

# UNRAVELING THE

Recent investigations of ancient mummies shed light on Egyptian health, life styles and the art of mummification

BY SUSAN V. LAWRENCE

The spectacular trappings of Tutankhamun's tomb whetted the curiosity of museum-goers about things Egyptian. Now the University of Pennsylvania's museum is providing a wealth of information about the life, culture, politics, health and disease patterns of ancient Egyptians — and about mummification — in a new show: "The Egyptian Mummy: Secrets and Science." According to its organizers, this is the most comprehensive look yet at mummification in ancient Egypt. It is intended to make "the point that mummies were more than just art objects. I have always regarded the embalmer as a craftsman, or an empirical scientist if you wish," says Stuart Fleming, scientific director of the Museum Applied Science Center for Archaeology (MASCA) in Philadelphia.

The show also offers a synthesis of the work of researchers who are gleaning information about health and disease in Egypt from X-ray studies and autopsies of mummified remains. X-rays are used to date mummies and can also show evidence of parasites and such diseases as tuberculosis, poliomyelitis, degenerative arthritis, heart disease and arteriosclerosis as well as dental damage.

These data can be helpful in identifying mummies and confirming historical records, although X-ray bone age estimates at times indicate earlier ages at death than records suggest. But as University of Pennsylvania Egyptologist David P. Silverman points out: "Sometimes the information can tell us precisely how an individual died or corroborate something we have in a text." For example, X-rays of Sekenenre II by German researcher Erhard Metzger showed several head wounds, apparently caused by an axe, with signs of bone regrowth. Partial paralysis of one arm was also detected and attributed to the head wounds, but death was apparently caused by a later spear thrust behind the left ear. Records indicate that Sekenenre II died in battle, but the X-ray studies indicate that he did not die from the axe wounds inflicted.

Researcher James E. Harris and his colleagues at the University of Michigan in Ann Arbor have used X-rays extensively to study the royal mummies at the Cairo Museum, and some of their findings are displayed in the Philadelphia exhibit. They

demonstrate the diversity of embalming techniques as well as the ravages of tomb robbers, who hacked the mummies apart searching for valuables.

The X-ray studies also provide information about the pharaohs' health: Pharaoh Siptah had poliomyelitis that affected his foot. Ramesses II had hardening of the arteries and severe tooth wear consistent with reports that he died at the advanced age of 90 in 1216 B.C.

Harris and his colleagues have also developed methods of cranial reconstruction using lateral skull X-rays and computer graphics. An unidentified mummy found in the tomb of Amunhotep II was identified through cranial reconstruction as Queen Tiye, wife of Amunhotep II, when images of her skull were compared with those of her parents. The identification was then confirmed through hair analysis — the trace impurities detected matched those found in a strand of her hair taken from a locket found in the tomb of her relative, Tutankhamun.

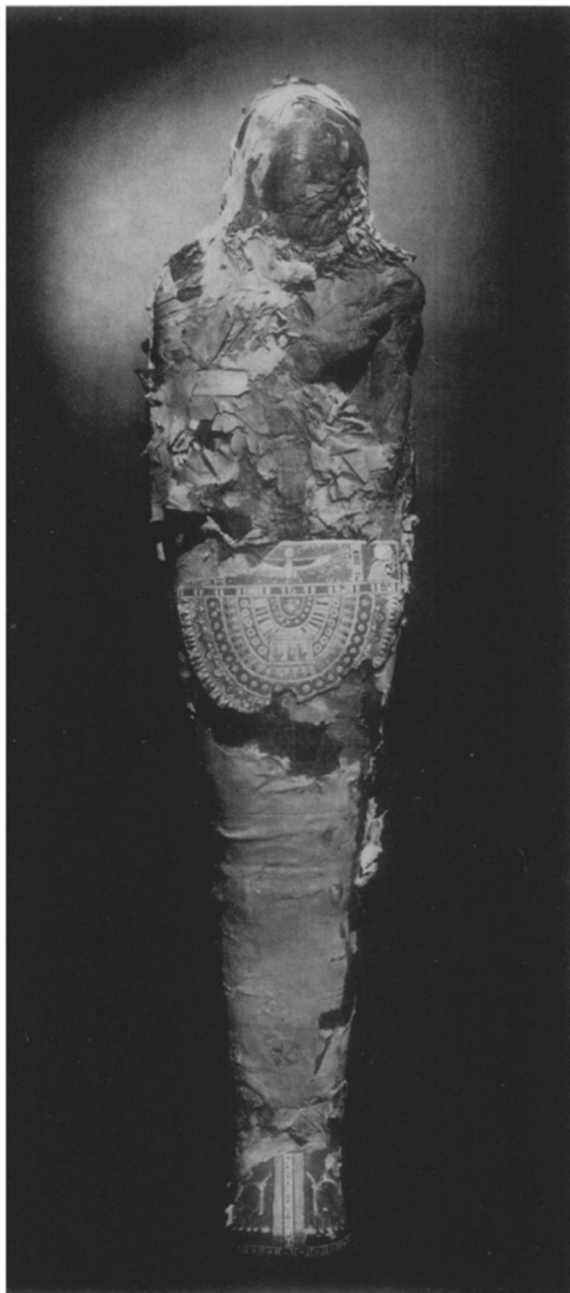
Fleming, an Oxford-trained physicist who specialized in authentication of art objects before coming to MASCA, says he plans to use hair analysis both as an aid to identification and as a way of assessing health. "I believe it will be very informative in terms of the trace impurities, because it is said that many medical ailments have, as it were, 'a fingerprint' in hair structure," he says.

