the past decade, although they hope the data will arm reformers like Walker. In addition to putting up $350,000 for the study, Pew is a partner with AACU and the Council of Graduate Schools in the Preparing Future Faculty project, a national effort to improve graduate training (www.preparing-faculty.org). This summer, the National Association of Graduate-Professional Students hopes to present the results of a similar survey organized around departments. Its goal is to help "consumers" select the graduate program that's best for them.

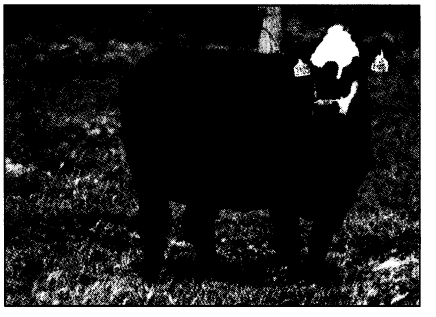
Students may indeed be the strongest force for change. This survey, for example, arose from a graduate course in academic ethics that Dore and Golde took at Stanford University. Dore has taken that interest with him to Georgia, where he is designing small organic molecules as probes to better understand the workings of the cell. "My future on the tenure track is tied to this project as well as to my research," he says about his plans to further analyze the survey's large database. "And my department chair and the graduate school dean are very interested in what I come up with." **–JEFFREY MERVIS**

ENDANGERED SPECIES

Cloned Gaur a Short-Lived Success

The first clone of an endangered species died last week, 2 days after its birth on 8 January. The baby gaur—a wild ox native to Southeast Asia—seemed healthy at birth but a day later developed a typically fatal bacterial infection that can plague young calves. The death "appears to be totally unrelated" to the cloning procedures, says Robert Lanza, vice president of Advanced Cell Technology (ACT) in Worcester, Massachusetts, the company that sponsored the project. ACT is ready to try again with gaur and other endangered animals, Lanza says.

Scientists at ACT produced the animal, named Noah, by fusing skin cells from a male gaur with cow eggs from which the nucleus had been removed. Forty-four embryos were then transferred into 32 surrogate mother cows at Trans Ova Genetics in Sioux Center, Iowa. Eight pregnancies resulted, five of which ended in miscarriage—common in cloning—and two fetuses were removed early for tissue examination. In October, the scientists reported that the fetuses seemed to be developing normally. That left Bessie with her calf, Noah, who was originally scheduled to be born by cesarean section in November. Shortly before the original due date the scientists learned that gaur gestation is longer than they thought and postponed the birth until last week.



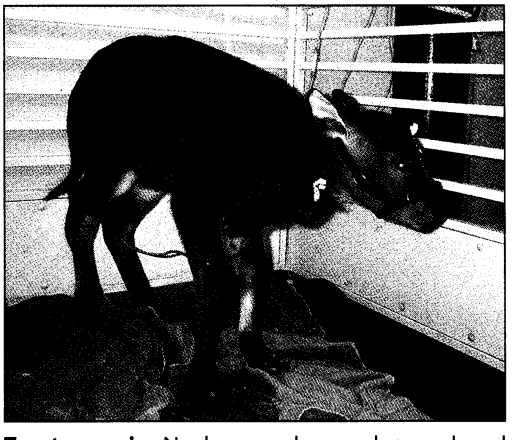
In a family way. Bessie, Noah's surrogate mother, is doing fine.

Many of the animals cloned to date have had serious health problems at or shortly after birth, including lung defects. Some have also been born abnormally large. But Noah, weighing in at 36 kg, initially received a clean bill of health. The C-section went smoothly, says Philip Damiani of ACT, and veterinarians who examined the newborn rated him in the top 3% of newborn cloned calves based on his alertness, eagerness to feed, and other factors. Within 12 hours, Damiani says, Noah was beginning to walk—a sign that he was strong and not oversized.

