Jet would skitter across globe in 2 hours

By skipping along the top of the atmosphere like a rock skittering across a pond, a proposed new style of aircraft could fly between most points on Earth in only 2 hours, its proponents say.

The plane, dubbed HyperSoar, could attian a hypersonic top speed of 3 kilometers per second, or Mach 10—10 times the speed of sound. It could transport freight and people, strike enemy targets, or help propel payloads into space. In most uses, it would not only go places faster but would also haul more load per kilogram of aircraft than existing planes or rockets do, says Preston H. Carter, an aerospace engineer at Lawrence Livermore (Calif.) National Laboratory.

After developing the concept for a decade, partly in collaboration with engineers at the University of Maryland, College Park, Carter has been pitching it during the past year to the military and NASA. He hopes to find sponsors willing to pay an estimated $500 million to build a 16-meter-long unmanned prototype. A full-scale plane would be 65 meters in length, roughly as long as the wingspan of a Boeing 747, Carter says.

"It's a great airplane. It's a great launch vehicle. But it's a new airplane and new technology, and therefore everyone is being very cautious," he says.

The aircraft, whose knife-edged profile resembles a folded paper plane, would make a conventional take-off from a standard runway, jet out of the atmosphere to a height of about 60 km, and then coast back toward Earth at a shallow angle to begin the skipping part of its flight.

Aerodynamic lift, increasing as the descending plane meets denser air, would cause the aircraft to glance back upward at an altitude of about 35 km. The engines then would kick in briefly, helping lob the plane back up to its peak altitude. The plane would repeat its porpoise-like bobbing, with an engine-assist on each upswing, until it reached its destination. It would bob roughly every 2 minutes, subjecting passengers alternately to about 1.5 times Earth's gravity—a little more than that of a normal take-off—and weightlessness, Carter says.

No plane has ever used a skipping trajectory, but the idea has been around for some 20 years, promoted mainly by Jason Speyer, an aerospace engineer at the University of California, Los Angeles. By regularly popping out of the atmosphere, an airplane flying faster than about Mach 8 would save fuel, heat less from atmospheric friction, and avoid creating a blanket of charged particles that disrupts radio communications, Speyer says.

The fastest military plane, the SR71, flies at speeds of between Mach 3 and Mach 4. The commercial speed champion, the Concorde, only reaches Mach 2.

The HyperSoar concept, which will be described in a future issue of the JOURNAL OF AIRCRAFT, "appears to be a reasonable approach," Speyer says.

Engineers at the Boeing Co. in St. Louis and James L. Hunt of NASA's Langley Research Center in Hampton, Va., have also proposed a hypersonic vehicle capable of both atmospheric and space use. Their Vision aircraft, unveiled in April at the Space Planes and Hypersonic Systems and Technologies Conference in Norfolk, Va., resembles HyperSoar but does not follow an undulating flight pattern.

Carter claims that HyperSoar is superior, but Hunt says both approaches need more detailed analysis. Neither group has yet investigated possible adverse environmental effects from emissions or sonic booms, which have plagued attempts to develop slower, supersonic transport planes (SN: 10/7/95, p. 229). —*P. Weiss*

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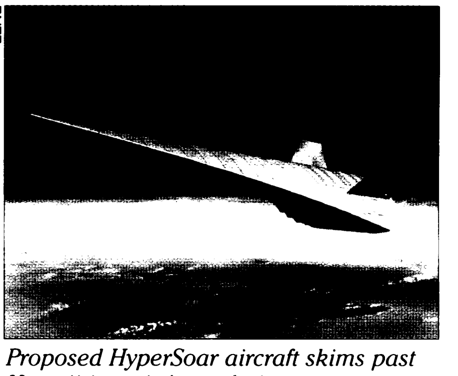


Proposed HyperSoar aircraft skims past Hawaii in artist's rendering.

New lead record is no honor

More than 70 percent of toddlers and preschoolers coming to an inner-city Philadelphia clinic had excess levels of lead in their blood, a new study finds, "the highest reported prevalence in a U.S. general pediatric clinic population."

Pediatrician Shoshana T. Melman of St. ChrisCare Pediatric Services in Philadelphia and her colleagues assayed blood collected during routine visits from 817 children. By excluding any child known to have ever had elevated blood-lead levels, the findings may even understate the problem's magnitude, Melman's team reports in the October ENVIRONMENTAL HEALTH PERSPECTIVES.

Children can suffer developmental delays, diminished IQ, small stature, and impaired balance from exposure to excess lead, defined as 10 or more micrograms per deciliter of blood.