Fleming also intends to use computerized axial tomography (CAT) scanning to study mummies, since the scans provide more detailed images than can be obtained by conventional X-rays. Blood typing, too, can now be done from bone samples of mummies.

A top priority is dating the University's own mummies more accurately, a process made much easier by newer radiocarbon dating techniques that can be used on very small samples of material (SN: 1/14/78, p. 29; 12/30/78, p. 442). Problems still exist, however, because tombs were robbed and mummies were damaged and moved from their original locations many times, making contamination of samples a problem, explains Silverman.

The three University of Pennsylvania mummies that are the stars of the current show have been X-rayed at the University medical school. Djed-Hapi, thought to date from about 750 B.C., suffered from degenerative changes in the vertebrae and hip joints and a minor spinal curvature, suggesting that he died at about age 50. For some reason — either to remove the brain or to make him fit into his coffin, it is believed — his head was severed from his neck after death.

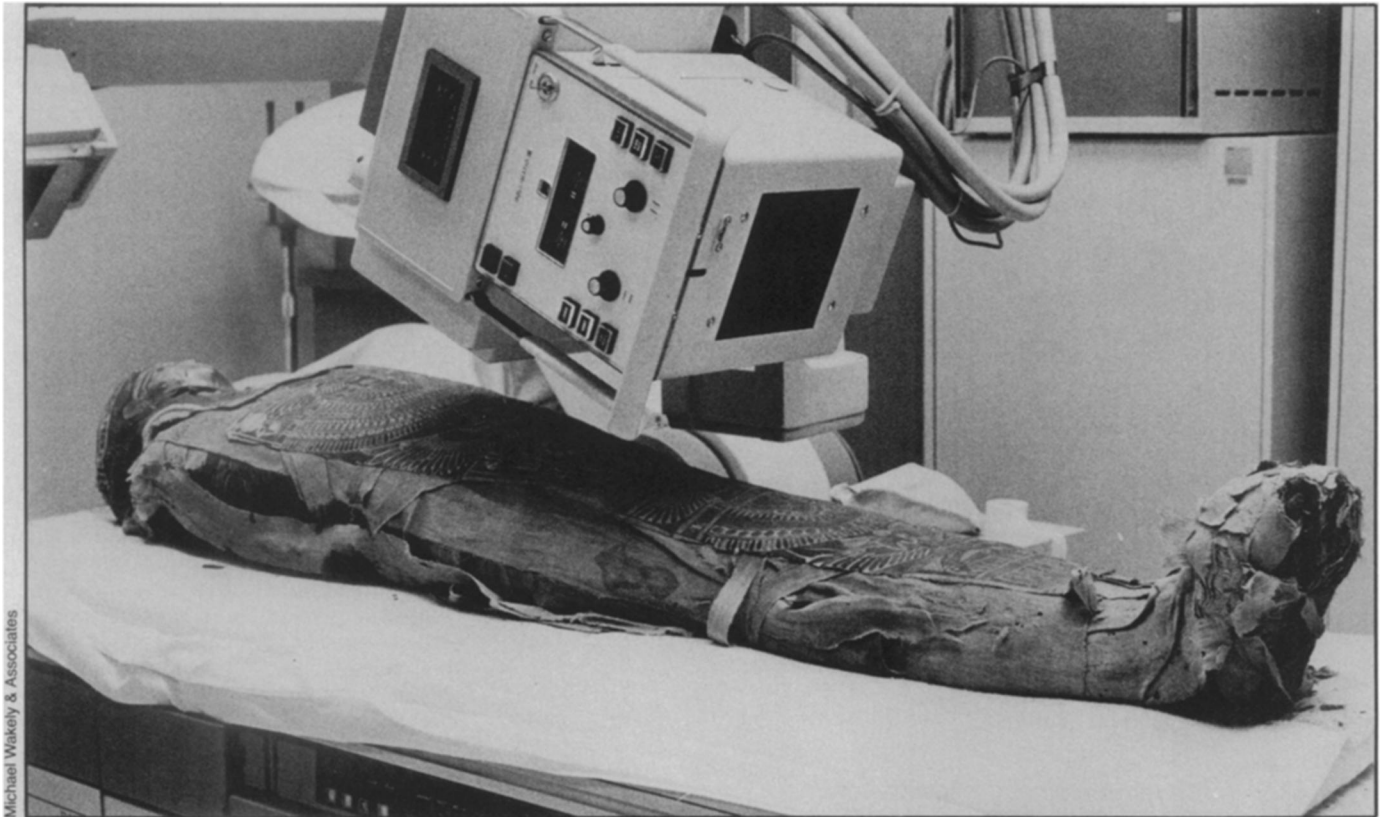
Hapi-Men, excavated in 1902 by famed



The mummy of Hapi-Men, the Priest of Horus, was found in 1902. It had been badly damaged by ancient plunderers searching for jewels.

Susan V. Lawrence is a Philadelphia-based science writer. She last wrote for SCIENCE NEWS about the Caribbean medical school controversy.

# MYSTERIES OF THE MUMMIES



*X-rays made at the Hospital of the University of Pennsylvania showed that Djed-Hapi had a slight curvature of the spine.*

Egyptologist Sir Flinders Petrie at Abydos, is thought to date from the Late Period and to have died in his forties. Looting by tomb robbers is evident on the X-rays through disarrangement of the protective amulets at his throat. Strangely, Hapi-Men was buried with a small mummified dog.

An unidentified mummy known as PUM II (because it is the second mummy acquired by the Pennsylvania University Museum) is believed to date from about 170 B.C., according to radiocarbon analysis of his linen wrappings. An autopsy of PUM II was conducted in 1973 at Wayne State University School of Medicine. For the most part, autopsying a mummy is like autopsying any other cadaver—once, that is, the many layers of wrapped linen and resin used in embalming can be chiseled through, according to Silverman.

