Societies for Experimental Biology (FASEB), noting that 15% exceeded his expectations. "We worked hard for his," he added. "I think we're seeing the fruition of a lot of active participation by individual scientists going to Washington." Brinkley says FASEB leaders have already held strategy meetings to discuss how best to spend the money, including striking the right balance between individual investigator grants and centers and other large awards.

Climate change scientists and renewable energy advocates were also celebrating an unexpected $210 million boost in research spending. Earlier this month, in approving budgets for the Department of Energy (DOE) and the Environmental Protection Agency, Congress had severely pruned the Administration's request for funds to fight global warming. At DOE, for instance, lawmakers approved just $275 million of a $357 million request for the solar and renewable energy program. In the closed-door negotiations, however, "the Administration twisted some arms until the global warming money appeared," said an exuberant but exhausted White House staffer.

In contrast, officials at the Commerce Department's National Institute of Standards and Technology (NIST) were happy that the news wasn't worse. The agency's core research programs received $280 million, $8 million more than last year, while the Advanced Technology Program—a once-incendiary effort that funds public-private research partnerships—got $204 million, an $11 million increase but $56 million below the request. Although the levels are only about 90% of what had been sought, a NIST source labeled them "excellent."

Another Commerce Department agency, the National Oceanic and Atmospheric Administration (NOAA), got a 6% increase, to $2.2 billion. NOAA's Sea Grant program, which funds university researchers, will grow by less than 3%, to $57.5 million, although lawmakers earmarked $4 million of the funds for research on zebra mussels and oyster diseases. The good news is that the earmarks, which aren't popular with many marine researchers, take up a smaller portion of the program's budget than they did last year, says Kerry Bolognese of the National Association of State Universities and Land-Grant Colleges in Washington, D.C. The bad news, he adds, is that "Sea Grant is not keeping pace with inflation."

In other moves watched by the research community, negotiators postponed a bitter partisan fight over the use of sampling in the 2000 Census by agreeing to fund the Census Bureau only through 15 June. This spring the Supreme Court is expected to rule on two cases involving the technique, which is aimed at making up for a serious shortfall in the 1990 headcount. Republicans oppose sampling because they say the Constitution requires an actual headcount, while Democrats and statisticians have generally supported the concept (*Science*, 6 February, p. 798). Use of the technique is expected to increase population estimates in neighborhoods seen as Democratic strongholds.

Although the ink is barely dry on the new budget deal, science lobbyists are already positioning themselves for the 2000 budget battles, which will formally begin when President Clinton presents his request to Congress next January. "Every scientific society," says one congressional aide, "is asking itself how it can replicate what the biomedical community did with NIH."

–DAVID MALAKOFF AND ELIOT MARSHALL

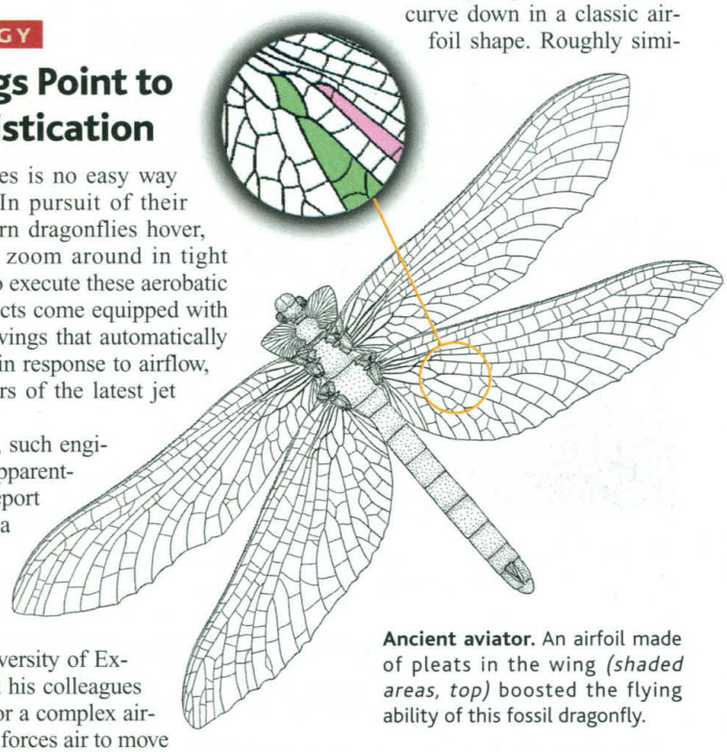
PALEOBIOLOGY

Insect Wings Point to Early Sophistication

Catching mosquitoes is no easy way to make a living. In pursuit of their darting prey, modern dragonflies hover, fly backward, and zoom around in tight high-speed turns. To execute these aerobatic maneuvers, the insects come equipped with highly engineered wings that automatically change their shape in response to airflow, putting the designers of the latest jet fighters to shame.

But in evolution, such engineering tricks are apparently old news. In a report on page 749 on a 320-million-year-old dragonfly from Argentina, entomologist Robin Wootton of the University of Exeter in the U.K. and his colleagues describe evidence for a complex airfoil, a structure that forces air to move faster over the top of a wing than underneath it, creating a pressure difference that gives a wing its lift. Not only did evolution come up with such sophisticated flying adaptations very early, but it also produced them more than once. Although the ancient fossil structures have the same effect as the airfoils of modern dragonflies, they are different enough that scientists think the two systems evolved independently. "It's a startling example of convergent evolution," says evolutionary aerodynamicist Adrian Thomas of Oxford University in the U.K.

To achieve the airborne agility needed to chase prey such as mosquitoes and houseflies, a dragonfly must be able both to twist its wings and change their shape to alter the airflow around them. Unlike birds and bats, which have muscles that control the shape of their wings, an insect wing is simply a membrane stretched over a series of veins. But in an example of what Wootton calls "smart engineering," modern dragonflies have a complex system of veins that stabilize and shape the wings without any muscle power. One region, called the basal complex, forms a series of pleats arranged so that when the insect flaps downward, the air pressure on the underside of the wing forces the trailing edge to stiffen and curve down in a classic airfoil shape. Roughly similar to the flaps that open on planes during takeoff and landing, the mechanism allows dragonflies to stay aloft at lower speeds.



Ancient aviator. An airfoil made of pleats in the wing *(shaded areas, top)* boosted the flying ability of this fossil dragonfly.

Wootten and paleoentomologist Jarmila Kukalová-Peck of Carleton University in

CREDITS: J. KUKALOVÁ-PECK

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

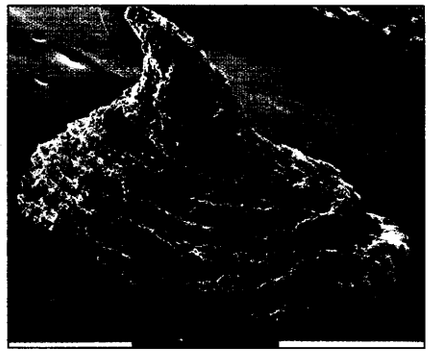
PALEONTOLOGY

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.