Insulin-resistance gene defect identified

Insulin, the hormone that directs metabolism of glucose in the body, has long been suspected to have a link to fat breakdown. Even though insulin doesn't itself guide fat metabolism, scientists have noticed that people with a lot of fatty acids—derivatives of fats—in the bloodstream don't use insulin efficiently, a condition called insulin resistance.

Insulin resistance, which frequently appears in obese people and those with high blood pressure, is a hallmark of type II diabetes. In contrast, type I, or juvenile, diabetes arises because pancreas cells fail to produce enough insulin.

A team of European and U.S. scientists now reports that insulin-resistant rats have a defect in a gene involved in fat metabolism. The gene, *Cd36*, encodes a protein that sits on the surface of fat cells, muscle cells, and heart cells.

Among its many roles, the CD36 protein transports fatty acids into a cell for processing. A dearth of CD36 leaves these fatty acids in the bloodstream, which not only abets obesity but seems to disrupt the insulin pathway and prevent cells from taking in glucose properly, says study coauthor Timothy J. Aitman, a diabetologist at the MRC Clinical Sciences Centre in London.

The researchers compared rats bred to have high blood pressure with a group of normal rats. They found *Cd36* defects only in hypertensive rats that were also insulin resistant. Moreover, a group of mice with an overactive *Cd36* gene proved to have low concentrations of fat in the blood. The scientists report their findings in the January NATURE MEDICINE.

"This is a very intriguing study," says Ping H. Wang, an endocrinologist at the University of California, Irvine. "This is the first report actually showing, at the genetic level, a defect that may link insulin resistance to fatty acid metabolism."

"If human diabetes is shown to be due, even in some cases, to CD36 deficiency, then it gives us a handle on a primary cause of the disease," says Aitman.

Insulin controls glucose metabolism by ushering the sugar into cells. The exact pathway is still unclear, as is the means by which excess fatty acids disrupt that process. However, the new findings suggest a genetic basis for a theory holding that, in the body, fat metabolism has priority over sugar use.

"With free fatty acids around, you don't burn a lot of glucose," says molecular biologist Graeme I. Bell of the Howard Hughes Medical Institute at the University of Chicago. "You burn the fat first."

"Diabetes has been viewed as a disorder of sugar metabolism," Aitman says. "But if [defective] *Cd36* is a cause of insulin resistance . . . some forms of diabetes may be more a result of defective fat metabolism."

Noting that obese people often develop high blood pressure and type II diabetes, Wang says that the new study "provides a very good argument" that the same genetic defects could underlie these three disorders.

The *Cd36* genetic defect appears in roughly 2 to 3 percent of Japanese, Thai, and African people but in less than 1 percent of whites in the United States. Type II diabetes, however, currently affects about 10 percent of African Americans and 7 percent of U.S. whites. —*N. Seppa*

Getting under a dinosaur's skin

Paleontologists spend their careers trying to reconstruct animals from meager piles of bones, but recent discoveries of fossilized dinosaur skin are providing researchers with a whole new feel for these ancient behemoths.

"This is about as close as you can get to petting a dinosaur," says Brian G. Anderson of the Mesa (Ariz.) Southwest Museum. In the Dec. 28, 1998 JOURNAL OF VERTEBRATE PALEONTOLOGY, Anderson and his colleagues describe a set of exquisite skin impressions associated with bones from a hadrosaur, or duckbilled dinosaur.

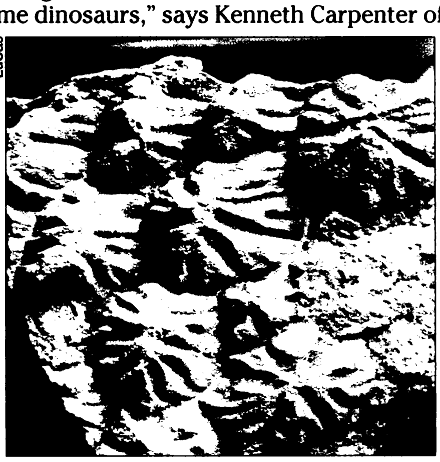
Found in southwest New Mexico, the impressions provide the best look yet at the outer covering of hadrosaurs, says coauthor Spencer G. Lucas of the New Mexico Museum of Natural History in Albuquerque. The fossils have small ridged bumps that look like miniature mountain peaks. "That skin would have felt like running your hand over a knobby mountain bike tire," says Lucas.