Federal guidelines recommend universal lead screening but say it may not be needed among children known to be low-risk. However, Melman argues, her "unexpected" findings suggest that pediatricians should be "reluctant to abandon universal screening" unless local health authorities have thoroughly documented where low-risk groups reside. —*J.R.*

Mooning over the dust rings of Jupiter

The deep impacts that killed the dinosaurs or excavated our moon's vast craters count among the most spectacular examples of collisions in the solar system. Even little crashes, however, can make a big difference.

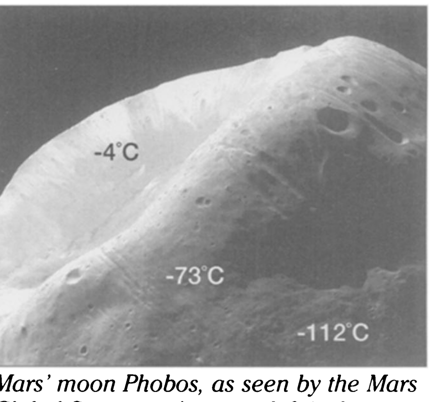
Images taken by the Galileo spacecraft reveal that the dust kicked up by scraps of interplanetary debris plowing into four of Jupiter's tiniest moons are the source of the giant planet's dust rings. Mars' moon Phobos also has been pummeled and its surface pulverized into powder perhaps a meter deep.

Faint rings encircling Jupiter's equator between the planet and its large moon Io were discovered by the two Voyager craft in the late 1970s. The craft revealed a flattened main ring, along with a puffier, inner ring called the halo. The observations also hinted at a third, wispy, outer ring. Galileo images, taken in 1996 and 1997 and released this week, show that the outer ring is in fact two rings, dubbed gossamer rings.

Jupiter's tiny moon Adrastea, only 20 kilometers across, skims the main ring's outer edge, while another small satellite, Metis, lies within the ring. The Galileo pictures confirm that the ring's densest part is the outer edge, adding weight to earlier suspicions that Adrastea feeds the ring. As one of the smallest Jovian moons, Adrastea has weak gravity and stands to lose great amounts of dust during any impacts.

The new pictures show that two other moons, Thebe and Amalthea, each orbit the outer edge of a different gossamer ring and provide the material for them. The halo appears to be made of charged dust particles that are lifted out of the main ring by electromagnetic forces, says

Malin Space Science Systems/ JPL, Christenson



Mars' moon Phobos, as seen by the Mars Global Surveyor. At upper left is the moon's largest crater, Stickney. The sunlit and nighttime regions show a huge variation in temperature.

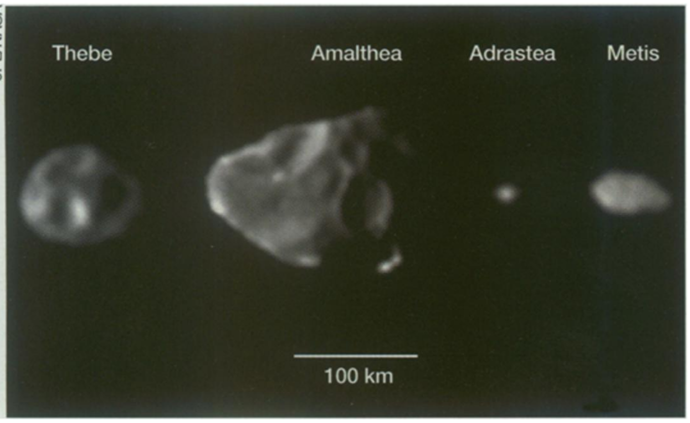
Joseph Veverka of Cornell University.

"For the first time we understand why Jupiter has rings and how the rings actually work," he says. Veverka and his colleagues unveiled the Galileo images at a Cornell press briefing.

All four moons appear dark, red, and heavily cratered, indicating that they have been bombarded by meteoroids, which are fragments of asteroids and comets. Correspondingly, the rings contain tiny, reddish particles that resemble dark soot. Galileo viewed the rings almost edge-on, lit from behind by the sun, an arrangement that made micrometer-size particles highly visible.

The angles at which the satellites orbit Jupiter, relative to the planet's equatorial plane, correlate with the vertical extent, or height, of the rings. Adrastea and Metis orbit Jupiter almost exactly in the equatorial plane. Such orbits do not wobble, and dust lifted from the surface of these moons forms a flat ring.

JPL/NASA



The four small, inner moons of Jupiter differ in size.

