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THIS WEEK

RESEARCH NOTES

ARTICLES

DEPARTMENTS

COVER: Some of the drugs in your medicine cabinet may be ineffective, but with a little prodding from some public interest groups FDA should complete its removal of ineffective drugs — begun 18 years ago — within another five years. See story p. 92. (Cover illustration by Carole Shebby)

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SCIENCE NEWS OF THE WEEK

Oldest Tool Kit Yet

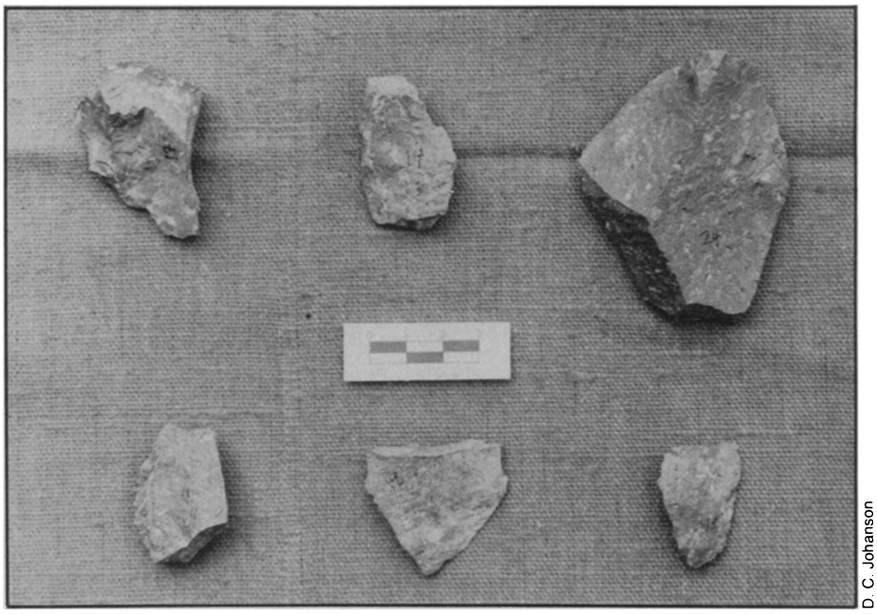
"Man is a tool-using animal. Nowhere do you find him without tools. Without tools he is nothing; with tools he is all."

Thomas Carlyle, 1836

Tool making has long been recognized as an ability unique to humans, and tools made of stone have long been used to date the antiquity of humanity. Now the date is being pushed back 500,000 years to at least 2½ million years ago. The reason: the discovery of 48 sharp flaked stone knives and three larger choppers in the Hadar of the Afar region of northeastern Ethiopia.

The story of this find begins in December 1976. While surveying in the Gomo River, Helene Roche of the Musee de l'Homme in Paris found a number of artifacts in geological sections that had been cut away by erosion. She was working as part of the International Afar Expedition led by Maurice Taieb of the French National Center for Scientific Research in Marseille and Yves Coppens of the Musee de l'Homme. Due to commitments in Paris, Roche had to leave the field, but John W. K. Harris of the University of Pittsburgh was asked to take a closer look at the site. In January 1977, Harris found stone tools on the surface near the original find and he, Donald Carl Johanson of the Cleveland Museum of Natural History and others began excavation. The result was a large kit of tools made of volcanic rock. Closely associated with the tools were a number of broken up bone fragments in what is believed to be a primary, or undisturbed, context.

"It wasn't a natural process that deposited those artifacts in that place," says Harris. "They were dropped there by some agency," he explains, "and we, of course, make the assumption that it was a human agency." He further suggests that the excavation may be of a campsite or sort of home base used by creatures who lived in or operated in groups and who had meat as at least part of their diet. "This concept of a home base," Harris told Associated Press, "is a possible example of group behavior. They may have been bringing food back to a central location to be shared."



D. C. Johanson

These simple flaked stone tools may represent the oldest known human artifacts.

Harris plans to publish a scientific description of the items discovered at the site this spring.

