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The myth of eternal preservation: patterns of damage in Egyptian mummies

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THE MYTH OF ETERNAL PRESERVATION: PATTERNS OF DAMAGE IN EGYPTIAN MUMMIES

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ABSTRACT

Mummification can preserve a body for several millennia, but it is a popular misconception that these bodies are in pristine condition. The activities of tomb robbers, archaeological excavation and transportation, and the embalming process itself may damage the body. This thesis examines published reports on Egyptian mummies from museums in the United States, Europe, and Egypt for the presence of osteological fractures, dislocations and other related damage. These reports include biographical information and the results of investigations made by one or more of the following techniques: unwrapping, autopsying, x-raying, and CT-scanning.

Data on 275 Egyptian mummies were collected and examined for patterns in the type and location of postmortem damage. These patterns were subsequently compared with the historic periods, geographical regions, social class and the presence or absence of coffins, cartonnage, amulets, and antemortem pathologies. The results do show relationships between the cause of the postmortem damage and the geographic locations, historic periods, and social class. Conversely, no relationship is observed between the postmortem damage and antemortem pathologies, amulets, and protective casings. These results offer insight into the mummification process and the activities of the tomb robbers through the postmortem damage the mummies incurred.

CHAPTER 1: INTRODUCTION

Mummification is the process of preservation of a body after death generally by the rapid removal of water from the tissues. A mummy can be either natural or artificial, but it must have its soft tissue preserved. While mummified remains can be found on all inhabited continents, Egypt is the source of the 'original' mummies and perhaps the most famous ones. "The word 'mummy' will always connote Egypt and an Egyptian invention, in spite of the fact that in the land where it originated mummification is now unknown" (Smith 1912:17).

The study of physical anthropology within Egyptology has seen a change in what analyses are deemed important. The first scholarly publication on mummies was *History of Egyptian Mummies* by Thomas Joseph in 1834 (Seipel 1996:41). Early reports (Budge 1894; Smith 1912; Smith and Dawson 1924) usually focused on the Royal mummies, particularly their anatomy and the mummification process, or their funerary objects. Research in paleodemography, morphology and metrics, and serology have now given way to studies on taphonomy, genetics and molecular biology, trace elements, and paleopathology (Rösling 1993:194). Recent studies are also interested in both the kings as well as the commoners, but the studies still focus on the level of the individual and avoid making conclusions regarding the mummies as a collection.

Dzierzydray-Rogalski (1986:91) estimated that if everyone in Egypt had been mummified in the two thousand years when mummification was practiced, over fifty million mummies would have been produced. Not everyone in Egypt would have been mummified, but even if only one percent of the population had been, over 500,000 mummies should exist. To date, I have been able to account for less than 1,000 complete

mummies, although there are countless fragmented remains. Moreover, the remaining mummies are often in poor condition. Many mummies show signs of deterioration or damage due to natural processes, the disruption of their burial, or robbers. Indeed, much of the damage to the Royal mummies has been attributed to the activities of tomb robbers: "not time but the extensive grave robberies in all periods of ancient Egypt caused the greatest damage to the mummified remains of the kings and queens" (Harris and Weeks 1973: 28). This thesis seeks to expand upon this statement by examining the postmortem damage to mummies to determine if patterns exist.

The presence of damage is examined for cause, specifically, from embalming and plundering. Other considerations include geographic locations, the Dynasty in which the mummy lived, and the social position of the individual mummified. Furthermore, coffins and cartonnage may provide protection to the body, while antemortem pathologies may weaken the body making it more susceptible to damage; these conditions are also examined. Finally, amulets are not expected to be found as frequently among the damaged and plundered mummies as in the mummies without damage, as the amulets were the impetus for the plundering. An understanding of the damage processes and their frequencies may be useful in understanding the Egyptian culture, both ancient and modern, as well as assist in the future preservation of the mummies.

CHAPTER 2: LITERATURE REVIEW

2.1 A Brief History of Mummification

The etymology of mummy stems from the Persian word *mummia,* which can be translated as bitumen, or pitch. Travelers in the Middle Ages saw some of the embalmed bodies, which appeared dark, and they assumed that the bodies had been preserved by bitumen. In the seventeenth century, it was determined through scientific studies, as well as improved translations of historic documents, that bitumen was not the preservative (Brier 1998a:112). By this time, the word mummy was synonymous with the preserved body, and the terminology not only endures today but also has spread to include any desiccated body.

Mummification during the Predynastic Period in Egypt was a natural process, the result of the body being buried in shallow graves wrapped only in linen sheets, reed mats, or animal skins (Harris and Weeks 1973:75; Reid 2001:114). (A Chronology of Ancient Egypt is presented in Figure 1). The hot, dry sand desiccated the bodies preserving the soft tissue. When Egyptians realized that the bodies were being preserved, their ideas regarding the afterlife and the necessity of preservation changed (Peck 1980:13; Smith 1912:23 – 24). The individual's spirit was thought to be dependent on the body even after death as the afterlife was accessed by recognition of the body by the gods, the person's actions in life, and the magic, amulets and funerary equipment he took with him. Thus, the decedent needed to be preserved both in tissue and in appearance (Peck 1980:11).

The wealthy Egyptians and the kings were placed in tombs resembling their palaces and were accompanied by personal belongings and offerings for use in the afterlife (Peck 1980:14). The poor, however, still had to bury their dead in the sand

(Hamilton-Paterson and Andrews 1978:35). As the Egyptians soon discovered, the air space that was created by the tomb prevented desiccation from occurring, so the Egyptians began experimenting with ways to preserve their dead.

