Outside researchers are vying for quicker access to key specimens, but fossil discoverers say they need control over new finds in order to prepare and analyze them carefully

# Glasnost for Hominids: Seeking Access to Fossils

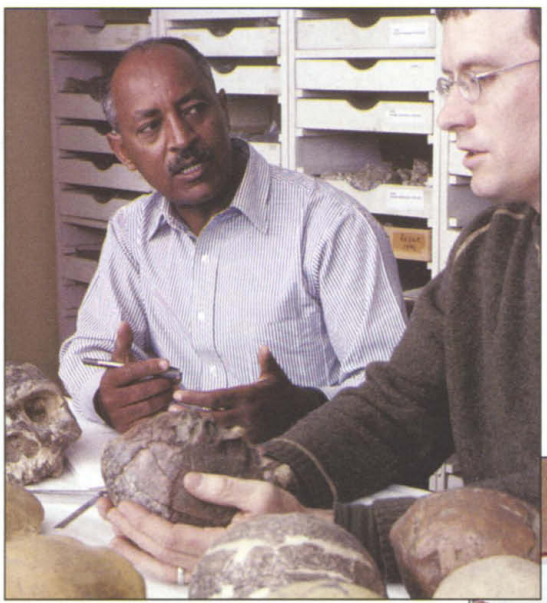
In February, paleoanthropologists Jeffrey Schwartz and Ian Tattersall traveled to Addis Ababa, Ethiopia, to attend a meeting and study fossils of one of the most important members of the human family, 4.4-million-year-old *Ardipithecus ramidus*. Armed with e-mail permission from an Ethiopian official, they planned to photograph and describe 17 *A. ramidus* fossils in an atlas of early human relatives; these fossils had been named and initially described in *Nature* in 1994.

But soon after the meeting ended at Ethiopia's National Museum, Berhane Asfaw, co-director of the Middle Awash Research Team that found *A. ramidus*, came in to work on the fossils and was surprised to learn that Schwartz and Tattersall had gotten a go-ahead to study them. Like most nations, Ethiopia allows discoverers broad control over specimens—and the Middle Awash team had refused Tattersall and Schwartz permission to study fossils of *A. ramidus* 2 years ago. The team doesn't allow others to photograph and study fossils until after they are described in detail, which in the case of *A. ramidus* involves painstakingly preparing and analyzing dozens of fossils, most unpublished and some found as recently as 2000. In the team's view, Tattersall and Schwartz were trying to go behind their backs to publish descriptions of fossils the team was still working on. So Asfaw quickly reminded the museum director of Ethiopian law allowing fossil discoverers to deny access.

Tattersall, livid, was left sitting in the fossil room outside the locked safe. "What are you trying to hide?" he demanded of Asfaw. Replied Asfaw: "You don't know how we suffered in the field to get these fossils. You have to give us a chance to study them first."

Tattersall and Schwartz tried again the next day, but they went home to the American Museum of Natural History in New York City and the University of Pittsburgh, respectively, without seeing *A. ramidus*.

This incident underscores the rising tensions in paleoanthropology between those who dig up fossils, who are few in number, and those eager to analyze them independently, who are growing in number. Such disputes are as old as the discipline and not limited to human ancestors. But a series of stunning discoveries has set off a new round of debate about who gets to see precious remains—and when. The great age and unexpected features of the first known hominids—the family that includes humans—are changing researchers' views of the dawn of humanity (*Science*, 15 February, p. 1214). Yet many of these specimens, some found as long as a decade ago, are still off-limits to all but the discoverers and a few scientists they trust. The high stakes have focused new attention on how to speed up access to fossils while protecting the rights of those who found them. "A remarkable amount of important fossils were excavated within the last [few] years," says physical anthropologist Gerhard Weber of the University of Vienna in Austria. "What has not changed are the old limits for access."



**Working to the bone.** Berhane Asfaw (*above*, left) has spent years studying fossils that Jeff Schwartz and Ian Tattersall (*right*) want to see.

In particular, researchers are sparring over what happens during the crucial period between the initial announcement of an exciting discovery (usually in a high-profile journal such as *Science* or *Nature*) and a more detailed description or monograph, which might come years or even a decade or more later. "The big awkwardness right now is when someone announces they have found a specimen that overturns everything we know, but almost no one has seen it," says John Fleagle of the State University of New York, Stony Brook, who collects primate fossils in Ethiopia and edits the journal *Evolutionary Anthropology*. "If you want to do further research, the initial announcement tells you so little that you can be sitting in limbo for a decade until there's a paper describing the fossils in detail."