PUM II was well-preserved, wrapped in about 12 layers of linen. He had lung disease, with patches of fibrous damage and deposits of carbon and silica. Plaque buildups on the aorta and fibrous thickening of the arteries indicated heart disease and arteriosclerosis. There was also evidence of roundworm infestation. Roundworm and other parasites can be detected in autopsied mummies because the resin used in embalming preserves the eggs and worms. Roundworm is spread through the

contamination of warm, moist soil with human feces and was prevalent near the Nile where sewage treatment was inadequate.

The ancient Egyptians also suffered from the effects of the inescapable desert sand. Silicosis, observed in PUM II and other mummies, results from the inhalation of sand and quarry dust. Anthracosis is thought to have been caused by the inhalation of carbon from wood fires and oil lamp smoke. The Egyptians had few cavities, since they did not use sugar, but sand added to grain to speed up grinding and blown by the wind into most foods wore away the teeth so severely and so rapidly that abscesses were common.

One spin-off of the medical studies has been the development of a detailed chronological history of the process of embalming as it evolved in Egypt. Fleming says that "a lot of the present concepts of how mummies were prepared are really very woolly in terms of their presentation to the populace. In particular, one has the feeling that mummies were made the same way every time, that a general recipe existed. This is entirely bogus."

Mummification actually developed as an empirical science, "groping its way from at least 2700 B.C., developing to a high point around 1000 B.C., and then going into decline," Fleming says. Periods

of political stability can be correlated with advances in embalming technique, while unrest, confusion and economic hard times caused regional variations and lapses in technique.

The earliest Egyptians simply buried their dead in the sand, where they were naturally dehydrated and preserved. However, the practice of wrapping the dead in linen and depositing them in burial shafts or roofed tombs soon developed to protect the bodies from predators and robbers. But in closed chambers decay became a problem. Early attempts to prevent it included the removal of lungs, liver, intestines and stomach—the heart was never removed. These organs were preserved separately, while the body was dehydrated with natron, a mixture of sodium carbonate and sodium bicarbonate found naturally in several parts of Egypt.

By the end of the Fifth Dynasty, about 2410 B.C., bodies were being encased in linen and plaster shells molded and painted to look lifelike. Later, embalmers began using resin obtained from what is now Lebanon for ritual purification—and preservation. The molten resin halted decay and then, on cooling, formed a sterile shell around the body.

