

lenges.

OTA recommendations are: fighting U.S. "functional illiteracy" in basic reading, science and math skills; immediately implementing job training, retraining and counseling programs for workers displaced by PA; cross-training or teaching workers a variety of job skills; developing better education and career guidance programs for both youth and adults; and fostering overall improved worker training in new technology through an orchestrated effort by government, industry and educators.

This OTA report will serve as background information for Congress members who must vote on legislation related to computer advances. For example, a House Committee on Science and Technology subcommittee this month will consider a bill that would create several centers for industrial technology (to study robotics and PA) and also create a federal robotics center under the National Bureau of Standards. One committee aide says, "As we move ahead on legislation, [the OTA study] flags areas where we need to study more."

This week a National Academy of Science committee released a report saying that future high school graduates need strong math, science and reading skills in order to compete in a job market changed by technology. And members of the Committee on Science, Engineering and Public Policy also note that these graduates will face life-long returns for more schooling to keep pace with high-tech advances and thus remain employed, says Markley Roberts, one panel member and an economist with the AFL-CIO.

"It's going to be a tough, competitive job market for a long time," says Roberts. "We are very concerned with job losses over the long run."

Blumenthal says no one can accurately predict exact job losses or shifts in the work markets because neither the future economy, retraining efforts, nor the need for entry level positions can be predicted.

—A. Rowand

## Copyright for chips?

The U.S. Senate has passed a bill providing 10-year copyright protection for the masks — original, stencil-like forms — through which each precisely designed and integrated layer of circuitry is written onto a semiconductor integrated-circuit chip. A similar bill is expected to pass in the House of Representatives soon.

Both bills provide protection against copying the original masks as well as the unauthorized production of chips made from registered masks. However, "reverse engineering" — the dissection and layer-by-layer reconstruction of a chip to see how it achieves its electronic functions — is allowed. □

## Ancient Maya tomb discovered

An untouched, perfectly preserved 1,500-year-old Maya tomb—adorned with elaborate wall paintings and an intact male skeleton — has been uncovered in the dense jungles of northeastern Guatemala. The find, announced this week by the National Geographic Society, gives researchers a dramatic, unusual view of the Early Classic period of the advanced Maya Indian civilization that flourished before disintegrating rather mysteriously 500 years ago. The tomb, dated between A.D. 450 and 500, also contained 15 ceramic vessels and several carved jade beads.

The May 15 discovery by a joint United States-Guatemalan expedition — financed by an emergency grant from the Society — occurred near the Rio Azul (Blue River) in Guatemala's Peten Region. The tomb is

part of a temple complex among hundreds of buildings in a 500-acre Maya settlement. Last year, the scientists discovered the capstone of the tomb beneath a pyramid that also housed another tomb, called No. 1, which was believed to be the burial place of a ruler of the civilization. But unlike that tomb, this latest chamber has not fallen prey to looters. The resulting treasure chest of artifacts — the first such untouched find in 20 years — has both surprised and elated the researchers.

"It's a major tomb," says R.E.W. Adams, expedition director and professor of anthropology at the University of Texas at San Antonio. "Because it's associated with ... 28 looted tombs, [it] gives the other tombs historical significance. It gives us more data on an Early Classic ruling family which seems to have been associated with



The newly discovered Maya tomb contained the skeleton of an "administrator." Paintings adorn the limestone walls and pottery is scattered on the floor.

Photos: National Geographic Society



*This pot, with its "childproof" top, may be the most significant find.*

the ruling family of Tikal." Tikal is the site of the largest Maya ruins in the Peten region.

"With some study," Adams says, "we should be able to get a better understanding of the whole Early Classic Maya world. There seem to have been a lot of wars at this time [and] competition among Maya states. And this family [Tikal] seems to have been involved in those wars."

The occupant of the tomb, Adams speculates, was probably an administrator in the ruling family. The three large wall paintings are punctuated with Maya symbols of authority, and the hieroglyphics on some of the ceramics refer to "Great Son," a royal title.

