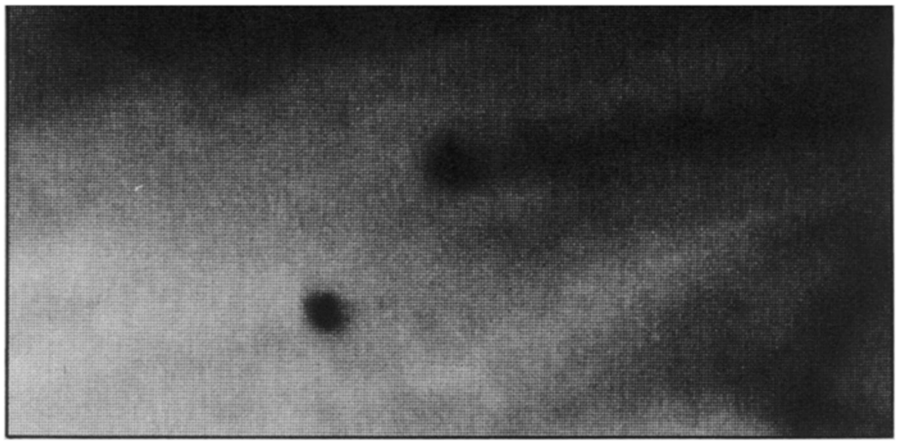
there is "some indirect evidence" that the higher mortality rate can be accounted for by the presence of subclinical disease, yet are at a loss to explain it. They point out that since the two studies involved different time periods unknown factors may have been involved. Nonetheless, they believe that their results "raise some questions as to the health benefits from weight reduction in persons of average or near-average weight." □



JPL

Newfound satellite and its shadow, seen crossing Jupiter by Voyager 1. Dark streak extending from shadow is cloud feature coincidentally aligned with shadow's position.

Another moon: Jupiter's 15th

Last year a 14th satellite of Jupiter was discovered in one of the Voyager 2 spacecraft's photos by scientists who had originally thought the point of light to be a star (SN: 10/20/79, p. 263). Now a researcher who was looking for the same object in photos from Voyager 1 has discovered yet another satellite, Jupiter's 15th.

Attempting to measure the 14th moon's orbit more precisely, Stephen P. Synnott of Jet Propulsion Laboratory (the Voyager control center) had been looking at Voyager 2 photos taken when the object should have been one or two orbits behind or ahead of its position in the photo that led to its discovery. Failing to find it at the time, he turned to pictures from Voyager 1, and in one of them, he says, "I saw what looked like a shadow against Jupiter's disk." The next frame showed the same shadow in a different position, and Synnott assumed it to be number 14 (designated 1979 J1) until an orbit calculated from the two images showed it to be on a clearly different path. After a search of "weeks and weeks," Synnott finally located a single photo that showed both the shadow and its source — a previously unknown satellite, now designated 1979 J2.

It orbits the planet at a mean distance of slightly more than 151,000 kilometers from the cloud tops, Synnott calculates from the several frames in which the object has by now been identified. This puts it between the orbits of Amalthea (about 107,000 km out) and Io (nearly 350,000), circling Jupiter once every 16 hours 16 minutes. It also becomes easy to see how as few as two photos could enable Synnott to tell that the object's orbit was not that of the 14th moon, whose mean distance from the clouds had been calculated as slightly over 57,000 km, just about along the edge of Jupiter's ring system (also discovered from Voyager pictures). Synnott has now revised his calculations, in fact, and determined that the true distance is only about 56,400 km — actually *in* the ring.

The newly found satellite appears tiny in the photos, and Synnott estimates it to be only about 80 km across — "at least in the direction we can observe." It has only been spotted in photos showing it against the disk of Jupiter, and since it is almost certainly gravitationally "locked" with its longest axis pointing at the planet, it is possible that the Voyagers were only able to see it, in effect, "end on." Amalthea, for example, measures 155 km in one dimension, but 270 km in the direction radial to Jupiter. To measure the new satellite's long axis, Synnott hopes to be able to pick out the object against the dark sky in photos taken off the edge of the planet, when the spacecraft would have been facing it broadside.

Its composition, too, is uncertain from the limited data, although Synnott says that it is "about as dark as Amalthea," whose surface has been found to approximate laboratory spectra of carbonaceous chondrite material augmented with sulfur possibly transported inward from Io. The yet-unnamed number 15, in fact, could turn out to be more sulfur-rich still, since its orbit is about 44,000 km closer to Io's than is that of Amalthea.

Jupiter may actually have not merely 15 satellites, but 16. In 1975, Hale Observatories astronomer Charles Kowal spotted a possible candidate in an earth-based photograph (SN: 10/11/75, p. 229), but subsequent observations failed to confirm its presence around the planet. It was seen far from Jupiter, so at least it cannot be confused with the two "Voyager moons," but if it is someday confirmed, it will probably be assigned a place as the 14th satellite, bumping the newcomers to 15th and 16th. And no one is ruling out the possibility that still more may be discovered. □

Waking up to a biological alarm

The human body, keeping time to a variety of biological clocks, somehow knows there is a time to every purpose. But where and what are the body's timepieces? According to recent work by Harvard Medical School researchers, one behavioral timer may have been found — the clock that dictates the time to be asleep and the time to be awake. If validated, the find will be the first identification of a biological timekeeper in humans.

The clock, described by Martin Moore-Ede, Ralph Lydic and co-workers at a recent meeting on sleep in Mexico City, is a small cluster of neurons in the hypothalamus of the human brain. A similar area was identified eight years ago in the brains of rodents and called the suprachiasmatic nuclei (SCN). When the region was destroyed, the rodents lost their circadian (approximately 24-hour) rhythm in feeding and other behaviors.

With these findings in mind and interested in the physiological basis for "jet lag" and sleep disorders, Moore-Ede and co-workers began to search for a structure that might be responsible for such behavior. They found that the brains of squirrel monkeys contain structures similar to the rodent SCN — actually two clusters of neurons in the hypothalamus located on either side of the tip of the brain's third ventricle (a fluid-filled cavity). When the neuronal clusters were destroyed, the rest-activity cycle of the monkeys was disrupted, while other rhythms — such as body temperature — were unaffected. "Obviously this is not the only biological clock, but it is certainly a major one," says Moore-Ede.

Moving systematically up the primate tree the researchers then studied the brains of eight New World (Western Hemisphere) and Old World (Eastern Hemisphere) primates and sections of 16 human brains, ranging in age from 28 weeks gestation to 50 years. In each, says Moore-Ede, the same cluster of small, rounded neurons — identified microscopically — was present. As the scientists moved up the evolutionary tree, however, the position of the 300-micron-wide clusters shifted, so that in humans the cells are more diffusely distributed and placed on the sides rather than at the tip of the ventricle. This more diffused distribution may be related to the observation that the sleep-wake cycle in humans is not as rigorous as in other species, says Moore-Ede.

While the exact mechanism is not understood, Moore-Ede says the cells are apparently an "endogenous, self-contained pacemaker" sending out precise signals to the rest of the brain. Because the appropriate human experiments cannot be done, proof that the cell clusters

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