash-program"—for Moon-Mars colonization, as initially outlined by Lyndon H. LaRouche at a conference held in 1985.[1] The Chang'e-4 mission can be the spark that ignites such a mission.

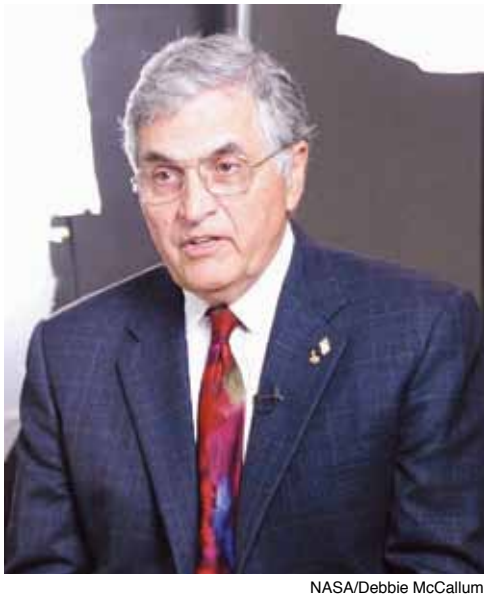
The intention of space exploration is truly the eventual colonization of the Solar system. LaRouche's "Moon-Mars Colonization" program treats the two heavenly bodies as one unit; that we do not explore the Moon "in and of itself," but that these investigations are the stepping stones to colonization of the Moon *and beyond*.

In his 1985 presentation, LaRouche emphasized the moral necessity of a crash-program for space exploration:

> Any intelligent and reflective person, must recall as the most joyful moments of his or her life as a pupil in primary and secondary schools, as those moments of discovery, in which the act of discovery was associated with an emotion at once impassioned and sublime. We sometimes speak of such moments as "a light going on in the head." It can best be described as a "beautiful experience." When we, as happy children, relive some discovery of the past in the course of our studies, we experience a kind of joyful excitement akin to the most profound sense of love, the quality of love summed up by Dante Alighieri in the concluding, empyreal canto of his Commedia. . . .

1. LaRouche, Lyndon H., "Private Initiative for Colonizing the Moon and Mars," *EIR* Vol. 12, No. 31. August 9, 1985.

In adult life, the individual's creative powers are an extension and maturation of such joyful experiences as young pupils. The adult scientist strives to experience those beautiful moments of childhood experience, within the scale of reference assigned to his practical duties as an adult member of society. To be able to retain such motives and creative powers, is to love oneself, is expressive of the highest degree of happiness an individual can attain in this mortal life. No matter how crabbed, peevish, or other the personality defects with which a scientist may be adorned in social practice in the classroom or in other practice of the profession or personal life, what makes him a fruitful scientist is a childlike quality within him, the sweet fruit among the worms of his personality defects.



NASA/Debbie McCallum

Former astronaut Harrison Schmitt, in 2009.

The essence of science is such passion, such task-orientation. Herein lies the source of energy for sustained concentration-span in rigorous reexamination of prevailing assumptions. Herein lies not only the passion indispensable to creative-scientific fruitfulness; herein lies the capacity of the layman, as factory operative, or other, to assimilate scientific progress efficiently, creatively.

It is such so-impassioned "task-orientation," situated within a fierce attachment to Socratic rigor, which is the wellspring of great upsurges of scientific creativity, and upsurges of the enlarged capacity of populations for "imparting and receiving profound and impassioned conceptions respecting man and nature." To afford to scientific progress, the unifying form of task-orientation supplied by a proper choice of grand mission-assignment, is the optimal circumstance for high rates of productions in the advancement of applications of fundamental scientific progress.

Fortunately—and perhaps ironically—other nations are rejecting the "Green Agenda," and instead adopting aspects of LaRouche's perspective.

China is using its national financial and physical resources for great infrastructure projects. Lunar mission chief designer Wu Weiren, in an interview on January 14 with CGTN, said that China must lift its people out of poverty, but in doing this, he added, "We should aim deeper into the sky. One philosopher has said that if a nation does not look up at the starry sky and only buries its head and feet, this nation has no hope and no future."

The future of mankind is taking shape through the space exploration missions of many nations, with China now leading the way in exploring the Moon.

Chang'e-4: A Mission of Firsts

The Chang'e-4 mission has demonstrated a number of firsts in China's lunar exploration program, but also firsts for the entire global exploration community. China's scientists were not the first to propose a high-risk lunar far-side mission. Apollo 17 astronaut and geologist Harrison Schmitt had proposed that NASA send astronauts to land on the far side. The space agency determined that such a mission was too risky, and of course it didn't have the funding for such a mission. Thereafter, the mission was ceded to China. The firsts carried out by the Chang'e-4 mission are, most notably:

- The first landing of a spacecraft on the far side of the Moon.
- The first deployment of a relay satellite to be the communication link between a lander and rover, and mission control on Earth.
- The first autonomous landing on the Moon, with the navigational ability to hover, in order to find a safe landing site.
- The first attempt to grow plants on the Moon.

