Anthropology

Bruce Bower reports from San Francisco at the annual meeting of the American Anthropological Association

Hammer time in the Stone Age

Battered quartz and limestone spheres, each about the size of a tennis ball, litter Stone Age archaeological sites dating from about 1.8 million to 40,000 years ago. For more than a century, investigators have granted that the stones served as a major class of prehistoric tools and assigned them all sorts of speculative titles, including bone smashers, club heads, plant grinders, and bolas, which some hunters still tie to thongs and throw to trip up and bring down game.

But new evidence suggests that human ancestors produced the ubiquitous stone balls through repeatedly using chunks of stone to hammer out other tools, such as sharp-edged scrapers and choppers, assert anthropologists Nicholas Toth and Kathy D. Schick, both of Indiana University in Bloomington.

Toth and Schick traveled to Zambia in central Africa, where angular pieces of quartz are the most common raw material in many areas. In field experiments, they found that after about four hours of hammering to remove pieces (called flakes) from the edges of stone tools, quartz stones assumed a round shape without any predetermined intent to produce a sphere. Quartz proves highly susceptible to gradual chipping and wear during prolonged battering, the scientists contend.

The use of quartz tools increased sharply between approximately 1.8 million and 1.2 million years ago at Olduvai Gorge in Tanzania, at sites both close to and far from local quartz deposits, Toth says. During the same period, the number of quartz spheres found at various Olduvai sites also increased dramatically, he points out.

Early toolmakers at Olduvai apparently carried quartz hammers with them from one place to another, and they may have returned frequently to sites where such implements received regular use, Toth theorizes.

"Sometime around 1.7 million years ago, opportunistic toolmakers evolved into dedicated toolmakers whose existence relied on flake-stone technology," he argues.

Stable gene scene in ancient America

Indians who occupied part of central Florida from about 8,000 to 7,000 years ago possessed surprisingly little genetic diversity, according to a preliminary analysis of DNA extracted from some of their shriveled, preserved brains.

If further work confirms this finding, it may suggest that the Florida group and other ancient settlers of the Americas avoided breeding with neighboring tribes, contends medical microbiologist William W. Hauswirth of the University of Florida College of Medicine in Gainesville. This practice would have produced genetic stability across generations that may now render the tracing of their ancestry through analysis of ancient DNA "relatively easy," Hauswirth asserts.

From 1984 to 1986, investigators removed the skulls and other skeletal remains of 177 individuals from a Florida peat bog that had apparently once served as a burial ground. In addition, scientists discovered that the watery bog had kept 91 brains remarkably well preserved, and they began successfully to remove DNA from the ancient tissue (SN: 11/8/86, p.293).

Since then, radiocarbon dating of samples of peat and bone taken from the prehistoric cemetery indicates that the site was used for more than 1,000 years and may contain members of as many as 50 generations, Hauswirth maintains.

He and his colleagues isolated and copied samples of nuclear DNA (inherited from both parents) and mitochondrial DNA (inherited from the mother) from 13 ancient brains. The scientists studied a specific section of the mitochondrial DNA that changes rapidly through random chemical substitutions.

A comparison of the samples reveals few differences in the chemical organization of the nuclear and mitochondrial DNA of the 13 individuals, at least so far, Hauswirth says.

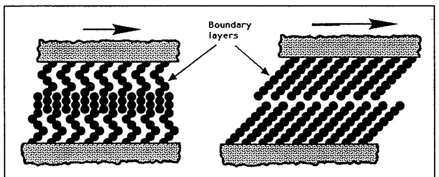
Materials Science

Elizabeth Pennisi reports from Boston at the fall meeting of the Materials Research Society

Tight spaces make lubricants misbehave

As engineers design ever smaller mechanical and electronic components, they need to reconsider the types of lubricants they use to keep those devices working smoothly. New research has confirmed that lubricating molecules confined to narrow spaces do not behave the same way they do in bulk form.

A polymer lubricant, when squeezed between two pieces of mica separated by just a few nanometers, will act more like rubber than oil, says Steve Granick, a materials scientist at the University of Illinois at Urbana-Champaign.



Israelachvili/Univ. Calif., Santa Barbara

Lubricant molecules exerting typical friction (left) become ordered and create a low-friction state (right).

Granick compared the energies needed to slide these plates when separated by the polymer, and when farther apart and separated by oils or rubbers. The polymer films proved less fluid and more elastic than scientists had thought, he says.

This rubbery nature means that as computer hard drives or engines start up, they may be subject to damage because the lubricant in narrow spaces isn't doing its job, he adds.

In addition, "dry" lubricants, called boundary layer systems, do not always act as expected, reports Jacob N. Israelachvili of the University of California, Santa Barbara. These lubricants consist of hydrocarbon chains that anchor into the surface being lubricated. They are most useful in devices employed in clean and high-vacuum environments.

Using a surface forces apparatus, he and his colleagues determined that these chains sometimes develop a different sort of slip-stick, the motion in which surfaces slide in jerks (SN: 5/30/92, p.360). The molecules become tangled and untangled and switch from exerting normal friction to exerting very low friction, so they slide by each other more easily. "It's like combing your hair. It starts out messy, then [the comb] suddenly goes smoothly," says Israelachvili.

At high velocities, "one might be able to have low friction, an order of magnitude lower than one normally has," he adds.

Laser yields knobby diamond film

Five years ago, scientists zapping carbon with a laser of unusually high intensities discovered they had created new forms of this common element. One, called amorphic diamond, represents a "true" diamond material, with a hardness that can match that of natural diamond, says Farzin Davanloo, a physicist at the University of Texas at Dallas. He, Carl B. Collins, and their Texas colleagues have now demonstrated that they can deposit this diamond film on many materials, including computer disks, medical implants, and infrared optics.

Most researchers make synthetic diamond films using a process called chemical vapor deposition. This technique requires high temperatures and reaction environments that would destroy many of the materials researchers seek to coat, says Davanloo. Although his group's new technique uses lasers with 500 billion watts per square centimeter to create a carbon-ion plasma, that plasma never heats the material it settles on to more than 35°C, he notes. He and his colleagues have coated 10-centimeter squares of silicon, titanium, gold, silver, aluminum, copper, stainless steel, ceramics, and polyimide.

Amorphic diamond consists of diamond nodules in a sea of other carbon forms. The researchers adjust the laser to vary the nodule density and thus the film's hardness, says Davanloo.

These diamond films still cost more than those made by chemical vapor deposition, but two companies are developing commercial applications of the new process, Davanloo says.