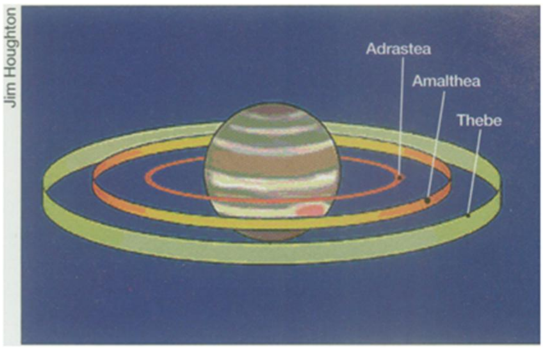
In contrast, the paths of Amalthea and Thebe tilt. Over several months, their orbits precess about the equator like gyrating hula hoops. Dust from these moons create rings with significant height, like the gossamer rings.

Because the ring particles eventually spiral into Jupiter, the rings would vanish without a supply of new material, Veverka says. The moons provide this reservoir as long as debris continue to pelt them. In a similar fashion, he adds, the small moons orbiting Uranus and Neptune may be the source of the faint dust rings surrounding those planets.

Saturn's famous rings, which are much more massive and contain larger, icy particles, are thought to have a different origin—either the breakup of a giant, frozen body or collisions between several large, icy moons. The Cassini mission, expected to reach Saturn in 2004, will fly through the ice rings. In December 2000, the craft will swing past Jupiter and is scheduled to view the dust rings from a different angle than Galileo did, notes Carl D. Murray of Queen Mary and Westfield College in London.

Closer to home, the Mars Global Surveyor has found another example of a body that appears to have been pounded by debris. In this case, the surface is pulverized into dust that stays on the moon.

Jim Houghton



Position of three of the small, inner Jovian moons relative to the main ring (interior) and the two gossamer rings. Metis lies just inside the main ring. The vertical extent of the gossamer rings is greater than that of the main ring.

Temperature measurements of the Martian moon Phobos reveal that it rapidly loses heat after sunset. Although Phobos completes one revolution in just 7 hours, its sunlit side has an average temperature of -4°C, far higher than the night side's average of -112°C.

Solid rock or boulders retain heat, but powder cannot, explains Philip R. Christensen of Arizona State University in Tempe. The large temperature variation on Phobos and the moon's lack of jagged surface features suggest that its topmost layer has been ground into a fine powder that might be as deep as 1 meter, he says. NASA announced the finding last week.

The powder "could be the future source of a dust ring around Mars," says Murray. —*R. Cowen*

Fish enzyme flexes to adapt to the cold

Fields

An Antarctic icefish, Chaenocephalus aceratus.

In the chilly seawater around Antarctica, fish thrive at temperatures that would turn warm-water species into fish-sicles. Now, researchers at Stanford University's Hopkins Marine Station in Pacific Grove, Calif., have proposed how an enzyme in the cold-water species accommodates those frigid temperatures.

Marine biologists Peter A. Fields and George N. Somero looked at the enzyme lactate dehydrogenase from closely related species of cold-water fish called notothenioids. They studied nine Antarctic species that live at temperatures as low as -1.86°C, the freezing point of seawater, and three South American species that swim in waters having temperatures up to 10°C.

During metabolism, lactate dehydrogenase, a well-characterized enzyme found in many animals, converts a compound called pyruvate into one called lactate. The researchers isolated this enzyme from the fishes' muscles.

In the notothenioids, lactate dehydrogenase converts pyruvate at speeds comparable to those in animals with higher body temperatures, even though cold generally slows such reactions. To determine how the enzyme maintains its speed, the researchers examined differences between the sequences of amino acids that make up lactate dehydrogenases in the different fish.

They found that the variation is concentrated in areas close to the enzyme's active site, the region that binds to pyruvate. Those changes "seem to be increasing the flexibility and mobility, greasing the hinges so that the enzyme can move more quickly," Fields says. Flexibility in the molecule appears to compensate for any slowdown caused by the cold.

The agility, however, has a price. The more flexible enzyme can more easily twist into shapes that can't wrap tightly around pyruvate, so overall, it doesn't bind its substrate as well as its warmth-adapted counterparts do. Fields and Somero report their findings in the Sept. 15 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Aside from insight into the fishes' biochemistry, says ichthyologist Joseph T. Eastman of Ohio University in Athens, the results provide clues to the evolution of notothenioids. For example, the amino acid sequence from one South American species resembled those from the Antarctic species, suggesting that it migrated from Antarctica.

"I thought it was a really nice study," Eastman says. "It was a tremendous amount of work to get such a wide ecological sample." —*C. Wu*