growth: the link between metabolism and brain size. He and Oxford colleague Mark Pagel showed in 1988 in the journal *Evolution* that animals with high basal metabolic rates for their body size, such as shrews, do not produce large-brained young. "I don't see this as an energetics problem," says Harvey, whose work with Pagel suggests that the way to grow larger brains is to have long gestation times, late weaning, and fewer offspring per litter.

Others aren't ready to give up on the correlation. Martin, responding in a talk at the AAPA, says that if one incorporates length of gestation and lactation and animals' degree of independence at birth, the link between metabolism and brain size holds up.

Despite the critics, the energetic approach is making its mark, as researchers accept the possibility of energetic constraints on evolution. This "is making us do experiments to measure how much energy the mother is putting into her offspring," says Francisco Aboitiz, a neuroscientist at the University of Chile in Santiago; he is comparing brain growth in different species of rats to see how different parts of the brain have evolved in response to varying ecological conditions. In the end, both hypotheses may be pieces in a complex puzzle—important physiological constraints that had to be overcome before selection could sculpt a larger brain. "I'm sure there's no single answer," says Aiello: "These things all work together. It all depends on your ecology." And perhaps on the size of your gut or the amount of your mother's energy.

–Ann Gibbons

ASTRONOMY

Taiwan, U.S. Team Up to Chase Shadows

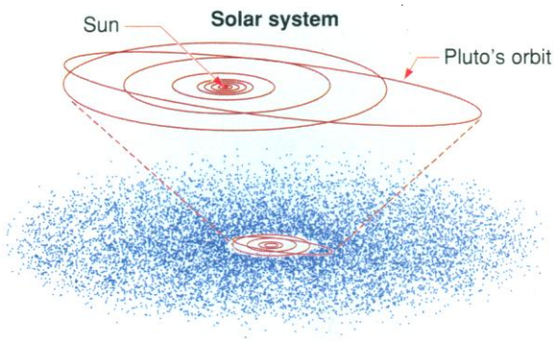
When a star in a telescope's view winks out, a passing cloud or bird is usually to blame. But astronomers think that sometimes, the shadow could be cast by a distant ball of ice and dust in a vast, uncharted comet reservoir beyond Neptune known as the Kuiper Belt. A U.S.-Taiwanese collaboration has set out to chase these shadows. It is building a robotic, three-telescope array to look for stellar blackouts from a mountain range in central Taiwan, beginning in 2000.

By counting and measuring these blackouts, the Taiwanese American Occultation Survey, or TAOS—a million-dollar joint effort of NASA, the Lawrence Livermore National Laboratory in California, Taiwan's Academia Sinica and National Central University, and others—aims to estimate the number of objects in the Kuiper Belt and determine their size distribution. The results could force astronomers to "rethink the comets," says astronomer David Jewitt of the University of Hawaii, Honolulu, co-discoverer of the first Kuiper Belt object in 1992.

Jewitt explains that comets, stored in the Kuiper Belt and the more distant Oort Cloud, "are thought to be fragments from the solar nebula that didn't change." The new size census could show how pristine they are, he says. "If they have been repeatedly smashed, it's likely they have changed," says Jewitt, who is enthusiastic about the new survey, although he is not a participant.

Objects from the Kuiper Belt can be seen when they plunge into the inner solar system as comets. All but the largest objects in the belt itself—those with diameters exceeding 100 kilometers—are invisible to ground-based telescopes, however. So Livermore astronomer Charles Alcock and his U.S. and Taiwanese colleagues conceived of the star-shadow strategy for counting the billion or so icy bodies there. Alcock explains that the technique should detect objects with diameters as small as 1 to 2 kilometers at the distance of the Kuiper Belt. If the object lies much farther away, starlight bleeding around it should wash out the shadow. If the shadow is due to a much closer object, a large telescope should be able to spot the culprit directly.

The comet hunters plan to monitor star fields that lie along the ecliptic, the plane of the solar system, and contain many bright, pinpoint stars. Three wide-angle, half-meter telescopes, linked electronically, will be dedicated to the task. Two will stand 10 meters apart—far enough that electronic noise and other sources of error are unlikely to affect both simultaneously. A third, "outrigger" scope will observe the same region of the sky from 7 to 10 kilometers away.



SOURCE: A. COCHRAN/UNIV. OF TEXAS/NASA

Uncharted cloud. The icy swarm of the Kuiper Belt is thought to extend far beyond the orbits of Neptune and Pluto.

When a star blinks out, other checks will kick in before the shadow will be tallied as a denizen of the Kuiper Belt. If many adjacent stars were also blotted out, for example, that would suggest that the culprit was a bird or plane. If the stellar eclipse registers at slightly different times at the outrigger and at the other telescopes—proportional to Earth's 30-kilometer-per-second velocity around the sun—observers at large telescopes will be asked within 2 hours of the sighting whether they can see the interloper. If they can, the odds are it's something too nearby to be in the belt. If not, the TAOS collaborators will estimate its size from how long the occultation lasts.

Because the swarms of objects in the Kuiper Belt are scattered through such a large volume of space, the telltale alignments should be rare. So the survey plans to take snapshots as rapidly as five times per second for some 3000 stars at a time, collecting an unprecedented billion starlight measurements nightly from all three telescopes. Even so, the researchers expect to identify just a handful of comet occultations—from three to 1000—in the 100 billion measurements to be taken per year.

To deal with the flood of data, the comet census will draw on data-crunching technology pioneered in another star survey directed by Alcock, called the MACHO project. MACHO also monitors vast swarms of stars, but it is searching for the temporary brightening or "microlensing" of a star that results when a distant, massive object—a planet or a burned-out star—passes across the line of sight, and its gravity focuses the light of the background star.

NASA is providing $350,000 to the Kuiper Belt project over 3 years, with an additional $220,000 this year coming from Livermore's internal coffers. Taiwan is footing an equal or larger share of the cost, team members say, and will pay for two of the three telescopes, which are now on order.

Locating the observatory in Taiwan makes sense because the ecliptic is high in the sky there. But Taiwanese participants also hope that the facility will help their country nurture its own world-class scientific establishment. "There is a widely held view in Taiwan that science and technology is the future of the country's well-being," says Kwok Yung "Fred" Lo, an Academia Sinica astrophysicist on the TAOS project. "TAOS is special because it is the first scientifically significant astronomy project to be located in Taiwan."

–Peter Weiss

Peter Weiss is a science writer in Washington, D.C.