Ottawa noticed a region similar to the modern basal complex as they examined a well-preserved, 8-centimeter dragonfly from La Rioja, Argentina. When Wootton, an expert on the mechanics of insect wings, made a three-dimensional paper copy of the wing region, it responded to a force on the underside of the wing—similar to the force of air as a dragonfly flaps its wings downward—in the same way as the modern dragonfly's. The authors propose that the structure played a similar role in the ancient insects, allowing them to get more efficient lift from a downstroke. Thomas agrees. "I made the cardboard models" from their diagrams, he says, "and they work in exactly the same way" as the modern basal complex.

Despite the similarity in function, it seems that the two designs arose independently. They use different sets of veins, and the modern basal complex forms a triangle while the fossil one is a parallelogram. In addition, the wings are attached to the body of the fossil insect differently than those of modern dragonflies, and the researchers believe it was a cousin to, not a direct ancestor of, insects alive today.

Dating from only 10 million years after the oldest known flying insect, the specimen shows how quickly insects evolved sophisticated aerodynamic engineering, says insect flight physiologist Robert Dudley of the University of Texas, Austin. Still, there has been some improvement over the eons. The Argentine fossil is missing another aerodynamic feature present in modern dragonflies—a stabilizing structure called the node, which helps the wings withstand stresses from the twisting required for hovering in place. That may have evolved, Wootton says, as dragonfly prey itself became more aerodynamically adept—adaptations that anyone who has chased a mosquito can appreciate.

–GRETCHEN VOGEL

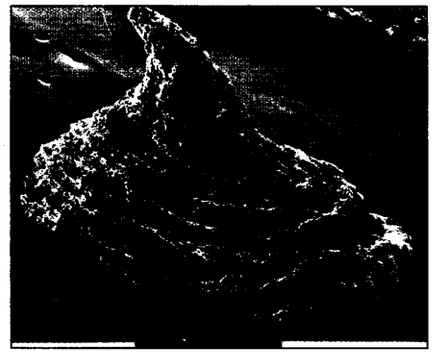
PALEONTOLOGY

Fossils Challenge Age of Billion-Year-Old Animals

Three weeks ago in the pages of *Science*, paleontologists pushed back the origins of multicellular life by 400 million years to a startling 1.1 billion years ago, based on ancient fossilized tracks found in central India. But a paper published about the same time in the *Journal of the Geological Society of India* may now yank those dates forward again to a more mundane figure of perhaps 600 million years old. The Indian paper, by paleontologist R. J. Azmi of the Wadia Institute of Himalayan Geology in Dehra Dun, presents tiny shelled fossils—unarguably about 540 million years old—from rocks that Azmi claims were laid down shortly after those holding the animal tracks. If so, the spectacularly old tracks would be transformed into simply another example of early animals.

Although other paleontologists confirm that Azmi's fossils are indeed relatively young, the authors of the original paper on the tracks, Adolf Seilacher of Yale University and his colleagues, are standing by their discovery. "I have strong doubts this one paper will blow us out of the water," says coauthor Friedrich Pflüger of Yale, noting that work by many other researchers supports the billion-year-plus age. To reduce the age, "you have probably 50 papers against you; you need to convince a lot of people."

The rocks in question, in the Vindhyan basin of central India, were repeatedly dated in recent decades using radiometric techniques, which rely on the slow decay of radioactive elements such as potassium, uranium, or rubidium. Done properly, this method is considered the gold standard for dating rocks. In dozens of studies, the sandstone holding the trace fossils yielded the age of about 1.1 billion years that is cited in the *Science* paper (2 October, p. 80). "Nobody expected the ages to be questioned," says Pflüger. "All the ages seemed to be consistent."



Tiny timekeeper. This millimeter-scale shell implies a younger age for Indian rocks.

But Azmi argues that in this case, the ages estimated from distinctive fossil species known to have lived at certain times in the geologic past are more accurate. In layers of limestone and shale just above the sandstone, Azmi found millimeter-scale "small, shelly fossils," the remains of unique shelled animals whose appearance marks the explosion of new animal forms in the early Cambrian period 540 million years ago. He says the fossils hadn't turned up in the Vindhyan before because "people have not looked from this point of view." The rocks were believed to be very old, so no one macerated them in the way that allows small shelly fossils to be extracted, he says.

