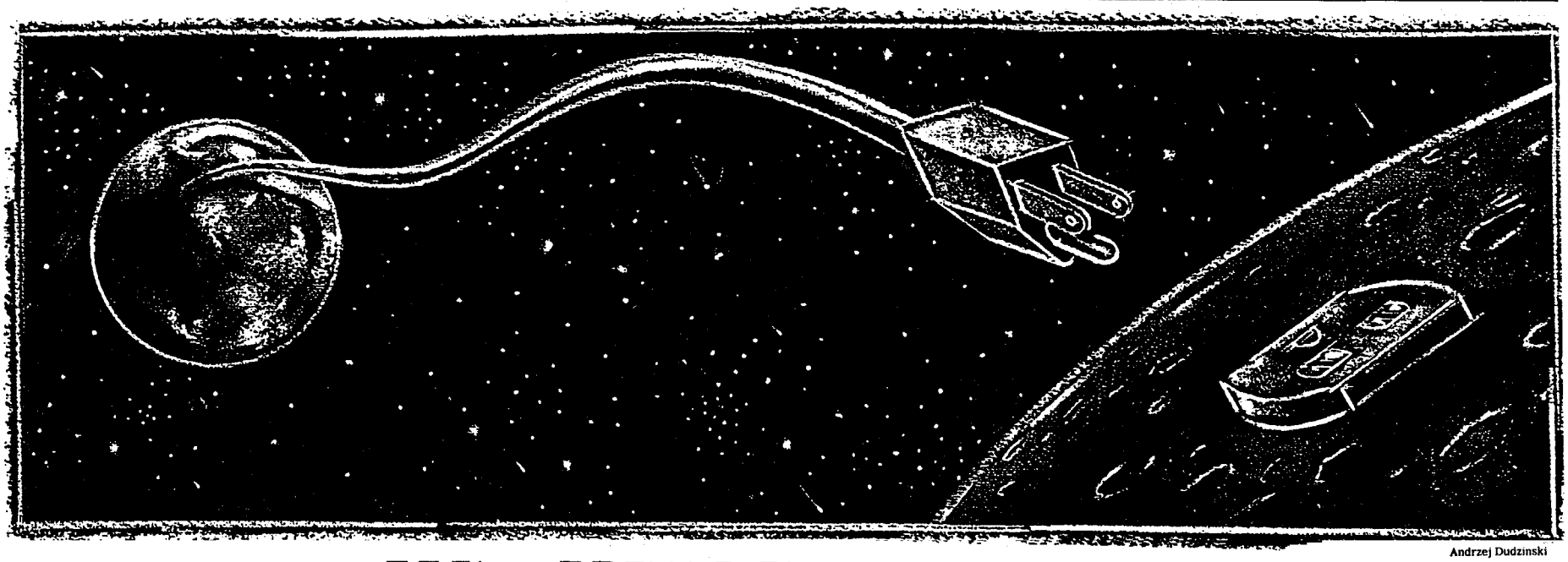

Andrzej Dudzinski

Who Will Mine the Moon?

By Lawrence E. Joseph

Perhaps the most important technological issue at the dawn of the 21st century is which nation will control nuclear fusion. Fusion is the mightiest known force in the universe, the one that powers the Sun, the stars and thermonuclear weapons. The energy future of the planet and the exploration of deep space may well depend upon whether we can harness this process for peaceful purposes.

The contest is coming down to two fuels: hydrogen, the perennial favorite, versus helium, the upstart. While Japan, Russia and the European Community are actively exploring both approaches, the U.S. Government supports hydrogen research only. And it may just be that we've bet our multibillion-dollar bundle on the wrong nag.

The standard method of creating nuclear fusion entails heating a gas to more than 100 million degrees centigrade while squeezing it so tightly that the nuclei of its atoms are forced to merge, releasing energy. Right now this process yields about 25 percent less energy than it takes to achieve and sustain fusion, but the working assumption has been that scientists will eventually pass the break-even point, and commercial fusion will go on to become a reality.

But there's a dirty little secret to nuclear fusion: it can be very dirty.

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Somehow, the myth has sprung up that unlike fission, the atom-splitting process that powers nuclear plants, fusion burns clean. In fact, deuterium-tritium fusion, the hydrogen-based process on which the U.S. Government has gambled nearly all its research funds, produces 80 percent of its energy in the form of lethal neutron radiation. At best this means enormous problems with high-level radioactive waste. At worst, the neutron fallout could weaken the reactor walls and cause a meltdown.

