Sperm stem cells beat ice, species barrier

In the space of a heartbeat, a male mammal creates thousands of sperm. These mature germ cells originate from an inexhaustible source of sperm stem cells, or spermatogonia, that replicate continuously in the testes.

Sperm have been routinely frozen and thawed for decades, but now researchers can cryopreserve mouse sperm stem cells. Thawed and transplanted into the testes of mice, these spermatogonia generate apparently normal sperm.

Cryopreserving sperm stem cells could help investigators store the genetic material of endangered species or animals that might be useful in research or agriculture.

"Any valuable animal and all its possibilities can be stored indefinitely for future use," says Ralph L. Brinster of the University of Pennsylvania's School of Veterinary Medicine in Philadelphia. He and his colleagues report their work in the June NATURE MEDICINE.

During spermatogenesis, explains Brinster, a stem cell's two sets of chromosomes are scrambled and winnowed to the sperm's single set of genes, preparing it to combine with the maternal set of chromosomes in the egg.

"When you freeze a sperm, you freeze an end product that will never divide again or rearrange its genes. When you freeze a sperm stem cell, you freeze an individual and make it immortal," says Brinster.

Researchers already have some means of cryopreserving animals, but those options have their limitations. "Freezing embryos is a complex and often costly process, and for many species, including mice, survival of frozen sperm is very poor. As these studies show, freezing spermatogonia is much simpler and more effective," observes Robin Lovell-Badge of the National Institute for Medical Research in London in an accompanying commentary.

Since spermatogonia of all species appear similar, the freezing of human sperm stem cells is probably feasible, Brinster says. He and Lovell-Badge suggest that this could benefit men about to undergo cancer chemotherapy that will render them infertile. Physicians might be able to transplant a patient's thawed spermatogonia back into his testes to restore his fertility.

In 1994, Brinster's group reported isolating spermatogonia from a mouse and transplanting the cells into the testes of another mouse (SN: 11/26/94, p. 356). The transplanted stem cells produced normal sperm in recipient mice and enabled previously infertile mice to father offspring. The scientists have not yet attempted to prove that sperm from thawed spermatogonia can fertilize eggs.

They have, however, performed another new trick with sperm stem cells: cross-species transplantation. Brinster's team has taken spermatogonia from rats and transplanted them into mice whose own sperm-generating ability had been chemically destroyed. These mice appear to yield ordinary rat sperm, the researchers report in the May 30 NATURE.

Although the evolutionary histories of rats and mice diverged 11 million years ago, the spermatogenic process has changed so little that mice testes can support the germ cells of rats and produce fully normal sperm, says Brinster. "That comes as a big surprise."

The mouse-made rat sperm can presumably fertilize rat eggs and generate healthy progeny, but the investigators have not yet performed that test.

The cross-species transplant stemmed from curiosity about what factors govern the creation of sperm. Mouse sperm take 35 days to form, notes Brinster, while rat sperm need 52 days. To discover whether the Sertoli cells in mice, which nourish developing sperm cells in the testes, influence maturation speed, Brinster plans to observe how long it takes rat spermatogonia to form sperm in a mouse.

Brinster suggests that it may be possible to transplant human sperm stem cells into a suitable host animal. He argues that such an unusual endeavor would help investigators understand human spermatogenesis and provide leads to new contraceptives and the causes of infertility. —*J. Travis*

Craft offers new views of Earth's auroras

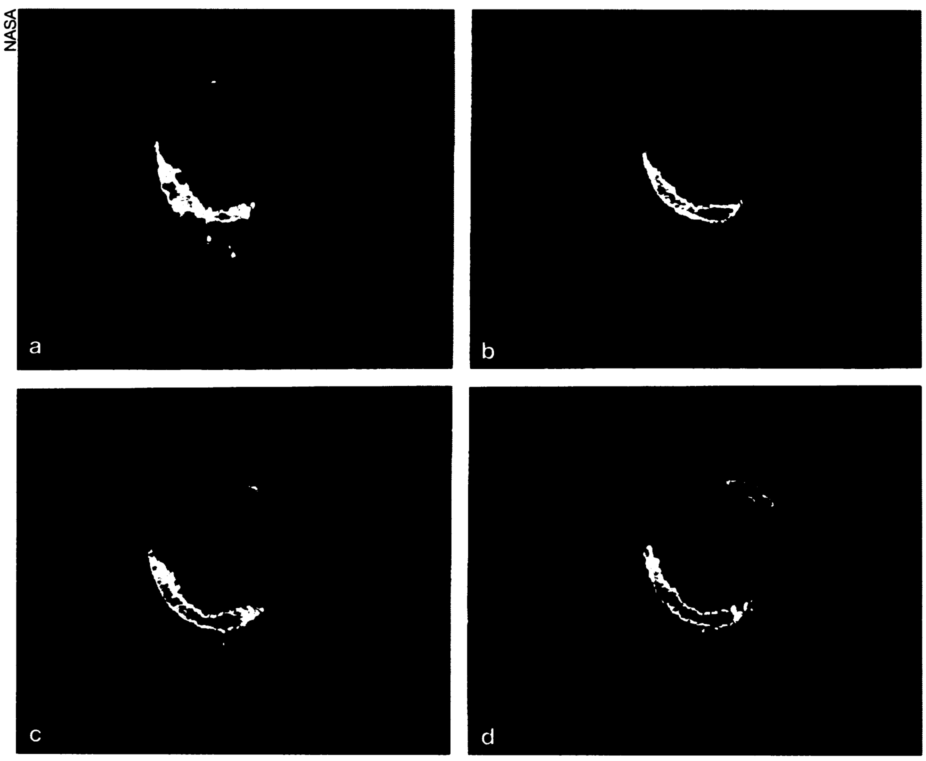
Like a shimmering curtain of light, bands of yellow-green and red dance across the sky, creating an otherworldly glow. More than just a riveting vision, Earth's auroras—the northern and southern lights—illustrate how energy from the sun travels to our planet.

Now, the recently launched POLAR satellite has taken the most detailed images of auroras ever made from space. In addition to visible-light pictures, the images include the first ultraviolet portrait of an aurora glimpsed simultaneously over the sunlit and nightside portions of the atmosphere and the first X-ray image of an entire aurora.

Researchers unveiled these pictures last week at a meeting of the American Geophysical Union in Baltimore.

The images shed light on the interaction between Earth's magnetic field and the solar wind, the breeze of charged particles emanating from the sun's outer atmosphere. As the wind approaches Earth, the planet's magnetic field steers the charged particles toward the North and South Poles. When the particles crash into the atmosphere high above

NASA



POLAR ultraviolet images, taken during a 47-minute period on April 9, show that sunlit and nightside portions of an aurora vary from each other: a) sunlit portion of an aurora over Canada and its more quiescent nightside counterpart over Siberia; b) brightening of the sunlit portion over the Hudson Bay; c) first brightening of the nightside aurora; and d) increased nightside brightening.