ARCHEOLOGY

# Did Early Humans Reach Siberia 500,000 Years Ago?

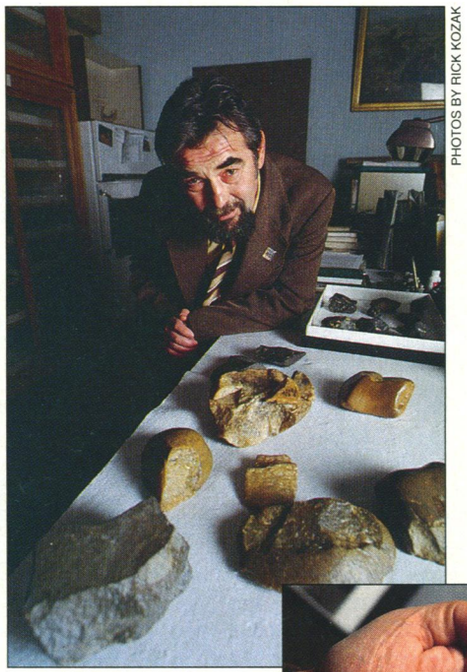
Twelve years ago, while excavating in northern Siberia, archeologists Yuri A. Mochanov and his wife, Svetlana Fedoseeva of the Russian Academy of Sciences, came upon a few unprepossessing rocks. That might not sound like much, but to Mochanov those rocks looked like very early stone tools, tools with which he could construct a new path for human evolution—a path that began in the cold north, rather than on the warm plains of Africa as almost all his colleagues believed.

To those colleagues, however, the find simply looked like unprepossessing rocks. But now, thanks to a reexamination of the material and high-tech geologic dating methods, those skeptics are beginning to think that while Mochanov may not rewrite prehistory completely, he may be able to revise a chapter about *Homo erectus*, a human ancestor who lived from approximately 1.7 million years to 200,000 years ago.

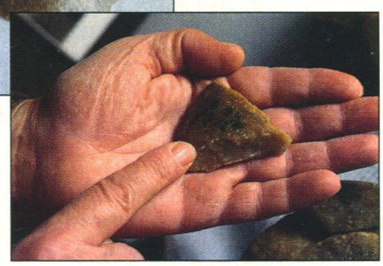
The rocks in question were discovered as the two Russians unearthed a 3000 to 4000-year-old tomb at the Diring-Yuriakh (Deep Creek) site on the Lena River. Below the tomb they spotted a scattering of crudely shaped stone tools. Mochanov and Fedoseeva had seen similar tools before, but they came from East Africa, and they were 2.4 million years old, the earliest known tools made by human ancestors. At the time, it was thought that the earliest human occupation of Siberia took place 20,000 to 30,000 years ago. "I was stunned," Mochanov recalls. "Nothing like this had ever been found in Siberia and I thought, 'This is impossible.'"

Over the next several years, his incredulity vanished as he amassed more than 4000 quartzite artifacts, primarily anvil stones, flakes, and choppers. And based on the similarities between the Siberian and African tools, as well as preliminary studies that dated the site at 3 million years of age, Mochanov proposed a northern Russian genesis for humanity, beginning at that time.

That didn't sit at all well with his colleagues, who thought Diring's geology and dates were far too shaky to hold up a theory that contradicted the abundant and well-accepted evidence pointing to African origins. To make matters worse for Mochanov, few archeologists accepted the artifacts as tools, believing instead that the quartzite cobbles could have been chipped by some geological process. "The site needs to be looked at with a properly jaundiced eye," says William Kimbel, a paleoanthropologist at the Institute for Human Origins in Berkeley.



PHOTOS BY RICK KOZAK



**Rock show.** Yuri Machonov *(above)* has been taking artifacts from his Russian site around the United States to convince scientists these are tools made by human ancestors.

Lately, however, the jaundiced eyes are beginning to open wide. For the past month, Mochanov and Fedoseeva have been barnstorming the United States, showing their artifacts to experts at Oregon State and the Smithsonian Institution, among other places. Many of these scientists had never seen the tools firsthand and many of them are impressed. And some new dating studies using a technique called thermoluminescence (TL) suggest that the artifacts may be at least 500,000 years old. That's a far cry from Mochanov's original claim, but still old enough to make former skeptics sit up and take notice.

