Jawboning Prehistory

One day last month, Hunter College anthropologist Tim Bromage woke up at the site of his team's dig in Malawi in the mood for excitement. "I climbed out of the tent and yelled over to the breakfast table, 'This is going to be a big day,' " recalls Bromage. "It's the only time I ever said it." And he was right. Later that day his team found a fossil jawbone that could help advance one of the hottest and most tangled debates in paleoanthropology. The finding was so spectacular that the team cut short its field work to travel to South Africa to study fossils at the Transvaal Museum and the University of Witwatersrand for comparison. While there, they consulted the university's eminent anthropologist Phillip Tobias, and together tried to figure out what to make of the specimen, UR-501, which came from a hominid living between 2 million and 3 million years ago.

In Bromage's words, the cause of all the excitement is that "this is the first hominid specimen ever recovered from the space between East Africa and South Africa." And because of that geographical origin, it could help shed light on the crucial evolutionary question of how the hominids from those two fossil-rich areas are related to each other.

So far, paleoanthropologists have drawn many possible evolutionary trees based on finds from Eastern and Southern Africa—specimens representing a half-dozen types of hominids, loosely grouped in the genus *Australopithecus.* But the is much disagreement over how they are related to one another—or even whether they represent one species or a half-dozen species or even two genera. One specific question mark in that jigsaw puzzle has been whether a type of hominid found in South Africa—*Australopithecus africanus*—was descended from one living in East Africa: *Australopithecus afarensis*, which is considered the rootstock of modern humans. Since the new jawbone bears a resemblance to both of those gracile hominids and lived in a region between the two, Bromage hopes it may help anthropologists draw in the evolutionary branch that links them.

Bromage and his co-leader, Friedemann Schrenk, a paleontologist at the Hessisches Landesmuseum in Germany, didn't exactly set out to find that branch of the human family tree. But they did set out (funded by the Deutsche Forschungsgemeinschaft) to study the hominid corridor linking southern and eastern Africa. They chose a little-studied site in Malawi known as the Chiwondo Beds, an arid region that is a relatively young and active western branch of the Great African Rift system, where the African continent is splitting apart. Although most of the fossils have been destroyed by earth motion and erosion in the Chiwondo Beds, researchers Christian Betzler, Uwe Ring, and Albrecht Gorthner—working with Bromage and Schrenk—collected flora and fauna and reconstructed the ancient geology, climate, and ecology. That proved a long and painstaking process, and after half a dozen field seasons the team was ready for some faster-paced excitement. And they got their wish: UR-501 surfaced.

Although the team's analysis of the mandible is preliminary, they think it shows features that could tie it to fossils from both East and South Africa. "The question is: Will this specimen look intermediate? Will it look like East African or South African species?" asks Bromage. "We don't know yet because lower jaws are difficult to characterize, and we also have the geographic intermediacy to contend with. One looks at it and says, 'Oh gosh it's a little robust.'" But, on the other hand, says Schrenk, the teeth are not as big as those of the largest gracile *Australopithecines*, so it could be considered gracile.

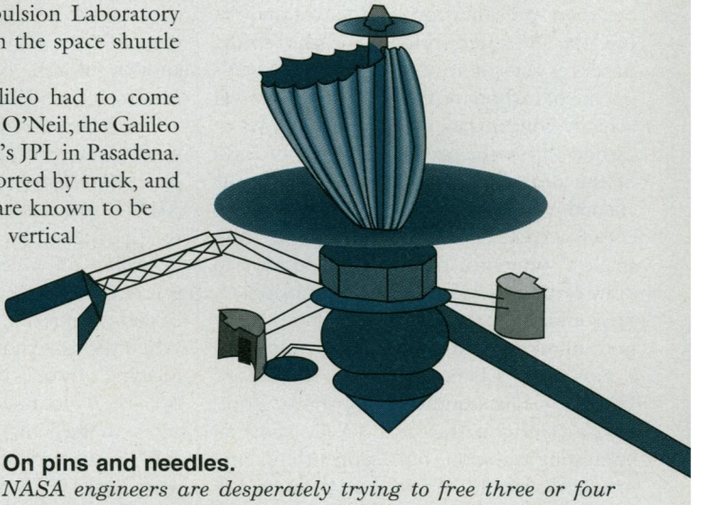
Indeed, the group's preliminary interpretation is that the specimen was from a gracile rather than a robust lineage, which could make it a candidate ancestor for modern human beings. And if it is an intermediate hominid between *A. afarensis* and *A. africanus*, it will have provided a key evolutionary link. But one radical idea goes even further than that—holding that the jaw comes from a species that links *Australopithecines* and *H. habilis*, the first member of the *Homo* line. Ideas like those are going to take time to be tested. Says Schrenk: "This specimen is going to need a hard and long look from a new biogeographical perspective." But at the very least, it will have begun to fill on a large blank area on the map of human origins in Africa. ■ ANN GIBBONS

