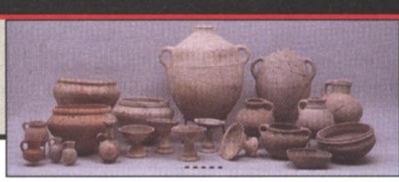
FOCUS

26
The plight of postdocs

LEAD STORY 28
The travails of archaeology in the Holy Land



budget of NCID, which includes Mahy's division. Reeves says CDC as a whole should absorb the loss. "This is going to severely compromise NCID's ability to do important infectious diseases research," he warns. But McDade predicts that things will work out. "Every year there are many things that need to be done, and there are always challenges about resource allocation," he says. "This is just one more challenge."

Finances aren't the only obstacle to full recovery for CDC. Reeves, who is protected by a federal whistle-blower law, has filed a complaint with the U.S. Office of Special Counsel in Washington, D.C. It claims that Mahy, upset at his speaking out, issued him an unjustified reprimand, reduced his performance appraisals, and removed staff from his supervision. Reeves says he wants those actions undone and is also asking for recovery of attorney fees and $300,000 in damages. McDade says CDC hasn't been officially notified of the case and declined to comment.

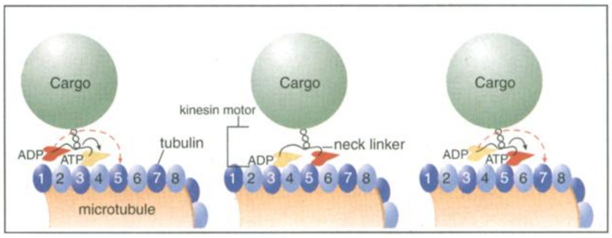
Meanwhile, the General Accounting Office (GAO), Congress's financial watchdog, is taking a closer look at chronic fatigue research at CDC and its sister agency, the National Institutes of Health. That study, to be completed in the spring, "will be a qualitative assessment of the [scientific] program," says GAO researcher Janet Heinrich. The study was requested by Senator Harry Reid (D–NV), a champion of CFS patient groups who helped obtain the special funding.

Whatever these investigations and studies conclude, CDC isn't likely to make the same mistake twice. "We have learned a valuable lesson through this experience, which will not be forgotten," said a statement that Koplan sent to patient groups this summer. For Woodall, that lesson is elementary: "As we all know, you have to be careful with what you do and how you deal with the people who control the money." **–MARTIN ENSERINK**

CELL BIOLOGY

Kinesin Movements Revealed

Edwin Taylor and Nobutaka Hirokawa are not your average mechanics. Instead of tinkering with grease and iron, they study the cell's molecular motors. And unlike ordinary mechanics, who know that all engines are basically alike, Taylor and Hirokawa are finding an unexpected diversity in molecular motor design. Take kinesins, motor proteins that drag protein-laden vesicles along microscopic tracks called microtubules to the cell's periphery. Last month, at the annual meeting of the American Society for Cell Biology, which was held in Washington, D.C., Taylor, a cell biologist at the University of Chicago, and Hirokawa, a cell biologist at the University of Tokyo, described new results showing that two different kinesins move in very different ways.



Forward, march! When ATP binds to kinesin's front "foot," it causes the neck linker to swing the rear "foot" forward, allowing the motor protein to take a step.

ILLUSTRATION: C. CAIN; SOURCE: RICE *ET AL.*, *NATURE* 402, 778 (1999)

The classic "double-headed" kinesin studied by Taylor and his colleagues plods systematically step by step along the microtubules, whereas the single-headed variant kinesin studied by Hirokawa ambles forward, relying on random movements to make progress. What's more, both kinesins move differently from myosin, a motor protein involved in muscle contraction. Some cell biologists had expected that the two-headed kinesin in particular would work in a similar fashion, partly because it and myosin both consist of two subunits, each with its own business end, or "head."

Cell biologists had learned that myosin moves when one head swings out like a lever and pulls the protein along the actin filaments of the contractile machinery. But Taylor found something quite different when he became part of a team led by Ron Vale, a biophysicist at the University of California, San Francisco, and Ron Milligan, an electron microscopist at The Scripps Research Institute in La Jolla, California. By attaching fluorescent probes or gold beads to each kinesin subunit, the researchers were able to use a variety of techniques, including electron microscopy, to monitor the molecule's shape and movements. In some experiments, for example, they treated the protein with altered versions of ATP, the energy-rich molecule that is the "fuel" for motor proteins, which caused it to freeze at various stages in the movement cycle.