The far-side landing mission was not part of the China National Space Agency's original three-phase lunar exploration plan, but it was rather quickly "repurposed" from an "extra" spacecraft—which showed agility and a prepared disposition on the part of the scientists and the bureaucracy.

Although the far side is often erroneously described as the dark side, both sides of the Moon receive an equal amount of sunlight, as the Moon rotates on its axis. We

never see the far side due to the "tidal locking" of the Moon with the Earth; the Moon's period of rotation on its axis is in sync with its rotation around the Earth (about a month), which results in the same side always facing the Earth. The far side is "dark," only in the sense of our lack of knowledge about it.

Due to this tidal locking, communications with spacecraft on the far side—commands sent from Earth to the spacecraft, and data from the craft back to Earth—cannot be done directly. Therefore, last May, China launched a relay satellite named "Queqiao," or "Bridge of Magpies,"[2] to a region about 60,000 km past the Moon to the gravitationally-stable "L-2" region, where it needs little fuel to maintain its position. From that vantage point, it can communicate with the spacecraft on the Moon's far side, and the scientists and engineers on Earth, simultaneously. China has offered use of the relay satellite to any other nation with a mission on the far side in the future.

A second challenge was to land Chang'e-4 autonomously. Even though the lag time in communication via the relay satellite is only 60 seconds, the choosing of a safe landing site had to be done quickly, and the spacecraft was equipped with the capability to decide where it was safe to land.

Another innovative design was the delightful inclusion of a small canister placed on the lander containing seeds, fruit flies and other very small living creatures—a miniature biosphere experiment—another first—the first ever to be carried out beyond low Earth orbit. The goal was to create a "mini-biosphere," in which as the plants grow, they produce the oxygen needed by the flies, and as the flies grow, they produce the carbon dioxide needed by the plants. This experiment involved the collaboration of 28 Chinese universities, led by Chongqing University.

The light for the canister was piped in sunlight from the outside, but there was no heating device to protect the plants. So, sadly, as the day turned to night at the landing site, the plants died. However, at a January 15 press conference, Chinese scientists reported that more than 170 photographs were taken of the activity inside the small tin canister. Images sent back, says Prof. Xie Gengxin from Chongqing University (who designed the experiment), show that at least one cotton seed has sprouted and started to grow. Until now, Xie says, such growth experiments were only conducted in low Earth orbit. This has been the first one on the Moon, and as news of this marvelous event has flashed around the globe, it has ignited the imaginations of youth everywhere: "A seed has sprouted on the Moon!"

unknown artist, after Tang Yin

In Chinese folklore, the goddess Chang'e.

Harvest of Anomalies

The far side of the Moon is distinctly different from the hemisphere seen from the Earth, which difference is yet to be explained. It is one thing to design experiments to look for those things you hypothesize exist; it is quite another to look for anomalies. On the far side, there are few smooth plains called *maria*, Latin for seas, because early astronomers thought the dark areas on the Moon were oceans of water. These *maria*, now known to be formed by ancient lava flows, are prominent features on the side that we "see" as "the Man in the Moon," or a Rabbit, or other such imagery, depending on our cultural traditions.

The far side is characterized instead by craters, with numerous smaller craters within larger, older ones. Chang'e-4 now sits inside the 186-km diameter Von Kármán crater, within the huge 2,500 km-wide South Pole-Aitkin Basin, which is the oldest and largest lunar impact crater. Previous orbital observations suggest there are large caches of water ice there.

Geology is another area of science which beckons us and promises amazing discoveries. Moon rocks from previous manned missions indicate that the Moon is

2. According to Chinese folklore, a Cowherd and Weaving Maid were in love with each other, but forbidden by their families to marry. The gods had pity on them, and lifted them up to the heavens. The Cowherd can be seen in the summer sky as a bright star in the constellation Aquila (west of the Milky Way) and the Weaving Maid as the star Vega (east of the Milky Way); they appear closer together than at any other time of the year. The star-lovers are permitted to meet once a year on the Bridge of Magpies, spanning the Milky Way; children are reminded that no magpies will be seen on that evening (the seventh day of the seventh month), because all the magpies have flown to form a bridge in the heavens with their wings.

Chongqing University

A Chongqing University research team holds the biosphere canister experiment they developed, housing plants and insects. It was carried on the Chang'e-4 lunar lander.

older than the Earth—how can this be?! Samples of soil from the lunar near side, brought back by the Apollo astronauts, are very similar—but not identical—in chemical composition to that of the far side (as measured from orbit by spacecraft such NASA's *Clementine* and the European Space Agency's SMART-1). Therefore, there are still lively debates regarding the origin of the Moon.

