

The general and probably all services to the king encompassing title of *jrj-jht-njswt* was superseded during the Fifth Dynasty by the more specialized and explicit titles referring directly to the function and responsibility of the officials employed at court. During the latter half of the Fifth and during the Sixth Dynasty, the title of *jrj-jht-njswt* recurs in connection with the funeral services for the king in the mortuary temples. In this instance, the true nature of the title can be ascertained by the associated priestly titles, among others with that of *hntj-š*. In this specific context the holders of the “property custodian of the king” title probably execute a purely symbolic duty in connection with the funeral services for the deceased king¹⁰⁵.

SUMMARY

This article analyses the title “property custodian of the king” during the Old Kingdom. In order to determine the meaning of the title as precisely as possible during the period under discussion, the associate titles born by the royal entourage at court are discussed first. The title occurs during two different periods. During the first stage, down to the end of the Fourth Dynasty, it was associated with high ranking officials at the royal court. Later on, however, during the second stage in the Fifth and Sixth Dynasties, the title is connected with lower ranking officials employed in the funerary temples of the kings. It is suggested that this shift in the title’s connotation was due to its inner coherency, i.e., the concept of caring for the king, during the first stage for the king himself, while during the latter stage for his soul.

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Surgical Procedures during ancient Egyptian Mummification

The ancient Egyptians practiced artificial mummification for more than two thousand years, but they have left us no description of the surgical procedures undertaken during embalming. The closest we have are the few papyri that describe what happened to the mummy after the surgical procedures.

The Rhind Papyri, discovered in 1856 by Alexander Rhind, a Scottish lawyer, describe many details of mummification³. The two Rhind Papyri were discovered in an intact tomb of the Roman Period. The first papyrus was prepared for Montu-Sehef who lived in Hermonthis and died at the age of 59 in 9 BC during the twenty-first year of the reign of the Emperor Augustus. Written in both hieratic and demotic, it provides many interesting details of mummification.

The papyrus specifies the exact dates on which various rituals of mummification took place. We learn that the mummy was bathed in the “Pool of Khonsu”, the legs, arms, torso and back were at rest for thirty days in the “Place of Cleansing”. The papyrus states that during the first thirty-six days of mummification eight ceremonies were performed, followed by an additional ninth until the seventieth day when the mummy was finally placed in its tomb. Considering all the ceremonies described in the papyrus it is surprising that there is no mention of the surgical procedures – the removal of the brain and evisceration – performed at the time of mummification.

¹⁰⁵ See also Posener-Krieger, Neferirkare I, 317–319.

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³ S. Birch, Facsimiles of Two Papyri Found in a Tomb at Thebes, London 1863.

The second papyrus in the tomb was for Taami, the wife of Montu-Sehef, who was the owner of the first papyrus. Taami's papyrus, also written in hieratic and demotic, suggests that she had little time to mourn for her husband. She died forty-eight days after him. In this papyrus, we are provided with details of the mummification procedures, but there is again no mention of the surgical procedures that were used.

The only other two papyri that tell us anything about mummification are called "The Ritual of Embalming". One version is in the Egyptian Museum in Cairo, the other in the Louvre in Paris⁴. The Cairo text was discovered in 1857 in a tomb at Thebes belonging to a man named Heter who bore the titles "Divine Father", "Prophet of Amun", and "Chief of the Priests of Sekhmet". The papyrus describes the bandaging of a mummy, including the order in which the limbs are to be wrapped, and the rituals performed. It is difficult to understand the purpose of this papyrus. It is not like the "Book of Dead", which has spells to assist the deceased's resurrection in the next world. Rather, it describes a procedure that had already taken place by the time the mummy had been placed in the tomb. It certainly wasn't intended as an embalmer's reference since it was written to be sold to the family of the deceased and to be placed in his coffin. It is, in fact, an ancient form letter. The papyrus, written in a fine professional hieratic hand dating from the Roman period, left blank the places where the deceased's name would occur, and were later filled in by the deceased's family in a crude hand. Perhaps the papyrus was intended to insure that proper rituals accompanied the mummy, in case the actual rituals and bandaging were not performed correctly.