Predynastic	**4800-3100 B.C.**	**New Kingdom**	
		Dynasty XVIII	1570-1293 B.C.
Archaic Period		Dynasty XIX	1293-1185 B.C.
Dynasty I	3100-2857 B.C.	Dynasty XX	1185-1070 B.C.
Dynasty II	2857-2705 B.C.		
		Third Intermediate Period	
Old Kingdom		Dynasty XXI	1070-946 B.C.
Dynasty III	2705-2630 B.C.	Dynasty XXII	946-712 B.C.
Dynasty IV	2630-2524 B.C.	Dynasty XXIII	828-765? B.C.
Dynasty V	2524-2400 B.C.	Dynasty XXIV	760-712 B.C.
Dynasty VI	2400-ca. 2250 B.C.	Dynasty XXV	767-656 B.C.
First Intermediate Period		**Saite Period**	
Dynasty VII	2250-2230 B.C.	Dynasty XXVI	685-525 B.C.
Dynasty VIII	2230-2213 B.C.		
Dynasty IX	2213-2175 B.C.	**Late Period**	
Dynasty X	2175-ca. 2035 B.C.	Dynasty XXVII	525-404 B.C.
Dynasty XI	2034-2061 B.C. (pre-conquest)	Dynasty XXVIII	404-399 B.C.
		Dynasty XXIX	399-380 B.C.
		Dynasty XXX	380-343 B.C.
Middle Kingdom			
Dynasty XI	2061-1991 B.C. (post-conquest)	**Persian Conquest**	**343-332 B.C.**
Dyansty XII	1991-1784 B.C.	**Ptolemaic Period**	**322-31 B.C.**
Second Intermediate Period		**Roman Period**	**31 B.C.-A.D. 395**
Dynasty XIII	1784-1668 B.C.		
Dynasty XIV	1720-1665 B.C.	**Coptic Period**	**A.D. 395-641**
Dynasty XV	1668-1560 B.C.		
Dynasty XVI	1665-1565 B.C.	**Arab Conquest**	**A.D. 641**
Dynasty XVII	1668-1570 B.C.		

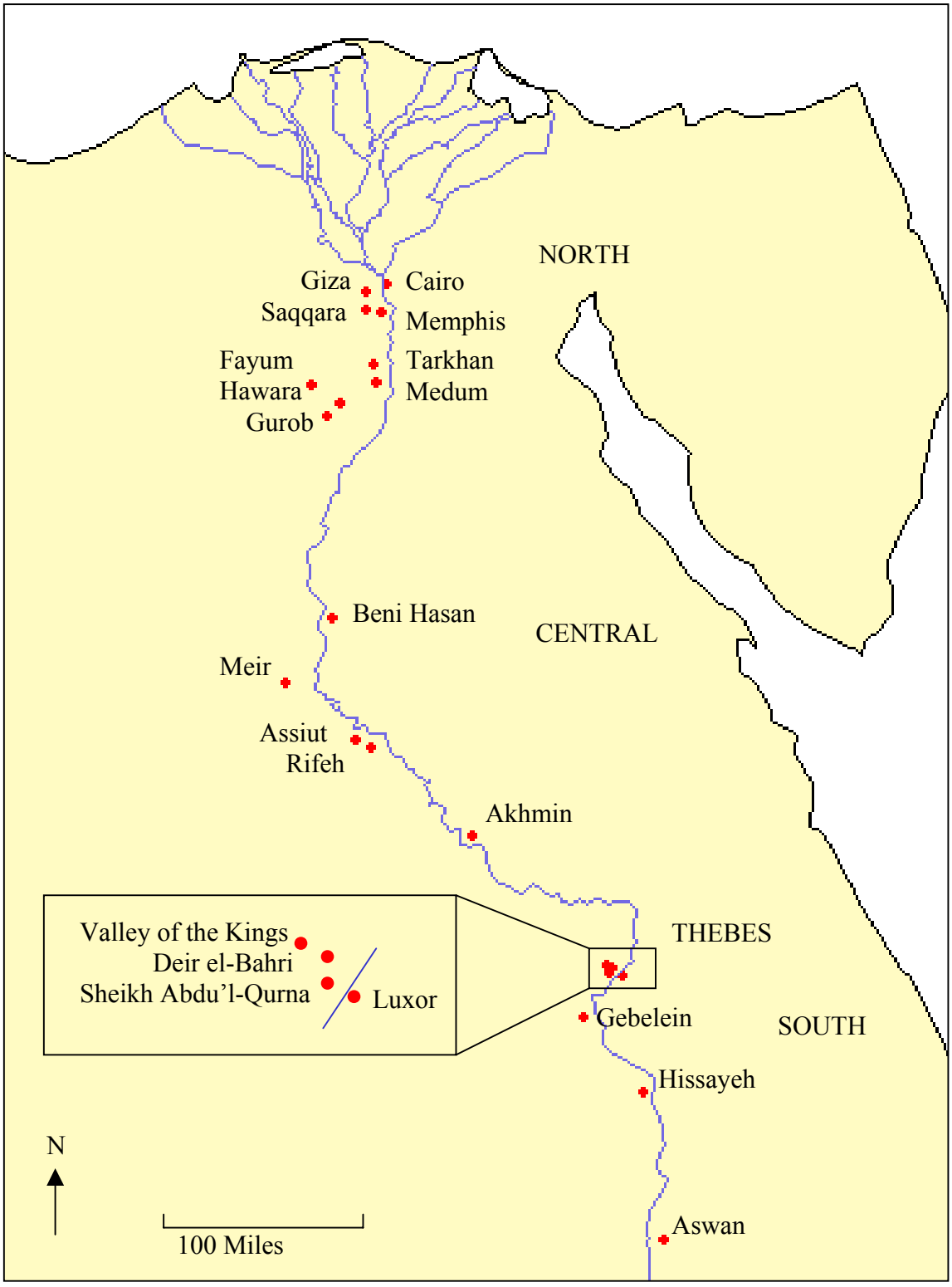
Based on the work of Klaus Baer as presented in D'Auria *et al.* 1988 and Flemming *et al.* 1980.

