Out of This World

Forget Sydney. The wildest Olympic sports could be played on the moon, Mars or the asteroid nearest you

by Ben Bova

The era of extraterrestrial sports began in February 1971, when *Apollo 14* astronauts Alan Shepard and Edgar Mitchell finished the second of their two moon walks in the Fra Mauro highlands. Shepard attached the head of a golf club (a six iron) to the handle of a sampling tool and swatted two golf balls. Swinging with only one hand because of his space suit's stiffness, Shepard topped the first ball; it rolled a few yards into a small crater. His second shot was better. "Miles and miles and miles!" Shepard exclaimed. Later he estimated that the ball flew for some 15 seconds and traveled about 200 yards.

Shepard's brief foray on the lunar links illustrates both the good and the bad of extraterrestrial athletics. The good news is that the alien environment can enhance athletic performance. The bad news is that the alien environment can diminish athletic performance.

Low gravity and lesser air pressure can allow humans to drive golf balls farther, hurl shot puts longer, lift greater masses and leap higher than their muscles let them do on Earth. But the human body must also be protected from the harsh radiation and lack of at-

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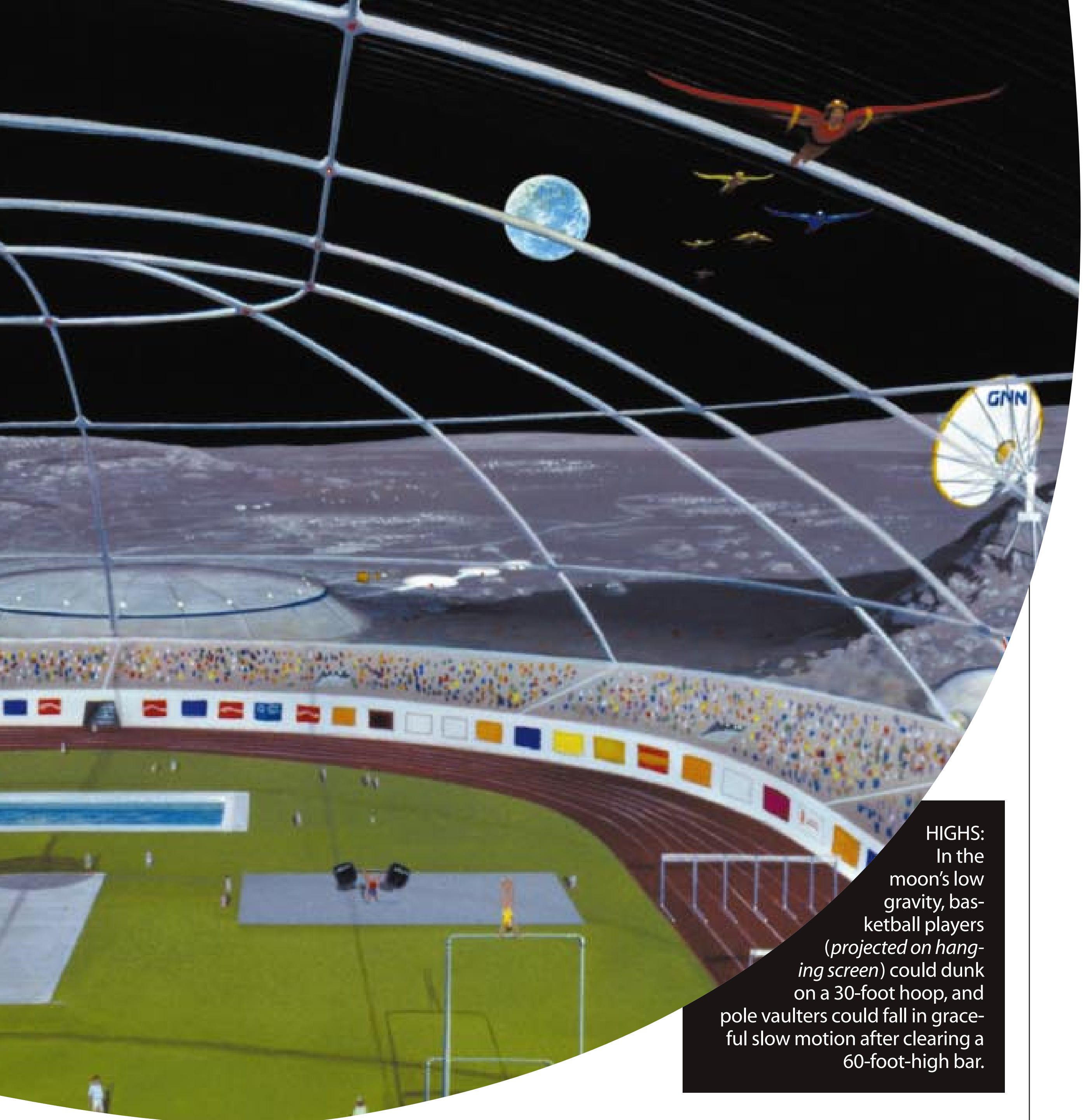

