Ancient adhesive surfaces in Israeli cave

Arie Nissenbaum, a geochemist and academic secretary of the Weizmann Institute of Science in Rehovot, Israel, has stumbled into a sticky situation of prehistoric proportions.

To his surprise, Nissenbaum has identified what is apparently the oldest known glue in the world, dating to around 8,200 years ago. The ancient adhesive, made of collagen processed from animal skins, appears on many artifacts previously found in a small Israeli cave near the Dead Sea.

The identity of the folks who concocted the collagen glue remains uncertain. They lived during a phase of the Neolithic period, or New Stone Age, when hunter-gatherer and agricultural groups coexisted in the Middle East. Pottery making had yet to be introduced.

"By Stone Age standards, [these people] had mastered at least one type of advanced technology," Nissenbaum says. "At this early period, humans had already become familiar with the use of collagen as an adhesive material."

Excavations at the Nahal Hemar cave, conducted in 1983, uncovered a wide array of artifacts. These include rope baskets, mat fragments, a linen headdress, wooden arrowheads, plaster beads, a wooden sickle, bone figurines, bone and flint utensils, two stone masks, and decorated human skulls.

A crisscross design made of collagen decorates a skull from Nahal Hemar.

Many items bear remnants of a black, asphaltlike material. The dark substance coats baskets and other containers, perhaps as a type of waterproofing, and it was used to create a crisscross design on the backs of skulls. Researchers had assumed that the dark stuff came from asphalt deposits a few miles from the cave.

Now, a chemical analysis, reported by Nissenbaum in the current issue (bulletin 5) of the Hebrew-language journal ARCHAEOLOGY AND NATURAL SCIENCES, identifies the material as collagen, a fibrous protein that is the main component of skin, sinews, and cartilage. Further chemical and microscopic studies indicate that the substance was made from animal skins.

Although collagen rapidly converts to gelatin under most circumstances, the extremely dry climate around Nahal Hemar prevented this transformation. Some North American Indian groups employed a similar collagen adhesive to make archery bows at least 1,500 years ago, remarks archaeologist Philip J. Wilke of the University of California, Riverside. About 4,000 years ago, Egyptians used gelatinous collagen to glue together wooden furniture.

An early farming community may have stored the collagen-bearing objects for use in outdoor ceremonies, a practice still observed among some nomadic Middle Eastern groups, notes archaeologist Ofer Bar-Yosef of Harvard University, a coexcavator of the site. *—B. Bower*

Electric cars . . . fueled by gasoline?

When you think about electric cars, the phrase "Fill 'er up!" doesn't immediately come to mind—but early in the next century it might.

A government-industry team has demonstrated a gasoline-fueled system that could form the heart of a clean, fuel-efficient electric car. The system consists of a fuel processor that partially oxidizes gasoline to create hydrogen gas, which is then sent to a fuel cell that generates electric power. Members of the partnership include the Department of Energy and Arthur D. Little of Cambridge, Mass.

In tests conducted earlier this month, the prototype fuel processor generated hydrogen at a rate sufficient to produce 50 kilowatts of electric power—enough to run a midsize car, says Robert S. Weber, a senior scientist for the project at Arthur D. Little.

Although the laboratory tests used gasoline and ethanol as fuels, the system can also use methanol and natural gas as sources of hydrogen. A car equipped with the system would get about twice the gas mileage of a comparable car with an internal combustion engine, Weber says.

Electric cars have faced two vexing problems—the need for heavy batteries that must be recharged after a few hours' use, and the lack of an infrastructure to support the recharging.

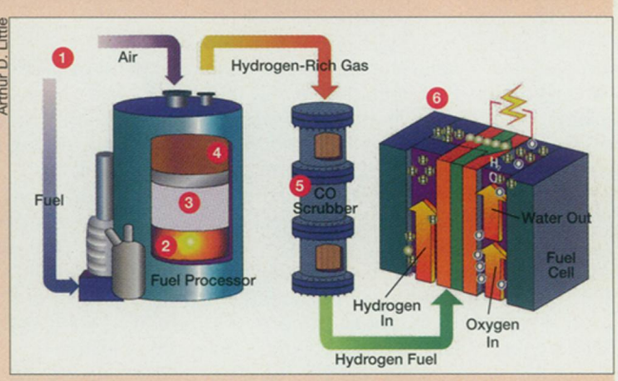
One attempt to get around these difficulties has been the development of so-called hybrid electric vehicles, which use a combination of electric and gasoline power (SN: 10/7/95, p. 232). Another approach depends on fuel cells working off stored hydrogen.

In May 1996, Daimler-Benz unveiled a prototype minivan that carried tanks of compressed hydrogen gas. In October 1996, Toyota announced that it had developed a hydrogen-absorbing alloy, thereby averting the need for storing large amounts of the gas at ordinary temperatures and pressures.

The new system, however, needs neither large batteries nor devices to store hydrogen and would take advantage of the gasoline distribution infrastructure already in place.

Fuel cell technology is just one of the initiatives that the California Air Resources Board has encouraged the automobile industry to explore, says spokesman Richard W. Varenchik. The system announced on Oct. 21, although promising, needs to be demonstrated in an automobile, he adds.

"We're always looking for efficient, low-emission technologies, but when it gets down to it, we want to look at equipment in the automobile, in real-life conditions." *—S. Perkins*



Liquid fuel is vaporized (1) and sent into the fuel processor, where it is partially burned in a multistage process (2, 3, 4) that produces carbon dioxide and hydrogen and removes sulfur contaminants. A catalyst (5) removes any excess carbon monoxide. In the fuel cell (6), hydrogen combines with oxygen from the air to produce electricity.