The Louvre Papyrus also gives details of mummification, stipulating that the embalming was to begin four days after death. This allowed time for the deceased to remain at home for a period of mourning and to allow his family and friends to organize the procession to ferry the body across to the west bank of the Nile for burial. The bandaging took place forty-six days after death, so there were forty-two days to perform various pre-bandaging procedures and rituals. The papyrus describes how frankincense oil was used in the mummification, the anointing of the body with fats, and instructs how to use "thick oil" (resin) to adhere the bandages to the mummy. In spite of these details the surgical procedures used in mummification are not mentioned. Why?

There are two reasons that come to mind. First, there was a prohibition against defiling a human body. Making an incision in the abdomen was, paradoxically, both necessary and ritually prohibited. Thus Diodorus Siculus in his famous description of mummification says:

"... the one called the slitter cuts the flesh, as law commands, with an Ethiopian stone and at once takes to flight on the run, while those present set out after him, pelting him with stones, heaping curses on him, and trying, as it were, to turn profanation on his head; for in their eyes everyone is an object of general hatred who applies violence to the body of the same tribe or wounds him or, in general does him any harm."⁵

Obviously the stoning of the slitter was not intended to cause injury. It was a ritual that had to be directed against those who damaged a human body, even when it was necessary for mummification. Thus perhaps the opening of a human body and removal of the internal organs was too profane to be written down.

There is a second, and far more mundane reason why the surgical procedures in mummification were not written. It was a trade secret. The Hawara Papyri⁶ frequently called the "Embalmer's Archive" reveal that the art of mummification was practiced by families whose trade was the caring for the dead. The "Archive" provides specific titles for members of the profession and makes a distinction between those who perform actual mummification as opposed to those

⁴ S. Sauneron, *Rituel de l'embaumement*: Pap. Boulaq III, Pap Louvre 5, 158, Cairo 1952.

⁵ Diodorus Siculus, *Library of History*, Book I, 91.

⁶ F. A. I. Reymond, *Catalogue of Demotic Papyri in the Ashmolean Museum*, Oxford 1973.

who merely carried out funerary rituals. The "Archive" even includes an oath taken by the different families of embalmers to specify the territory each controlled. Like the "Ritual of Embalming" papyri discussed earlier, the "Archive" makes no mention of surgical procedures. The process may well have been a secret, handed down from father to son.

Although there is no written record of how to mummify a human, there is a papyrus dealing with how to prepare an Apis bull. The only papyrus that describes surgical procedures in mummification is the "Apis Papyrus"⁷. In this papyrus there is a detailed description of how the Apis bull was embalmed including the removal of the internal organs. There may be a simple explanation to why there is no written record of how to mummify a human, but there is a papyrus detailing how to prepare an Apis bull. Human mummification was a continuous industry; someone could always be found to pass on the skill to an apprentice. The mummification of the Apis bull on the other hand was not an ongoing industry. There was only one Apis alive at any one time. Since a bull can live more than thirty years, it was possible that the last person who mummified an Apis had died by the time it was necessary to repeat the process on the next Apis. Thus the procedure had to be preserved in writing.

The first description of the surgical aspects of human mummification comes from the Greek, Herodotus⁸. It is doubtful that he would have been permitted to witness a mummification, and also he is extremely brief in his description of the surgical procedures:

"... They first draw out part of the brain through the nostrils with an iron hook, and inject certain drugs into the rest. Then, making a cut near the flank with a sharp knife of Ethiopian stone, they take out all the intestines, and clean the belly, rinsing it with palm wine and bruising spice; and presently, filling the belly with pure ground myrrh and cassia and any other spices, save only frankincense ..."

Herodotus has described the two essential surgical procedures, the removal of the brain and evisceration. Let us examine each in some detail.