But about 24 hours after his birth, Noah developed diarrhea, often called scours. Doctors immediately suspected *Clostridium perfringens*, a bacterium that is normally found in the intestines of cattle. It can overgrow in young animals and produce a deadly toxin. Veterinarians treated Noah with antibiotics and an antitoxin. Despite these efforts, he died the next day. Clostridial infections are not uncommon in newborn calves, says veterinary infectious disease expert Robert Holland of Iowa State University in Ames, but are unusual in animals delivered by C-section. Damiani says the team is working to trace the source of the bacteria. A "control calf" fed the same colostrum and kept under the same conditions as Noah is doing fine, he says.

After such promising initial signs, "to lose him to scours is devastating," Damiani says. "When I left on Tuesday, he was walking around and even being a bit difficult to handle."

The death has not derailed the company's program to clone endangered animals. They plan to try again with a gaur, says Damiani. And Lanza says that within a few months the company will embark on a project to clone the bucardo, a Spanish mountain goat, from cells taken from the last living member of the species. The bucardo project should be both faster and easier than the gaur, as researchers have had more success with cloning goats and the animals' gestation period is only 5 months as opposed to 10 for a gaur. Predicts Lanza: "We could have live kids by end of summer or early fall." **–GRETCHEN VOGEL**



CREDITS: ADVANCED CELL TECHNOLOGY INC.

Try, try again. Noah, an endangered gaur cloned from an adult skin cell, lived just 2 days.

ASTRONOMY

Weird New Exoplanets Leave Theory Behind

SAN DIEGO—Now that astronomers have found planets orbiting some 50 sunlike stars, you might think they have seen everything. Far from it. The latest pair of extrasolar systems, which a prolific U.S. team of planet hunters unveiled at a conference here last week,* jolted even the most jaded onlookers.

"After finding so many exoplanets, we thought we understood their masses and orbits," says team leader Geoffrey Marcy of the University of California (UC), Berkeley. "Maybe we became a little cocky. But the new systems, with two planets each, are unique and a little frightening. These systems stump us."

The first of the cosmic puzzlers belong to

* American Astronomical Society, 197th meeting, 7–11 January.

a dim dwarf star known as Gliese 876, just 15 light-years from Earth in the constellation Aquarius. Two planets are waltzing around the star in lockstep, the inner one completing two orbits as the outer one circles the star once. Computer simulations by Hal Levison of the Southwest Research Institute in Boulder, Colorado, indicate that planetary resonances are fairly common. "We encounter them in 25% of all cases," Levison says. In our own solar system, in fact, Pluto and Neptune share a 3:2 resonance, while three of the four large satellites of Jupiter display a 4:2:1 resonance. What makes Gliese 876 different is that it is poised on the brink of instability. Calculations by Jack Lissauer of NASA's Ames Research Center in Moffett Field, California, show that a slight change in masses or orbits would cause the planets to fly into their star or out into space. The near-instability suggests that the system may have had a turbulent history, although the details are still unclear.

"It's a very exciting discovery, with profound theoretical implications," says theorist Douglas Lin of UC Santa Cruz. Lin suspects that the system once contained more planets in larger orbits. Gravitational interactions with the gaseous disk from which they formed then caused the planets to slowly spiral inward. Some of the planets may have been flung into outer space; the remaining two became locked into the mutual resonance.

