An Apollo astronaut argues that with its vast stores of nonpolluting nuclear fuel, our lunar neighbor holds the key to Earth’s future.

BY HARRISON H. SCHMITT
ILLUSTRATION BY PAUL DIMARE

Apollo 17 astronaut Harrison Schmitt left the moon 32 years ago with 244 pounds of rocks and an abiding desire to see humankind continue its exploration of space. Now, in an exclusive essay for POPULAR MECHANICS, Schmitt explains why the time is right for America to return.
A sample of soil from the rim of Camelot crater slid from my scoop into a Teflon bag to begin its trip to Earth with the crew of Apollo 17. Little did I know at the time, on Dec. 13, 1972, that sample 75501, along with samples from Apollo 11 and other missions, would provide the best reason to return to the moon in the 21st century. That realization would come 13 years later. In 1985, young engineers at the University of Wisconsin discovered that lunar soil contained significant quantities of a remarkable form of helium. Known as helium-3, it is a lightweight isotope of the familiar gas that fills birthday balloons.

Small quantities of helium-3 previously discovered on Earth simmered in the scientific community. The unique atomic structure of helium-3 promised to make it possible to use it as fuel for nuclear fusion, the process that powers the sun, to generate vast amounts of electrical power without creating the troublesome radioactive byproducts produced in conventional nuclear reactors. Extracting helium-3 from the moon and returning it to Earth would, of course, be difficult, but the potential rewards would be staggering for those who embarked upon this venture. Helium-3 could help free the United States—and the world—from dependence on fossil fuel.

That vision seemed impossibly distant during the decades in which manned space exploration languished. Yes, Americans and others made repeated trips into Earth orbit, but humanity seemed content to send only robots into the vastness beyond. But changed on Jan. 14, 2004, when President George W. Bush challenged NASA to land on the moon. This summer, the federal government supported the building of the transcontinental railroad with land grants. By the end of the 19th century, the private sector came infrastructure for our inevitable journeys to Mars and beyond.

A REASON TO RETURN
Throughout history, the search for precious resources—from food to minerals to energy—inspired humanity to explore and settle ever-more-remote regions of our planet. I believe that helium-3 could be the resource that makes the settlement of our moon both feasible and desirable.

Although quantities sufficient for research exist, no commercial supplies of helium-3 are present on Earth. If they were, we probably would be using them to produce electricity today. The more we learn about building fusion reactors, the more desirable a helium-3-fueled reactor becomes.

Researchers have tried several approaches to harnessing the awesome power of hydrogen fusion to generate electricity. The stumbling block is finding a way to achieve the temperature required to maintain a fusion reaction. All materials known to exist melt at these surface-of-the-sun conditions. For this reason, the reaction can take place only within a magnetic containment field, a sort of electromagnetic Thermos bottle. Scientists have developed a way to achieve fusion using deuterium, an isotope of hydrogen found in seawater. They soon discovered that sustaining the temperatures and pressures needed to maintain the so-called deuterium-deuterium fusion reaction for days on end exceeded the limits of the containment technology. Substituting helium-3 for tritium allows the use of electrostatic confinement, rather than needling magnets, and greatly reduces the complexity of fusion reactors as well as eliminates the production of high-level radioactive waste. These differences will make fusion a practical energy option for the first time.

It is not a lack of engineering skill that prevents us from using helium-3 to meet our energy needs, but a lack of the isotope itself. Vast quantities of helium originate in the sun, a small part of which is helium-3, rather than the

“Learning how to mine the moon for helium-3 will create the technological infrastructure for our inevitable journeys to Mars and beyond.”

message implied an important role for the private sector in leading human expansion into deep space. In the past, this type of public-private cooperation produced enormous dividends. Recognizing the distinctly American entrepreneurial spirit that drives pioneers, the President’s Commission on Implementation of U.S. Space Exploration Policy subsequently recommended that NASA encourage private space-related initiatives. I believe in going a step further. I believe that if government efforts lag, private enterprise should take us back to the moon, then to Mars and, ultimately, beyond.

Although the president’s announcement did not mention it explicitly, his

It was an electrifying call to action for those of us who share the vision of Americans leading humankind into deep space, continuing the ultimate migration that began 42 years ago when President John F. Kennedy first challenged NASA to land on the moon. We can do so again. If Bush’s initiative is sustained by Congress and future presidents, American leadership can take us back to the moon, then to Mars and, ultimately, beyond.

Throughout history, the search for evidence of large amounts of helium-3, a potential energy source.
more common helium-4. Both types of helium are transformed as they travel toward Earth as part of the solar wind. The precious isotope never arrives in the form of rock and soil to isolate the mate-
rial, making helium-3 rare on Earth.

Because the concentration of helium-3 is extremely low, it would be necessary to process large amounts of rock and soil to isolate the mate-
rial. Digging a patch of lunar surface

thoughly three-quarters of a square mile to a depth of about 9 ft. should yield about 220 pounds of helium-3—
ough to power a city the size of Dallas or Detroit for a year.

Although considerable lunar soil would have to be processed, the mini-
tests would not be high by terres-
trial standards. Automated machines, perhaps like those shown in the illus-
trations on pages 56 and 57, might perform the work. Extracting the isotope would not be particularly difficult. Heating and agitation release gas-
es trapped in the soil. As the vapors are cooled to absolute zero, the vari-
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rate out of the mix. In the final step, special membranes would separate helium-3 from ordinary helium.

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1. Helium is created in the sun. In space, helium is struck by cosmic rays. Cosmic rays knock out neutrons from helium, turning it into helium-3. Stray neutrons strike other helium atoms, creating more helium-3. 2. Diverted by Earth’s magnetic field, helium-3 collects on the moon. 3. heating rock and soil releases helium and helium-3.

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Living Off The Land

Exploration of the solar system will be fueled by materials found scattered across asteroids, moons and planets.

Studies conducted by NASA and others have determined that water, rocket propellant and chemicals needed to sustain a human outpost could be manufactured from martian soil and ice caps (right). Future astronauts might set up production plants that expand as others arrive. Eventually, the Mars base could become a resupply base.

As early as next year, we may learn whether Saturn’s largest moon, Titan, preserves organic molecules similar to those believed to exist on primeval Earth. The Cassini-Huygens spacecraft is designed to determine whether the atmosphere of Titan indeed contains ammonia and hydrocarbons such as ethane and methane. All these chemicals contain a common element: hydrogen.

Extracting this gas in a minus 400˚F environment could be easier than on Earth since it would be already liquefied and ready to be used as the most powerful chemical rocket fuel. With organic chemicals as ingredients, a limitless array of synthetic materials could be manufactured.

Taking advantage of this natural source of energy made perfect sense to some within the space community. A lightweight sail (above) could be folded and launched into space. Once in the vacuum of space, the frame attached to a spacecraft would deploy and the square-mile sail could push a spacecraft through interplanetary space faster than conventional propulsion systems, and reach the outer planets in one-fourth the time spacecraft currently take.

—S.C.