The discovery of the tools has been kept on ice since 1977 so that the tools could be examined and adequate dating could be done. But Glynn Isaac of the University of California at Berkeley (and currently at Harvard University) knew of the find, and he says, "There isn't any doubt that they are stone tools. They are very simple, but that's not an issue. The issue was the age." But now he and some others who know of the find are satisfied. "Even good geologists can be wrong," he admits, but he goes on to say "the chances that the age is as they say seem to be very good." And the age is the crucial point.

Dating of the volcanic ash in which the artifacts were situated as well as of the site itself was held up in part, explains James Aronson of Case Western Reserve Univer-

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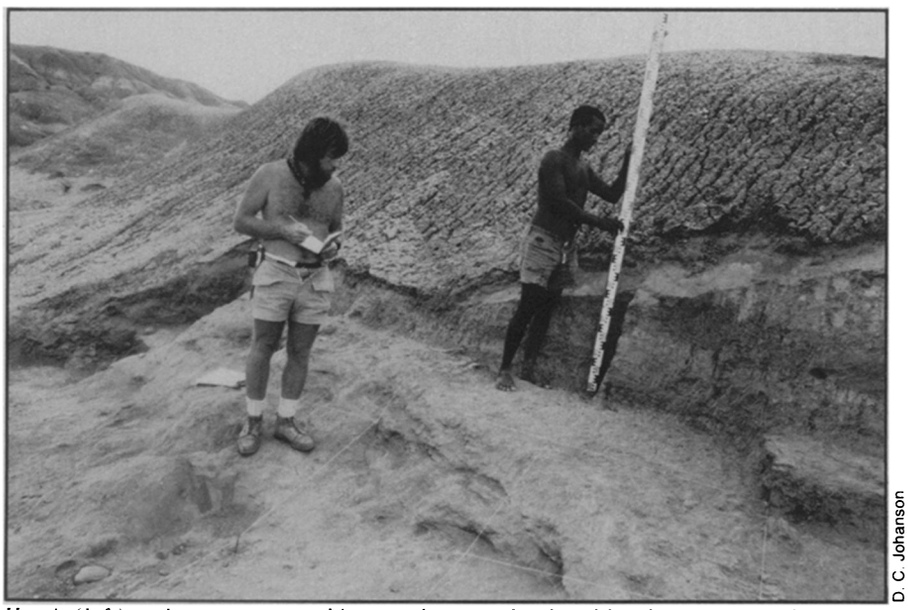


D. C. Johanson

Harris (left) and excavator working at what may be the oldest human campsite.

sity in Cleveland, because of the political situation in Ethiopia. But the dating team did gain access to the site last January, and they have since been able to complete their work. Aronson says he and the others are fairly confident of the dates they got, which range from 2.9 to 2.7 million years old. Also involved in the dating project were Taieb, Robert Walker of the University of Toronto, Jean-Jacques Tiercelin of the Center for Scientific Research in Marseille and Michel Beden of the University of Poitiers in France.

If the dating holds up as it is expected to, these tools will be the oldest known human artifacts. They will, however, fall into a gap in the story of human evolution as we know it. The Afar region has yielded fossil hominids *(Australopithecus afarensis)* that roamed eastern Africa between approximately 3 and 4 million years ago (SN: 1/20/79, p. 36). Many researchers feel that *A. afarensis* was on the direct line of human evolution, but it was a small-brained creature that probably was not capable of manufacturing tools. Hominids with larger brains have been dated back to 2 million years ago, as have stone tools, but that leaves nothing between 3 and 2 million years ago — until now. "That's why this thing is exciting and intriguing," says Isaac. "It opens the possibility that perhaps the first use of stone tools preceded the development of a significantly enlarged brain and were part of the behavior or way of life that helped to induce, or influence, the enlargement of the brain." That's one possibility. The other, he says, "is that the trend toward brain enlargement began earlier than the oldest fossils we yet have."