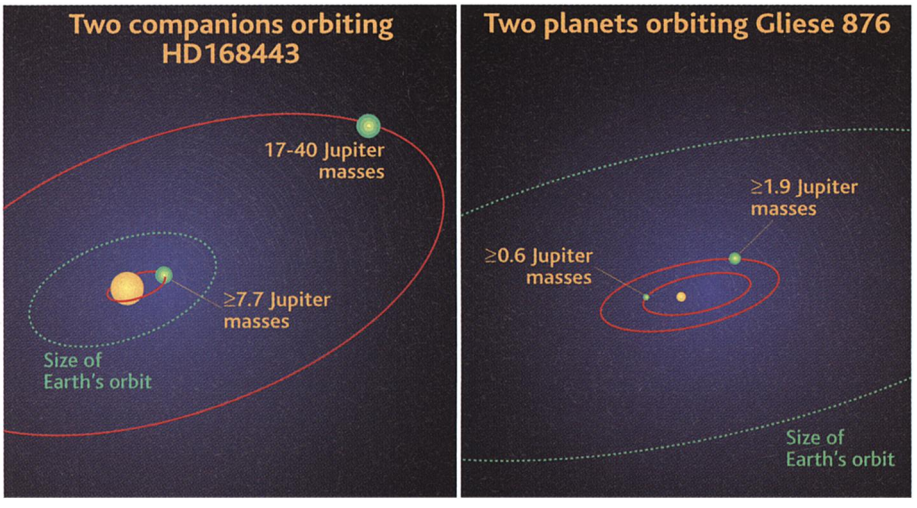
While theorists may scratch their heads over resonance, it's the second discovery that really has them flabbergasted. It's a humongous gaseous planet, at least 17 times more massive than Jupiter. "We've never seen anything like this before," says team member Paul Butler of the Carnegie Institution of Washington. "This is a whopper."

The Goliath planet orbits a sunlike star known as HD 168443, 123 light-years from Earth in the constellation Serpens. In 1998, Marcy's team found another planet, weighing at least 7.7 Jupiter masses and circling the star every 58 days at an average distance of just 45 million kilometers. The new giant orbits the star every 4.8 years at an average distance of 410 million kilometers, almost three times the distance between Earth and the sun.

The "whopper planet" is clearly too massive to be a normal planet, Marcy says. Most astronomers agree that planets form in a swirling disk of gas and dust surrounding a nascent star. In Levison's computer simulations, however, planets forming in such disks never grow more massive than 8 to 10 Jupiters before sweeping their surroundings clean. Larger objects can form outside disks, but above 13 Jupiter masses or so, the core of a gas ball becomes so hot and dense that deuterium (heavy hydrogen) starts to burn, turning the object into a failed star, or brown dwarf.

But that label doesn't quite fit, either, says Butler: "Calling this object a brown dwarf means you're sweeping all of the mysteries under the rug." Brown dwarfs, he points out, are thought to form directly from collapsing clouds of interstellar gas. That couldn't happen so close to the parent star. Moreover, HD 168443's other companion, a planet, presumably formed in an accretion disk. No one understands how both processes could occur together.

A few astrophysicists suspect the new finds may be less mysterious than they appear. David Black of the Lunar and Planetary Institute in Houston, Texas, an outspoken exoplanet skeptic, points out that the technique Marcy's team uses to find exoplanets—deducing their gravitational pull on the star from Doppler shifts in the star's light—likely underestimates the planets' masses. The more an object's orbit is tilted with respect to



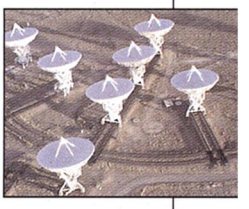
Weird worlds. The latest two-planet systems are the hardest for astrophysicists to explain.

CREDIT: (LEFT TO RIGHT) GEOFFREY W. MARCY/UC BERKELEY; DAVE FINLEY/NATIONAL RADIO ASTRONOMY OBSERVATORY/ASSOCIATED UNIVERSITIES INC.

ScienceScope

Astronomical Pressure They have yet to hire an enforcer. But Canadian astronomers last week began some serious arm-twisting in their bid to get the federal government to spend the $100 million needed to fund a long-term plan that includes promises to help build several international observatories.

Following a road map for the field (*Science*, 4 February 2000, p. 781), Canada's National Research Council this month inked pacts with the U.S. National Science Foundation to buy into the two facilities. One tentatively commits Canada to providing $20 million for the $400 million Atacama Large Millimeter Array project in Chile, a U.S.-European project with possible involvement by Japan. The other promises $10 million toward an upgrade of New Mexico's Expanded Very Large Array (above).