Figure 1: Chronology of Ancient Egpyt

Although trends in the mummification practice are seen through the dynasties, there is considerable variation due to regional preferences, social status, and the work of the embalmers, such that at any time, no two mummies are identical in details (Iskander 1980:7). The following description of techniques, therefore, only accounts for the most common techniques and not the variations.

Early experiments during the First through Eleventh Dynasties involved wrappings and chemicals, the two important components of Egyptian mummification as it came to be practiced, but not yet performed in the right proportions. In the First and Second Dynasties, the bodies were wrapped tightly in linen bandages and then put inside wooden coffins (Kemp 1967:25). Studies on remains from the First Dynasty show evidence of the use of natron, "a naturally occurring mixture of salts" (Aufderheide 2003:255) and embalming with wood tar compounds applied to a defleshed or skeletonized body (Koller et al. 1998:344). An excavation at Saqqara uncovered the remains of a female from the Second Dynasty who had been wrapped in more than sixteen layers of linen (Peck 1980: 17). (A map of Ancient Egypt is presented in Figure 2). The wrapping did preserve the shape of the person, but the tissue still decayed inside, leaving only bones in a linen shell (Hamilton-Paterson and Andrews 1978:35).

The first evidence of evisceration was dated to the Fourth Dynasty. An incision was made in the abdomen and all the organs except the heart were removed as the heart was believed to be the center of thought and emotion and would be weighed in the afterlife to determine the goodness of the individual (Iskander 1980:2). The liver, lungs, stomach, and intestines were preserved and each protected by one of the four sons of Horus (Iskander 1980:21).



Map created by Ellen Salter-Pedersen
based on *An Atlas of Ancient Egypt* (1894) and Fleming et al. 1980.

Figure 2: Map of Ancient Egypt showing locations referred to in this study

In 1913 at Giza, archaeologists found the tomb of Queen Hetepheres, wife of Sneferu and mother of Cheops. Although no body was found, a compartmentalized, alabaster chest containing her viscera was recovered. Studies into the contents of the chest determined that the viscera had been placed in liquid natron (Iskander 1980:5; Peck 1980:18). In addition to the chest that was recovered from Hetepheres' tomb, canopic jars have also been found dating to the Fourth Dynasty (Peck 1980:18). Each jar held a different organ and was shaped to represent one of the four sons of Horus (Aufderheide 2003:258-259). Thus, the organs were not merely removed but preserved as individual organs. At this time, the bodies were placed in an extended position instead of a fetal position (D'Auria 1988:16; Strouhal 1992:260).

Other discoveries of this date show that an effort was made to preserve the form of the body (Peck 1980:18). A mummy found by William Matthews Flinders Petrie at Medum, and eventually dated to the Fourth Dynasty, was "shrunk, wrapped in a linen cloth, then modelled all over with resin, into the natural form and plumpness of the living figure, completely restoring all the fullness of the form" (Peck 1980:18). Finally, a mummy from the Fifth Dynasty was shaped out of linen soaked in an adhesive upon which facial features were drawn in ink (Harris and Weeks 1973).

In the Middle Kingdom, solid natron was used instead of liquid natron, which resulted in a shorter desiccation process (D'Auria 1988:16). This period also marks the start of excerebration (removal of the brain), although the technique was refined in the New Kingdom (D'Auria 1988:16). The brain was not believed to have any importance, so it was cut into small pieces to facilitate removal and discarded (D'Auria 1988:16; Iskander 1980:19). The empty cranial cavity was often filled with linen and/or resin

(Bertoldi and Fornaciari 1997:12). Finally, linen pads were placed over the eyes to help give them shape, a practice that developed into the use of artificial eyes (Bertoldi and Fornaciari 1997:12).

Also dating to the Middle Kingdom is the first evidence of removing the viscera without making an incision. The embalmers injected a substance such as oil of turpentine into the anus, which dissolved the internal organs so they could be flushed out of the cavity (D'Auria 1988:16). This technique persisted and was described by Herodotus about 450 B.C. as a less expensive form of mummification (Leca 1981:39-41). In fact, three processes were used that corresponded with the status and wealth of the person to be mummified. The best method, which took seventy days to complete, involved evisceration, the extraction of the brain, and the use of the best spices and chemicals available. The other two methods did not involve evisceration, and organs were dissolved instead with chemicals and rinsed out of the abdominal cavity; the brain was not removed (Iskander 1980:13-14; Peck 1980:15). These two methods were used primarily by the commoners in Egypt as they used poorer quality materials and took less time and effort, thus costing less.

Mummification reached its peak in the Eighteenth Dynasty, the start of the New Kingdom, and continued in nearly the same manner through the Third Intermediate Period (Iskander 1980:15). Each finger and toe were individually wrapped to show the body's form (Peck 1980:19). Artificial eyes began to be used and the facial features were often enhanced with color (Bertoldi and Fornaciari 1997:12; Iskander 1980:24). The brain was usually removed through the nose which resulted in damage to the cribriform plate of the ethmoid bone (Leek 1969:12). Less frequently, the brain was extracted

through the foramen magnum, necessitating the displacement of the cervical vertebrae. (Iskander 1980:19). The cranial cavity was no longer filled with linen, rather by resin, while the abdominal cavity was filled with both resin and linen (Bertoldi and Fornaciari 1997:12; Iskander 1980:23). In addition to solidifying and strengthening the body, the hot liquid resin served to prevent the growth of bacteria and acted as a disinfectant and deodorant (Iskander 1980:24).

During the Third Intermediate Period, the viscera were wrapped into four parcels and placed in the abdomen. Subcutaneous packing with linen, sand, or sawdust was also practiced in this period only (Bertoldi and Fornaciari 1997:12; D'Auria 1988:18). The packing gave the mummies a life-like appearance although over packing resulted in the skin cracking or "producing a grotesque orang-outan-like appearance" (Smith and Dawson 1924:118).