HIGHS: In the moon's low gravity, basketball players (*projected on hanging screen*) could dunk on a 30-foot hoop, and pole vaulters could fall in graceful slow motion after clearing a 60-foot-high bar.

mosphere on extraterrestrial worlds. A space suit must overcome the fundamental problem of maintaining at least several pounds of pressure per square inch on its inside while facing essentially zero pressure in the vacuum of space on its outside. Mismatched in this way, fabric suits balloon so much that they make it difficult for people to move their arms, legs and fingers. Harder suits of metal or stiff composite-plastic shells limit bending at the joints. Gloves that enable fine finger motions are a particular problem. And oh yes, space-worthy athletes need oxygen to breathe.

Given the limitations, sports around the solar system will most likely fall into two major categories: games played in enclosed spaces, such as orbiting space stations or underground habitats, and games played on the surfaces of alien worlds, in protective gear. Which leaves plenty of possibility for creativity and competition. The basic psyche of athletes—the desire to push the limits of body, mind, gear and environment—fuels the imagination to conjure up all kinds of fantastic new athletic challenges.

MOON FLYING

Athletes headed for the moon or beyond might warm up their competitive juices with some friendly gymnastics in the near-zero gravity of orbit. The living and working areas of the National Aeronautics and Space Administration's space shuttle are cramped, but for those with good muscle control there's room for some weightless spins, somersaults and twists.

HANG TIME: Muscle power alone would be enough to propel human fliers in lunar races of speed or endurance.

Once on the moon, our stellar stars would probably head right indoors. The surface of the moon is quite inhospitable. Airless, it is drenched with hard radiation from the sun and stars and is peppered with incoming meteoric dust. Surface temperatures can range from a boiling 270 degrees Fahrenheit in sunlight to a stiff –240 degrees F in darkness. It is possible to encounter a temperature swing of more than 400 degrees F merely by stepping from sunshine to shadow—a bit more of a shock than jumping into a "cold" lake on Earth.

A viable lunar base would be built mostly underground to protect its inhabitants. The interior areas of the base would be filled with a breathable mixture of oxygen and nitrogen, perhaps at nearly full Earth pressure. The athletic advantage would come from the gravity felt in the base, the same as that found anywhere else on the moon: approximately one sixth of terrestrial gravity. An object weighing 100 pounds on Earth would weigh only 17 pounds on the moon. Weight lifters could press many times their own Earthly weight, although they'd have to hang on real tight once they started pushing hundreds of pounds over their heads; stopping the momentum of the massive objects could be a greater test than lifting them.

More interesting would be the indoor flying event. It is feasible to fly on the moon using nothing more than ordinary human muscle power. In an enclosed space filled with air, under the low lunar gravity, a person's Earth-formed muscles are strong enough to lift him or her off the floor to fly, once the person is fitted with a proper set of wings.