The most valuable find in the tomb, according to Adams and National Geographic archaeologist George E. Stuart, is a ceramic pot with a stirrup handle on its removable top and a highly sophisticated flange arrangement to fasten the top — similar to today's "childproof" medicine bottles. It may be the first evidence of such a top, say the scientists.

The Maya are believed to have been one of the most advanced peoples in history. The civilization is thought to have existed in Middle America between 1500 B.C. and A.D. 1500. It was the Classic period, from about A.D. 300 to 900, that brought the greatest advances in the arts and sciences, which included the use of mathematics, the calendar and astronomy. Their architecture, art and farming techniques were among the most advanced of pre-Columbian peoples.

All of the items found in the Rio Azul tomb were transported to the Institute of Anthropology and History in Guatemala City for more detailed study. The move also removes the artifacts from the danger of looters — who have removed countless relics from ancient ruins throughout Guatemala.

—J. Greenberg

## Ancient technology: Pouring a pyramid

From "Cleopatra" to "The Ten Commandments," Hollywood is well known for altering ancient history. But this time, even Egyptologists may eventually have to revise their thinking about how the great pyramids of Egypt were built.

For generations, people have believed that building the pyramids

was a massive construction project that involved tens of thousands of workers who quarried the limestone, hauled the huge slabs to building sites, pulled the blocks up long ramps and set them into place. Polymer chemist Joseph Davidovits, however, suggests that the Egyptians actually used man-made stone that was cast at the pyramid site, where it was needed. The process, he says, involved pouring a slurry of crushed limestone and a special mineral binder into wooden molds. Within a few hours, the mixture would harden into a material almost indistinguishable from rock. Such a construction method would have taken less time and required far fewer workers.

Davidovits, originally from France and now associated with Barry University in Miami Shores, Fla., first presented his controversial idea in 1979. Since then, he has been collecting evidence to support his hypothesis. Last week at the 1984 Archaeometry Symposium at the Smithsonian Institution in Washington, D.C., Davidovits reported the results of his analysis of rock samples from three of the pyramids and two limestone quarries (at Turah and Mokhatam) traditionally associated with pyramid building.

Davidovits looked specifically at the limestone "casing stones" that formed a smooth shell over a pyramid's stone core. He found that the pyramid samples contained traces of minerals that were not found in the quarry. Instead, they contained as much as 13 percent of what Davidovits calls a "geopolymeric" binder. In addition, microscopic examination of the samples showed that the quarried limestone consisted almost entirely of tightly packed calcite crystals that gave it a uniform density. In contrast, the casing stone was less dense and contained numerous air bubbles.

"Consequently, if the casing stones were natural limestone, quarries different from those traditionally associated with pyramid sites must be found. But where?" asks Davidovits. "That's why we suspect that these were man-made lime-



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stone blocks."

Not everyone agrees with this analysis. Michael S. Tite of the British Museum Research Laboratory in London reported that his laboratory's recent mineralogical analysis of a pyramid casing sample did not show the same features found by Davidovits. "All of the features that they saw can be explained on the basis of natural origin," he told the symposium, "and there is really no need to introduce this hypothesis of reconstituted stone."

Davidovits argues that because the man-made stones contain chunks of natural rock, sampling must be done very carefully and the analysts have to know what to look for. "What we see from time to time is pure limestone but embedded in a very loose matrix," he says. "Our problem is to be able to sample different locations within the material."

There are other clues that point toward the manufacture of stone, says Davidovits. The ingredients needed for the mineral binder—sodium carbonate, various phosphates (obtained from bones or guano), quartz and Nile silt—were readily available to the Egyptians. In addition, the casing stones have a millimeter-thick surface coating that appears to consist entirely of this binder. Davidovits suggests that during setting some of the binder came to the surface to form a "skin." It was the presence of this obviously man-made coating that originally prompted Davidovits to look for traces of this material within the rock itself. Davidovits's theory also helps explain why the casing blocks fit together so well that a postcard can't be inserted between the blocks. The sides of two previously molded blocks could be used as the walls for making the stone in between them.

While pursuing further clues in support of his theory and while experts debate the evidence, Davidovits is investigating whether this long-lost, ancient technology can be used for building modern structures.

—I. Peterson