tures than any of the other feathered dinosaurs," says James Clark of George Washington University.

"Everything about the fossil is skewed toward similarity to birds," adds Wu, citing the mobility of the shoulders, the shape of the breastbone, and the proportions of its limbs. Unlike other meat-eating dinosaurs, it has forelimbs nearly as long as its hindlimbs, which may have originally served in "a form of predation associated with grabbing and clutching," says Thomas Holtz of the University of Maryland, College Park, and could easily have evolved into wings. And the downy fringe that appears to cover much of the new dromaeosaur is "a nice confirmation of the existence of feathers—or whatever we want to call them—on dromaeosaurs," notes Holtz.

What *Sinornithosaurus* lacks are complex feathers like those of *Caudipteryx*, which troubles advocates of the bird-dino connection. If *Caudipteryx*—which they view as less birdlike—had true feathers, so should this missing link. This conundrum leads Wu to suggest that the dromaeosaur did have true feathers that somehow weren't preserved, perhaps because the wind blew them away, leaving only the down, before the animal was buried and fossilized. To doubters such as Larry Martin of the University of Kansas, Lawrence, however, the absence of true feathers is telling. "Flight feathers are bigger and have more structure than these fibers," so they should have been preserved along with any down, he argues.

Ruben adds that if this dromaeosaur—supposedly so close to birds—didn't have true feathers, the "down" is probably a chimera as well. He thinks the same is true for *Sinosauropteryx*, the first "feathered" dinosaur, as well as another downy creature, a so-called therizinosaur, reported in the 27 May issue of *Nature*. As Ruben puts it, "All of these things are in all likelihood something like collagen connective fibers."

But if Ruben and his fellow skeptics are wrong about the nature of these fibers, the images of many familiar dinosaurs should be softened with a coating of down. In the family tree of small, meat-eating dinosaurs, *Sinosauropteryx* lies well away from the dromaeosaurs and the putative ancestors of birds. "It's an ordinary ground-running dinosaur," in Holtz's view. So creatures that perch in between could well have been downy too. Says the AMNH's Norell, "If you're willing to consider the fluffy stuff that's covering the body of *Sinosauropteryx* as feathers, you've got to contemplate *T. rex*, ornithomimids [a group of long-legged, ostrich-sized dinosaurs], and many others as having this kind of plumage at one time in their lives."

Don't start describing *T. rex* to your 4-year-old as a toothy version of Big Bird, though. "Whether an adult *T. rex* had full plumage—well, there's no direct evidence for it, and it might not have been great to have a lot of insulation when you weighed 5 or 6 tons and lived in an environment like Louisiana," says Holtz. "I wouldn't be at all surprised if adult *T. rex* had lost its plumage, although it may have had feathers here and there." **–TIM APPENZELLER**

MEETING AMERICAN CHEMICAL SOCIETY

Raising a Glass to Health And Nanotubes

NEW ORLEANS, LOUISIANA—For the 12,000 researchers who sweated out the dog days of summer at the American Chemical Society (ACS) meeting here from 22 to 26 August, the hot papers included a novel explanation for the healthy effects of moderate alcohol consumption, and both triumph and trials on the road to electronic devices based on carbon nanotubes.

Fathoming the French Paradox

The French seem to have it all. They eat an exquisite diet full of high-fat foods such as cheese and meats washed down with fine wines, and yet they suffer from only one-third as much heart disease as do inhabitants of the United States. One explanation for what health experts have dubbed the "French paradox" is that antioxidant compounds in red wine prevent fats from being oxidized into forms that tend to build up in coronary arteries, among other places. Yet simply eating grapes that harbor the same compounds as wine doesn't seem to confer the same benefits. "So something else must be going on," says Yousef Al-Abed, an organic chemist at the Picower Institute for Medical Research in Manhasset, New York. At the meeting, Al-Abed reported that rat studies suggest a new possibility: that an alcohol metabolite prevents the formation of harmful compounds called advanced glycation end products (AGEs), which are thought to initiate the potentially deadly plaque buildup in coronary arteries.