Lunar flying would be somewhat like hang gliding, except that someone in decent aerobic shape could actually fly, not merely glide. Of course, fliers would need a large enclosed space in which to move and would sport lightweight wings on their arms. The wings would probably be made of thin plastic, braced with struts of magnesium, and could be manufactured at the lunar base, with all the necessary raw materials retrieved from the moon's surface. Once outfitted, a person could take off, climb, soar and even do aerobatics in the gentle gravity.

With the discovery of significant ice deposits at the lunar poles, it should also be possible to construct at least one swimming pool at the lunar base. It would be built in a separate enclosure, with an efficient water recycling system, and sealed to prevent water loss through evaporation. The water could be purified with oxygen produced from the lunar rocks rather than with chlorine. Although swimming offers good exercise and the psychological benefits of recreation, lunar athletes—and tourist visitors—would be attracted to the high-dive platforms. In the low gravity, platforms could be placed 30, 60, even 90 feet high. Dives would be spectacular; the low gravity means that divers would fall in graceful slow motion—a velocity of less than six feet per second, rather than Earth's 32. Divers would have a seeming eternity to complete numerous somersaults, pikes, gainers and swans before their ultrasoft landing in the water.

Court games on the moon would require much larger playing surfaces than those on Earth do. In lunar basketball, the hoops would be placed some 30 feet above the floor, and the court would be enclosed in clear plastic so that players could literally climb the walls! The ball would arc through the air in dreamy slow motion, yet the competitors would run just as fast as on Earth and jump many times higher. Champion teams would be defined by their ability to execute the slow break and the ceiling drop dunk.

LUNAR LINKS

Shepard's 1971 golf shots demonstrated the difficulty of trying athletic activities in a space suit. If a Lunar Olympic Games took place on the surface, however, there would have to be regulations that took into account the difficulties of running, throwing and lifting while enclosed in a bulky, stiff suit.

Running and walking are quite different on the moon than on Earth. The Apollo astronauts found that their muscles tended to bounce them up off the ground when they tried to take a normal step. Running turned into a series of gliding hops. A foot race would look more like a potato-sack race at a county fair, with the contestants hopping along the course.

Lunar athletic fields would have to be carefully prepared. The ground is rugged and difficult to traverse, littered with stones and boulders and pitted with craters ranging from the size of finger pokes to depressions that could swallow a school bus. Moreover, athletic competitions on the lunar surface would have to be shorter because of the radiation that constantly rains down. On Earth the average person is exposed to about 200 millirads of radiation per year, from natural and man-made sources. On the moon's surface the dose is thousands of times higher. Space suits would provide some protection, but surface activities would need to be strictly limited, for safety reasons.

Despite Shepard's enthusiasm, then, golf on lunar links poses numerous challenges. A decent duffer with a decent suit might hit a ball 500 yards with a driver. Given the need to speed the game to reduce exposure, players might be limited to a pitching wedge and putter to shorten play, or they might drive around the course in updated lunar rover carts. A brightly colored ball would be easier to find amid the rock-strewn landscape. There would be no dearth of sand traps; most of the lunar surface is covered with a powdery residue of micrometeorite dust with the approximate consistency of beach sand.

WHERE NO ONE HAS GONE BEFORE

The quality of the lunar surface suggests another, noncompetitive surface activity for lunar residents and visitors: a First Footprints Club (a concept originated by Hal Clement in his 1974 story "Mistaken for Granted"). Moon walkers could leave their footprints—or rather, boot prints—where literally "no one has gone before." Astronauts left boot prints wherever they walked—prints that will last millions of years in the silent, weatherless vacuum of the moon. A club member would find a spot that had not yet been disturbed, leave his or her boot prints there and spray them with a quick-setting clear plastic to protect them against newcomers. The site could be registered with the club, and the individual could receive a certificate bearing the lunar latitude and longitude of the prints.