Fossil hunters, who often sink years of effort into their sites, say they are understandably wary of being beaten to publication (see sidebar, p. 1465), especially if they have risked disease, wild animals, or military coups to make their finds. Even where field conditions are tame, it can take years to find and prepare a set of fossils and describe their full scientific value to the satisfaction of increasingly demanding journal editors and peer reviewers.

"It is frustrating when you have trained to find fossils, you have the skill to find them, you apply for grants, you get the grants, you live away from home for months," says paleoanthropologist Alan Walker of Pennsylvania State University, University Park, a member of teams that

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## Can a Fossil Be Too Accessible?

In 1997, when the government of Myanmar invited paleoanthropologist Russell Ciochon of the University of Iowa, Iowa City, to study newly discovered fossils of a 37-million-year-old primate, he was so delighted he hopped the first flight he could get to the National Museum of Natural History in Yangon. But delight turned to concern when he learned that two teams from France and Japan would soon be arriving to study the same sites and unpublished fossils, which included a candidate for the first ancestor of apes and monkeys. Concern turned into irritation the next year, when he had to withdraw two manuscripts from journals, including one from *Nature*, after a reviewer pointed out that the French and Burmese teams had beaten him to publication.

Although some researchers argue that fossil hunters who restrict access for too long create problems for the field (see main text), the Myanmar incident suggests that unlimited access to fossils is no solution. The Myanmar government funded a 1997 fossil-collecting expedition of Burmese scientists and then opened their specimen drawers to any researchers who wanted to see them. Although this might seem admirably democratic, by early 1998 three teams were at work on the same fossils and sites, creating a whole new set of problems, says paleoanthropologist John Fleagle of the State University of New York, Stony Brook.

Ciochon and Gregg Gunnell, a paleontologist at the University of Michigan, Ann Arbor, describe those difficulties in the September issue of *Evolutionary Anthropology*. For example, in November 1998, a Japanese team collected a partial jaw of an ancient primate, *Bahinia pondaungensis*. Two weeks later, a French team visited the site and collected the other part of that same jaw, which it soon published as the type specimen of a new species. At the time, the French researchers were unaware that the Japanese had the rest of the jaw, which is still unpublished.

The wide-open access has led to a flurry of work in Myanmar, where at last count 24 new fossils from five different primate taxa had been described. "So in a sense, science does advance," says Ciochon. But he, for one, is not going back. "It's too complicated." For his next field project, he's heading to Java.

**–A.G.**

discovered several famous hominids in Kenya. "You do all this and then people immediately want you to share the hominid fossils; no one wants the animal fossils … I've shown people a brand-new hominid that I'd just found, and they have asked me if they could write it up! … Why would you do all this to get robbed?"

But a growing number of researchers—particularly those who don't run field projects—argue that limited access stifles research in a field where there are fewer crucial hominid specimens than paleoanthropologists to study them, and these researchers are agitating for change. Weber has floated a proposal to set up an electronic archive of virtual three-dimensional copies of fossils, under the banner of "Glasnost for Paleoanthropology." The National Science Foundation (NSF), the chief funder of U.S. paleoanthropologists, plans to gather researchers next winter to talk about data sharing, and the American Association of Physical Anthropologists (AAPA) is considering guidelines.

Whether they are pushing for quicker access or not, many researchers agree that paleoanthropology's unwritten rules need explicit clarification. "There should be some guidelines laid out by our profession," says Terry Harrison of New York University (NYU), who does fieldwork in Tanzania and is editor of the *Journal of Human Evolution*.

### The unwritten rules

Some guidelines for showing specimens do exist, but unlike patent laws that give a drug developer exclusive patent rights for many years, the "rules" governing access to fossils are mostly voluntary and often ambiguous. National governments usually own fossils and require them to be stored in museums, but discoverers are usually given power to control access until they finish describing them. The International Code of Zoological Nomenclature recommends that the fossil used to describe a new species—the "type specimen"—be made "accessible for study," but it doesn't say how or when. NSF reminds researchers in grant award letters to make "data available," but it doesn't specify when, nor how to enforce access. And although many journals, such as *Science*, require that "data" (presumably in the form of casts or fossils) be made available on a "reasonable basis" after publication, there are no specified time limits and compliance is based on an honor system. "There is no written agreement about when to give access," complains Weber.