But there's an alternative: helium 3, an isotope of the gas that makes balloons float. Fusion based on helium 3 is much cleaner and more efficient than hydrogen fusion; only a few percentage points of its energy yield is in the form of harmful radiation, meaning that there is little or no waste or risk of meltdown. And unlike deuterium or tritium, which are radioactive, helium 3 is an inert gas, safe to handle. Glenn T. Seaborg, who won a Nobel Prize in Chemistry and has been a pioneer of peaceful nuclear technology, and Paul Nitze, an arms control adviser to every President from Harry S. Truman to Ronald Reagan, argued on this page in 1991 that no other source of energy could come close to providing as much power with as little pollution as helium 3.

Unfortunately, the gas is extremely hard to come by. Although it is present in the Earth's mantle and in the atmosphere, it is in such a diluted form that a sufficient amount can't be economically recovered, according to William Wilkes, a Department of Energy consultant who surveyed the world's helium 3 supply in 1993. He estimates that global reserves amount to 100 kilograms (about 220 pounds), most of it from the decay of tritium in nuclear warheads. This is enough for research but not for commercial use.

There are vast amounts of helium 3, however — perhaps a million metric tons, or the energy equivalent of 10 times all the recoverable fossil fuel that ever existed on this planet — lying ready to be extracted from the surface gravel of the Moon.

Last year, Japan announced plans to begin an exploratory project to mine helium 3 on the Moon. Government and private laboratories will begin tests this year with the goal of sending up robots and eventually manned missions. Japan has the money and information technology, and the driving need of a nation with few natural resources to secure its energy supply. Gerald Kulcinski, director of the Fusion Technology Institute at the University of Wisconsin, estimates that Japan's helium 3 fusion program outspends U.S. helium 3 research by 100 to 1.

> It's round two of the space race, and we're losing.

Japan's space program lacks the hardware and expertise for lunar missions. But Japanese investors have backed joint ventures with NPO Energia, the Russian space contractor that makes massive booster rockets. And collaboration between Japanese and Russian scientists on the proposed lunar mission is under study, according to Japan's National Space Development Agency.

Russia, with its formidable nuclear weapons stockpile, would be an attractive and logical partner. It offers decades of fusion expertise and about half the world's stock of helium 3 — and a space program that would love more than anything to beat us in round two of the race to the Moon.

Helium 3 may be the next chapter in the saga of great American discoveries that other nations capitalize on. The gas was first identified by the American scientists Robert Cornog and Luis Alvarez in 1939, but no one gave much thought to technological or commercial applications because it was so rare. And though the gas was found embedded in most lunar soil samples, that fact didn't really register until 1986, when University of Wisconsin researchers re-examined the Apollo missions' findings. Since then, Madison has become the center for U.S. helium 3 research.

Harrison Schmitt, the former Apollo 17 astronaut who also served a term as U.S. Senator from New Mexico, has taken up the cause. He believes that compact helium 3 fusion reactors will one day extend the range of space vehicles much the way that fission reactors have enabled nuclear submarines to spend months at a time underwater. Mr. Schmitt, the only geologist ever sent to the Moon, is convinced that it's possible to extract helium 3 economically and efficiently from the lunar soil. "One 25-ton space-shuttle cargo load of helium 3 would meet the equivalent of U.S. energy needs for about a year," he says.

Will the Moon become the Persian Gulf of the 21st century?

For most Americans, the oversized orb has fallen into a curious disrepute, stranded somewhere between a nostalgic "Right Stuff" past and a dim, distant future. The idea of Moon-mining just seems too far out, conjuring up fancy artists' representations that everyone knows will never amount to anything more than NASA deficits. If we can't stop kids from shooting each other in the schools, how on Earth are we going to mine the Moon?

But we could start small. With the new, parsimonious Congress, the Department of Energy's budget will certainly be reviewed. Rather than dedicate our entire fusion research budget to hydrogen-oriented technologies, how about 10 percent for alternative approaches, including helium 3? Why not spread the risk and diversify our fusion portfolio? And NASA's case for financing space programs will be a lot stronger if the objective is profit as well as prestige. If we ignore the potential of this remarkable fuel, the nation could slip behind in the race for control of the global economy, and our destiny beyond. □