"I feel quite excited about it," says Helen Vlassara, an AGE expert at the Mount Sinai School of Medicine in New York City. Although the notion that alcohol suppresses AGEs has been around for a while, "this was the first time it was solidified [experimentally]," she says. In addition to helping explain the French paradox, the new work may also lead to the development of novel drugs that combat heart disease by targeting AGEs—work that biochemist Richard Bucala, the senior scientist on the Picower team, says is already under way.

Cup of good health? Does an alcohol metabolite protect drinkers from heart disease?

AGEs begin to take form when common proteins circulating in the blood pick up a sugar group or two in their wanderings, which bind to the proteins to create key AGE intermediates called Amadori products (APs). The sugar groups on APs can adopt either a looped structure that behaves like a molecular Dr. Jekyll or a Hyde-like linear form. The linear form is harmful because the glucose remains reactive and can act as a molecular coupler, linking proteins together to form AGEs. The AGEs in turn can aggregate to form a thick, cross-linked web of proteins, which is thought to play a role in everything from atherosclerotic plaques to the loss of tissue flexibility with age. AGEs also bind low-density lipoprotein, the so-called bad cholesterol, and slow the rate at which it is cleared from the blood, thus increasing a person's cholesterol level and overall risk for heart trouble.

Amadori products with looped sugars are less reactive, but the rings can still open up into the Hyde-like chains—except on certain APs containing a pair of rings that seem frozen in their safe, unreactive form. Researchers weren't sure what causes the freezing, but Al-Abed thought some ring-forming compounds called aldehydes could be responsible. So he decided to test one called acetaldehyde, a byproduct of alco-

CREDIT: B. BERG/VISUALS UNLIMITED, C. GUPTON/UNIPHOTO PICTURE AGENCY hol's chemical breakdown, to see if it could transform the ring-shaped glucose molecules on APs into a stable double ring, thereby preventing the APs from going on to create AGEs.

In the test tube, acetaldehyde did prove capable of turning the single-ringed glucose into its double-ringed cousin. To see if the same thing happens in the body, Al-Abed and his colleagues turned to rats that had been bred to serve as animal models for diabetes. Like human diabetics, these rats tend to have high levels of glucose in their blood, which the researchers thought might enable them to see sugar-protein reactions more quickly than in animals with normal blood sugar levels.

For their study, they fed one group of diabetic rats a normal diet supplemented with a modest amount of alcohol. The other group received just water and a bit more food, so that their overall calorie intake was the same. After 4 weeks the researchers measured the AGE levels in the animals and found that rats receiving the alcohol had only about half the AGE levels of their counterparts. The researchers also isolated an AP called HbA1c from the alcohol-fed rats and showed that some of it had the same stabilized double-ringed glucose structure that forms in the test tube.

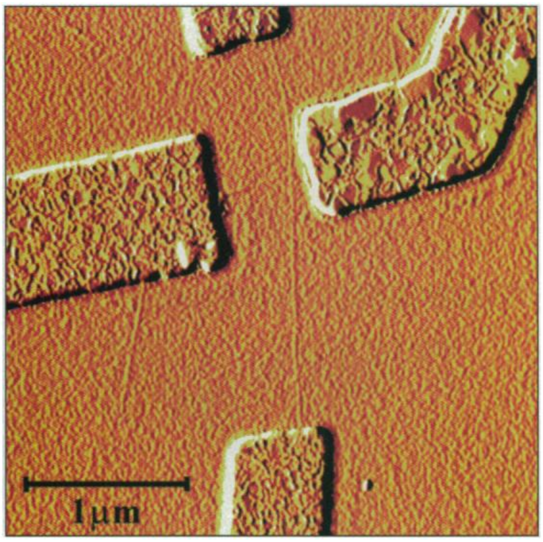
The new work "gives us a real molecular mechanism" that may help explain alcohol's protective effect, says Bucala. As an encore to their current work, the Picower researchers are currently searching for potential drugs that may stabilize the Jekyll-like glycoproteins even better than acetaldehyde does. Such a drug could benefit diabetics, who are more likely to form AGEs because of their higher levels of blood glucose, and elderly patients at risk of heart disease. For the rest of us, the new work offers yet another line of evidence that drinking alcohol in moderation may produce more than just bonhomie.

