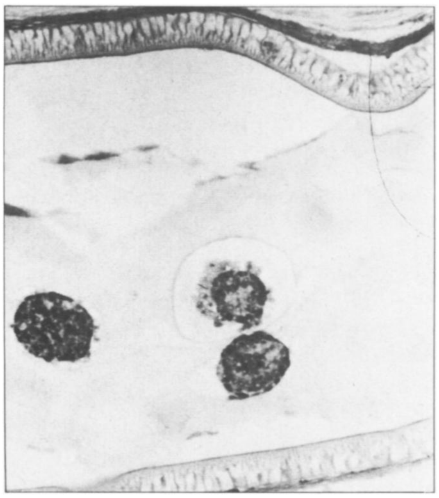
New clues to diabetes' cause and treatment

Type I diabetes, the most serious form of the disease, results from an abnormality in a class of immune-system proteins, a new study involving human diabetics indicates. A second study suggests that transplants of hollow fibers containing pancreas cells may one day help diabetics maintain normal blood-sugar levels without insulin.

Usually striking by early adolescence, Type I diabetes — the insulin-dependent form of the disease — currently afflicts roughly 1 million people in the United States. Because the pancreatic "beta" cells no longer produce enough insulin to process diet-derived sugar, these diabetics must frequently inject themselves with supplemental insulin.



Lacy

Healthy beta cells inside fiber implant.

In recent years, researchers have gathered evidence implicating Type I diabetes as an autoimmune disorder, in which the immune system turns against the body. They have found antibodies to beta cells in the blood of diabetics (SN: 6/18/88, p.389). People with a particular immune-system marker also prove more vulnerable to autoimmune diseases, and therefore run a higher risk of developing diabetes (SN: 6/10/89, p.357). The marker, a cell-surface protein belonging to the "major histocompatibility complex (MHC) class II," normally recognizes foreign proteins.

Denise Faustman of Massachusetts General Hospital in Boston and her colleagues now suggest that the disease might instead be associated with MHC class I proteins, which normally help the immune system discriminate between healthy body cells and those that are precancerous or infected by viruses. Blood cells from diabetic mice and people both possess lower than normal levels of MHC class I proteins, they now report in the Dec. 20 SCIENCE.

The immune system in an individual with Type I diabetes may fail to recognize its own beta cells because they are deficient in the MHC class I proteins, which tag them as "self," Faustman says. "We think [a reduction in MHC class I] is present even before autoantibodies occur," she says. If true, her team's discovery may lead to a clinically useful way to predict which children will eventually develop Type I diabetes.

The new study "should redirect interest to MHC class I as a susceptibility marker for diabetes," says Mark Atkinson, a diabetes researcher at the University of Florida in Gainesville. He adds, however, that proof of MHC class I's value as a prognostic tool must await the outcome of larger studies.

In the same issue of SCIENCE, Paul E. Lacy of Washington University in St. Louis and his co-workers report developing a potential treatment for Type I diabetes. The researchers implanted permeable plastic fibers containing healthy beta cells into the bellies of rats with diabetes symptoms. Protected from the immune system by the encasing fibers, these implanted cells thrived during the 60-day study period, the reseachers report. More important, the implants produced enough insulin to regulate the rats' blood-sugar levels. When the team removed the fibers, the rats' blood-sugar levels soared back to unregulated levels.

— C. Ezzell

More evidence of a solar neutrino shortfall

The first published results from a gallium experiment reveal that the number of low-energy solar neutrinos detected on Earth falls significantly short of the number expected based on the theoretically predicted rate of neutrino production in the sun. These measurements follow the pattern of two long-running solar neutrino experiments, which show a similar deficit of high-energy neutrinos.

The new data come from the Soviet-American gallium experiment (SAGE), located at the Baksan underground laboratory at Mt. Andyrchi in the Northern Caucasus. Members of the SAGE collaboration report their findings in the Dec. 9 PHYSICAL REVIEW LETTERS.

The perplexing results strengthen a growing conviction among physicists that standard particle physics theory fails to account fully for the observed behavior and characteristics of neutrinos. "An observation in a gallium experiment of a strong suppression of the [expected] low-energy neutrino flux requires the invocation of new neutrino properties," the SAGE team suggests.

The SAGE neutrino detector initially consisted of 30 tons of liquid gallium metal in four large tanks. Though nearly all neutrinos emanating from the sun pass through the Earth unhindered, a few interact with ordinary matter. On the rare occasion when a gallium atom absorbs a neutrino, the interaction transforms the atom into an isotope of germanium. To count the number of neutrinos captured, SAGE researchers chemically extract germanium-71 from the liquid gallium and determine its quantity.

Results from five measurements carried out in 1990 between January and July show that the neutrino capture rate is surprisingly low. Taking statistical and experimental uncertainties into account, the researchers deduce that the observed capture rate can be no more than 60 percent of the rate predicted by the standard solar model. Indeed, the data point to a "best" value of only 15 percent of the predicted rate.

Preliminary SAGE results presented last year at a number of scientific conferences had shown a similar neutrino shortfall (SN: 9/1/90, p.141). However, additional data and analysis now permit the researchers to set tighter limits on the neutrino capture rate, establishing more firmly the existence of a serious deficit in the number of neutrinos detected.

The researchers have done several systematic checks of the gallium experiment, and everything checked out correctly, says SAGE group member Thomas J. Bowles of the Los Alamos (N.M.) National Laboratory.

To increase the probability of capturing neutrinos, the researchers added another 30 tons of gallium last summer. So far, data from the larger experiment are consistent with the newly published results, Bowles says.

The SAGE measurements pose a serious threat to conventional theory because a gallium detector picks up low-energy neutrinos generated inside the sun during proton-proton fusion reactions. Shortfalls in high-energy neutrinos, seen in previous experiments, had prompted theorists to speculate that either the sun's core temperature is lower than expected, or neutrinos somehow change their identities before they reach the detector, and thus fail to interact with Earth-based detectors in the expected manner. Because the rate of proton-proton fusion reactions does not depend strongly on the sun's core temperature, the data from the gallium detector favor the change-of-identity explanation.

Some theorists argue that an electron-neutrino (one of the three known types of neutrinos) created in a proton-proton fusion reaction can, on its way to Earth, transform itself into another type of neutrino. Such a transformation is possible only if neutrinos have mass. The current standard model of particle physics envisions neutrinos as massless.

— I. Peterson