In a related discovery reported in the Nov. 19, 1998 NATURE, researchers in Patagonia found fossilized dinosaur embryos, complete with skin impressions. These embryos were the first discovered for the four-footed giant herbivores known as sauropods.

The recent discoveries feed into a growing interest in the exterior of dinosaurs. "It's causing us to look at the way we name dinosaurs," says Kenneth Carpenter of the Denver Museum of Natural History. Paleontologists designate dinosaur species by bones alone, but many modern animal species are defined by their skin or feathers and cannot be distinguished solely from their bones.

As researchers collect more examples of skin fossils, says Carpenter, "we may see that there is a lot more variation among dinosaurs."—*R. Monastersky*

Lucas



Fossilized skin impressions, with bumps reaching the size of dimes, came from a dinosaur that inhabited New Mexico roughly 70 million years ago.

Tiny galaxies have hearts of darkness

Small ghost galaxies, devoid of stars but harboring dense clumps of invisible matter, may outnumber the entire population of luminous galaxies in the universe.

John Kormendy of the University of Hawaii in Honolulu and Kenneth C. Freeman of the Mt. Stromlo Observatory in Canberra, Australia, base that assertion on studies by several teams over the past 20 years that have traced the motion of stars and gas in a wide range of galaxies. Kormendy reported the results Jan. 6 at a meeting of the American Astronomical Society in Austin, Texas.

Since the late 1970s, astronomers have come to accept that at least 90 percent of the matter in the universe is invisible. Studies of gas at the fringes of many galaxies show greater orbital velocities than the gravity exerted by visible matter can explain. Researchers conclude that some kind of unseen matter, dubbed dark matter, keeps the rapidly orbiting material from flying away. Other studies have shown that the tug of visible matter is too small to account for the velocity of stars in gas-poor galaxies.

Analysis of several studies led Kormendy and Freeman to conclude that the tinier the galaxy, the higher its density of dark matter. Although dwarf galaxies are barely detectable fuzz balls of gas and dust, they contain dark matter with densities 100 times larger than those in giant galaxies, notes Kormendy.

"That's a result that has been hinted at for quite a long time," comments Rosemary F.G. Wyse of Johns Hopkins University in Baltimore. Kormendy agrees, noting that the finding only became clear-cut as more and diverse galaxies have been studied.

Dwarf galaxies are known to be far more numerous than larger galaxies. By extrapolation, Kormendy and Freeman argue that galaxies with too few stars to be seen at all have even higher densities of dark matter and may be the most populous. It's even possible—but by no means certain—that these unseen galaxies, estimated to be only one ten-thousandth as massive as the Milky Way, could account for a significant fraction of the mass of the universe, Kormendy suggests.

He explains how dark matter became such a prominent component of the small galaxies. When the first massive stars in these galaxies died, some exploded as supernovas. Because the dwarfs have relatively little mass, the explosions easily drove gas—the raw material of stars—out of the galaxies. The dark matter stayed put, however, because it reacts only to gravity. The galaxies, believed to be the first to form, became pristine relics of the dark-matter content of the early cosmos, Kormendy says.

Wyse speculates that a dwarf galaxy recently discovered near the Milky Way (SN: 4/9/94, p. 228) has maintained its shape despite the tug of our galaxy because it possesses a dense core of dark material. The interaction between this seemingly gossamer galaxy and our own might explain the warp of the outer edge of the Milky Way, she adds. —*R. Cowen*

C.J. Grillmair/NASA

X's show stars in the Draco dwarf spheroidal galaxy.

Puddle that spins together stays together

In conventional electronics, typified by semiconductor devices, charge rules. Circuits sense, direct, store, and process electrons as units of electric charge. In the infant field of spin electronics, or "spintronics," however, a different electron property, known as spin, serves as the coin of the realm.