Nanotubes Show the Way

Carbon nanotubes are the materials science counterpart of the high school student judged "most likely to succeed." Made of a hexagonal lattice of carbon atoms, nanotubes are strong, light, flexible structures that conduct heat well, and depending on their precise arrangement of carbon atoms, can conduct electricity freely like a metal or reluctantly like a semiconductor. Last year, researchers built the first nanotube-based transistor, which sparked hopes for creating computers based on these molecular circuits. At the ACS meeting, Alex Zettl, a physicist with the University of California, Berkeley, and the Lawrence Berkeley National Laboratory, offered more evidence of nanotubes' promise—and also a major caution.

Zettl initially fanned hopes by reporting that his group had built a nanotube version of a diode, a standard electronic device that routes an electric current in a preferred direction. But then just minutes later he described other experiments showing that nanotube electronics suffer greatly from electronic "noise," a background hiss that interferes with a device's ability to send and receive signals.

Zettl's new work was "one of the highlights" of a nanotube symposium that drew many of the top names in the field, says Robert Haddon, a physicist and nanotube expert at the University of Kentucky, Lexington. Haddon conceded that the tubes' noisiness—likely due at least in part to atomic contaminants on their outer surface—could spell trouble for their use in electronics, although he thinks it could be overcome by controlling contamination, as conventional chipmakers do. The new work, he says, "is a heads-up that eventually we'll have to work on the same problem."



Diminutive diode. Two carbon nanotubes, barely visible, join opposite gold contacts to form a cross.

CREDIT: M. FUHRER, P. MCEUEN, AND A. ZETTL/DEPT. OF PHYSICS, UC BERKELEY AND LAWRENCE BERKELEY NATIONAL LABORATORY

For now, wiring nanotubes into electronic devices is challenge enough. The standard printing techniques that pattern conventional silicon circuitry can't come close to creating anything as small as nanotubes. So, Zettl, Berkeley physicist Paul McEuen, postdoc Michael Fuhrer, and their colleagues had to take advantage of a little randomness to make their devices. First, they dusted a silicon-dioxide surface with a small collection of nanotubes. They then scanned the surface with the fine probe of an atomic force microscope to find a pair of tubes that formed a cross and didn't touch any neighbors. Once they had tracked one down, they used a conventional technique involving an electron beam microscope to position tiny electrical contacts made of gold at each of the four ends of the cross.

After hooking these contacts to a power supply and current meter, the researchers turned on the current through one tube and watched as it jumped to its neighbor. A conventional diode routes current in a preferred direction by juxtaposing a metal and a semiconductor, as electrons can flow easily from the metal to the semiconductor but hit an electronic wall at the junction when they try to go the other way. Zettl and his colleagues reasoned that any crosses that happened to combine a semiconducting and a metallic nanotube would work the same way. Current measurements showed that the new nanotube-based devices "look as good as any diode you can buy," says Zettl. "One can envision using these devices in certain kinds of [electronic] architectures."

All of which caused Zettl to wonder just how good wires made of nanotubes would be. So he and another associate, Philip Collins, decided to see if nanotubes suffer much from noise—fluctuations in the voltage measured when current is passed through a conductor. They wired up gold contacts to opposite ends of individual tubes, tube bundles, and even thick mats. After running current through the tube or tubes, they simply measured the noise with a standard device known as a spectrum analyzer. To their surprise they found that it didn't matter if they looked at individual tubes or bundles. All were noisy, as much as 10 orders of magnitude noisier than conventional metal conductors.

"These nanotubes are some of the noisiest conductors in electronics," says Zettl. Part of the problem could be that they are long and thin, says Haddon. Whereas the noise in bulk metallic conductors increases linearly as they get longer, in molecule-based systems such as nanotubes, it increases exponentially.

Equally important, Zettl suggests, may well be oxygen and other electron-hungry contaminants that scurry up and down the nanotubes, attracted by whirling electrons that dance between the tubes' carbon atoms. Those contaminants could be deflecting some of the conducting electrons. "The message is that chemistry obviously influences the electronics," says Zettl. But that is not necessarily a bad thing, he adds, suggesting that the effects could be tapped to produce an extremely sensitive oxygen sensor—yet another potential talent of these well-rounded materials.

–ROBERT F. SERVICE