The researchers found that the kinesin moves one foot at a time. First, ATP binds to the front foot, causing a 15–amino-acid region called the neck linker to zip up with a nearby part of the molecule and stiffen. This stiffening yanks the back foot off the microtubule, swinging it ahead of what was the front foot. Then, ATP can bind to the new front foot, and as this process is repeated, the kinesin motor plods along, with cargo in tow. "The motion here is a much smaller change" than the one seen with myosin, Taylor said in his talk at the cell biology meeting. (The work also appeared in the 16 December 1999 issue of *Nature*.) Or as Thomas Pollard, a cell biologist at The Salk Institute in La Jolla, puts it, "The myosins are dancing while kinesin is hiking, steadily chugging along step by step."

Hirokawa found that the kinesin called KIF1A works quite differently, however. In early 1999, the group reported a preliminary clue: They found that KIF1A moves on its own, without pairing off (*Science*, 19 February 1999, p. 1152). Now the researchers have an idea of how it does that.

The starting point for the new work was their finding that although the *KIF1A* gene is quite similar to other kinesin genes, it has extra bases that code for a sequence of six lysine amino acids. Thinking that the lysines might be the key to this kinesin's ability to move solo, the researchers synthesized the part of the protein containing the sequence and used cryo-electron microscopy, in which samples are stabilized in glassy ice, to examine how it interacts with microtubules. They also made other versions of this part of KIF1A, varying the number of lysines to see whether that affects KIF1A's movement.

The electron microscopy studies revealed that KIF1A grasps the microtubule both with its foot and the stretch of lysines, which form part of a positively charged loop that is attracted to the negatively charged tubulin protein in microtubules. Based on that finding, Hirokawa proposed that the loop acts as a sliding clamp that holds KIF1A to the microtubule as it moves.

The studies of KIF1A with altered numbers of lysines bore this idea out. "If we take the lysines out, [the motor] doesn't work," Hirokawa's Tokyo colleague Masahide Kikkawa said when he presented some of the

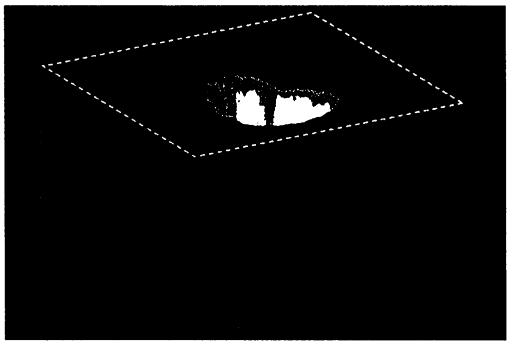
KIF1A data at the meeting. "It's very nice work and leads to new questions," such as what biases KIF1A's movement in one direction, comments David Hackney, a biophysicist at Carnegie Mellon University in Pittsburgh.

Taylor thinks there may be still more kinds of motors chugging away under the hood of the cell. "The mechanisms you can generate from the [general myosin-kinesin] structure are much broader than we had thought," he explains. "There are a whole bunch [of these proteins] out there whose details have not been worked out." —ELIZABETH PENNISI

REMOTE SENSING

Satellite Radar Spies City Subsidence

NAPLES, ITALY—For the past 9 years, researchers have been using the European Space Agency's remote-sensing satellites ERS-1 and ERS-2 to detect small movements of Earth's surface caused by earthquakes or volcanic activity, thanks to a technique known as radar interferometry. One team of researchers based here has been studying movements in Campi Flegrei, a volcanic area west of Naples, since 1992, when ERS data for that area became available. Much to their surprise, in recent images the researchers noticed that a well-defined 4-square-kilometer area of Vomero, a part of Naples, appeared to have subsided. "We observed that between 1992 and 1996 there was a rather significant subsidence of 5 to 6 centimeters," says Riccardo Lanari of IRECE, Italy's National Research Council laboratory for research in electromagnetism and electronic components in Naples, noting that this is the first time subsidence has been detected this way in a city.



Sinking feeling. Radar spotted subsidence in Naples that coincided with excavation of a new metro tunnel.