Other paleontologists accept the identity

CREDIT: R. J. AZMI

ScienceScope

GERMANY'S NEW MINISTER STEPS OUT OF SHADOW

Germany's new research and education minister says she will support bigger budgets for the nation's scientists and universities.

Bulmahn

This week, the newly elected ruling coalition of Social Democrats and Greens announced that Edelgard Bulmahn—the Social Democrat's parliamentary spokesperson for science—will replace Jürgen Rüttgers when the new government assumes control on 27 October. In making the announcement, the "Red-Green" coalition resisted calls from rival ministries to split the portfolio, which includes basic and applied research. Leading German scientists had opposed the idea. However, the coalition moved several small business-related research programs to the economics ministry.

Although Bulmahn, 47, is a political scientist by training, she is no stranger to science policy. She recently served as "shadow minister" for science while the Social Democrats were in the opposition and since 1995 has served on the Bundestag's science and education committee. Bulmahn has a good grasp of the issues facing German science, says biochemist Ernst-Ludwig Winnacker, who heads the Deutsche Forschungsgemeinschaft, Germany's basic-research granting agency.

Bulmahn says that the new ruling partners, led by chancellor-designate and longtime ally Gerhard Schröder, "agree on the importance of scientific research for Germany's future." In a new position paper, the coalition promises a "significant strengthening" of science budgets next year and moves to bolster German universities.

Bulmahn told *Science* that she opposes "major changes" in biotechnology policies, despite a push by some Greens for stricter controls on research involving genetically engineered plants. However, she expressed support for studies into the potential risks of certain biotechnology methods. It is not yet clear, however, how her ministry will respond to the research implications of the coalition's plans to phase out Germany's nuclear industry. The move could pinch fusion research and possibly delay the FRM-II neutron source now under construction in Garching.

prised, but everybody is very happy," says University of Chicago theorist Jonathan Rosner. Why the decays should look any different forward and backward is still a fundamental mystery. It's possible, he says, that the reigning theory of the microworld, called the Standard Model, can explain this if some of its parameters are just right. Other possibilities include a new "superweak" force that would break time-reversal and CP symmetry. Eagerly awaited studies of other kaon decays at KTeV or another experiment called NA48 at CERN may reveal which is right, Rosner says. CP asymmetry may also explain why the universe is not filled with equal parts of matter and antimatter.

Could a microscopic arrow of time also explain why humans perceive a past, present, and future? Maybe, Kostelecky says, but "that's pretty ambitious." Such questions may be too deep for physics to answer, he says.

–DAVID KESTENBAUM

PALEONTOLOGY

Young Dinos Grew Up Fast

SNOWBIRD, UTAH—The giant dinosaurs known as sauropods were the most massive creatures ever to tread on land. Now a detailed look at one species' bones, described here earlier this month at the annual meeting of the Society of Vertebrate Paleontology, suggests that these hulking beasts could grow to full size—tens of tons and longer than a tractor-trailer—in just a decade. By clocking the sauropod childhood, the work "provides a whole new dimension to sauropod studies," says Philip Currie of the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta.

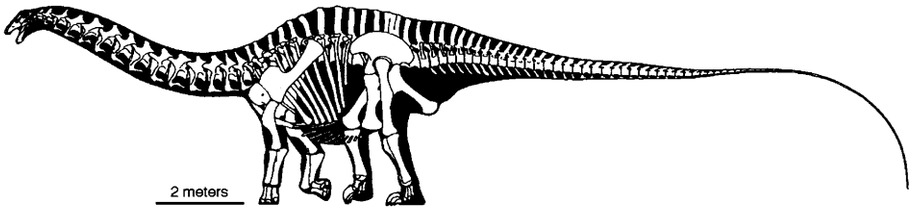
Paleontologists had estimated that it would take more than a century for a modern reptile to reach the size of an adult sauropod. But under the microscope, dinosaur bone seems to tell a different story: It looks more like the fast-growing bones of mammals and birds than that of reptiles. To sharpen the age estimate, Kristina Curry, a graduate student at the State University of New York, Stony Brook, examined forelimbs and shoulder blades from specimens of *Apatosaurus* (once known as *Brontosaurus*), a sauropod that roamed North America some 150 million years ago.

