found that the ape version, which they provisionally named siglec zz, had the arginine residue, and it prefers to bind Neu5Gc. A single base-pair mutation is responsible for the loss of this arginine residue in the human version of siglec zz. "It is hard to imagine that these two [genetic differences] in sialic acid biology are not evolutionarily connected," Varki says.

But which one came first, and when? Varki suggests that it is unlikely the genetic mutation occurred first in Neu5Gc, followed by a precise "surgical strike" that hit the siglec zz arginine residue and left the rest of the molecule intact. Instead, he believes the first mutation was probably the loss of the arginine residue on human siglec zz, and that reduced, but did not eliminate, Neu5Gc binding sites. This may have then set the stage for the subsequent mutation in the hydroxylase.

For Caro-Beth Stewart, a molecular anthropologist at the University at Albany in New York, the research raises the possibility that what humans lost during evolution might be just as important as what they gained. Maybe, she quips, "we're just apes with lost functions." **–DENNIS NORMILE**

SOLID-STATE PHYSICS

Nanotube 'Peapods' Show Electrifying Promise

Take a microscopic buckytube, stuff it with buckyballs, and what do you get? Just possibly room-temperature superconductivity

SEATTLE, WASHINGTON—Materials that lose their electrical resistance at a whisper above absolute zero are too common to grab much attention nowadays. But when a French and Russian team reported that carbon nanotubes perform this trick, other researchers at the March meeting of the American Physical Society took notice.

The transition temperature—a measly 0.55 kelvin—isn't likely to entice engineers to spin the tiny all-carbon cylinders into superconducting wires. But calculations show that nanotubes filled with other materials could do much better, perhaps even superconduct at room temperature.

"It's impressive work," says David Tomanek, a nanotube expert at Michigan State University in East Lansing. "This is the first direct evidence that nanotubes superconduct." That's important, he continues, because other teams have already shown that crystals of fullerenes—carbon spheres informally known as buckyballs—can superconduct at temperatures as high as 52 K. And theory suggests that lining fullerenes up in wirelike rows would raise the threshold dramatically. Researchers in Japan and elsewhere have aligned fullerenes by packing them inside nanotubes like peas in a pod. Electronic interactions between the tubes and the fullerenes could further boost the superconducting temperature of fullerene wires, Tomanek says. Now the race is on to see if these peapods will superconduct at a high temperature.

Detecting superconductivity in empty nanotubes has been tough. In 1999, a group led by Mathieu Kociak and Helene Bouchiat at the University of Paris-South in Orsay reported in *Science* (28 May 1999, p. 1508) that ropes of 100 or so nanotubes could carry supercurrent between two superconducting electrodes. In superconductors, electrons pair up and travel through conductors without any electrical losses. In this earlier study, the electrons traveled in pairs through the nanotubes, but poor contact with the electrodes caused electrical losses that kept the experiment from confirming that superconductivity was taking place.

To prove that the nanotubes were truly superconducting, the researchers had to show that the electron pairs were not due to superconductivity in the electrodes. Kociak and his colleagues at the French national research agency CNRS and the Russian Academy of Sciences in Chernogolovka started with an array of metal pads made from a nonsuperconducting sandwich of aluminum oxide, platinum, and gold. After placing a batch of nanotube ropes atop a wire mesh suspended above the array of metal pads, the researchers blasted the ropes with a brief laser pulse. That shook loose some of the ropes, which fell atop the contacts below, in certain cases creating a bridge between two electrodes.

Then, using additional laser pulses, the researchers soldered the nanotubes to the metal pads to make clean electrical contact. Finally, they ran currents between selected metal pads to test the nanotubes' behavior.

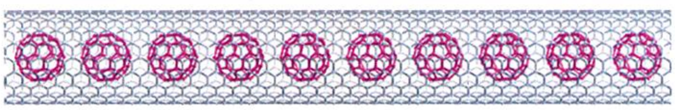
The painstaking work paid off: Measurements of both the electrical and magnetic behavior reported at the meeting and in the 12 March issue of *Physical Review Letters* show that the nanotube ropes were indeed superconducting.

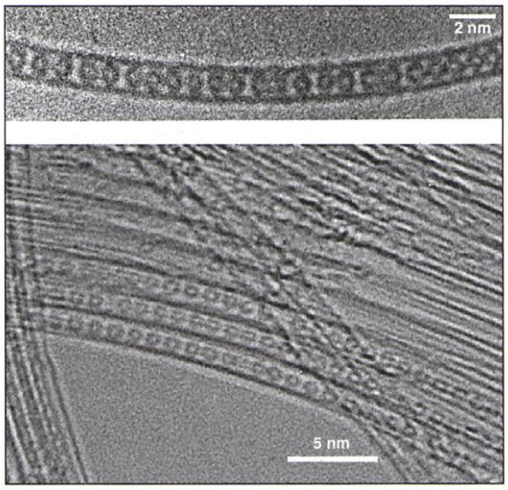
Now the question is whether Kociak's team can pull off the same feat with nanotubes packed with fullerenes. The all-carbon spheres themselves became a big story in superconductivity last year when Bertram Batlogg and colleagues at Lucent Technologies' Bell Laboratories in Murray Hill, New Jersey, raised their superconducting temperature from about 9 K to 52 K by putting the spheres in the middle of a transistor. Turning on an electrical voltage between metals on either side of the transistors swiped electrons from the fullerenes in between. That opened up space for superconducting pairs of electrons in the material to hop around more easily, thereby raising the temperature at which it could superconduct.

According to Tomanek, theory suggests that placing the fullerenes in a wirelike arrangement could do even better: Lowering the number of immediate fullerene neighbors increases a quantum mechanical property known as the density of states—a situation favorable to a higher temperature superconductor.

"Fullerene peapods should give you room-temperature superconductivity," says Tomanek. However, he says, it could also lead to a type of magnetic behavior in the materials that would undermine superconductivity completely. The winner will likely be known in the next few months.

–ROBERT F. SERVICE





Hot threads. Packing fullerene spheres into carbon nanotubes may boost their superconductivity threshold to high temperatures.

CREDITS: (TOP TO BOTTOM) JST AND NEC; D. LUZZI AND B. W. SMITH, *CARBON* **38**, 1751 (2000); B. BURTEAUX, D. LUZZI AND J. FISCHER, *CHEMICAL PHYSICS LETTERS* **310**, 21 (1999)