Herodotus says an iron hook was used, which may be the case. It is well established that iron was in use in Egypt at the time of Herodotus' visit⁹, so he certainly could be right on this. The hook, he says, is used to "draw out" part of the brain. This is an important detail as we will show later. It suggests that gravity assists the process. He also mentions that not all of the brain was removed this way; drugs were somehow injected.

With regard to evisceration, he is equally brief. All we are told is that via an incision in the flank, "all the intestines" were removed. Autopsies on mummies have shown this to be basically true, so again, Herodotus seems pretty accurate, as far as he goes. More details, however, are supplied by Diodorus Siculus who visited Egypt four centuries after Herodotus. Diodorus says that the slitter made the incision on the left side and then:

"when they have gathered to treat the body after it has been slit open, one of them thrusts his hand through the opening in the corpse into the trunk and extracts everything but the kidneys and heart ..."¹⁰

We know from examination of mummies that Diodorus is correct about the incision being on the left side. The advantage is that there is better access to the descending colon from the left side. When Diodorus mentions that the heart and kidneys were left in situ he is again correct, though sometimes the kidneys were removed. After Diodorus, the records about the surgical procedures in mummification are silent for two thousand years.

⁷ W. Spiegelberg, Ein Bruchstück des Bestattungsrituals der Apisstiere, ZÄS 56 (1920) 1–33.

⁸ Herodotus, Histories, Book II 86–89.

⁹ A. Lucas, Ancient Egyptian Materials and Industries, London 1989⁽⁹⁾, 237–240; G. A. Wainwright, Iron in Egypt, JEA 18 (1932), 3–15.

¹⁰ Diodorus Siculus, Library of History, Book I, 91.

During this century the discussion is picked up again but usually focuses on how the brain was removed. In 1911, Karl Sudhoff published a pioneering study on Egyptian Embalming Instruments¹¹. As the title suggests, the paper is concerned primarily with tools used by embalmers, and in an almost casual manner, Sudhoff mentions that he removed the brains of human cadavers in the ancient Egyptian manner:

„Ging man nun in den Schädel ein, zerriß das Tentorium und alle sich entgegenstellenden festen Membranteile im Schädelinnern unter Einhaken der Hakenspitzen oder unter Stoßen mit der gewölbten Stumpfseite des Hakens, rührte das leicht mazerierte Gehirn um und legte die Leiche dann auf den Bauch, so lief unter leichtem Nachhelfen mit dem Haken oder seinem Stielende in 15–20 Minuten das Gehirn so gut wie völlig aus, wie wir (der findige Anatomiediener HAGEDORN und ich) uns nachträglich bei der Eröffnung der Schädelhöhlen in einer Reihe von Fällen überzeugen konnten.“¹²

There is only one article written specifically on the removal of the brain¹³, and it has some unusual features. Leek attempted to determine how ancient embalmers removed the brain by using a stainless steel probe, surgical hammer and chisel in his attempt to remove the brain from two sheep. The anatomy of a sheep (*Ovis Domestica*) is, of course, quite different from that of a human, and steel tools differ from those available to the ancient embalmers, but still there is something to be learned from his attempt. Leek describes placing his long probe through the sheep's nasal passage and into the cranial vault. When the tool was withdrawn it “held a covering of brain tissue which was glutinous and viscid in character. Although this covering was thin, it would have been only a question of time before most of the brain was removed by repeated insertions and withdrawals of the instruments.”¹⁴

From Leek's account, it is clear that he never, in fact, removed the brain. After a few trial probes he concluded that brain could have been removed because “its viscid consistency caused it to adhere to the instrument.” He began the process but never completed it. As we will discuss below, we do not believe the process is adequate for brain removal.

Leek, however, mentions a second variation in which he suggests the head is turned face downwards so the brain could drain out. Again, he never did it. “Had the process been continued and the head turned face downwards, much or all of the tissue would eventually have drained away.”¹⁵

We do not suggest that Leek's observations are without value, we merely wish to point out that he did not actually remove a brain by the techniques he describes. In appendix II to Leek's article, Mark Lister Patterson describes how he actually removed the brain of humans in an attempt to replicate ancient Egyptian methods.