The question posed by these possibilities will not be answered until the toolmaker is found. In the meantime, the tools themselves are likely to create some excitement. Elwin L. Simons of Duke University (who also knew of the find) puts it this way: "The oldest documentation of stone tools is the beginning of archaeology; it's the beginning of cultural history." □

Reflecting X-rays normally

Textbooks of optics will tell you that X-rays cannot be reflected by a mirror at normal (near perpendicular) incidence as visible light and radio waves can be. The difference between the indices of refraction for air and for most solid substances is too small at X-ray wavelengths to cause much reflection. (At visible and radio wavelengths the difference is big enough.) For the same reason there will not be any appreciable refraction in a lens.

X-rays can be reflected at grazing incidence. Reflection depends on the angle the incident beam makes to the perpendicular and the difference in refraction index. Here the large angle from the perpendicular compensates for the small index difference. Most of the devices used to reflect and focus X-rays up to now have been based on grazing reflection.

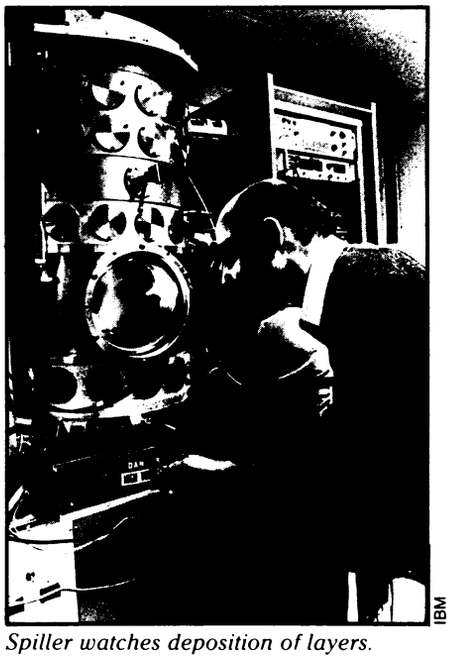
Now the alternative of normal reflection, since Isaac Newton's day the preferred method of focusing light with mirrors, seems likely to become available for X-rays. A group of scientists including Eberhard Spiller and Armin Segmuller of the International Business Machines Corporation Research Division, in Yorktown Heights, N.Y., Jack Rife of the National Bureau of Standards (now at the Naval Research Laboratory) and Rolf-Peter Haeblich of the University of Hamburg and the Deutsches Elektronen Synchrotron (DESY) have developed and tested a multilayer mirror coating that will reflect up to 10 percent of X-rays incident from a near normal direction. The work is reported in the latest issue of APPLIED PHYSICS LETTERS.

Multiple layer coatings of this sort have been used for some time for the best visible-light mirrors. They alternate layers of a transparent and an opaque material. If a single pair of layers is one-half a wavelength thick (for whatever radiation one wants to reflect), the alternation of transparency and opacity will set up a standing-wave condition. A standing wave has components going both forward and backward. The backward component contributes a certain amount of reflection.

Extending the multilayer technique to X-rays was something of a problem in close tolerance fabrication. The boundaries of the layers must be smooth to within 1/20 of a wavelength. For visible light at, say, 5,000 angstroms that means 250 angstroms tolerance, for X-rays at 200 angstroms that yields about 10 angstroms leeway. The X-ray coatings have to be laid down to about the accuracy of a single layer of atoms. The group developed a way to do it that can lay down 200 layers with a cumulative thickness error of only 5 angstroms, they report. The mirrors were tested at the National Bureau of Standards and at DESY.

With this technique spherical mirrors for X-rays can be manufactured. This means more flexibility in the design of X-ray telescopes. It also means better resolution, the researchers point out. The grazing-incidence mirrors used up to now in X-ray telescopes have to be curved as sections of paraboloids or hyperboloids. These are harder to machine to true shape than spheres. So they tend to focus less well.

Combined with the extremely intense X-ray beams that come as synchrotron radiation from some of the world's largest electron accelerators, spherical mirrors



IBM

Spiller watches deposition of layers.