Has Challenger Knocked Out Galileo?

When the Challenger space shuttle exploded in January 28, 1986, the immediate impact was obvious: The tragic loss of six astronauts and a schoolteacher, and the derailment of the nation's space program. Now 5 years later it appears the disaster has claimed yet another victim: the $1.3 billion Galileo spacecraft, which is limping toward Jupiter with a broken antenna. At press time, NASA engineers told *Science* that they think they have found the cause for a failure that could essentially scuttle the entire mission: The lubricant used on the antenna's joints was rubbed away as the craft was shipped back and forth between the Kennedy Space Flight Center and the Jet Propulsion Laboratory (JPL) due to the delay in the space shuttle program.

"After Challenger, Galileo had to come back to JPL," says William O'Neil, the Galileo project manager at NASA's JPL in Pasadena. "The antenna was transported by truck, and the (antenna's) ribs that are known to be stuck were lying in the vertical position, where there was rubbing of the pins (that held the antenna in a close position) against the receptacles. So it rubbed away the lubrication."

Unfortunately, that problem was not known to NASA scientists until last April 11 when Galileo was already sailing toward Jupiter. That was when they tried to unfurl its fragile, gold-plated mesh antenna for the first time. "The problem was obvious immediately," recalls Bob Murray, who retired Friday as NASA's Galileo/Ulysses program manager. The deployment should have taken 4 minutes at most, but at the end of 8 minutes no indications had been received at JPL's Deep Space Network that the antenna was unfurled. Subsequent analysis of data from the spacecraft showed that three, or perhaps four, of the graphite ribs in the umbrella-like antenna were jammed in the



On pins and needles.
NASA engineers are desperately trying to free three or four balky pins that have kept Galileo's antenna from unfurling.

closed position. NASA scientists say they are "98%" certain that small pins on the ribs that lock into receptacles on the antenna's mast are stuck in place—and the problem results from the lack of lubricant.

If those pins can't be pulled free, the result will be "a serious degradation of the science," admits NASA Associate Administrator Lennard Fisk. Fisk's comment is an understatement. In fact, the "degradation" would mean that Galileo could not transmit the bulk of the data it collects as it orbits Jupiter for 22 months—the main purpose of the mission. The antenna was designed to transmit 134,000 bits of data per second from Jupiter—the equivalent of sending a complete image from Galileo's camera to Earth in 1 minute, as well as sending data from the other nine experiments aboard. But if the antenna is not fixed, these tasks will fall to Galileo's two small antennas, which transmit only 10 bits per second. That's enough antenna capacity to allow Galileo to transmit data coming from a probe that it will drop into the Jovian atmosphere in July 1995 but far too little to relay the information from the main orbiter.

With so much at stake, NASA engineers have desperately been looking for ways to fix the antenna before Galileo reaches Jupiter in 1995. But they've had no luck so far. This week they failed in their most ambitious effort to date: a series of commands intended to spin the spacecraft around so its broken antenna would be shielded from the sun. The hope was that cold would shrink the fragile antenna's nickel alloy mast so it would slip down, and free the jammed pins on the graphite ribs.