"I would have been excited if the tools were only 50,000 years old," says one recent convert, Dennis Stanford, chairman of the anthropology department at the Smithsonian. "But 500,000 years opens up a Pandora's box of possibilities." The date is within the time period of *erectus*, and one of those possibilities is that *erectus* could have pushed much further north than previously believed (the next most northern *erectus* site is 2500 kilometers south of Diring, in China). It's also possible that early humans —*erectus* descendants—could have pushed from Siberia through Beringia and into America long before the currently accepted colonization date of around 14,000 years ago (see Report in this issue, p. 660).

The key to this Pandora's box is an ongoing series of studies by Michael Waters, a geoarcheologist at Texas A & M University, whom the National Geographic Society sent to Diring to help Mochanov evaluate the site. Waters confirmed that the artifacts lay in windblown quartzite sand deposits, which are well-suited for TL dating. This technique measures time by counting the number of stray electrons trapped in minerals, an entrapment that takes place at a steady rate. Although a relatively new—and still controversial—method, TL is the only game in town at sites such as Diring, where there are neither fossilized animal remains that might be correlated with those from another securely dated site nor volcanic ash deposits for potassium-argon dating. The sediment samples Waters collected at Diring were dated by geochronologists Steve Forman and James Pierson at Ohio State University.

But the TL dates are not the only evidence that is beginning to shift the consensus on the Diring site. It's also the tools themselves. Mochanov has unearthed 33 areas marked by anvil stones, quartzite flakes, and, in some cases, the quartzite cobble from which the flakes were chipped; often the flakes can be refitted onto the cobbles. These elements, all definitive signs of human activity, convinced Rick Potts, a Smithsonian archeologist and expert on early tools, that he was looking at hominid handiwork and not just randomly broken rocks.

"The Diring artifacts are very, very simple one-step tools," explains Potts, who had only heard sketchy details about the site until Mochanov's visit. "All they were basically doing was smashing one rock with another, just to get a few pieces off. That's why the tools look very rough and crude—I think Diring was their quarry site." Perhaps, Potts speculates, the inhabitants broke the rocks into smaller pieces that were easier to hold, then carried these to other sites where they may have fashioned more elaborate tools.

If human ancestors did live at a site that's just below the Arctic Circle, "it implies a range of behaviors and adaptations that we have never given *Homo erectus* credit for, from making mitts and boots, to controlling fire and having winter survival strategies," says Waters. Until Mochanov's discovery, no one had found any signs of *erectus* any

farther north in Asia than Zhoukoudian, the huge limestone cave in central China used by the famous "Peking Man" nearly 500,000 years ago. "What Mochanov may be seeing at Diring is part of a south-north migration pattern," suggests Robert E. Ackerman, an archeologist at Washington State University in Pullman, who visited Diring 4 years ago. "Perhaps this is part of a movement north out of China during a warming trend." However, scientists have little data about the paleoclimate of Siberia, and there is as yet no way of knowing how cold or warm the Diring peoples' environment really was. Waters suspects the site is at a high enough latitude that, even during a warm interglacial period, the climate would be similar to the climate today—and that can be chilly indeed. At Yakutsk, just north of Diring, the mercury falls as low as -45 degrees Farenheit in January.

The ability to cope with cold at that time in human prehistory also figures in the peopling of the Americas. "For those who've wanted to see an earlier date for the peopling of the Americas this [500,000-year-old] date is a cause for celebration," says Stanford. He notes that critics have always argued that people did not have sophisticated enough technologies to survive in the Arctic until very recently. "But if people were dealing with the cold that far north in Siberia 500,000 years ago, then a little bitty ice age like the Wisconsin isn't going to stop you from getting to America," he says.

No one, however, is going to push Diring as evidence for early American pilgrims until the twin issues of the environment and dating are much more settled. Mochanov has found no *erectus* fossils, which would clinch the case for the site as an *erectus* habitat, or animal fossils, which would go a long way toward clearing up questions about just how cold it was back then. "Those are the kinds of questions that have to be answered before we can explain the Diring peoples' behavior," says Potts. "We need to know what the survival strategies were of other animals in the area. If they were all cold weather-adapted, then you'd have to say these hominids made a real breakthrough—one that no others were doing."