Researchers have harnessed spin in metals already—for instance, in the circuits used in computers' hard magnetic disk drives. For semiconductors, however, scientists are still exploring rudimentary manipulations of electron spin, which physicists describe as analogous to the rotation of a particle about an axis. Development of a spin-based semiconductor could hasten the advent of extraordinarily compact, speedy computer memory and other circuits. The devices would combine advantages of spintronics with the low-cost mass production typical of semiconductor circuits.

In the Jan. 14 NATURE, James M. Kikkawa and David D. Awschalom of the University of California, Santa Barbara report experimental evidence hinting at practical control of electron spin in semiconductors.

The researchers used electric fields to propel "puddles" of electrons within ultracold strips of gallium arsenide. First, they used a laser pulse to induce the millions of electrons in the sample to orient their spins alike. The experimenters found that they could move this puddle more than 100 micrometers—a distance hundreds of times greater than the spacing between components in an integrated circuit—before the spin coordination broke down.

"This experiment shows that the spin puddles can move without significantly increasing the loss of quantum information to outside of the electronic system," Kikkawa says.

One potential use of spintronics is in quantum computers (SN: 9/12/98, p. 165). Although extremely rudimentary today, such devices may eventually outdo conventional computers by exploiting the quantum-mechanical nature of matter.

The new result suggests that scientists may yet find a way to shuttle fragile data around inside a quantum computer without loss or damage, says Bruce E. Kane of the University of New South Wales in Sydney, Australia. "Maybe the physics is going to allow us to do that. It's a very interesting result."

The physics itself may have to stretch. Theories of electron spin flow seem unable to fully explain the surprising distance the puddles go. "The data suggest there's new semiconductor physics here that people may have missed," Awschalom says.

The fragility of quantum data arises because the spin orientation of a quantum-mechanical entity, such as an electron, can be represented as a complex set of probabilities of different spin directions. This complexity collapses to a single state—with loss of valuable data—if the electron's spin is measured or in other ways interacts with the environment.

The authors stress that the experiment stopped short of proving that the spin characteristics of the individual puddle electrons remained fully intact. Although not affected by outside forces, the electrons themselves may have interacted to cause collapses. —*P. Weiss*

New polymer soaks up more cholesterol

A plastic may one day help people control their cholesterol by preventing the greasy, artery-clogging stuff from being absorbed by the gut. Scientists in Germany report that they have designed a polymer that soaks up cholesterol in simulated intestinal fluid.

Some commonly prescribed drugs, such as cholestyramine, use a related strategy. In the intestines, they bind to, or adsorb, bile acids, which are derived from cholesterol. The bile acids are then eliminated in feces and are replaced via a process that removes cholesterol from the bloodstream.

The new polymer, however, "instead of adsorbing bile acids, would adsorb cholesterol directly," says Börje Sellergren of Johannes Gutenberg University in Mainz. He and his colleagues at Gutenberg and the University Hospital Grosshadern in Munich report their findings in the Dec. 21, 1998 CHEMISTRY OF MATERIALS.

The researchers made the polymer with a technique known as molecular imprinting, which allowed them to pack each particle with binding sites customized for cholesterol (SN: 2/27/93, p. 132). To do this, they added cholesterol to a solution containing the polymer's building blocks, which then solidified around the cholesterol molecules. "By removing cholesterol," Sellergren says, "we have a material that contains pockets that can take up cholesterol again."

Sellergren and his coworkers measured how much cholesterol the polymer adsorbs in a solution designed to mimic intestinal fluid. They found that 1 gram of the material took up about 17 milligrams of cholesterol—30 percent more than the same polymer prepared without molecular imprinting. To make the polymer practical, they would like to double or triple that capacity, Sellergren says.

He would also like to enhance the selectivity of the material, since it also binds to steroid compounds that are found in plants. "If you have a lot of those present in the intestine, they might occupy the binding sites on the polymer," he says. In such a case, for instance after eating vegetables, the material would adsorb less cholesterol.

The building blocks used by the German team are cheap, which is an advantage for a potential drug, says Michael J. Whitcombe, a chemist at the Institute of Food Research in Reading, England. He and his group synthesized an imprinted polymer several years ago that binds to cholesterol in organic solvents that could be used in food processing. The method used by Sellergren and his colleagues is more practical in water-based solutions, such as intestinal fluid, Whitcombe says. —*C. Wu*