Now, "it's time for the government to ante up," says astronomer Peter Janson, co-chair of the Coalition for Canadian Astronomy. Supporters hope that the government will back both projects, if only to avoid the embarrassment of voiding letters of intent signed by its foremost in-house laboratory. The government's answer may appear in a new budget that goes into effect on 1 April.

Staying Cool A prominent standard-setting group for animal care is struggling to stay neutral in the increasingly testy fight over whether the U.S. Department of Agriculture (USDA) should regulate the use of laboratory rats, mice, and birds, which constitute 95% of research animals.

Two years ago, the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC), which sets voluntary standards that are widely used by major U.S. research universities, gave its qualified support for USDA regulation, heartening animal rights activists. The activists then cited AAALAC's statement in responding to research community claims that regulation would be too onerous. But AAALAC chief John Miller now suggests that the activists stop mentioning his group: "AAALAC is neutral on this issue," he told *Science*.

In a clarification last month, Miller noted that the statement never won the support of AAALAC's entire board, which includes 50-odd major science societies, some of which have opposed regulation. Instead, board members opted to take their own positions on possible new rules, which a congressional moratorium has put on hold for at least a year.

Earth, the smaller the shifts. As a result, Black says, both objects orbiting HD 168443 could be low-mass stars instead of planets or brown dwarfs. "There are plenty of [triple star] systems like this," says Black.

But none of the thousands of triple star systems known has all three members within a few hundred million kilometers of one another, Butler notes. Besides, he says, if the mystery object were a dwarf star, the European Hipparcos satellite would see HD 168443 wobbling slightly because of the orbiting object's gravitational pull. The absence of sideways motion, Butler says, means that the object can't be more massive than 40 Jupiter masses—well within brown dwarf territory.

The new discoveries show how little astronomers know about the formation of planetary systems, Marcy says. Yet the data should help scientists test their models and weed out the unfit. "I regard these discoveries as our gift to the theorists," says Butler. Lin, for one, is a grateful recipient. "I lose sleep over this," he says, "but I'm very happy, because these results will keep me busy."

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

EVOLUTIONARY GENETICS

Horses Domesticated Multiple Times

For several millennia, horses have been lending a hoof to humans. But despite extensive archaeological excavations, researchers have not been able to pin down the exact history of where and when these animals were domesticated. Now, on page 474, evolutionary geneticist Carles Vilà and Hans Ellegren of Uppsala University in Sweden and their colleagues present new genetic evidence on how wild horses came to be beasts of burden. Contrary to conventional wisdom, explains Ellegren, head of the Uppsala lab, "in many places over the world, people must have independently started to domesticate their local horses."

Many horse lovers and researchers have long traced their steeds' ancestry back to the grassland steppes of Eurasia, in the vicinity of the current Ukraine, Kazakhstan, and Mongolia. There, horses hunted as food were eventually tamed, fueling the expansion of their masters and, consequently, the domesticated horse across most of Europe.

Not everyone accepts that scenario, however. Archaeological evidence from that time, some 5000 years ago, is difficult to interpret. Horse bones unearthed at archaeological sites could just as easily reflect a horse-meat diet as a horse-riding or horse-breeding culture. Some researchers have examined fossils and found telltale signs, such as horse teeth worn down by a bit. Yet even with these data, "we've had a big problem with [understanding] horse domestication," says Sandra Olsen, an archaeologist at the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania.

While Vilà was a postdoc in Ellegren's lab in 1998, the two realized they might be able to pinpoint the origins of domestication by tracing the genetic lineages of different breeds of modern horses and comparing those lineages to DNA collected from ancient horse fossils. They first focused on mitochondrial DNA (mtDNA), genetic material inherited only from the mother, because mutations there accumulate fast enough to reveal some insight into the breeding history of these animals in recent millennia.