During the Late, Ptolemaic (also referred to as Greek), and Roman Periods, the skill used by the embalmers in mummification declined (Strouhal 1992:260). Instead of focusing on the treatment of the body, the embalmers focused more on the exterior appearance of both the body and the wrappings (Smith and Dawson 1924:121). Often, mummification did not occur until the body was in an advanced state of decomposition (Smith and Dawson 1924:124-127). The brain was not consistently removed and the viscera parcels were placed between the legs as well as in canopic jars (Bertoldi and Fornaciari 1997:12). The bodies were covered in large amounts of bitumen and resin; the wrappings were done tightly in a geometric pattern and often colored (D'Auria 1988:18; el Mahdy 1989:72). In the Fayum region, portraits of the deceased were painted on wooden boards then affixed to the exterior of the wrappings (Aufderheide 2003:249).

After the fall of the Roman Empire in A.D. 395, Christianity and Islam became the dominant religions, so mummification was banned and eventually stopped being performed (Aufderheide 2003:248-250; el Mahdy 1989:18-20).

Coffins were used as early as the Predynastic Period but were quite plain (Smith and Dawson 1924:133). Over time, the coffins became more elaborate in construction and decoration (Leca 1981:190). Beginning in the Old Kingdom, sarcophagi were carved from alabaster, granite or basalt, and the coffins were put inside (Leca 1981:190). The First Intermediate Period marked the start of the use of two coffins, an inner and an outer, both made of wood; by the New Kingdom, three coffins were used. Now the coffins were anthropoid in shape instead of square (Leca 1981:191). Trees were not abundant in Egypt and the wood was of poorer quality. Therefore, in order to build coffins, the Egyptians imported wood from other countries including the regions of Syria and Lebanon (Lucas 1962:430-439). The inner coffins were often constructed from cartonnage, which was made from linen or papyrus soaked in plaster, shaped, and allowed to harden (Hamilton-Paterson and Andrews 1978:75; Leca 1981:191). The first use of cartonnage was for masks placed on top of the mummy during the Fourth Dynasty (Peck 1980:19). Foot and chest plates were also made from cartonnage (Dawson and Gray 1968:24; el Mahdy 1989:72).

Coffins were sometimes reused for other individuals. This occurrence was especially common among the mummies of the kings after they had been plundered, although some substitutions were done in modern times by antique dealers (Dawson and Gray 1968:xii; Smith 1912). One study suggests that around ten percent of mummies were found in another individual's coffin (Cockburn et al. 1975:1158).

While the cultural practices and beliefs associated with death, mummification, and funerals were altered, the actual techniques of mummification changed little over two thousand years. The few changes that did occur were primarily for reasons of aesthetics, costs, and accessibility to resources, along with changes in ceremonies and beliefs. When the practice of mummification first began, it was only available to the royalty. The kings were considered gods and were worshiped as such. By being preserved eternally, the king's position as ruler was strengthened. Changes to the hierarchy of the gods are thought to have weakened the power of the kings and allowed anyone to be mummified for eternal life according to religious beliefs (Aufderheide 2003:224). By the Fourth Dynasty, it appears that both the royalty and the nobility were preserved in the same manner, namely mummified (Peck 1980: 18). At this time, the cost of mummification was still great, due to the cost of the materials for the embalming process and the amulets and funerary equipment needed for the afterlife. The deceased's family was required to provide wages for the large number of specialists involved in the embalming process and the religious people needed to perform rituals. These rituals not only took place during the embalming process but also continued indefinitely once the mummy was placed in its tomb (Sluglett 1980:166). The high costs would have been prohibitive to all but the very wealthy.

On occasion, a person who had served the king faithfully would be rewarded with mummification and could, therefore, continue to serve the king in the afterlife. One of the best examples was Wilkinson's discovery in 1923 of sixty mummies dated to the Eleventh Dynasty. The bodies had all been robbed and damaged, but from the inscriptions on the linen, the mummies were identified as members of the king's army.

Two of the mummies were officers and had been wrapped even better than the other soldiers. All the mummies showed wounds consistent with having died in battle (Leca 1981:72-77).

In the First Intermediate Period, Egypt entered a time of political instability when riots occurred, the production of food and goods decreased, and many people left the cities (White 1970:152-153). At the end of this period, the seat of power shifted from Memphis in the north to Thebes in the south (Aufderheide 2003:226-227). The Middle Kingdom was more peaceful and the king again ruled the country. One major change that remained was that the royal crown was no longer passed by heredity but rather appointment (White 1970:155). This stability lasted only two dynasties (approximately 300 years) until the Second Intermediate Period when foreigners arrived and gained power in the north through economic dominance. The Theban kings still ruled in the south until the foreigners were expunged in the Seventeenth Dynasty (Aufderheide 2003:227-230).

While Egyptian rule was again secured in the New Kingdom, military campaigns continued, and the central power further diminished, giving more power to the nobility (Aufderheide 2003:232). During this time, many foreigners married into the noble and royal families, and religion was changed due to this influence (White 1970:169-170). Furthermore, the Egyptian kings had less money, as the rulers since the Old Kingdom had invested it in the military and in building lavish pyramids and tombs (Aufderheide 2003:232).

Cemeteries containing the mummies of commoners, such as the workers from the Valley of the Kings, have been found dating to the New Kingdom. The bodies were

prepared in one of the less expensive methods previously mentioned (Aufderheide 2003:241). Following the New Kingdom, Egypt once again entered a time of decreased political stability through the Third Intermediate Period and the Late Period when the Persians ruled intermittently until the Ptolemaic and Roman Periods. During that time, Egypt was ruled by the Greeks and Romans, respectively (Aufderheide 2003:243-247). Throughout these periods, mummification became available to all and competition between embalmers kept the costs down (Fleming et al. 1980:50; White 1970:108). After A.D. 395, mummification eventually stopped altogether.

