# Regimen Slows Diabetic Complications

By keeping blood sugar concentrations as close to normal as possible, people with Type I diabetes can prevent or slow the life-threatening complications of this disease, according to a new study. An independent review panel halted the research after nine years—one year short of its planned length—because preliminary analysis of the data revealed such substantial benefits for people with Type I diabetes that continuing the study seemed unnecessary.

The findings surprised some researchers, who didn't expect to see such dramatic results. "I think we hit a home run. You can substantially reduce the risk of progression," says Julio V. Santiago, a diabetes specialist at Washington University in St. Louis and one of the study's principal investigators.

Type I diabetes, like other forms of the disease, makes it difficult for the body to process glucose, a simple sugar and the main source of energy for cells. People with Type I diabetes must get daily injections of the hormone insulin in order to use glucose in their bloodstream.

For years, some researchers had argued that by keeping a tight rein on glucose concentrations in the blood, patients could slow the development of medical conditions associated with diabetes. Those complications include retinopathy, a blinding disease in which tiny blood vessels in the retina begin to leak; nephropathy, in which blood vessels in the kidney are damaged; and neuropathy, in which nerves in the feet, legs, and fingertips are damaged.

Before advising diabetic patients to embark on more complicated treatment regimens, researchers had to confirm that tight control of blood glucose really provided significant gains. Thus, the National Institute of Diabetes and Digestive and Kidney Diseases sponsored a trial of 1,441 people with Type I diabetes, which usually develops before age 30.

Researchers at 29 medical centers throughout the United States and Canada randomly assigned volunteers, who had no complications or mild complications at the study's start, to either a standard treatment or a rigorous therapy group.

People getting standard care received one or two shots of insulin daily but did not make any extraordinary effort to keep blood sugar concentrations low.

By contrast, volunteers assigned to the more rigorous group received three or more injections of insulin per day or relied on a small, battery-powered device called an insulin pump to continuously deliver insulin through a tiny needle inserted under the skin. Volunteers assigned to this group had to measure their blood sugar four times a day and then adjust their insulin intake accordingly. This regimen more closely resembles the way the body regulates glucose.

The researchers found that people getting the standard therapy had about 231 milligrams of glucose per deciliter of blood, an amount that far exceeds the norm of 110 mg/dl but falls within the usual range for diabetics. By contrast, people in the rigorous therapy group had glucose concentrations of about 155 mg/dl.

Despite the fact that their blood sugar was higher than normal, people in the rigorous therapy group experienced a 60 percent reduction in the risk of complications. Those results, which experts say will revolutionize the treatment of diabetes, were announced this week at the American Diabetes Association's annual scientific sessions held in Las Vegas.

Compared to the standard therapy, the new treatment delayed the onset or slowed the progression of retinopathy by 76 percent. It also prevented or delayed progression of kidney disease by 35 to 56 percent, the researchers found. And rigorous treatment forestalled nerve damage that can lead to loss of sensation in the feet, legs, and fingertips.

Diabetics following the more exacting regimen also shouldered some risks. The trial revealed that people in the experimental therapy group faced three times the risk of developing hypoglycemia, a condition in which concentrations of blood sugar dip too low. These attacks can cause shakiness, disorientation, and in severe cases, coma.

Most Type I diabetics can reduce their risk of hypoglycemic attacks, adds James R. Gavin III, newly elected president of the American Diabetes Association. The danger of hypoglycemia can be reduced by frequent monitoring of blood sugar, fine-tuning of insulin dosage, and changes in diet and exercise, he says.

The new study focused on Type I diabetes patients, but many scientists think more rigorous glucose control may also benefit people with Type II diabetes, which generally strikes after age 40. Excessive glucose in the blood may also cause the eye, kidney, and nerve complications that afflict these people.