The description is frustratingly brief, two short paragraphs to describe the three different methods used. Patterson does not say if the three methods were used on one cadaver, or if several cadavers were used. He does mention that in one method the rod was rotated to break down the brain tissue and the skull positioned so the brain would drain out. In another method the brain was aspirated through the wide-bore catheter with a piston-type syringe, but it is unlikely that the ancient embalmers had such apparatuses. In the third method the brain was evacuated by irrigating the interior of the skull with water, flushing the tissue out.

With the work of Sudhoff, Leek and Patterson as background, we began our attempt at a complete mummification in the ancient Egyptian manner. Prior to beginning work on our mummy candidate, we performed trials in order to plan and observe our intended approach –

¹¹ K. Sudhoff, *Ägyptische Mumienmacher-Instrumente*, *Archiv für Geschichte der Medizin* 5 (1911), 161–171.

¹² *Ibid.*, 165–6.

¹³ F. Filce Leek, *The Problem of Brain Removal During Embalming by the Ancient Egyptians*, *JEA* 55 (1969), 112–116.

¹⁴ *Ibid.*, 113.

¹⁵ *Ibid.*, 113.



Fig. 1. X-ray of bronze rod inserted in nasal cavity to break ethmoid bone

bilaterally through the sinus, penetrating the ethmoid plate that would allow us access into the cranial vault and ultimately remove the brain.

In the first trial, we had a human head specimen with calvaria exposed and the brain removed as in a routine autopsy. From that vantage point we could observe the insertion of the straight bronze rod as it entered along the vomer, tapping it through the ethmoid on both sides of the nasal cavity until it penetrated the skull base. This permitted us to judge the correct angle and see the location of the rod in relationship to the brain.

In our next attempt, we repeated this procedure on a second human head specimen in which the brain and calvaria were left intact (Fig. 1). As before, the bronze rod was inserted into the left nasal cavity reaching the inferior ethmoid bone. With a hand held wooden block, the rod was then tapped until it fractured the thin plate and entered the cranial vault. We repeated this procedure on the right side, also entering the skull base. At this point several X-rays were taken to verify the angle and location at which the rod entered the brain. Using a long bronze wire tool with a hooked end, we attempted to extract the brain, by hooking the tissue in a manner similar to Leek's first procedure. This was found ineffective. Small pieces of the meninges were removed as the dura mater tore, but very little else adhered to the hook when it was removed. We repeatedly inserted the hook, but soon we became convinced that the brain could not be removed in this manner.

Our final trial was on another intact specimen. Following the same procedures as before, we reached the brain from the nasal sinus area, but this time we attempted to flush the brain out by infusing the cranium with water using the positive pressure of a hydroaspirator. This, too, was unsuccessful. The water and pressure exerted by the force distended the soft tissue around the orbital area of the face. No brain tissue came out. We were now convinced that irrigation with water was not the key to the removal of the brain, but rather that maceration as described by Sudhoff was the crucial element.

On May 24, 1994 we attempted both the removal of the brain and the evisceration of the body cavities in the manner we feel was most like that performed by the ancient Egyptian embalmers. The first step was the brain evacuation.

Brain Evacuation

The descendent body was placed on its back with the cervical spine extended. Using the nasal septum and vomer bone as anatomical guides, the bronze instrument was inserted with the sharpened chisel end forward into the right nasal passage until the ethmoid bone was reached. We used a hand-held wooden block to tap the instrument through the bone structure. The resulting hole permitted the instrument to enter the cranial vault at the olfactory tract. The instrument was extended to its greatest depth when it went through the brain and reached the posterior sutures that communicate the parietal bones. The same procedure was repeated on the left side so that now there were two relatively small holes reaching into the right and left hemispheres. Using the hooked end of our instrument the bony spine between them was fractured and removed to enlarge the hole at the skull base. This would permit easier evacuation of the tissue and fluids *en masse*, brain, dura mater, etc.