This summary of mummification in Egypt is simplified as the practice of mummification existed for over 3000 years. Although the mummification practices changed over the millennia, adornment of the bodies is seen in all periods.

2.2 Amulets and Jewelry

Amulets were essential in transcending to the afterlife. During all steps of mummification process, the amulets were placed in specific locations including around the neck, waist, and limbs, as well as between the layers of the wrappings (Andrews 1984:31). At least seven charms were needed as the number seven was considered magic. In later periods, one hundred and four amulets provided the best protection (Leca 1981:26). Furthermore, the better the method of mummification, the more amulets were used. For example, Tutankhamun was entombed with one hundred and forty-three amulets (Leca 1981:26). Unfortunately, in ancient Egypt, the embalmers were unconscientious at times: they did not properly embalm the bodies, omitted the amulets, and made mistakes in the funeral papyri, all of which were considered essential to enter the afterlife (Leca 1981:26).

Amulets were made of a variety of materials and usually reflected the family's wealth and position in society. Materials included gold, bronze, stone, glass, wax and enamelled clay (Leca 1981:26). Stone moulds were sometimes put in the tomb so that if the deceased ran out of amulets, more could be made (Leca 1981:26). The amulets were spread out over the body to protect all the different parts. They would be placed inside the body, placed on the surface of the body, and placed in various layers of the bandages and incorporated into jewelry (Bucaille 1990:9; Leca 1981:26).

The talismans were moulded into a variety of figures and objects. Figures of the gods or images to represent the gods were the most common. Three of the most important amulets were the Udjat-eye (also spelled Wajat), the Djed pillar, and the heart scarab (Andrews 1984:33-34; Leca 1981:26-27). The Udjat-eye represented the eye of the god Horus, a falcon. This amulet was usually placed over the incision in the abdomen from where the internal organs were removed and represented clairvoyance and physical prosperity, while the Djed pillar protected the dead by calling on the goddesses (Leca 1981:26). Scarabs were common, especially the figure of the beetle pushing cow dung with its hind legs, a symbol for the sun encircling the earth (Leca 1981:27). The heart scarab was placed on the mummy's chest near the heart. The scarab was usually large and made of green stone to symbolize vegetation and rebirth. An engraving on the surface, an excerpt from the Book of the Dead, served to prevent false evidence being presented against the individual at the time of judgment when his heart was weighed (Leca 1981:27). Other scholars interpret the engraving as protecting the mummy from having his sins shown and, therefore, guaranteeing the mummy's entrance into the afterlife (Andrews 1984:35-36). Some amulets were in the shape of the gods and

goddesses or sacred animals, while others represented different parts of the body (Andrews 1984:37-38; Hamilton-Paterson and Andrews 1978:81). Hundreds of different amulets have been found and the meanings of many are still under investigation.

Mummies also were adorned with jewelry which often incorporated symbols for protection. Gold was the preferred material among the Pharaohs and the elite while the poor relied on wax and gilded plaster (Leca 1981:28). A ring was commonly worn on the third finger of the left hand. The wealthy might wear rings on all fingers as well as diadems, necklaces, bracelets, pendants and pectorals (Budge 1894:231). Necklaces were often made of beads in all shapes and of many different materials including mother-of-emerald, carnelian, agate, lapis-lazuli, amethyst, rock crystal, onyx, jasper, garnet, gold, silver, glass, faience, clay, and straw. Each stone had a special property and the beads were arranged to provide the best protection. Often pendants in the shape of gods, animals, or amulets were added to the necklace (Budge 1894:231). Rings were usually of gold, silver, bronze, precious stone or faience, while bracelets were primarily made of gold or silver with inlaid stones and colored paste. Gold earrings were also worn on occasion (Budge 1894:266).

Although the amulets were well made, the jewelry for the mummies was usually less sturdy than jewelry made for use by the living. Sometimes cheap materials, such as plaster or wood, were painted or disguised as more expensive materials (Andrews 1984:31) and other times necklaces were painted onto the mummies' wrappings (Budge 1894:231). Other necklaces did not have fasteners and were just laid on the body or within the bandages (Andrews 1984:31).

The amulets and jewelry placed with the mummies were an important component of mummification. These antiquities are both valuable and beautiful even by today's standards. As a result, they have been desirable collectors items for many centuries and are central parts of museum exhibits.

2.3 Foreign Interest in Egyptian Mummies

Visitors to the Egyptian tombs are reported from nearly all periods in history starting with the Greeks and Romans who ruled Egypt from the Fourth century B.C. to the Seventh century A.D. The Europeans showed renewed interest starting in the Renaissance, as many of the ancient Greek and Roman literary works that described Egypt were revived (Dannenfeldt 1959:7-8). Furthermore, pilgrims would visit Egypt due to its reference in the Old Testament and return home with tales of the land (Leca 1981:252). Ground up mummy became popular as a cure-all medicine called *mummia* (Dannenfeldt 1959:17; 1985:167; Leca 1981:214). The desire for *mummia* was so great that some merchants even produced fake mummies (Dannenfeldt 1985:170). The mummy medicine was purported to stop bleeding but often caused violent nausea (Andrews 1984:69). Continuing the trade in mummies, the linens from mummies were used to make paper in the nineteenth century. The paper was permanently brown and supposedly initiated a cholera epidemic, resulting in its discontinuation (el Mahdy 1989:33; Leca 1981:225).

Also at this time, Egyptian antiquities and mummies became popular collector's items (Leca 1981:253). A French visitor in the 1770s reported that the locals had sold him "a pretty ample collection of fragments of antiquity" (Manniche 1987:97). In some cases, fake mummies were made from linen, wood, clay or animal bones and sold to the

collectors (Gray 1967:37). Another boost to the interest in Egyptian antiquities was the visit of Napoleon in 1799-1800, during which time he collected antiquities to take home (Leca 1981:259).