*—K.A. Fackelmann*

# Dawn of a telescope: Keck gets first images

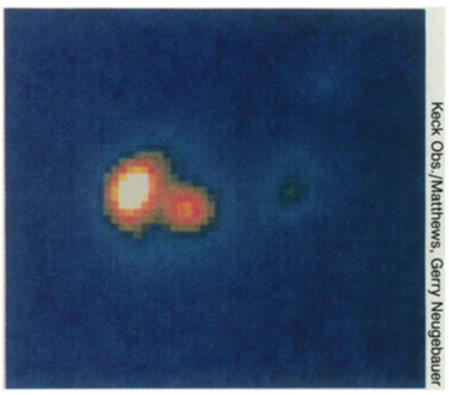
For astronomers growing up in the 1950s, '60s, and '70s, one telescope symbolized the ultimate in viewing the distant reaches of the universe: the 5-meter Hale Telescope on Mt. Palomar. Now a new instrument has claimed the crown as the largest optical telescope in the world. Perched atop an extinct Hawaiian volcano, the 10-meter W.M. Keck Telescope made its debut in March, using a near-infrared camera to study the heavens.

Last week at a meeting of the American Astronomical Society in Berkeley, Calif., astronomers displayed Keck's first research images. None reveals major new discoveries, but the telescope's unusual optics—a mosaic of 36 mirrors that acts as a single 10-meter mirror—have probed gravitational lenses, distant galaxies, and quasars in unprecedented detail, says Jerry Nelson, director of the Keck Observatory.

Keck's near-infrared image of 4C41.17, the most distant galaxy known, reveals that at least five faint bodies surround it. If spectroscopic studies with Keck show that the objects lie at the same distance as 4C41.17, some 12 billion light-years from Earth, their proximity on the sky to 4C41.17 would suggest they are companion galaxies that will eventually merge, says James R. Graham of the University of California, Berkeley.

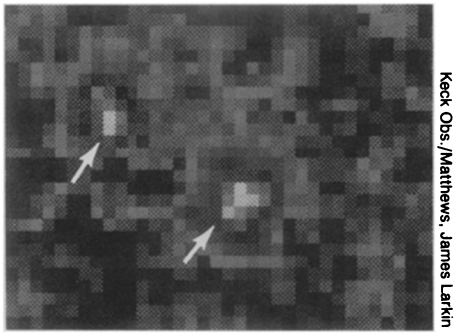
Spectroscopy should indicate the age of stars in these companions, he notes. If the companions are indeed as distant as 4C41.17, they would appear through the telescope as they did when the cosmos was just 10 to 25 percent of its current age. And if such galaxies contained stars 1 to 2 billion years old, this might set a new minimum age for the universe and pinpoint when most galaxies formed.

Keck's infrared view of another galaxy, one that ranks among the most luminous objects ever observed, may shed new light on the origin of its radiation. The image shows that some of the radiation comes from an elongated region, rather




*Infrared image shows the ultraluminous galaxy FSC10214+4724, which appears surrounded by faint companions.*

than a point-like source indicative of a quasar, reports Keith Matthews of the California Institute of Technology in Pasadena. Although the finding doesn't rule out a quasar, it supports previous obser-



Keck Obs./Matthews, James Larkin

*Photo shows quasar light that has been gravitationally bent, or lensed, into two images (arrows) by a foreground galaxy. Other images indicate that the galaxy may be the second known example of a dusty gravitational lens.*

vations that a burst of star formation contributes to the luminosity of the galaxy, known as FSC10214+4724, Matthews says. He adds that wing-like structures near the galaxy's edge may indicate a stream of stars and gas torn off by a collision with one or more other galaxies.

Nelson says the Keck Telescope will have its five detectors in place by the end of the year. Visible-light studies will begin this summer. — *R. Cowen*

# Freedom's redesigns reach the White House

You say you want to buy a space station but you're short on cash this budget year. Well, take a look at this little number right here — we call it the Big Can. Drive it into orbit for $11.9 billion. . . .

Last week, still struggling to sell its beleaguered orbiting laboratory to Congress and President Clinton, NASA offered three cost-cutting alternatives to Space Station Freedom, projected to cost $18 billion over the next four years.

In February, Clinton asked NASA to halve the price of completing the Earth-orbiting craft. At the same time, the redesign had to preserve the station's scientific capabilities and still honor prior commitments to international partners (SN: 4/3/93, p.218). The 50-member NASA team found it could not meet these goals within the cost limit set by the White House — $9 billion or less spread over five NASA budgets, 1994 through 1998.

