Biomedicine

Stefi Weisburd reports from Edmonton, Alberta, at the 24th annual meeting of the Society for Cryobiology

Sweet success in freezing islets

A surgical team recently removed most of a baby's pancreas because his pancreatic islets were producing too much insulin. While this procedure solved one problem, it may eventually make the child diabetic, because as he grows he will need more insulin-producing islets to control his blood sugar levels. So the surgeons have frozen the baby's islets in the hope of being able to transplant them back if the need arises in the future.

If the surgery is successful, it will be due largely to the cryopreservation studies of Ray Rajotte, Garth Warnock and Marilyne Coulombe at the University of Alberta in Edmonton. This group says it has now shown conclusively that animal islets can be successfully frozen, thawed and transplanted. The researchers report that they have reversed drug-induced diabetes in rats with healthy cryopreserved islets grafted in the animals' kidneys. They know that the transplanted islets were responsible because when they removed the kidneys, the animals became diabetic again. Testing the viability of islets in this way was not possible in past studies, Coulombe says, because cryopreserved islets were grafted into the liver, which could not be removed without killing the animal.

The ability to freeze and thaw organs and tissues without damage has been a longtime goal of cryobiologists. Researchers have cryopreserved relatively simple tissues such as skin, but they are still far from storing organs at freezing temperatures. Islets, says Rajotte, "are the most complicated multicellular structures we've been able to freeze."

Scientists have been interested in collecting and storing islets from donors mainly because they hope to use islet transplants as a safer and more effective treatment for some types of diabetes. The traditional approach — periodically giving large doses of insulin that are not tailored to the diabetic's actual blood sugar levels — often leads to later complications such as blindness.

According to Coulombe, there have been a few human transplants with fresh islets, but these have met with only limited success, possibly because insufficient numbers of donor islets were collected. Cryopreservation would give surgeons time to collect many islets from different donors. But Rajotte says his group has also developed a technique for extracting high yields of pure islets in dogs, and this may help surgeons isolate sufficient quantities of islets in new human trials scheduled to begin shortly.

Another potential advantage of cryopreservation is that certain freeze-thaw conditions may preserve tissue while selectively killing off donor "passenger" leukocytes, the white blood cells that trigger an immunological rejection of the tissue. Rajotte's group has also demonstrated that cryopreserved rat islets grafted into mice generally withstand rejection longer than grafted fresh islets. However, the researchers have not yet proved that freezing and thawing *per se* are in fact solely responsible for the prolonged survival.

Working on the assumption that cryopreservation can affect tissue and leukocytes differently, Michael Taylor and his colleagues at the Medical Research Council in Cambridge, England, are looking for the best freezing regimes for reducing rejection of the transplanted islets. While Rajotte has shown that the survival of islets is optimal during a slow-freeze-quick-thaw procedure, Taylor suspects that this does not kill all leukocytes. Since there has been some suggestion that leukocytes do poorly when frozen quickly, he has set out to see if at least some islets can survive under rapid freezing. His preliminary conclusion is that they can. From his and other studies, says Taylor, islets appear to be able to withstand a much wider range of cryopreservation conditions than any other tissue system. "Why this should be," he says, "is the question that is uppermost in cryobiologists' minds."

Paleobiology

Facing up to a backwards fossil

Fossils of primitive, jawless fish dating back 470 million years are the oldest known examples of vertebrates, a subphylum to which both human beings and salamanders belong. Because the evidence of these fish, called agnathans, is scant and fragmentary, scientists know little about the agnathans' appearance or about their evolutionary history. However, one scientist is discovering new information simply by turning around a "backwards" fossil.

This fossil is one of a handful of the earliest known agnathan fossils, all of which date back to the Ordovician period. In a reexamination of the fossil, David K. Elliott from Northern Arizona University in Flagstaff realized that "the person who had described it had somehow gotten it back to front."

Because of this error, the fossil had been dismissed as a headless, tailless mass of scales and plates. But in the July 10 SCIENCE, Elliott reports that both head and tail are well preserved, making this the most complete vertebrate known from the Ordovician, he says.

Because of new information discovered by the fossil turnaround, Elliott believes that this fossil and several similar ones had been inappropriately assigned to an order of fish, Heterostraci, whose members have only a single set of tube-like openings that run to the gills. Elliott, however, has found several sets of openings on the reexamined fossil.

Discovery of unhatched dinosaur eggs

Canadian scientists last week announced finding nests of dinosaur eggs containing well-preserved embryos. These unhatched eggs, found southeast of Calgary, Alberta, will aid in the study of dinosaur development, say researchers from the Tyrrell Museum of Paleontology in Drumheller, Alberta, who discovered the nests. To date, only one other group of dinosaur embryos — from nearby Montana — has been identified.

Pulling each other through bad times

Scientists believe that when the early plants first left the oceans and lakes for a home on land, they were greeted by a harsh environment, where dryness, ultraviolet radiation and nutritional problems made life exceedingly difficult. According to a popular theory, the earliest land plants survived these conditions through symbiotic relationships with fungi — a situation quite common today.

In a prevalent form of the modern symbiosis, fungi live in or around a plant's roots. They aid the plant in the uptake of nitrogen and phosphorus, and receive needed carbohydrates in return. Scientists have yet to find conclusive evidence that this in fact took place in prehistoric times, but a recent find suggests that it did.

In previous support of the theory of early symbiosis, some scientists have pointed to fossils of plants that contain characteristic fungal structures. However, these structures have not given researchers enough information to determine exactly what kind of relationship was occurring, says paleobotanist Sara P. Stubblefield of Ohio State University in Columbus. In an apparent answer to this question, Stubblefield and her colleagues report in the July 3 SCIENCE that they have found fossilized fungal organs, called arbuscles, which Stubblefield says are the most definitive structural evidence for symbiosis. Scientists believe that arbuscles allow the exchange of nutrients between fungus and plant, but fossilized arbuscles had previously been unknown.

Although these fossils, dating back approximately 220 million years, do not prove any relationship, says Stubblefield, they strengthen the argument that symbiosis was occurring at that time. This discovery should help scientists in locating even older arbuscles, she says.