As in Sudhoff's description, the removal of the brain required the destruction of the membranes and the liquefaction of the soft tissue to permit easy drainage through the passage created from the skull base and out the nasal cavity. To macerate the brain, we used a bronze wire, very much like a coat hanger with one end coiled so it would be just smaller than the opening made in the cranial floor of the skull.

The wire was inserted through the right nasal passage and into the cranial vault. With the coiled end extended into the right hemisphere of the brain, the wire was rotated for approximately twenty minutes to reduce the brain tissue to a semi-liquid state. Periodic removal of the wire brought out residue of dura and aerated brain tissue. Removal of larger pieces of dura mater or tissue was attempted but without success due to tearing and maceration. The thick and tough dura mater was reduced to thin strands. We then repeated the same procedures to the left hemisphere of the brain.

The brain cavity was irrigated and filled to capacity with water using a hollow reed connected to a leather bladder type flask. This method used only the force of gravity pressure and thus the force did not distend the soft outlying tissues of the face. The body was repositioned so that it was lying on its abdomen. The head was placed on a downward slope to enhance drainage from the frontal lobe of the brain cavity, through the openings created and out the nasal passages. Inserting the wire with its coiled end permitted the initial and easy removal of a significant amount of brain and dura mater tissue to escape. The body was left in that position for approximately one hour and a half to allow for thorough drainage. The basin used to collect the drainage was substantially filled, and further probing with the head in position did not produce additional discharge of fluid or tissue. We, therefore, concluded that most of the loose brain tissue and debris had been evacuated.

Although no more of the soft tissue was running out, we wanted to be sure that we had completely evacuated the cranium, a problem that ancient Egyptian embalmers also faced. We repositioned the cadaver on its back and using the wire tool, forced several strips of linen that were one inch wide and two feet long through the nasal passage and into the cranium. Using the wire tool and linen strips, we swabbed the cranial area and then removed the strips. At first the linen came out covered with soft tissue and blood, but after several repetitions they came out clean and we then were confident that all the brain had been removed. This was a procedure that the ancient embalmers could have followed and we now believe that it almost certainly was.

Evisceration

As mentioned above, there is no ancient text that details the removal of the internal organs at the time of mummification and there are many unanswered questions about this procedure. For example, we do not know the order in which the organs were removed, nor why sometimes the kidneys were left in place but in some mummies they were removed.

It is often assumed that because the ancient Egyptians practiced mummification they were knowledgeable in anatomy, but this is not necessarily true. We must remember that embalmers worked through a small abdominal incision, unable to see the organs as they dissected them. This is literally like performing surgery in the dark. There is no specific word in Middle Egyptian for "kidney"¹⁶ and it is even possible that some embalmers were unaware that there were kidneys. Also, to anyone with even a rudimentary knowledge of anatomy, it seems strange that there were only four canopic jars because there are far more internal organs. It has been pointed out¹⁷ that the hieroglyphic determinatives, of both internal and external organs are of animals, not humans. This suggests that ancient Egyptian physicians were more familiar with animal anatomy than with human anatomy. As far as we know, the ancient Egyptians did not practice dissection until Ptolemaic times and this certainly supports the theory that the ancient Egyptians were not so skilled in anatomy as their patients would have liked. To answer some of the questions left unanswered by the ancient embalmers, we attempted to replicate the procedures used.

Using an obsidian stone flake blade, an incision, approximately 2 1/2 inches long was made two inches to the left of the umbilicus following a sagittal and hypochondriac plane. The incision was deepened into the anterior abdominal wall at the superior level of the tendinous intersection of the rectus abdominis muscle, through the anterior layer of the rectus sheath and the transverse abdominis and below the deep fascia, exposing the peritoneum cavity.

To right hand of the prosector was placed inside and moved throughout the cavity to rule out connective tissue adhesions and to insure the integrity of the visceral lining and freedom within the abdominal cavity. With the right hand still inside the cavity, the diaphragm and the inferior portion of the esophagus were located. The hand followed the path along the gastric fundus, tracing the body of the stomach to the pylorus. The superior aspect of the duodenum was ligated and an incision was made above the ligature using a small curved bronze knife, freeing the upper portion of the intestinal tract. The stomach remained in place for separate removal.