Unlike the near side, which is shielded by the Earth from a certain amount of galactic cosmic radiation, the far side is completely exposed. Perhaps this exposure to radiation could account for some of the difference in the geologic history of the two different hemispheres of the Moon, such as volcanic activity. Could it account for differences in chemistry?

Additionally, the surface of the Moon is extremely hard—the *maria* are composed primarily of ilmenite—an ore of titanium. The rock outcroppings have a different chemical composition than the moon dust—what are their origins? Usually, when planets form, heavier elements migrate to the core, and the lighter elements move toward the surface—but, on the Moon, the heavier elements are on the surface! How can this be? It is precisely these kinds of burning questions which Chang'e-4 can begin to address.

Science on the Moon

The Yutu-2 rover is equipped with an imaging spectrometer, enabling an analysis of the chemical composition of the lunar surface. The ground-penetrating radar aboard will create images of the various layers of the Moon, to reveal the history and geologic features below the surface. These can be compared to radar data that Yutu has been gathering from the near side of the Moon, on the Chang'e-3 mission.

In 2015, when the Chang'e-4 mission was under development, China invited other countries to contribute experiments. The Advanced Small Analyzer for Neutrals, contributed by Sweden, will explore how the solar wind interacts with particles and the soil on the Moon. And, the German "Lunar Lander Neutrons and Dosimetry" (LND) experiment will make measurements of the radiation environment in the vicinity of the landing site. As the scientists note, the poles of the Moon are the ideal place for lunar bases.

The lunar poles possess concentrations of water ice inside perpetually dark craters, due to the migration of water molecules (the mechanism for which is still under investigation), delivered by comets, meteorites, or the effects of the solar wind. The far-side south pole region also has mountains with "peaks of eternal light," that is, they are in sunshine most of the time, rather than just two weeks per month. For any future base to be visited by crew, access to water and solar power will be key. The Chinese plan is to create a robotic science base that would be visited periodically by astronauts.

A third international scientific payload takes advantage of the fact that, in never facing the Earth, the far side is not bombarded with manmade radio and other manmade electromagnetic noise. The Moon's quiet far side is the perfect place for radio astronomy, enabling us to peer ever more deeply into the Universe. Aboard the relay satellite is the Netherlands-China Low-Frequency Explorer. Its job is to map the radio sky to study large-scale "noise" in our galaxy, and to detect and explore solar and planetary radio bursts.

The Chinese scientists have pledged that they will share what they learn about the Moon with the international scientific community. This has not always been the case. The fact that two of the experiments on this mission were provided by non-Chinese institutions will most likely spur timely release of data, since the principal investigators traditionally get first access to the raw data as it is received—in this case from the relay satellite—by China's mission control, which will then make the data available to the public.

Chinese Academy of Sciences

Ouyang Ziyuan, father of the Chang'e program, speaking at the Xi'an Institute of Optics and Precision Mechanics of the Academy of Sciences in Xi'an, China, in November 2010.

The Father of Chang'e and Helium-3

China's series of lunar missions began in the mind of the now 84-year-old Ouyang Ziyuan drawing on the legend of Chang'e, the woman who flew to the Moon with her Jade Rabbit, having been banished from Earth on gaining immortality.

Despite an early interest in astronomy, Ouyang decided to study geology and mineral resources after high school. In a 2013 interview with Lu Yishan, a reporter with the *Yangcheng Evening News*, Ouyang explained:

> In 1957, Sputnik opened for humanity a new era of exploration. This gave me an extreme shock. I always believed China would have the capability of launching a satellite.
>
> I began to conduct a study of a meteorite in 1958, creating "Cosmo-chemistry." … Gradually, we pulled together a theory and an array of researchers for investigations of meteorites from the Moon and other celestial bodies.
>
> In 1978, President Carter's National Security Advisor, Zbigniew Brzezinski, visited China and left a small Chinese flag that had been taken to the Moon by an astronaut, and second, a piece of the Moon mounted in plexiglass about the size of a thumb.… The State Council asked the Academy of Sciences Guiyang Institute of Geochemistry to investigate the time and place where the rock was found.
>
> With great care, they examined the 0.5 grams. [They] issued a 14-page report and affirmed that the rock was picked up by the Apollo 17 astronauts, and determined where the rock was from, whether there was sunlight there, which they could tell from certain characteristics.
>
> In 1993, we submitted a proposal for a first lunar science mission.… Experts approved it. The Institute of Geochemistry issued a report in 1994, "The Necessity and Feasibility of China's Development of a Lunar Probe." In 1995, the Academy of Sciences proposed to continue the study of a program, which led to a more detailed proposal, "The Development Strategy and Long-Term Plan for China's Lunar Exploration." … The Academy approved a plan with three parts: 1) Unmanned probes; 2) Manned landings; and 3) Creation of a lunar base, with the development of resources and the lunar environment.
>
> The first, unmanned phase was later divided into three parts: orbiting, landing and sample return.