When Curry drilled samples from shoulder blades, she found regular changes in the density of microscopic canals that presumably once held blood vessels. The layers resemble the concentric rings laid down each year in manatee and sea turtle bones, so Curry assumed that they were annual and used them to age the sauropod shoulder blades. Bones from half-sized individuals were 4 to 5 years old, while the largest sauropods had apparently reached full growth in just 8 to 11 years.

That growth rate may sound extraordinary. But it implies that sauropods deposited about 10.1 micrometers of bone tissue per day—about the same rate as living ducks, which deposit an average of 10.0 micrometers of bone per day. Ducks, however, grow to full size in about 22 weeks, while *Apatosaurus* apparently kept up its growth spurt for years.

As a check, Curry used the rate derived from the *Apatosaurus* scapula to estimate the age of the forelimb bones, which have no rings, and came up with similar numbers. The bone growth rate also fits reasonably well with the lone previous estimate, by Armand Ricqlès of the Université Paris VII, who used faint layers in sauropod humerus bones to clock their growth at roughly 7 micrometers per day. "Even though *Apatosaurus* may have lived for centuries, they certainly didn't take that long to reach their full size," Curry concludes.

The finding makes sense, says Currie of the Royal Tyrrell Museum, as hatchlings wouldn't survive long if they grew slowly. Besides the threat of predators, just living with a 30-ton mother would be dangerous. "You'd probably get stepped on," he notes. Moreover, if dinosaurs took more than 30 years to mature, their populations could sink to dangerously low levels, according to 1989 calculations by Arthur Dunham of the

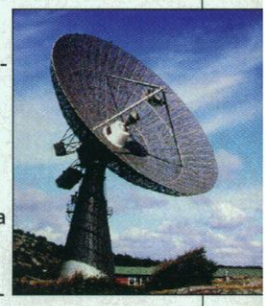


All grown up. Growth layers in shoulder bones suggest that an *Apatosaurus* like this one grew to full size in only about a decade.

CREDIT: (TOP) NRAL, JODRELL BANK; (BOTTOM) GREGORY PAUL

ScienceScope

COMPUTER TO PINPOINT DISTANT GALAXIES



European radio astronomers have switched on a new supercomputer that will provide some of the sharpest views of the universe ever obtained. Yesterday, researchers at the Joint Institute for Very Long Baseline Interferometry in Dwingeloo, the Netherlands, dedicated the $10 million European VLBI Network Data Processor, which will knit together data from 16 telescopes across Europe. Together, the telescopes create a virtual dish 9000 kilometers wide that can detect the faintest radio emissions from distant galaxies.

"It's a fantastic system they've built," says Jonathan Romney of the U.S. National Radio Astronomy Observatory, which runs a similar but less powerful "correlator" in Socorro, New Mexico. Still, it will take the new machine, which makes 16 trillion calculations per second, days or weeks to construct an image from a single observing session. The first images are expected later this year.

PARTY INSIDER GETS AUSTRALIAN SCIENCE POST

Australia has a new science minister with added clout as a result of a Cabinet shuffle by newly reelected Liberal leader John Howard.

South Australian Senator Nick Minchin, formerly the special minister for state, takes over the science and industry portfolio from John Moore, who will now oversee defense. A confidant of Howard and a rising star within the party, Minchin played a key role in pushing through controversial legislation limiting Aboriginal land claims and in organizing a national convention to review the country's constitution.

Science appears to have done well in the reshuffle. Its move into a ministry that includes industry and the previously separate resources "strengthens the portfolio by linking research and technology with some of the most important economic bases," says Australian Academy of Science President Brian Anderson. Anderson described Minchin, a 45-year-old career politician, as "forthright and respected for his judgment."

Contributors: Robert Koenig, Govert Schilling, Elizabeth Finkel