All this can lead to confusion and conflict. For example, in the case of *A. ramidus*, Schwartz notes that in the 1994 *Nature* article, the first 17 fossils of the new species were initially described, including one as the type specimen. He argues that under the international code they were "published" and described in enough detail to justify the naming of a new species, and therefore they should be accessible to the scientific community to review the classification. "How do we know the fossil is real if we can't ever see it?" asks Schwartz. "How can science proceed?"

But paleoanthropologist Tim White of the University of California, Berkeley, co-leader of the Middle Awash team, counters—and most hominid researchers who find fossils agree—that an initial report in *Nature* does not constitute full publication. "Until a fossil is described in detail, it contains unpublished data," he says. "Normal practice is to allow limited access until a detailed description and analysis in a specialty journal or monograph is published." He argues that Schwartz and Tattersall, who wanted not just to see but to photograph and describe specimens, tried to use the Ethiopian bureaucracy to "short-circuit the normal protocols" of access and publish data before his team. He adds that the Middle Awash team does allow researchers to see, but not measure, high-resolution casts of initially published fossils, if they agree not to publish until after the detailed description is out. White says that Schwartz never asked to see casts, although Schwartz says he would have accepted that offer if it had been made.

Despite this incident and other complaints about access from reviewers of his

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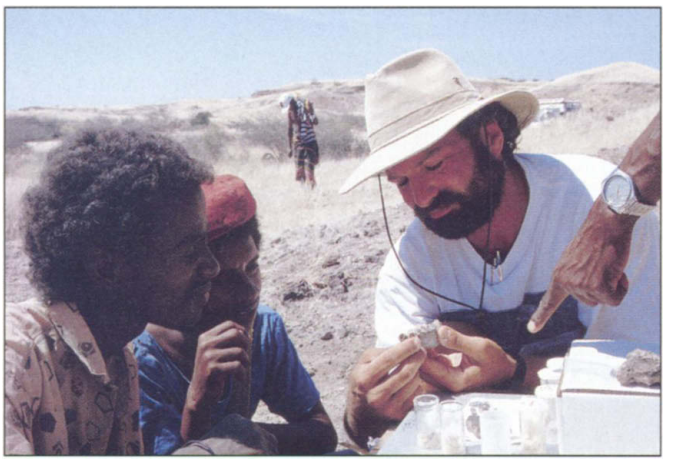
**Share and compare.** Tim White (left) and Michel Brunet study each other's casts.

last two NSF grant applications, White insists that his team's policies are not more restrictive, just more explicit, than others. After taking an informal poll of fieldworkers with significant new fossils, he reports that "not a single project allows photography and detailed description to be published until after the discovery team publishes its own descriptions."

In interviews with *Science*, many leading fossil hunters confirmed that their policies are broadly similar to White's. Discoverers must control access until after publication of a more detailed description, agrees paleoanthropologist William Kimbel of the Institute of Human Origins at Arizona State University in Tempe, who has helped find many specimens of *Australopithecus afarensis*, which includes the famed skeleton Lucy, at the Hadar site in Ethiopia. "Anyone trained in paleoanthropology knows that fieldworkers need to be granted breathing space," he says. "If you're rushed, you can't do a good job."



**Fossil finder.** William Kimbel says analyses of fossils can't be rushed.

Fieldworkers say such an arrangement is necessary to protect the enormous investment they make in the sites and fossils that supply data to the entire discipline. To develop sites in Ethiopia, for example, White says he and Asfaw assemble and manage a team that includes dozens of specialists who find, prepare, and analyze hominid and other fossils, date the sites, and interpret the prehistoric environments. He and other fossil discoverers stress that these team members are not only fossil collectors but accomplished lab workers.

And the fieldwork itself can be rough. Paleontologist Michel Brunet of the University of Poitiers in France, who discovered the oldest known hominid, *Sahelanthropus tchadensis*, after a decade of work in Chad, has been arrested in Iraq, been caught in a coup in Kabul, and seen a close colleague die from malaria in Cameroon. He says: "After all this, when you have got the chance to get new scientific data, I think that you have earned the right to study them first, even if some colleagues think we are just field technicians."

Many fieldworkers tell stories of granting access to fossils only to see others' papers come out first. Walker recalls working with paleoanthropologist Richard Leakey, then of the National Museums of Kenya, in the 1970s when their team found some important fossils. Colin Groves of the Australian National University in Canberra and a colleague described and named the fossils as a new species, *Homo ergaster*, without Leakey's knowledge. "As far as I was concerned, the fossils had been announced and described—briefly but quite well—in *Nature*; they were therefore in the public domain," says Groves. He adds that he later apologized to Leakey for "an unintended ethical breach" and "quickly patched up" the dispute.

