they've dropped that term. Variations in the charged particles' pitch-angle distribution, he says, indicate that it could be a diffuse extension of the F ring — or it may not be a ring at all. The data show signs of what could be taken as a number of larger objects, perhaps tens of kilometers across, suggesting that the region might be better described as a collection of little moonlets. (Missing, however, are any signs of a much wider "E ring," hinted at by past earth-based data.)

Of the two clearly defined new satellites, says Van Allen, one — an object at least 100 km across — lies actually within the distinct portion of the F ring, some 80,580 km from the clouds (2.343 R_s from the center). The other, a 170-km object loosely known as Pioneer Rock and visible in one Pioneer photo, lies 92,040 km from the clouds (2.534 R_s from the center). A particle "dip" 91,320 km out (2.522 R_s from center) may be another satellite, or part of an eccentric wake of Pioneer Rock.

Conspicuously absent, Van Allen says, is any sign of Janus, Saturn's controversial "tenth satellite," expected by the astronomer who first reported it to be at about 2.65 R_s. Other researchers, however, have calculated that it could be at about 2.82 R_s, points out Van Allen, and there is a slight particle dip at that distance, some 109,200 km from the clouds.

Cameras on the Voyager 1 and 2 spacecraft, due at Saturn in 1980 and 1981, should help, though their paths will pass too far from Saturn for relevant particle data. □

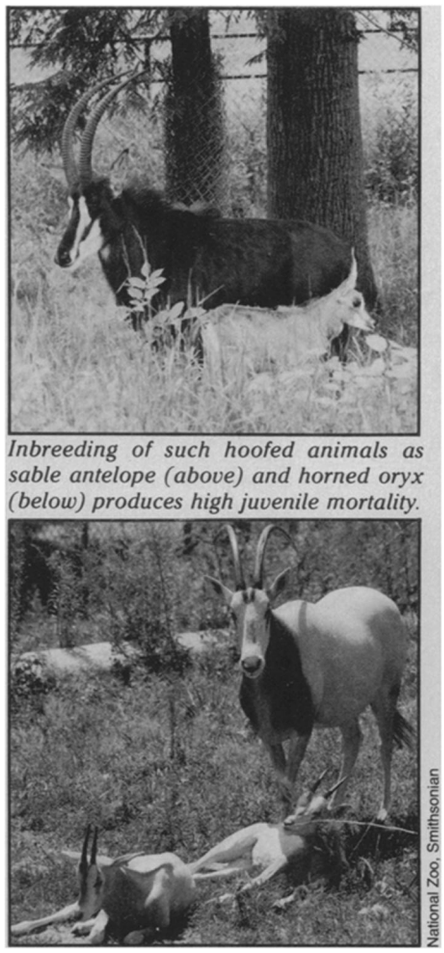
Inbreeding harmful, even in the zoo

The last hope for the preservation of an increasing number of animal species involves breeding them in zoos or in small protected herds. More and more hoofed animals, for example, exist only in relatively small populations. But researchers at the Smithsonian Institution's National Zoo warn that inbreeding, which is generally permitted among hoofed animals in zoos and conservation parks, is detrimental to the offspring. After analyzing detailed breeding records covering more than 10 years, they conclude that inbred animals have a significantly higher death rate in the first 6 months of life than do non-inbred animals.

"The study has major implications, not only for the management of zoo breeding programs, but also for conservation and wildlife specialists who are responsible for managing small populations of hoofed species in reserves and in areas where species have been introduced back into their natural habitats," says Katherine Ralls, who directed the study. She points out, for example, that among the 25 roan antelope in a Kenya reserve, all young born since 1970 have the same father.

Many workers in conservation and wildlife management have been skeptical of the research on laboratory and domestic animals indicating that inbreeding leads to increased mortality in young animals. But Ralls and colleagues Kristin Brugger and Jonathan Ballou say in the Nov. 30 SCIENCE that the effects of inbreeding have not been previously recognized in exotic animals because most zoos have not maintained detailed breeding records.

Ralls and co-workers examined records of 16 species — the Indian elephant, zebra, pygmy hippopotamus, giraffe, four species of deer and eight species of antelope. Approximately 25 percent of the 559 young of non-related animals died before the age of six months; 50 percent of the 380 young of related animals died.



Inbreeding of such hoofed animals as sable antelope (above) and horned oryx (below) produces high juvenile mortality.

National Zoo, Smithsonian

A striking difference in the pattern of deaths was discovered for one species well represented in the sample. Among the Dorcas gazelles, non-inbred calves seldom died after the age of four days. Inbred calves continued to succumb to a variety of later medical problems.

The zoologists say that "the time has come to institute sound genetic management of small ungulate [hoofed] populations." They recommend that zoos exchange non-related animals for breeding and suggest maintenance and analysis of mating, birth and death records. □

Leg 68: Victory at a crossroads

A complete sedimentary record of the past 8 million years has been recovered by Leg 68 of the Deep Sea Drilling Project, marking a "new era in oceanography," according to co-chief scientist James V. Gardner of the U.S. Geological Survey in Menlo Park, Calif. The recent achievement also signifies another triumph for the newly developed Hydraulic Piston Corer (SN: 2/10/79, p. 85) as well as a crucial crossroads for the futures of the DSDP and the *Glomar Challenger.*

The Hydraulic Piston Corer (HPC), developed earlier this year by three engineers at Scripps Institution of Oceanography, enables ocean-going geologists to get undisturbed sediment samples from the sea floor (SN: 9/18/79, p. 118). Rotary drilling, routinely used by the *Challenger,* jumbles up soft sediments so badly that they are virtually useless to scientists who require a layer-by-layer record. And the HPC, because of its hydraulic design, can punch significantly farther into sediments than can other piston corers.

Devoting Leg 68 entirely to the HPC, co-chief scientists Gardner and Warren L. Prell of Brown University and co-workers drilled in the Caribbean Sea 100 miles north of Panama and in the Pacific Ocean about 200 miles west of Galapagos. The relatively short voyage (35 days from August to September) was the first DSDP leg to obtain a continuous record of magnetic and biological events in a single column. According to Prell and Gardner, the 200-meter long, 8-million-year record (which goes back about 7.5 million years further than the previous record piston core) contains every known magnetic field reversal and has a resolution two times better than any other such core. Now, the researchers suggest, scientists may be able to distinguish oceanographic events that occurred as little as 1,000 years apart.

The record-breaking core is a scientific windfall for a variety of disciplines. For climatologists, the 8-million-year core will provide the longest record yet of climate changes. The best core samples available to climatologists have been only 200,000 to 400,000 years long; longer piston cores could not be obtained or were pieced together with substantial gaps. For biologists, the core will be a continuous evolutionary scale — more complete than any land or sea fossil record — and will allow precise dating of fossils. For geologists, the sample may help solve problems such as nuclear waste disposal. Previously, no piston core was long enough to assess the permeability and seismic history of the ocean bottom.

By its ability to reach such depths, the HPC has created "not just an extension, but a whole new area" of very precise, "quantitative" paleooceanography, say re-