After the French military left Egypt in 1801, the English, French and Italians all became frequent visitors. The focus was on rediscovering forgotten and undamaged tombs, and the wall decorations were precisely recorded or even moved to Europe (Manniche 1987:102-110). At this time, the mummies were regarded with little interest, perhaps because of the large number of mummies in Egypt (Cohen 1980:40).

Jean-Baptiste Belzoni inspired interest in the mummies during the 1800s by conducting excavations in Egypt and then displaying many of his findings in Europe. In 1821, Belzoni spurred public interest by holding a public unwrapping and dissection of a mummy (Sluglett 1980:167). Following this event, unwrapping parties for the purposes of both science and entertainment became popular in Europe and North America (Leca 1981:260; Lombardi 1999:9). In 1858, the Antiquities Organization in Cairo was formed, helping to curb the trade in antiquities (el Mahdy 1989: 33). In spite of the laws protecting the antiquities, the sale and smuggling continues to this day. This interest in the mummies and their accoutrements is a contributing factor to their damage.

2.4 Damage to the Mummies

Although the role of the embalmers was to preserve the bodies, often the mummies were not well made. Bones were broken or added in order for the mummies to fit the coffins better (Gray 1966:138; 1973:52). In the Ptolemaic and Roman Periods, the poor quality of mummification and the fact that the bodies were in an advanced state of decomposition before they were embalmed often resulted in many of the bones being

dislocated (D'Auria 1988:18; Fleming et al. 1980:50). Fractures were also common due to the embalmers' carelessness (Leca 1981:44). In addition, the mummies were fragile and easily damaged by the embalmers who attempted to cover up their mistakes by using resin, wood, and other bones. These extra bones were remnants from animals or humans also mummified (Brier 1998b:169).

Unfortunately the mummies were not left to rest in peace. Tomb robbing spans nearly all time periods in Egypt both ancient and modern. Some scholars have suggested that tomb robbing predated the development of artificial mummification techniques and, thus, is among the oldest professions in Egypt (Reid 2001:114). Archaeological evidence shows that predynastic graves were plundered, and mummies in a cemetery from the first dynasty were both plundered and burned (el Mahdy 1989:24; Kemp 1967:25). The robbers searched for funerary objects such as jars and furniture as well as the amulets and jewelry that were placed on the bodies. Even amulets that were left inside the body are now missing (Bucaille 1990:9). In order to access the amulets and jewels, the tomb robbers desecrated the bodies of the mummies. The bandages were torn and coffins damaged (Bucaille 1990:12). Sometimes, axes were used to hack through the bandages to reach the amulets and jewelry (Fleming et al. 1980:48).

The funerals themselves were quite elaborate and showed off the funerary belongings to all the public, perhaps even tempting thieves (Hamilton-Paterson and Andrews 1978:135). Howard Carter, who discovered the tomb of Tutankhamun, said, "by providing his mummy with the elaborate and costly outfit which he thought essential to its dignity, the king was himself compassing its destruction" (Bucaille 1990:35). A

single piece of jewelry from one of the mummies could be equal to several years' pay for a workman (el Mahdy 1989:27).

Attempts were made to protect the dead, although most were unsuccessful. Desecration and theft of the royal tombs were probably among the worst crimes in ancient Egypt. Punishments were severe, including exile after having hands or noses cut off or even death by impalement on a stake. The criminals would also be doomed in the afterlife (Hamilton-Paterson and Andrews 1978:136-137). Yet, these threats were not discouragement enough and other measures were required to protect the dead.

Early on, the wealthy were buried farther away from settlements and hidden in the hills (Reid 2001:114). When the pyramids were in use, the mummies were placed in the center with dead ends and blocked passages restricting access to the mummies (Reid 2001:119). The entrances were often hidden at a distance away from the pyramid itself (Hamilton-Paterson and Andrews 1978:124). In spite of these measures, however, broken bones were still found in the pyramid of Zoser (also spelled Djoser), the largest of the pyramids, and the majority of the remains were lost some time in the 1800s (Bucaille 1990:25-26).

The First Intermediate Period was a time of political problems and an increase in the tomb robbers and desecrations occurred (Andrews 1984:35). Often the tombs were robbed only shortly after the mummy was placed inside (Bucaille 1990:12). The royal mummies of the New Kingdom were buried in the Valley of the Kings where the tombs were built in cliffs accessible by galleries of varying lengths (Bucaille 1990:16-17). The late Twentieth dynasty was marked by civil conflict and tomb robbing occurred usually unpunished and on a large scale. Some of the tomb robbers were members of the Libyan

army who had invaded (Fleming et al. 1980:47) or even the guards who had been hired to protect the tombs (Hamilton-Paterson and Andrews 1978:138).

With regard to the Royal mummies, Whitehouse (1980:290) reported that "virtually all the specimens show evidence of post-mortem trauma either due to grave robbers, handling by previous investigations, or disruption following further deterioration of the specimens. … Much of the postmortem trauma is attributed to the grave robbers who mutilated the mummies in their haste to obtain the jewels present on the bodies." Of the thirty-one specimens analyzed by Whitehouse, only four were listed as "free of postmortem trauma" (1980:290).

In the Twenty-First Dynasty, the high priests moved the bodies of the Royal mummies to protect them from further damage. The bodies were rewrapped and then hidden at Deir el-Bahri near the Valley of the Kings, as well as in the tomb of Amenhotep II at Biban el Molouk in the Valley of the Kings (Fleming et al. 1980:48; Reid 2001:132). The funerary objects that remained in the original tombs were transferred to the new hiding places with the mummies, but no new objects were included. Coffins were remade or empty coffins of other mummies were used with only a few short notes on the identity of the body (Fleming et al. 1980:48).