In early times, only the royal family and highest nobility were mummified. By the time of the Middle Kingdom (about 2050

B.C. to 1780 B.C.), however, mummification became more widespread. In the Eighteenth Dynasty, between 1570 B.C. and 1293 B.C., court officials, civil servants, lower orders of the priesthood and skilled artisans were mummified. By then "the art of embalming was ... fast approaching its

peak of quality, with the important exception (among royal burials) of the mummy of Tutankhamun, which was badly burnt by the excessive use of resins," according to the comprehensive handbook *The Egyptian Mummy: Secrets and Science* prepared for the University Museum ex-

hibit by Fleming, Silverman, Bernard Fishman and David O'Connor.

In the era classified as the New Kingdom — 1570 B.C. to 1293 B.C. — embalmers began removing the brain from the skull by breaking the ethmoid bone in the nose and inserting a probe. Until the 20th Dynasty, internal organs were preserved in canopic jars decorated with images of the Four Sons of Horus. After that time, embalmers began wrapping the viscera in linen bundles and placing them back in the abdominal cavity.

Linen pads and resin-soaked bandages were used to fill out the shape of the corpse being mummified. The rites of mummification traditionally took about 70 days, with half the time spent on the initial preparation of the body and organs. After that, the body — packed with linen, sawdust and straw — was oiled and wrapped in fine linen strips. Once the body shape had been defined, hot resin was poured on and jewelry and amulets were added. The mummy was then wrapped in coarser linen shrouds and tightly bandaged.

Although embalmers did not play a high role in Egyptian society and probably implemented, rather than originated, the embalming techniques refined over so many centuries, they can be called "empirical scientists" who developed many refinements of technique through direct observation. Their surgical skills were also of a high order — and were eventually applied to a rather bizarre practice.

In the Graeco-Roman period of Egyptian civilization, as pressures on Egypt produced a "retraction, if you like, into strong local religious belief," according to Fleming, animal mummification became widespread. "Apart from the Apis bull, which was revered from fairly early times and mummified as far as we know from about 800 B.C., other animals were not treated to mummification — except perhaps for an occasional beloved pet — until this very late period." Then, pilgrims seeking to honor particular deities began purchasing mummies of the animals to which those gods were linked and donating them to the temple priests, "who incarcerated them in a general tomb. In some cases, there were hundreds of thousands of them, like votive offerings," Fleming says.

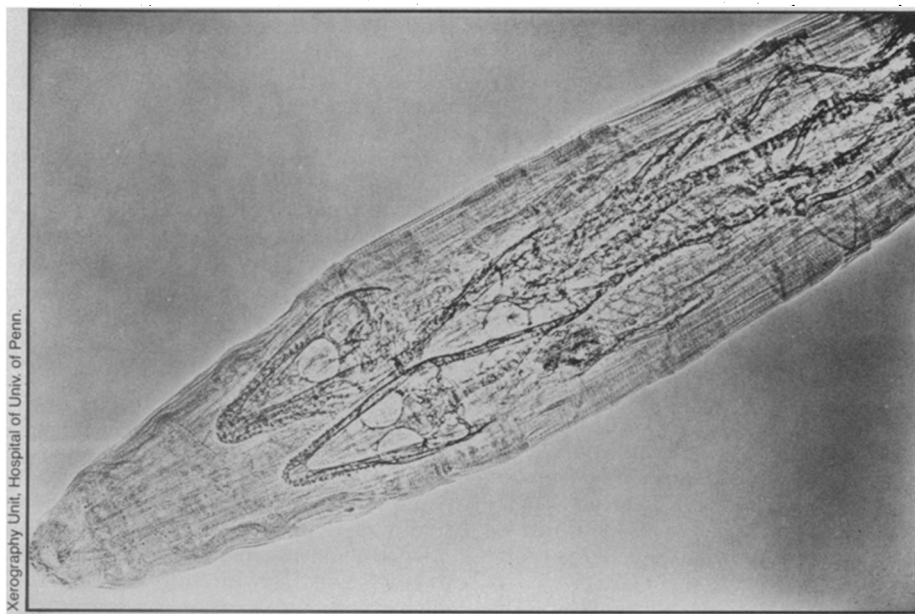
The practice became so widespread that even scarab beetles were elaborately preserved. Pools of crocodiles were raised in luxury, pampered until they died and then lavishly mummified with gold and other trappings and "as much effort as was put into the mummification of humans" — a practice, Fleming says, that was regarded as "quite bizarre by the Greeks and Romans. They fully appreciated Egyptian architecture and other aspects of Egyptian culture, but they found this deification of animals tasteless."

Tasteless, perhaps, but fascinating to those today who are piecing together the complexities of ancient Egyptian life from the artifacts that still remain. □



Cats were commercially bred and killed so they could be mummified and then offered to Bastet, the cat goddess.

Manchester Museum, Manchester, England



Xerography Unit, Hospital of Univ. of Penn.

X-rays revealed three baby crocodiles mummified in a crocodile-shaped case.