At first, the team thought this apparent slump was a data error or due to atmospheric effects, until they noticed that it coincided, in both location and time, with the construction of a new underground railway line. The researchers have informed the city administration of Naples, as well as civil protection authorities and the railway company, about their discovery.

The two ERS satellites produce detailed radar images of the ground by bouncing pulses of radar waves off the surface. Radar interferometry involves taking an image of a certain area of terrain and then snapping the same spot some time later. Using a computer, one image is subtracted from the other. If there has been no change in the terrain, the resulting interferogram will be blank, but if the terrain has shifted, some of the reflected waves in the second image will be out of step with the corresponding waves in the first. This "phase" change will show up on the interferogram as interference fringes, each of which corresponds to a displacement of the surface of half the wavelength of the radar waves, which in the case of the ERS satellites would be 2.8 centimeters.

Using this method, the Naples team has detected ground movements in Campi Flegrei of as much as 25 centimeters. At first the team dismissed the much smaller shifts in Vomero as artifacts. However, they kept finding the same fringes consistently in several interferograms generated from data taken over different time spans. Lanari recalls that one of his co-workers said: "Hey, this is the area where they are building the metro."

From a study of 45 interferograms spanning different time periods, the subsidence became apparent in 1992 and coincided with the excavation of the new metro tunnel under Vomero. When the team superimposed the trajectory of the underground line on the interferograms, they found "a very strong correlation between the location of the maximum subsidence and the development of the underground. … It is clear, and there is no discussion," says Lanari. They also observed that the subsidence gradually slowed after 1996 when excavations were completed.

Team leader Giorgio Franceschetti of the University of Naples says that their fortuitous finding may open up a variety of applications for radar interferometry. It could be used to keep an eye on densely populated areas where human activity may be affecting the stability of surface terrain, such as the Padano area near Venice, where natural gas is being extracted, and an area of Paris where other researchers believe they have already detected subsidence of about 1.5 centimeters. Jean-Claude Souyris of France's space agency, the CNES, in Toulouse confirms that "preliminary results" obtained using the same satellites show subsidence in a 100-meter-square area around the Condorcet metro station in Paris.

—ALEXANDER HELLEMANS

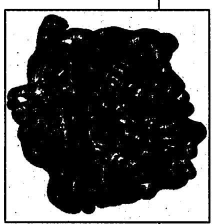
Alexander Hellemans writes from Naples, Italy.

ScienceScope

LOOKING AHEAD

The future may be "made of the same stuff as the present," the French philosopher Simone Weil wrote in the 1940s, but time finds surprising ways to transform the familiar into the fresh. *Science* previews what may be some of 2000's new twists on old tales:

Help Wanted Some plum science policy jobs are open—but who will risk taking them in the last year of the lame-duck Clinton Administration? The answer might come this spring, once search committees are through vetting candidates to replace former National Institutes of Health (NIH) head Harold Varmus and Department of Energy science czar Martha Krebs. The White House Office of Science and Technology Policy (OSTP) is also seeking an infusion of new blood. But according to Duncan Moore, OSTP's associate director for technology, "it's getting harder to attract good people [in the] eighth year of an 8-year administration."



Sharper Focus Cell gazers are anticipating more detailed looks at some of the major molecular complexes that make life possible. Using improved methods and machines, crystallographers may unveil the first high-resolution structure of one of the ribosome's two subunits by year's end, revealing the innards of the cell's protein factory (above). And researchers will get to know other structures—such as the nuclear pore that allows molecules to migrate in and out of the nucleus—in more vivid detail.

Third Time Out The Kyoto Treaty to stem global warming is frozen in political limbo in the United States, where the current Congress is likely to reject the pact—but that won't stop international teams from stepping up work on climate change science and policy. A September deadline looms for what one researcher calls "the climate Bible"—the Intergovernmental Panel on Climate Change's (IPCC's) draft *Third Assessment Report*, a once-every-5-years bid to sum up the state of the world's climate knowledge. But donor nations may have to cough up some cash quickly: The IPCC faces a "dire financial situation" because many nations have stiffed the body, according to chair Robert Watson. The "lack of financial commitment is rather disturbing, given the incredible effort of the experts who give so freely of their time," he says.

CREDITS: (LEFT TO RIGHT) ESA/IRECE; MALHOTRA *ET AL*