Often the priests would make an attempt to restore the damaged mummies. In some cases the methods of restoration were quite involved while in other cases they were as basic as putting the pieces in a linen shroud (Smith 1912:87). A more advanced method of restoration included using artificial limbs made of linen, sticks, reeds or even other bones to replace missing limbs (Gray 1966:138). In other cases, the broken bones

were splinted with wood and linen (Smith 1912:72). Sometimes during restoration, other bones, both human and animal, would be included (Smith 1912:49).

When travelers visited Egypt in the early 1700s, they reported outlaws living in the caves at Luxor (Manniche 1987:93-96). Dry mummies were apparently quite flammable and the Arabs living in the region would burn piles of them and their coffins for warmth (Leca 1981:222; Manniche 1987:98). There are other reports that mummies were used as fuel on trains, although these reports are often disputed (Pringle 2001:188).

Other interferences by humans have also damaged the bodies. Many of the mummies were unwrapped for academic study as well as pure curiosity. In doing so, the protective coverings of the mummies were removed, often speeding the deterioration processes (Bucaille 1990:18). Even the mummy of Tutankhamen, which was unharmed when it was discovered by Carter in 1922, was damaged for scientific study (Brier 1988b:169; Bucaille 1990:52). In addition, by opening the tombs, the ambient temperatures inside were changed and this climate may be hard to duplicate when the mummies are moved to museums and private collections, all of which may further add to the deterioration of the bodies (Bucaille 1990:19; Hamilton-Paterson and Andrews 1978:60). Bucaille (1990) describes searching for the mummy of Merenre I in the Egyptian Museum in Cairo. This mummy, which may once have been the oldest and most complete mummy, was damaged and decaying, even emitting a strong smell. After Bucaille was allowed to photograph the mummy, he reports that "the mummy was sprayed with a cloud of goodness knows what from an extremely ancient-looking can" (1990:27).

Another problem affecting the preservation of the mummies is technological development in Egypt. The Aswan Dam, which was built in 1907 and then renovated in the 1950s, flooded areas where mummies were buried. Although many were rescued, it is likely that even more mummies were lost (Pringle 2001:50). The problem continues today as new roads and buildings are constructed but the funds and resources are not available to protect the mummies (Dzierzukray-Rogalski 1986:92).

Although the goal of mummification was to preserve the body, this goal was not always reached. Much interference with the mummies has contributed to their damage, including the mummification process itself. In the following chapters, the damage is examined for patterns and contributing factors.

CHAPTER 3: MATERIALS AND METHODS

Data for the current research were collected on 275 mummies (Appendix). The main sources of information were published reports and articles, although museum records, websites, and personal communication with researchers were also used. Table 1 presents the published sources of data used while Table 2 presents the individuals with whom personal communications were held. Six museums were visited in order to gain insight on mummies in general and to learn details regarding the museum's collection. These museums visited include the Field Museum of Natural History, Chicago; Louisiana Arts and Science Center, Baton Rouge; Metropolitan Museum of Art, New York; Michael C. Carlos Museum, Atlanta; Royal Ontario Museum, Toronto; and Tulane University, New Orleans.

The methods of study employed in the reports include unwrapping, autopsying, x-rays, CT-scans, and a combination of these methods. Some of the sources were the published results of a scientific study (Moodie 1931; Smith 1912). Other reports were part of books on the Egyptian way of life (David 1979; Whitehouse 1980). Finally, some reports were articles intended for general interest (Bridgeman 1967; Langone 1984). Reproductions of x-rays and CT-scans were often included in the published sources; the pictures of the mummies, x-rays, and CT-scans were examined when present. Original x-rays were also viewed at the Louisiana Arts and Science Center, Baton Rouge. Although many museum collections had been x-rayed or CT-scanned, the files are not usually accessible and they may be part of the private files of the doctor or hospital performing the procedure.

Table 1: Published sources of data used in this study

MUSEUM	SOURCE
Bristol Museum	el Mahdy 1986
British Museum, London	Dawson and Gray 1968
Buffalo Museum of Science	Bridgeman 1967
Cairo Museum, Egypt	Bakry 1965; Harris and Weeks 1973; Ikram and Dodson 1997; Krogman and Baer 1980; Miller 2003; Smith 1912; Whitehouse 1980
Chatham-Kent Musuem, Ontario	Nelson 2003
City of Liverpool Museums, Liverpool, England	Gray and Slow 1968
County Museum and Art Gallery, Truro, England	Gray 1970
Detroit Institute of Arts	Kristen and Reyman 1980
Field Museum of Natural History, Chicago	Moodie 1931
Girton College and the Fitzwilliam Museum, Cambridge, England	Bourriau and Bashford 1980
Hancock Museum, Newcastle, England	Gray 1967b
Indianapolis Children's Museum, Indiana	Vahey and Brown 1984
Manchester Museum, Manchester	David 1979; Isherwood et. al. 1979; Murray 1910
Metropolitan Museum of Art, New York	Mininberg 2000; 2001
Minnesota Mummy Project – Minneapolis	el Mahdy 1986; Moss 1985; Notman 1986
Michael C. Carlos Museum, Atlanta	Miller 2003
Munich Egyptological Museum	Parche and Ziegelmayer 1986
Museum of Royal College of Surgeons	Dawson 1927
Museum of Fine Arts, Boston	Langone 1984; Marx and D'Auria 1986
National Museum of Natural History, Washington, D.C.	Hunt and Hopper 1996
Philadelphia University Museum	Cockburn et al. 1975; 1980; El Mahdy 1986; Kristen and Reyman 1980; Reyman and Peck
Rijksmuseum van Oudheden, Leiden	Gray 1966b
Royal Ontario Museum, Toronto, Canada	Harwood-Nash 1979; Kristen and Reyman 1980; Millet et al 1980
Stockholm's Museum of Mediterranean and Near Eastern Antiquities, Sweden	Diener 1986
Tulane University, New Orleans	Lombardi 1999
Wesleyan Univerisity, Middletown, Connecticut	Dyson 1979