Mountain climbing could be another sport. Major lunar craters are ringed with significant mountains. The prominent crater Alphonsus has crests that average more than 10,000 feet. In the lunar south pole region, several peaks are higher than Everest. But despite the light gravity, mountain climbing would be difficult and dangerous. Although most lunar mountains are neither as steep nor as rugged as the Alps, Rockies or Himalayas, their surfaces have been smoothed by billions of years of "sandpapering" by the constant infall of meteoric dust. Their slopes would be slick, perhaps even glassy, making lunar mountain climbing more like terrestrial ice climbing.

The tallest peaks in the solar system are on Mars. The Red Planet is home to several ancient shield

SUNJAMMING

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Interplanetary space itself might become the arena for the grandest yachting race. In Earth's vicinity, photons streaming from the sun exert a minuscule but real pressure, enough to accelerate a sail with a thrust of roughly 2.25×10^{-6} pound per square yard of sail. To get any reasonable push, solar sails would have to be of enormous size. The bigger the sail, though, the heavier it becomes, and the more difficult to accelerate. Sails would need to be no thicker than one ten-thousandth of an inch. Engineers believe that a plastic such as Kapton, coated with aluminum to reflect sunlight, could be this thin.

Sunjammer races would be majestic affairs, though painfully slow ones at their outset. It would take at least two days for a sail of 2.152 million square feet (a square with sides of more than a quarter of a mile) to go from an orbit around Earth to escape velocity, but once that speed had been achieved, the sailcraft could reach lunar orbit just as quickly as the Apollo spacecraft did: in roughly three days. In fact, once heading for the moon, sailors would make slightly better time than the Apollo astronauts did, because the sailcraft would be accelerating all the way (albeit slowly), whereas the Apollo vehicles coasted once their rocket engines burned out.

Earth-to-moon yacht races might be arranged when there are facilities on the moon to welcome the winner—and shuttles to rescue sailors in trouble. Sunjammer races would be leisurely, to say the least, but the news media would cover them the way they now cover the America's Cup seafaring races, which take many days to conclude. The world's television screens would show the stately racing yachts, gleaming sails unfurled against the black of deep space. They might appear to be motionless against the background of stars, but each second they would be pushed by the force of sunlight toward their distant goal. *—B.B.*

NO LIFT LINES: Skiers on Mars could enjoy a long, screaming run down the dry ice slopes of Olympus Mons, the tallest peak in the solar system at 88,500 feet.

volcanoes—similar to Mauna Loa and other Hawaiian volcanoes but much larger. The biggest is the aptly named Olympus Mons, three times higher than Everest. Its mighty lava flows cover an area the size of Washington State.

Shield volcanoes tend to have gentle slopes, and Olympus Mons's gradient is only a few degrees. Climbing it, even in space suits, should be relatively easy. Of course, the climbers would need to carry air to breathe, because the Martian atmosphere is as thin as the high stratosphere of Earth and composed almost entirely of carbon dioxide.

Mars is also extremely cold and dry. Although the ground temperature at the Martian equator in midsummer might rise to 70 degrees F, the temperature at nose level—a mere five feet higher—would be zero degrees F, because the thin Martian atmosphere retains virtually no heat. At night the temperature plunges below –100 degrees F.

Temperatures at the top of Olympus Mons's 88,500-foot peak regularly get cold enough to freeze out the carbon dioxide in the atmosphere. As a result, the peak can be covered with a thin layer of dry ice. This would make the going even more treacherous for climbers. When dry ice thaws, it does not melt. It sublimes, going directly from its solid state to gaseous carbon dioxide, with no liquid state in between. Although dry ice is not as slippery as water ice, the pressure of a human body's weight on a thin coating of dry ice might be enough to make the dry ice sublime into a thin coating of carbon dioxide gas. Gas bearings are used in machinery because they are almost friction-free. A mountain climber stepping onto a thin coating of dry ice might suddenly find herself slipping helplessly.

Skiers would love it, though. The thrill of sliding down the flank of the highest mountain in the solar system might be well-nigh irresistible to ski buffs, despite the cost and risks of reaching Mars and getting to the top of Olympus Mons.