If horses had been domesticated once from a limited number of ancestors, the mtDNA of all modern domesticated horses should look basically alike. Essentially, the horse family tree would branch off when domesticated horses diverged some 5000 years ago; the small variations among modern horses could be represented as twigs coming off that one branch. By contrast, most DNA from truly wild horses (not the feral horses that roam free today) would belong on other branches.

To probe the puzzle, the Uppsala researchers compiled a database that provides "a good blueprint of the diversity of different horse types," says Ellegren. They had ready access to blood samples from a Swedish registry of 191 pedigree horses, including primitive English and Swedish animals and one breed derived from animals imported to Iceland by the Vikings. Vilà and colleagues then acquired DNA samples from one Przewalski's horse, a small Mongolian equine thought by some to be a sister species to the original wild horses. The team also obtained DNA from the leg bones of horses that have been preserved in the Alaskan permafrost for more than 12,000 years. Another eight samples came from 1000- to 2000-year-old archaeological sites in southern Sweden and Estonia. The study is unique, Ellegren says, "in that we combined an analysis of modern horses and ancient horses."

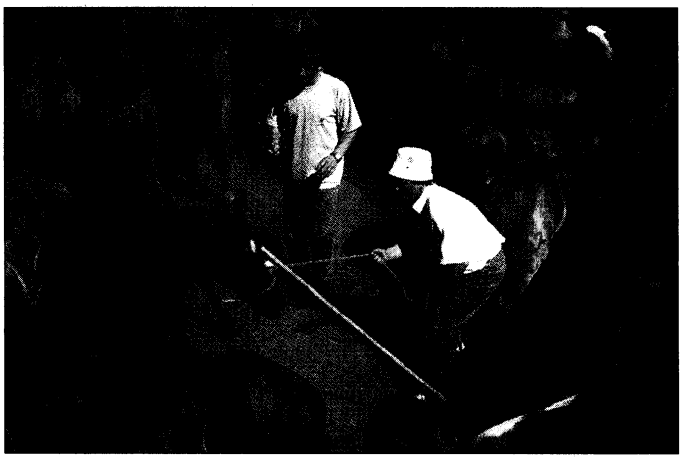
Similar DNA analyses for cattle, sheep, water buffalo, and pig indicate that those modern livestock derived from a small number of animals domesticated in just a few places 8000 to 10,000 years ago. That's because today's animals are much less genetically diverse than their ancient forebears. The mtDNA in today's pigs, for instance, falls into a few distinct groups, suggesting that the offspring of the original livestock were traded and used to establish herds elsewhere.

But the horse mtDNA tells a different story. To the researchers' surprise, the mtDNA samples from the modern horses showed almost as much genetic variation as did samples from the fossil horses—and no distinct branches as there are in domesticated pigs or cattle. The genetic diversity in modern horses implies "that the domestication of the horse was different in time, place, and process from that of other animals," says Daniel Bradley, a geneticist at Trinity College, Dublin, Ireland.

The new work "eliminates the possibility that horses were domesticated in one place and spread from there," says David Anthony, an archaeologist at Hartwick College in Oneonta, New York. Instead, it suggests that today's domestic horse resulted from the interbreeding of many lines of wild horses in multiple places. Even so, Anthony still thinks that horses are likely to have been domesticated first on the steppes, because the archaeological evidence suggests that people there depended heavily on horses for food. Perhaps what spread, he says, was not the horses themselves but the idea and know-how of taming horses.

Marsha Levine is not convinced. An archaeologist at the McDonnell Institute for Archaeological Research in Cambridge, U.K., she takes issue with both the archaeological evidence cited by Anthony and others and the new mtDNA data. She worries that modern horse DNA won't tell the whole domestication story. But, as Olsen points out, solving the riddle of equine domestication has been so difficult that "anything that helps nail it down is a big help."

–ELIZABETH PENNISI



CREDIT: C. VILÀ *ET AL.*

Time-tested tradition. Wranglers in northern Spain capture feral horses, possibly reenacting what their ancestors did 5000 years ago.