The least expensive of the three space station designs, option C, would blast off in a single package. Informally dubbed the Big Can, this $11.9 billion, 92-foot-long cylinder would be launched with external fuel tank, main engines, and solid boosters cannibalized from a space shuttle. Option B, a scaled-down version of Freedom, would cost $13.3 billion in the next five fiscal years to build and loft into orbit. Option A, a mixture of components designed for Space Station Freedom and flight-ready parts from other sources, would cost $12.9 to $13.2 billion. The redesigned station would operate for 10 to 15 years.

On June 7, NASA Administrator Daniel Goldin sent the new design options to a special advisory panel appointed in April by Vice President Albert Gore to undertake an independent assessment of the space station program. The panel submitted its report to the White House late last week, assessing the three options in terms of cost, inherent risk to crews, and technical feasibility.

The panel rejected option B as too risky, explaining that astronauts would have to spend too much time on spacewalks assembling and maintaining the station. Instead, the advisory panel recommended options A and C as technically simpler and less dangerous to construct.

One likely problem: Rep. George E. Brown Jr. (D-Calif.), chairman of the key authorizing committee for space projects in the House, favors option B as the only design likely to muster lasting support in Congress.

President Clinton will decide shortly which design option he will ask Congress to adopt in the 1994 budget. — *D. Pendick*

# Cooling the vision of Earth's hot core

Heat trapped deep within Earth during its formation provides the energy that ultimately moves continents, powers volcanoes, and triggers earthquakes. So to understand better the planet's workings and its 4.6-billion-year geologic evolution, geophysicists want to know how much heat is stored inside Earth's iron-rich core.

New experiments now suggest a cooler core than previously thought.

To determine Earth's reserve of internal heat, scientists must know the melting temperature of iron at the boundary between the solid inner core and the molten outer core. Since that boundary lies 5,100 kilometers below Earth's surface at a pressure of 3.3 million atmospheres, it cannot be reached directly, nor can such high pressures be created in a laboratory.

Previously, the pressure limit at which scientists could hold iron was just 1 million atmospheres. Now, geophysicist Reinhard Boehler of the Max Planck Institute for Chemistry in Mainz, Germany, has pushed that to 2 million atmospheres. And he has extrapolated his data to 3.3 million atmospheres, calculating a temperature of 4,800 kelvins at the inner core-outer core boundary — a much lower figure than prior estimates of up to 8,000 kelvins.

Boehler reports his findings in the June 10 NATURE.

"We have reached the upper limit of pressure and temperature that can be achieved using this equipment," says Boehler, who used a diamond anvil that squeezes tiny iron samples between two diamond crystals.

While Boehler cranked up the pressure exerted by the diamonds, he heated the iron sample with a laser. Heating iron shifts its color from red to blue. Boehler determined the iron's melting temperature under different pressures by monitoring the sample's changing spectra.

He also estimated the heat loss at the boundary between the liquid outer core and the overlying solid mantle — an area of dramatic physical changes resulting in large part from the huge drop in temperature between the two regions, the geophysicist says. The temperature drops from 4,000 kelvins at the edge of the outer core to 2,700 kelvins at the bottom of the mantle, he calculates.

This transfer of heat can cause huge plumes, or currents, of solid rock to inch slowly upward, ultimately driving the motion of crustal plates. Yet as large as the temperature gap is between core and mantle, it is still much less than predicted by previous experiments.

This unexpectedly low temperature and Boehler's newer research on mantle rocks radically alter the picture of the lower mantle. In unpublished work on perovskite, the mineral that makes up most of the lower mantle, he finds evidence that perovskite's melting temperature is 7,000 to 8,000 kelvins — much higher than previously calculated.

Putting the two findings together, Boehler proposes that the lower mantle will prove to be a rigid area with limited flow and little chance of chemical reactions between mantle and core. "All predictions of flow in the lower mantle have to be reworked," Boehler contends.

Geophysicist Raymond Jeanloz of the University of California, Berkeley, says that only four or five scientific groups worldwide are carrying out work similar to Boehler's and emphasizes the need for cross-checks. Jeanloz has carried out high-pressure diamond anvil experiments, with different results. He anticipates that further experiments will resolve those differences in numbers and illuminate the true dynamics of Earth's inaccessible core.

— *B. Wuethrich*