And in 1999, while working on a monograph of *A. afarensis,* Kimbel learned that an unpublished skull found by his team had been flown to Vienna, where Horst Seidler of the University of Vienna had scanned it using computerized tomography (CT) and shown it to visiting colleagues. Kimbel complained, and Seidler wrote him a letter of apology, promising not to publish until after Kimbel's monograph appears next year.

### The exceptions

But although fieldworkers might seem territorial, in practice many do show the fossils they have found to people they trust. For example, Ron Clarke of the University of the Witwatersrand in Johannesburg, South Africa, Juan Luis Arsuaga of the University Complutense in Madrid, and David Lordkipanidze of the Republic of Georgia State Museum in Tbilisi all say their policies overall match those of the Middle Awash team. But all these researchers have allowed Tattersall and Schwartz to photograph their fossils (or have given them photos), with the understanding that the discoverers' descriptions will be published first.

"The critical point is do you close access completely during that long, time-consuming, painstaking process," says Kimbel, who allows those who agree not to publish to even measure original specimens. "My view is it is better for science to accept the risk to allow controlled access. I find it intellectually stimulating to hear what other researchers have to say."

But because discoverers have control over access, a buddy system has long prevailed, with old feuds and alliances influencing who sees what. In many cases, the informal arrangements often boil down to one group saying, in essence, "I'll show you my fossil if you show me yours." White says the Middle Awash team deliberately adopted its strict written policy in order to avoid such favoritism. But the team makes case-by-case exceptions for colleagues with original fossils who need to compare similar anatomy in order to describe their own finds.

In fact, the most successful fossil hunters have actually gotten more open about sharing even unpublished fossils—at least with each other. For example, there are now three extremely ancient hominids, older than 4 million years, whose very existence demands new thinking about the origins of our lineage: *A. ramidus*; *S. tchadensis*, discovered by Brunet in Chad; and *Orrorin tugenensis*, discovered by Martin Pickford and Brigitte Senut in Kenya. All three have been published in initial announcements but not in detail, and the discoverers have shared some fossils and casts with each other and with a few other researchers.

For example, Senut of the National Museum of Natural History in Paris and Pickford of the Collège de France in Paris say they allow "anyone who makes a reasonable request" to see but not study casts of *O. tugenensis*. Brunet made a much-noted tour of the United States with a cast and photos of his partial skull from Chad, allowing colleagues including White, Senut, and Pickford to study it even before it was initially described. In return, White allowed Brunet to study casts of some unpublished *A. ramidus* fossils, and Senut and Pickford showed Brunet and a member of White's team some casts of *O. tugenensis*. And in Ethiopia, Asfaw showed Meave Leakey of the National Museums of Kenya the original 17 specimens of *A. ramidus* (as well as a few others) so she could sort out the identity of her fossils, which include another crucial new species, the 4-million-year-old *Australopithecus anamensis*.

But such arrangements irritate those who do not have major fossils or special expertise to bring to the table. At this point, there is apparently only one person—Brunet—who has seen fossils or casts of all the earliest hominids, and no one has studied them long enough to make a detailed comparison. "How do we know the *A. ramidus* stuff is not the same thing as *Orrorin*? That should have been resolved

before *Orrorin* was ever published," complains Milford Wolpoff, a paleoanthropologist at the University of Michigan, Ann Arbor. "When the only people who can comment are the discoverers or friends of the discoverers, there is no sense of independent observer. We're not practicing science. We're practicing opera."

**The long wait**

Those who must hold out for detailed publication to evaluate the discoverer's claims or propose their own ideas often have a long wait. The Middle Awash group, for example, doesn't expect to publish more on *A. ramidus* for another year or so. "It's better to get it right than to rush it," says White. "We're not talking about the cure for a disease here. We're talking about preventing an epidemic of bad data if science is rushed."

And sites vary in complexity and condition of the fossils. In the Middle Awash site, Asfaw describes the tedious process of using a syringe to insert a gluelike substance into each piece of chalklike bone and then excavating the fossil-bearing block and painstakingly extracting the bones in the lab in Addis Ababa. "The skeleton of *A. ramidus* took 3 years of continuous excavation," he says. "More quickly would be nice, but you can't do the description until you finish the excavation, because you don't want to report on one piece at a time."

