Mummification: How did the Egyptians Perfect Their Techniques?

How did the ancient Egyptians perfect their sophisticated mummification techniques? Before preserving flesh, they may have practiced for centuries on skeletons.

Herodotus, on the egyptian art of mummification: "First they draw out the brains through the nostrils with an iron hook. . . . With a sharp Ethiopian stone they make an incision in the side, and take out all the bowels . . . having filled the belly with pure myrrh pounded, and cassia, and other perfumes, frankincense excepted, they sew it up again; and when they have done this, they steep it in natron, leaving it under for seventy days. . . . At the expiration of the seventy days they wash the corpse, and wrap the whole body in bandages of flaxen cloth, smearing it with gum."

The process Herodotus describes-salting the body with natron and embalming it with resins-was thought to have reached its peak around 1200 b.c., during the era known as the New Kingdom, to which the best-preserved mummies date. But how did the practice begin? Now a detailed chemical analysis of a 4,150-year-old skeleton from Egypt's Old Kingdom is providing clues to the origin of ancient Egyptian embalming techniques.

The new study shows that before the ancient Egyptians perfected the art of mummifying flesh, they apparently learned to preserve skeletons, which will crumble and decay if not treated. An example of their early handiwork is the mummified skeleton of Idu II, who lived around 2150 b.c. Idu II was, an inscription on his coffin informs us, the chairman of the pinewood trade office-an apparently powerful position in a country that imported all its timber. His skeleton was found at Giza in 1914.

Soon after its discovery, the skeleton was brought to the Pelizaeus Museum in Hildesheim, Germany. There Idu II remains, immersed in paraffin, with only scraps of flesh clinging to his bones, and now missing a few flecks of bone removed by Ulrich Weser, a biochemist at the University of Tübingen. Until Weser's study, no one knew whether Idu II's remains had been embalmed or just preserved naturally by Egypt's dry climate.

A preliminary chemical analysis of his bones provided some early hints. The bones' sodium content, for example, was 12 times higher than that of ordinary bone, suggesting that whoever prepared his body for the grave first stripped the flesh from the skeleton and then applied natron directly to the bones to dry them. The fact that the embalmers went to the trouble of removing the flesh suggests that some earlier experiments in embalming the whole body had gone awry. "They probably had the experience that the flesh had decayed," says Weser. "So they thought it's just better to embalm the bones."

Next, Weser analyzed a liquefied bone sample and found an abundance of antiseptic organic compounds common to wood tars. These substances are known to destroy the bacteria and fungi that decompose dead bodies and bones. The most highly concentrated

were chemicals that form when pinewood is smoldered in air. This means, says Weser, that Idu II's body may have been preserved somewhat like a smoked ham.

"If you preserve ham, first you put it in a concentrated salt solution and keep it there for weeks. Then you dry it, and you make a fire. You take, for instance, juniper wood and pinewood, and you hang your ham in the smoke," says Weser. "And then the wood-tar components condense on the surface of the ham. Then you don't have any bacterial infection or mold growing on the surface." Idu II's skeleton, Weser says, was probably never hung up and smoked. Instead the wood tar may have been produced separately and pasted directly onto the natron-covered bones.

The mummification of Idu II's skeleton was so perfect, in fact, that it enabled an enzyme called alkaline phosphatase-which produces the phosphate needed to build up the bone mineral apatite-to remain intact and active for more than four millennia. Weser was able to extract the enzyme from a ground-up scrap of Idu II's collarbone.

Weser's study suggests that it may be time to rewrite the history of Egyptian mummification. "According to specialists dealing with mummies of the Old Kingdom, this embalming process was considered to be in a more or less experimental state," says Weser. But the remarkable condition of Idu II's skeleton shows that at least some of the practices described by Herodotus were well established very early in Egypt's history.