To remove the intestinal track with minimal waste discharge, several ligatures were applied both superior and inferior to the tenicili, transverse colon, and small bowel prior to removal. The upper most portion of the intestinal tract, including the omentum and pancreas were removed from the body and placed on a tray for rinsing and treatment with natron. With the upper portion of the intestinal tract removed, the next organ removed was the spleen. The gastric and epiploic vessels near the gastro-splenic and splenorenal ligament were incised and the spleen removed.

The kidneys were removed next. The kidneys in normal anatomical position are somewhat isolated, anterior to the diaphragm, transversus abdominis aponeurosis, quadratus lumborum and psoas muscles. Using a curved small bronze knife, an incision was made through the lateral border of the fibromuscular capsule, exposing the left kidney, its major vessels and ureter from the hilus. The blood vessels and ureter were excised and the kidney removed from the capsule. The same procedure was followed for the right kidney. With the kidneys removed, the next step was the removal of the digestive tract at mid level that remained in the greater sac of the peritoneum at the level of the pelvic floor.

The ligatures made to the teni coli, transverse colon and small bowel prior to the removal of the upper portion of the intestinal tract were located and retracted. The remaining ligaments (folds) that attach between organs and the peritoneum body wall were severed. At the level of the pelvic floor, incisions were made to free and release remaining visceral contents of the greater sac at the superior aspect of the rectum. These organs were removed, rinsed and placed in natron.

¹⁶ K. Weeks, *The Anatomical Knowledge of the Ancient Egyptian and the Representation of the Human Figure in Egyptian Art*, U.M.I. Dissertation Information Service, Ann Arbor 1970, 72; J. H. Walker, *Studies in Ancient Egyptian Anatomical Terminology*, Warminster 1996, 278.

¹⁷ A. H. Gordon, *Orgins of Ancient Egyptian Medicine*, KMT, Summer 1990, 26–29.

The contents of the perineal region and rectum remained for separate removal. A deep incision was made anteriorly encircling the peritoneum and the pelvic floor and extending posterior and deep to the anal canal. The visceral pelvic fascia was only slightly membranous, with moderate fat and areolar. The bladder was reflected to incise attachments and structures within the perineal region (i.e. the puboprostatic ligament, membranous urethra), and the rectum was excised from the ani internus.

At this point we were ready to remove the stomach. It had been located earlier when the superior aspect of the duodenum had been ligated to remove the upper portion of the peritoneal sac. Now the ligature made previously, superior to the duodenum and inferior to the pyloric sphincter, was retracted and the stomach incised free at the esophagogastric junction, left on the midline and below the diaphragm. Once removed the stomach was rinsed and placed in natron.

The last organ in the abdominal cavity to be removed was the liver. It is by far the largest organ and occupies an extensive area in the right side of the abdominal cavity. We were not sure if it could be removed in one piece through the 2 1/2-inch abdominal incision we had made. To remove the liver, the triangular ligaments were cut that connect the liver to the diaphragm. Once the ligaments were free, the hepatic vessels were incised. At first we attempted to push the liver out from the cavity with one hand, but it could not fit through the small incision. Then we attempted to manipulate the liver with both hands on the outside of the abdominal cavity, but still it would not go through the opening. Finally the incision was lengthened by one-half inch and with much manipulation, the liver finally was removed intact. The liver was delivered through the incision a lobe at a time. One lobe following the next out, much like delivering a newborn baby at term.

Thoracic Cavity

The diaphragm, the most important muscle of respiration, separates the abdominal cavity from the thorax. The diaphragm is divided into three parts: sternal, lumbar, and costal (rib). We wished to remove the lungs while leaving the heart and its great vessels intact, so incisions were made approximately two inches along the right and left lateral costal borders, leaving the sternal and lumbar attachments intact.