In 1998, Ouyang and his team were asked for specific designs, and following a gathering of experts from around the country from a variety of technical domains, Ouyang and his colleagues wrote a prospectus for the Chang'e program. On January 24, 2004, the State Council approved the report, as did Premier Wen Jiabao, ratifying the development of the Chang'e-1, which inaugurated the China Lunar Exploration Program (CLEP). Since its inception, Ouyang has been the chief scientist of the lunar program.

In 2007, China became a deep-space-exploring nation, when Chang'e-1 orbited the Moon. Three years later, Chang'e-2 took high-resolution photographs from lunar orbit to prepare for Chang'e-3 that would place a lander and the first Yutu rover on the surface of the Moon in 2013. As the United States *used to do for planetary missions*, an identical Chang'e-3 back-up spacecraft had been made, in case the mission failed. As the mission was a success, China's scientific community decided to "repurpose" the now-extra craft and announced in 2014 that they would attempt an historic first and send it to the far side of the Moon. It became the current mission, Chang'e-4.

From the beginning of China's lunar program, Ouyang lobbied for the development of the resources on the Moon. The most game-changing resource is

Helium-3 (He-3). Rarely found on Earth, He-3 is the perfect fuel for nuclear fusion. Lyndon LaRouche in his 2014 "Four New Laws to Save The U.S.A." specifies in his Fourth Law the need for a Fusion-Driver "Crash Program." Fusion energy will be achieved most efficiently using He-3 from the Moon as a fuel. The industrialization of the Moon, as elegantly described by space visionary Krafft Ehricke, will depend upon He-3 as a fuel source for fusion, to create an artificial biosphere to support people, and to operate mining and other equipment.

Painting by Christopher Sloan

Artist's depiction of the latest in a row of spherical fusion power plants under construction on the Moon, based on the concepts of space visionary Krafft Ehricke.

Footprints Across the Solar System

At the 36th Scientific Assembly of the UN Committee on Space Research, held in Beijing in July 2006, Ouyang presented a special lecture:

> One hundred tons of He-3 will be needed each year if nuclear fusion technology is applied to meet global energy demand. The Moon has reserves estimated to be between 1 and 5 million tons. Each year three Space Shuttle missions could bring back enough fuel for all human beings across the world. Millions of tons of He-3 on the Moon could provide "at least 10,000 years of energy for all mankind."

Ouyang explained that China's lunar missions have enabled the analysis of minerals in craters covering five elements. They will try to improve that to 14, he said. The target, he explained, is to "improve our understanding of He-3 reserves," and refine the estimate of the amount. Of course, available resources aren't fixed; they are created by the mind of mankind, and always a function of the prevailing technology—the more advanced the technology, the more resources become available.

Although many media have reported that the Yutu rover would be looking for He-3, as lunar scientist Paul Spudis explained to this author, because the He-3 resides on the Moon in concentrations of parts-per-billion in the soil, samples must be brought back to laboratories on Earth for analysis. That is exactly what the next mission, Chang'e-5, will do.

On January 14, the CNSA held a press conference on the ongoing Chang'e-4 mission and future lunar exploration missions. During the briefing, Wu Weiren, general designer of the lunar program, said that the CNSA is organizing Chinese experts to work on the follow-on lunar missions, and that following the Chang'e-5 near-side sample return mission, scheduled for launch later this year, three future missions are being planned:

- Chang'e-6 will conduct a south pole sample return. Whether it will be conducted on the near or far side of the Moon depends upon the results of the sampling mission of Chang'e-5.
- Chang'e-7 will conduct comprehensive exploration of the south pole, including its land forms, material composition and environment.
- Chang'e-8 will test key advanced technologies on the far side. Companies will be invited to industrialize the technologies. *China Science and Technology Daily* reports that Wu Yunhua from the CNSA added, "On Chang'e-8, we are planning even more crucial experiments for our lunar exploration, including to determine the possibility of establishing a lunar base for scientific research, if we can do 3D printing on the Moon, and whether it is possible to use the lunar soil for the construction of buildings, in order to jointly construct a lunar base for further exploration of the Moon."

For the scientists carrying out China's lunar exploration missions, the Moon is not the limit, but a necessary stepping stone to the rest of deep space.

Ouyang Ziyuan, now 84 years of age, attends the Chang'e lunar mission launches, and is looking beyond the Moon. He told Xinhua on November 23, 2012: "I hope Chinese people can set their 'footprints' all over the Solar System."