Surface sports on Mars would be a modified version of lunar surface sports. The gravity is greater, roughly twice that of the moon and one third that of Earth. Although Mars has an atmosphere, it is much too thin to protect people against the solar system's hard radiation. Mars also lacks a magnetic field strong enough to deflect charged particles pouring in from space. So sporting events there would be limited in duration as well.

Mars is the most Earth-like planet in the solar system. The environments on Mercury and Venus are extremely hostile. And Jupiter, Saturn, Uranus and Neptune are gas giants; if there is any solid surface on these planets, it is buried beneath thousands of miles of atmospheric gases—mostly hydrogen, helium, methane and ammonia. Pluto, the smallest and farthest planet, is so cold that nitrogen condenses out of its atmosphere and falls as snow. None of these worlds seems a likely place for sports.

BLOODBOILING: THE ULTIMATE DAREDEVIL SPORT

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The human body cannot survive in the hard vacuum of space for more than a few moments. When exposed to vacuum, the blood begins to boil, as do the fluids in the eyeballs. Gases in the lungs and other organs erupt violently. But this does not happen immediately; a person suddenly exposed to vacuum may have nearly half a minute before his body is irreversibly damaged. This could lead to the "sport" of vacuum breathing, or bloodboiling: daredevils deliberately exposing themselves to vacuum, intent on setting a new record. As in "chicken" games on Earth, the casualty rate would be high, and such activities would be strictly prohibited—making them all the more tempting for rash tourists and workers bored with living in sealed space habitats. The rush would be greater than that of any Earth-bound "extreme" sport. *—B.B.*

A STONE'S THROW: Athletes on nearby asteroids would compete to hurl boulders into the farthest orbit.

If habitats are placed in orbit around them, however, the same opportunities for microgravitational athletics that are available in Earth orbit would be possible. Jupiter's four Galilean moons range in size from just smaller than our own moon (Europa) to slightly larger than Mercury (Ganymede). Saturn's largest moon, Titan, is bigger than the planet Mercury and covered with a thick, smoggy atmosphere of hydrocarbons. Habitats similar to those built on the moon would be needed to live on these distant satellites, and similar indoor sports might be accomplished on them. Surface activities on Jupiter's moons would be even more hazardous than on our own moon, because the intense Jovian radiation belts engulf the satellites' orbits.

ASTEROID HURLING

Although planets and moons grab our attention, we can't ignore the smaller worlds around us. Our solar system is rife with rocky and metallic asteroids ranging in size from Ceres, with a diameter of 560 miles, to specks hardly bigger than dust motes. Many of the moons of the outer planets—including Mars's Deimos and Phobos—are undoubtedly former asteroids that fell into orbits around those planets.

Athletic contests on these worldlets where gravity is at a minimum could be exciting, even in space suits. An asteroid such as Gaspra (roughly the size of Manhattan Island) would have such low gravity that a person could throw sizable objects into orbit around the asteroid or even fling them to escape velocity.

A new sport could arise: asteroid hurling. There could be a variety of ways to score points: throwing stones of the same mass into the farthest orbit (without throwing them to escape velocity, beyond orbit, which would be considered a foul); throwing the most massive stone into orbit—a kind of asteroidal form of weight lifting; or throwing a stone into an orbit of predetermined radius around the asteroid.

On such small bodies, contestants with a powerful throw would have to be wary of lifting themselves off the asteroid as a result of their own exertion, which would leave them floating helplessly out in space.

INTERPLANETARY OLYMPICS

Athletic records set on our solar system's many worlds could not properly be compared with records set on Earth because of the totally different environmental conditions, just as records from any one world could not reasonably be compared with those from another. But records from one Olympiad to another on the same world could be compared against each other. Or an interplanetary Olympics could be held—*lasting* four years, instead of being held every four years—in which famous athletes travel from planet to planet, attempting to set new records for each local event.

Despite this fantastic notion, for some time to come sports beyond Earth will be the domain of amateurs—the workers and researchers who are on those other worlds to study them or build habitats or run the facilities erected there. The cost of space travel alone will not soon encourage professional athletics. Perhaps this is all to the good.

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FURTHER INFORMATION

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