Walker and Meave Leakey both say their policy is to try to publish a detailed description of a fossil within a year or two of the initial announcement. But their monograph on *A. anamensis*, published last December, included additional specimens found in 4 years of fieldwork at two sites—and the first fossils of the species were found 13 years earlier. "That's as fast as you can do it without everyone getting divorces or nervous breakdowns," says Walker.

All the same, others say there has to be a limit to how long one group can monopolize fossils: "If you can do a Ph.D. in 5 years, why can't you describe a fossil in 10 years?" asks Harvard University paleoanthropologist Daniel Lieberman, who needs access to other groups' fossils for his research on what traits are useful for sorting out species relationships. "There should be a reasonable limit, particularly for an important specimen that is necessary for other people to test their hypotheses."

Several researchers add that when research is publicly funded, taxpayers should get a timely return on their investment. Paleoanthropologist Bernard Wood of George Washington University (GWU) in Washington, D.C., says that teams need to be structured to allow reasonable progress. "Federal agencies should stipulate that if you have found so many fossils that you can't manage to interpret them, you either need to stay out of the field until you're done or recruit more people to interpret them," he says.

To some researchers, such as NYU's Harrison, the most important fossils are type specimens that "should be made available immediately after initial description." Instead, he claims the reverse is true: "It is getting increasingly difficult to get access to see fossils." Schwartz says that's why he and Tattersall began their atlas in the first place. Many scientists should analyze the fossils, he says: "Diversity of perspective is important."

**Dreams of glasnost**

Part of the problem lies with the brief initial descriptions themselves, says Fleagle. These announcements let the world know the fossils exist, but he says "the original descriptions almost always are wrong, since the implications are usually only figured out after they have been studied and debated by a larger group of researchers." The clamor for quicker access might lead fossil discoverers to abandon those announcements and keep their fossils under wraps longer, says White—not a change many would welcome.

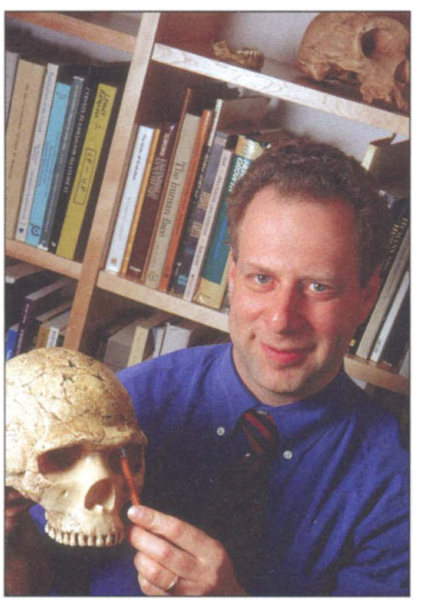
Some think technology could help. "The tools are there," says Lieberman. "Anyone who has a Web site can put a skull on the Web. You can download your CT scan from anywhere in the world and do your work." As a result, a new (and growing) generation of researchers is adept at analyzing three-dimensional images of fossils. And a few researchers are putting published data on the Web. This month Lieberman posted images of one of the earliest modern humans from the Skhul cave in Israel, and Weber, Seidler, and colleagues at the University of Vienna began publishing a copyrighted CD-ROM of fossil hominid images, starting with the 600,000-year-old Bodo hominid cranium from Ethiopia, with proceeds going to Ethiopia's National Museum.

**Double take.** Mrs. Ples, a 2.5-million-year-old australopithecine, in original and electronic form.

Weber's group is seeking a more organized arrangement, proposing a nonprofit archive for high-resolution CT scans of fossils, particularly type specimens, starting in 1999 with published fossils to build up the database. His concept is modeled after community databases such as GenBank, where geneticists are typically required to deposit sequence data when they publish. "This isn't a replacement for fossils," says Weber. "But it can contribute to a more transparent way of doing research."

But posting CT scans of fossils published decades ago is not the same as posting a hot new hominid. And many paleoanthropologists think there is no substitute for working with original fossils. "Fossils have sources of information that no CT scan will ever capture," says Kimbel. White adds that quality control can be a problem if images are made from distorted fossils or inaccurate casts.

The initial response to the e-archive is lukewarm, according to an informal e-mail survey Weber sent this spring to 145 international paleoanthropologists. Only about half of the 50 who responded said that



**Fossil analyst.** Dan Lieberman urges timely sharing of fossils and e-data.

CREDITS: (TOP TO BOTTOM) GERHARD WEBER/INSTITUTE FOR ANTHROPOLOGY/UNIVERSITY OF VIENNA; GRAHAM RAMSAY

they would share their electronic data—although 94% said they would use other people's electronic data. Others prefer to see museums post their own images rather than give power to a centralized database.