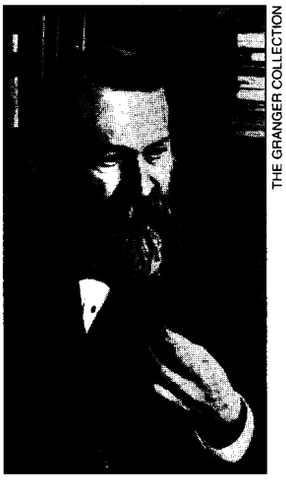
As for the 500,000-year-old date, there is still at least one scientist who is dissatisfied with it—Mochanov. He doesn't think it is old enough, and he is still sticking to his 3-million-year-old claim. "That is preliminary work," he says of the TL date, adding that he wants to wait for Waters' and Forman's final report, which is due by the end of this summer. "If we find we have a mistake [with the earlier date]," says Mochanov, "then we will correct it." At least his North American colleagues have already begun to correct their notion that Diring is a dud.

**–Virginia Morell**

PHYSICS

# Inertia: Does Empty Space Put Up the Resistance?

As a child, the Nobel Prize–winning physicist Richard Feynman asked his father why a ball in his toy wagon moved backward whenever he pulled the wagon forward. His father said that the answer lay in the tendency of moving things to keep moving, and of stationary things to stay put. "This tendency is called inertia," said Feynman senior. Then, with uncommon wisdom, he added: "But nobody knows why it is true."

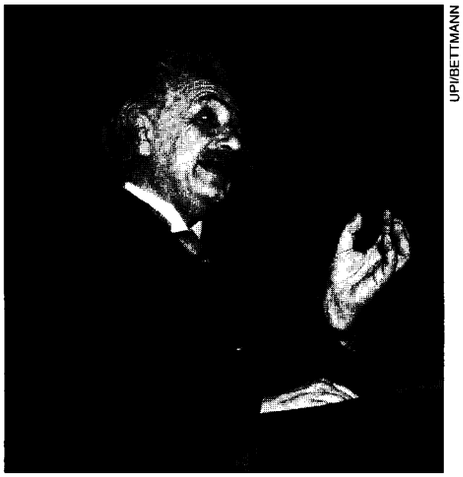


THE GRANGER COLLECTION

**Seeking a reference frame.** Mach defined inertia with respect to the distant stars.

That's more than even most physicists would say. To them, inertia does not need explaining, it simply "is." But since the concept was first coined by Galileo in the 17th century, some scientists have wondered if, perhaps, inertia is not intrinsic to matter at all, but is somehow acquired. Those who have tried to come to grips with inertia include Feynman junior, once he had grown up, and Albert Einstein, who tried—and failed—to show that inertia was related to the arrangement of matter in the universe.

Now three researchers think they have found the source of inertia—and it turns out to be much closer to home. Inertia, they say, comes from the apparently empty space that surrounds us all—or rather, from the buzz of activity that, according to quantum theory, fills even a perfect vacuum, where subatomic particles are being created and annihilated in the blink of an eye. It is this ever-present sea of energy that the researchers believe resists the acceleration of mass, and so creates inertia.



UPI/BETTMANN

**Another try.** Einstein tried to incorporate Mach's principle into general relativity.

Reaching this conclusion took more than just a simple application of quantum theory for Bernhard Haisch of the Lockheed Palo Alto Research Laboratory, Alfonso Rueda of the California State University at Long Beach, and Hal Puthoff at the Institute for Advanced Studies at Austin, Texas. Their idea, published in the 1 February issue of *Physical Review* A, is based on an esoteric mathematical treatment of the vacuum and a long-forgotten attempt by the Soviet theorist and dissident Andrei Sakharov to explain another great mystery, gravity. These unfamiliar foundations, together with the new proposal's boldness, would be more than enough to stir up controversy. But the paper raises an even more provocative notion: that inertia, once understood, might be controlled.

It is a bit too early to be talking about building inertia-free starships, the researchers say, but they maintain that there may soon be hard evidence supporting their claim, from experiments that will search for changes in the mass of electrons when they are exposed to powerful laser beams. Certainly many of their colleagues are intrigued. Says Stanford University astrophysicist Peter Sturrock, "No one would say that it's the last word, but I think it may really be one of the first words in what could be a very interesting approach."

One inspiration for the effort was a much earlier try, by the German philosopher-physicist Ernst Mach. In 1872, Mach argued that acceleration—and hence inertia—is not absolute, but only has meaning within a frame of reference. For Mach, that frame of reference consisted of the other matter in the universe: After all, in utterly empty space, how do you know you are moving? Einstein later tried and failed to work that notion into general relativity. Haisch and his colleagues also invoke a frame of reference: not the distant stars, but the quantum vacuum.

The seething activity of the vacuum is an upshot of Heisenberg's uncertainty prin-