

## Sperm sort: On the road to sex selection

Dairy farmers want female calves; beef farmers want males. A method to give them, and sheep and hog farmers, their preferences could save the U.S. livestock industries almost \$700 million annually, says Lawrence Johnson of the USDA Agricultural Research Service in Beltsville, Md. Johnson and his colleagues report a technique to sort X-chromosome-bearing sperm, for female offspring, from Y-chromosome-bearing sperm, for male offspring. Such "sexed" sperm could eventually be used for artificial insemination of

animals. The development of this method for farm use is expected to take several years, but it is already being used to measure sperm ratios.

Several techniques have been proposed previously to select X-bearing or Y-bearing sperm, and some semen now on the market for livestock insemination carries claims of being enriched in sperm of one type or the other. In a paper to be published in the *JOURNAL OF ANIMAL SCIENCE*, Johnson, along with Dan Pinkel and Bart Gledhill, both of Lawrence Livermore Na-

tional Laboratories in Livermore, Calif., report tests of five current techniques for enriching semen in sperm carrying an X or a Y chromosome. These methods include the albumin gradient technique, which has been applied to human sperm (SN: 3/3/79, p. 135).

"Commercial 'sexed semen' now on the market is probably no more reliable than asking mother nature to yield offspring of one sex or the other," Johnson says. "We see no significant difference from 50 percent of each type [of sperm] for any of these enrichment techniques."

The evaluation and sorting method used by Johnson has grown out of work at the Livermore laboratory. It takes advantage of the greater amount of DNA in sperm containing an X chromosome rather than a Y chromosome. For counting or sorting, the sperm membranes and tails are stripped off and the naked sperm heads are stained so that their DNA fluoresces when exposed to a laser beam. The sperm containing an X chromosome glow slightly more brightly than those with a Y chromosome. As the cells move in a flowing stream of liquid past a fluorescence sensor, the machine counts the number of each type. A similar approach has been used to distinguish individual chromosomes and to determine the location of genes (SN: 2/23/85, p. 120).

To sort sperm cells, the system can give a droplet, containing a single sperm head, a positive or a negative charge depending on whether the sperm contains an X or a Y chromosome. The droplet then passes through an electrical field that separates the oppositely charged droplets, so that the sperm cells fall into one of two collecting tubes.

The difference in DNA content for sperm of most livestock is quite small—less than 4 percent for sperm of a bull, boar or ram. So, for their first experiments, Johnson and his colleagues used sperm of the chinchilla, a rodent raised commercially for its fur. There is more than a 7 percent difference in DNA content between chinchilla sperm bearing X and Y chromosomes. These sperm have been sorted by the fluorescence technique into samples containing 85 percent X-bearing or 85 percent Y-bearing sperm. Preliminary experiments injecting the sorted sperm into hamster eggs demonstrate that the DNA remains intact throughout this treatment. More recently, ram sperm has been sorted into samples containing 90 percent X-bearing or Y-bearing sperm.

The technique must now be modified in several ways to become useful for artificial insemination—for example, intact sperm, rather than stripped sperm heads, must be used. In addition, a speedier method is required. The current machine sorts 50 cells per second, but farmers routinely use 10 million sperm to inseminate a cow. Still, the USDA says that farmers may finally be on the road to controlling the sex of livestock offspring. —J.A. Miller

## Another hint at an asteroid with a moon

One of the major controversies of solar system astronomy in recent years has been the question of whether some asteroids have their own moons. There have been many intriguing observations that could support the idea—such as an asteroid briefly blocking the light of a star and the starlight then blinking a second time, as though a second object got in the way—but all have lacked sufficient confirmation. Often such a "secondary event" would be noted by only one of several observers at different locations, a perfectly reasonable result but worthless at adding reliability to the one case in which something showed up.

Part of the problem has been that a few astronomers have taken the growing number of these unresolved examples to be evidence that the case for asteroids with moons is getting stronger. Such views have been rendered in scientific journals, but more conservative researchers have noted that two or three—or 10—unproven cases do not equal even a single firmly established one. The result has been that the question has to an extent become "tainted" with skepticism, with some scientists electing to avoid studying the matter rather than be subjected to possible ridicule.

Now four French astronomers have reported evidence for a possible moon around yet another asteroid, 146 Lucina. This case, too, is inconclusive, however, and the researchers—J.E. Arlot of the Bureau des Longitudes in Paris and colleagues from the Meudon and Toulouse Observatories—wrap their journal presentation in an extensive reminder of past nonconservatism. "Clearly," they write in *ICARUS* (Vol. 61, p. 224), "since 1980, many observers have been more and more on guard against enthusiastic overinterpretation of transient brightness changes actually caused by the atmosphere." In fact, they point out, one result may even have been that possible evidence of *real* secondary events was "suppressed."

Fortified with that caveat, the authors

describe a "secondary" of their own. On April 18, 1982, they aimed Meudon Observatory's 102-centimeter refractor at a star (AGK3 +17°1309) whose location was close to where 146 Lucina was due to pass in its orbit. Later analysis indicated that the line through the asteroid and the star actually followed a track on earth's surface that was about 60 kilometers south of Meudon, and other observers, based much closer to the track, even reported a blink in the starlight that apparently represented Lucina itself. Arlot's colleagues at Meudon, however, also recorded a blink, though they were out of position to see Lucina's own. "A possible interpretation," they suggest, "is the existence of a faint satellite in the neighborhood of 146 Lucina." Projecting the lines of sight back to the asteroid's distance, the researchers calculate that the possible moon would be at least 5.7 km in diameter and about 1,600 km from Lucina.

The researchers used a video camera equipped with an image-intensifier tube to record the image digitally, and note that the system eliminated the need for an aperture-restricting diaphragm to narrow down the amount of sky in view. Such diaphragms can sometimes produce false signals or noise that can mislead interpretation of an uncertain result. The French team, though spared that difficulty, had another: the lack of a second, "reference" star in their field of view. Such a star, by maintaining its usual brightness while the other star was being briefly blocked by some intervening object like a moon of Lucina, would have served to indicate that the brief blink of the primary star was not due merely to some irregularity like an electrical surge in the image intensifier's power supply.

That lack leaves some U.S. researchers unpersuaded, but the French group readily acknowledges that "we must now wait for observations." The Space Telescope, for example, due for launch in 1986, may be able to help in at least some cases. —J. Eberhart