But a few researchers have welcomed the idea. In South Africa, Francis Thackeray, manager of the Transvaal Museum collection in Pretoria, immediately offered to post photos and scans on the e-archive if it proceeds; already he has jointly published with Weber a CD-ROM of a famous, nearly complete 2.5-million-year-old skull known as Mrs. Ples.

No matter how fancy the technology, however, access relies on people's willingness to trust each other. "Getting researchers to give their data will be the most difficult part of this," says Meave Leakey. Even the National Museums of Kenya's request that visiting researchers share standard measurements of fossils has not been honored, she says.

One solution would be for funding agencies such as NSF to require that access to fossils be provided after a certain period, in the form of either high-quality images on the Web or access to casts. "The time has come for the community to discuss these issues," says Mark Weiss, physical anthropology program director at NSF, who plans a winter meeting on the topic. AAPA is considering action, too. Anthropologists filled a session on the topic of access at the annual meeting in April, where it was proposed that the association come up with voluntary guidelines. "As long as fossils remain tangible, fragile, and concealable items that are, in some cases, a source of revenue and power, then problems of access will always exist," Lee Berger of the University of the Witwatersrand wrote in the current AAPA newsletter. "But that doesn't mean the current levels of access cannot be improved upon."

However these efforts move forward, momentum is building for faster access to crucial fossils. Yet this is already having a chilling effect on fossil discoverers, who are moving to define and defend their policies. White says, "I'm afraid the consequences of this contrived momentum may ultimately serve nobody's purpose." He and other discoverers warn that any new guidelines will have to consider their rights, too. Otherwise, "it won't be worth it to go to the field," says Walker. And, as GWU's Wood notes: "Without their work, the rest of us would be out of a job."

–ANN GIBBONS

ELECTRONIC PUBLISHING

# Online Pioneer Winds Up Lost in Cyberspace

**The American Geophysical Union wants its electronic journals to be the next wave in science publishing. But some fear that it's gone off the deep end**

Mary Scott was stumped. As a geology librarian at Ohio State University in Columbus, she was used to tracking down obscure references. But the request she received this April was unlike anything she had seen before. "A scientist was searching for a *Geophysical Research Letters* article he'd seen referenced in *Science*," she says, but the citation looked like gobbledygook: *Geophysical Research Letters* **29**, 10.1029/2001GL014304 (2002). "I had no way to figure out what issue we needed," Scott recalls. "All I could do was pull all the current year's issues from the shelf and go through each one."

Scott never found it; at that point, the article had appeared only in the electronic version of the journal. Her frustration is a symptom of what's gone wrong since the journal's publisher, the American Geophysical Union (AGU), took a belated leap last year into the world of electronic publishing. In giving its online journals pride of place, the organization abandoned traditional sequential page numbers in its paper journals. Early this month, AGU backtracked by adopting a four-digit "article number" that serves much the same purpose as a page reference. AGU officials hope that it and other changes will help them right a publishing ship that in the past year has been listing wildly. "It's really quite a mess," says Paul Lucey, a planetologist at the University of Hawaii, Manoa, who edits AGU's *Journal of Geophysical Research—Planets*. AGU's management "is focusing so much on electronic that they just discarded the print version."

AGU's woes stem from a bold come-from-behind strategy, says geophysicist Marcia McNutt, director of the Monterey Bay Aquarium Research Institute in Moss Landing, California, and immediate past president of the society. For decades, AGU—which publishes many leading journals in the earth, atmospheric, and oceanographic sciences—required authors to submit their papers practically ready for publication. The policy kept costs low but was hostile to new technologies, McNutt says. "In the 1980s, we considered alternatives but decided that, as a small nonprofit, we couldn't afford to be on the leading edge."

When AGU took the e-plunge in 2001, however, it went all out. Online papers, the organization declared, would be treated not as sneak previews of printed versions but as publications of record. The switch also paved the way for extras that scientists want but that hard-copy journals can't match, namely, "multimedia enhancements" such as videos, simulations, and three-dimensional chemical structures.

First, though, AGU needed a permanent way to tag on-


**Disoriented.** Geoscientists complain that AGU's identifier for online papers is next to useless for navigating its print journals.

ILLUSTRATION: TIM SMITH