As NASA engineers received data Monday night indicating that the "cold soaking" effort failed, they were "a little bit down." "It was not a good night," said Don Ketterer, whose first day as the new Galileo program manager was marred by the stubborn antenna. But he was hopeful that the method—and even colder temperatures that Galileo would encounter farther from the sun in December—eventually would unfurl the gold-plated mesh umbrella. If that doesn't work, there's precious little else in NASA's bag of Galileo fix-it tricks—the agency has never seriously considered sending a rescue mission, and options from Earth are severely limited. But there is one last-ditch possibility. NASA scientists hope that when the orbiter drops its probe or turns on its engines again to clear itself out of the probe's way, the shock will jiggle the pins from their receptacles. They concede that these are long shots, but if the big chill fails again, they are the only hope of rescuing a mission that's fallen under the long shadow of Challenger. ■ ANN GIBBONS

Policy-Making: Getting Better Data

Each year, Congress considers about 5000 bills and passes some 5% of them. In many cases, a major consideration—sometimes the only consideration—is the bottom line. But predicting the cost or economic effect of a policy change is impossible without a wealth of statistical data, fed into mathematical models that simulate individual economic behavior. And though any model of a complex system is liable to stray from reality, lately some of these "microsimulation models" have been faltering badly, according to a report* released earlier this month by the National Research Council (NRC). Not only are the models themselves often unreliable, but the statistics that are fed into them are frequently suspect—a consequence, in part, of cutbacks in federal data-gathering during the Reagan years, the report states. Its conclusion: With so much at stake, it's time for the government to restore the integrity of its statistical and modeling system.

The new report cites a number of cases to underscore its argument that the government's budget and spending decisions for national health care, welfare, and tax programs may be resting on shaky predictions. On three separate occasions while drafting the Tax Reform Act of 1986, congressional staffers found that problems in their data or model specifications caused them to overestimate revenues under the new tax law by $17 billion. Since the bill was supposed to leave the tax code "revenue-neutral," each setback—discovered when internal checks turned up flawed assumptions—sent the staff back to the drawing board.

Similarly, projections of what it would cost the government to pay for prescription drugs under the 1988 catastrophic health care act (since repealed) were based on 10-year-old data—the best then available. When a new survey provided more up-to-date information, the prescription drug estimates had to be doubled. And the 1988 Family Support Act contained such poor estimates of the impact on child support and welfare programs that Congress enacted these provisions "in large measure on faith," according to the report.

Part of the reason faith is playing such a large role in predicting the bottom line of policy changes, the report argues, is that many of the models have never been validated. Model predictions marshaled for or against a bill are rarely compared with the actual effect of the policy change once it becomes law. Yet knowing the track records of the available models is vital if users are to evaluate competing estimates and determine when "fine-tuning" a policy becomes self-defeating—when the information from models just isn't good enough to distinguish reliably between alternatives. Validation isn't easy, but it is important enough that statistical agencies should allocate between 10 and 15% of their modeling budgets to it, the report states.

But the models are only half the problem, according to the NRC report. Cuts in the budgets of the 70-plus agencies that gather federal statistics—they lost 13% of their budgets in real terms from 1980 to 1988—have eroded the quality of data available to the modelers. While these cuts have been somewhat restored—the system's inflation-adjusted budget is now about 1% higher than in 1980—statistics spending still lags well behind the growth of the United States economy. Furthermore, the cuts will leave a lasting legacy in terms of information not gathered during the 1980s.

The remaining collection efforts often overlap or allow important holes in the nation's data to go unfilled, the report states. Many sets of health care data, for instance, don't include the information on patient incomes necessary to model health care choices "precisely because it never occurred to [health care survey-takers] to collect better wage or income data," says University of Rochester economist Eric Hanushek, chair of the NRC panel. Such problems arise at least partly because federal coordination is in disarray. The office responsible for managing the statistical agencies was reduced during the Reagan administration (it was even eliminated briefly) and is now buried within the Office of Management and Budget, where it is staffed by less than a half-dozen administrators.

The report notes that spending on statistics-gathering and model-building is highly leveraged. The government annually spends some $300 billion on social insurance programs such as Medicare and an additional $75 billion on public assistance, according to the report—but less than $2 billion on statistics and modeling to ensure that all those billions are well spent. ■ DAVID P. HAMILTON

*_Improving Information for Social Policy Decisions: The Uses of Microsimulation Modeling,_ National Academy Press, Washington, D.C., 1991.