With one hand inserted through the diaphragm along the left costal side, the existing attachments to the left lung and the pulmonary and bronchial inlets were identified. Using the right index and middle finger as guides with the knife between them, the pulmonary vessels and bronchial branches were cut and freed. The lung was now manipulated against the pleura and rib cage to remove air within the alveolar spaces decreasing the lung mass, and was removed from the body. The same procedure was used for the removal of the right lung from the right lateral costal border of the diaphragm. The heart was left fully intact within the pericardial sac with its great vessels in place, just as ancient Egyptian mummification required.

Observations

With regard to brain removal, we are quite certain that it was not removed with the body supine on the embalmer's table as had been suggested. Our experience indicates that an organ as fluid as the brain could not have been lifted out piece-meal with the hooked instrument. Almost certainly the brain was broken down into a semi-liquid state and then, assisted by gravity, it was evacuated through the nasal passage when the cadaver was positioned with the head downward. X-rays of several mummies attest to the fact that bodies in the embalmers shops were subject to such positioning. Often two hardened resin levels in one cranium show that resin was introduced, allowed to harden, and then the body repositioned and resin introduced again, producing a second fluid level.

Our experimental removal of the internal organs establishes at least a reasonable order in which the organs could have been removed. Some organs, such as the kidneys hidden behind the peritoneum, could indeed have been unnoticed or easily overlooked by the embalmers.

To hold the internal organs we created replicas of fairly large canopic jars with wide openings¹⁸. When it came time to place the liver in its jar, it would not fit, so we sectioned it. We suspect this is precisely what the ancient embalmers did. On display in the Metropolitan Museum of Art in New York is half of a liver, perhaps the result of the same problem that we had. One wonders what was done in the many cases when the volume of organs exceeded the capacity of the canopic containers. For example, if one looks at the four canopic coffinettes in which the organs of Tutankhamen were placed, it is evident that they could not possibly hold all the organs. The contents of these containers has never been properly studied and indeed, a careful study of the contents of canopic jars in general could provide interesting insights into the world of the ancient Egyptian embalmer.

Although we feel reasonably certain that we recreated the actual surgical procedures used by Egyptian embalmers, we do not mean to suggest that everything is now known about the ancient art of mummification. If our project encourages others to repeat and improve on our work, and fill in other missing pieces, we will feel our efforts have been worthwhile.

SUMMARY

In a previous article¹⁹ the authors described their experimental mummification of a human cadaver in an attempt to understand how ancient Egyptian embalmers used natron. In this report the authors describe the probable surgical techniques (removal of the brain and evisceration) employed in ancient Egyptian mummification. There are no papyri discussing surgical techniques during mummification, and the reasons for this absence are discussed.

After surveying the modern research on the removal of the brain, the authors conclude that it could not have been removed as has been suggested in the literature. The authors' attempts at brain removal with human cadavers are described and the most probable method used by ancient embalmers is suggested. The details of ancient Egyptian evisceration at the time of mummification are also reconstructed based on the modern mummification of a human cadaver.

LEO DEPUYDT

Condition and Premise in Egyptian and Elsewhere and the Laws of Thought in Expanded Boolean Algebra

To the memory of William Dwight Whitney

Lest the title of this article in a humanities journal send the reader scurrying for cover, I wish to stress at the outset that what follows is not an exercise in mathematical logic but an examination of every day speech in ancient Egypt. If the minimal algebraic notations cause apprehension, it should be emphasized that hardly any prior knowledge of algebra is required. This article is designed to be self-sufficient. I can otherwise see no other way of explaining the never explained distinction between condition and premise as an undeniable empirical fact of Egyptian and other languages than by reducing the distinction to its true origin, the nature of thought and reasoning.

¹⁸ We would like to thank Evan Rosenthal of the Ceramics Department of the C. W. Post Campus of Long Island University for making the canopic jars.

¹⁹ B. Brier and R. S. Wade, *The Use of Natron in Human Mummification: A Modern Experiment*, ZÄS 124 (1997), 89–100.