Table 2: Personal communications contributing to this study

Museum	Researcher
Chatham-Kent Musuem, Ontario	A Nelson 2003
City of Liverpool Museuems, Liverpool	P Bienkowski (2003)
Louisiana Arts and Science Center	LK Adams (2003)
Metropolitan Museum of Art, New York	DT Minninberg (2003)
National Museum of Natural History, Washington, D.C.	DK Hunt (2003)

A database entry included the museum where the mummy was located and the identification number assigned by the museum. Also included were the source of the data and the methods of study, biographical information, details on antemortem and postmortem trauma, and any other information deemed useful. An example of this other information was whether or not the mummy had been unwrapped prior to study. Although information for all the categories listed was desired, in many cases, the reports did not include all the details. This problem was due largely to a difference in what was deemed important by the different researchers as well as who the intended readers were.

The biographical data included name, rank, age, sex, the location where the mummy was found, the dynasty or period to which the mummy belonged, if any amulets were found on the body, and if the body was contained in a coffin and cartonnage. Although not all of the biographical information listed above was used in analysis, some, such as name, age, and sex, proved useful in identifying the same individual from multiple reports to prevent double counting. The dynasty or period was recorded as it was given by the researchers, but, for analysis purposes, the dynasties were combined into the periods shown in the chronology (Figure 1). In order to be consistent throughout this thesis, one chronology was chosen and used. This chronology is the work of Klaus Baer as published in Fleming et al. (1980) and D'Auria et al. (1988). The locations where the mummies were from were combined into four geographic regions as shown on the map (Figure 2). This map, created using ArcView GIS 3.3, shows only the places referred to in this thesis.

The coffin, if referred to in the source, was listed as either 'yes' if the original owner was found in the coffin or 'other individual' if the coffin was from someone else.

Cartonnage could be full, partial, or none. Partial refers to when cartonnage mask, pectoral, or foot plates are present but are separate pieces.

Antemortem trauma and pathologies of both bone and soft tissue were recorded. Arthritis and Harris lines occur frequently in the Egyptian population and, as a result, are not always reported (Dawson and Gray 1968:41; Gray 1973:52). For this reason, these pathologies were not considered in analysis.

The details collected with regard to postmortem trauma included the presence of any damage, if the damage was attributed to the embalmers or plunderers, where the damage was located on the body, and a description of the damage. The embalming damage and plundering categories were only for those mummies who were reported in the source to have one or other type of damage. Because brain removal through the nose was known to damage the ethmoid bone, many researchers did not include this damage in their reports. Furthermore, the damage to the ethmoid may be slight or obscured by packing and thus not observed even if present. Therefore, damage to the ethmoid was not included in the database, even when reported in the source.

Of the 275 mummies entered into the database, 20 were excluded. The most common reason for exclusion was due to insufficient details on the mummy. Other reasons included the mummy was not fully unwrapped, x-raying was not possible due to the coffin, or the x-rays were obscured, thus limiting possible analysis. One mummy was excluded because the primary researcher felt that further examination was needed (Minninberg 2003, personal communication). Finally, three mummies were excluded because the information presented was contradicted by another researcher or by an accompanying picture.

Once the data were collected, they were analysed statistically using SPSS 11.0 for patterns in relation to the damage and associated reasons for the damage including the mummy's social class, geographic region, and historic period. Those mummies known to have embalming or plundering damage were examined for patterns in the location on the body and cause of damage. Chi-square analysis was performed where applicable. Pearson Chi-square was used to test the hypothesis that the two variables are independent. A low value for significance (less than 0.05) shows that a relationship is present. In order to determine the strength of the relationship, Cramer's V, a nominal symmetric measure was used. The values for Cramer's V are between 0 and 1; the larger the value, the stronger the relationship. The results were then viewed within the context of social and cultural factors.

CHAPTER 4: RESULTS AND ANALYSIS

The mummies used in this thesis were housed in twenty-eight museums. The majority of the sample came from seven museums with large collections. The remaining twenty-one museums each had between one and six mummies. Table 3 shows the major collections included in this thesis. Of the 275 mummies, twenty were excluded as explained in the methods chapter and are presented in Table 4. All further analysis is based on the remaining 255 mummies.

Table 3: Museums with mummies that were included in this study

Museum	**Number of mummies**	**Percent**
British Museum, London	82	29.8
Cairo Museum, Egypt	55	20.0
City of Liverpool Museums, England	18	6.5
Field Museum of Natural History, Chicago	18	6.5
Manchester Museum, Manchester	17	6.2
Metropolitan Museum of Art	15	5.6
Rijksmuseum van Oudheden, Leiden	27	9.8
Other (21 museums)	43	15.6
Total	**275**	**100.0**

Table 4: Museums with mummies excluded from analysis

Museum	**Number**
British Museum, London	5
Cairo Museum, Egypt	8
City of Liverpool Museums, England	3
Detroit Institute of Arts	1
Metropolitan Museum of Art, New York	1
Museum of Fine Arts, Boston	1
Munich Egyptological Museum, Germany	1
Total	**20**

The methods of analysis in the sources consulted were x-raying, CT-scanning, unwrapping, autopsying, or a combination of methods. Figure 3 presents the frequency of the different types of analysis as used in this study. Only 6.3 percent of the mummies were examined by unwrapping alone. The importance of the use of x-rays and CT-scans for this thesis is that since the focus is on the skeletal damage, unwrapping may not reveal damage. The sixteen unwrapped mummies were examined by Smith (1912) and Dawson (1927), both of whom studied hundreds of mummies during their careers and their results have been confirmed.

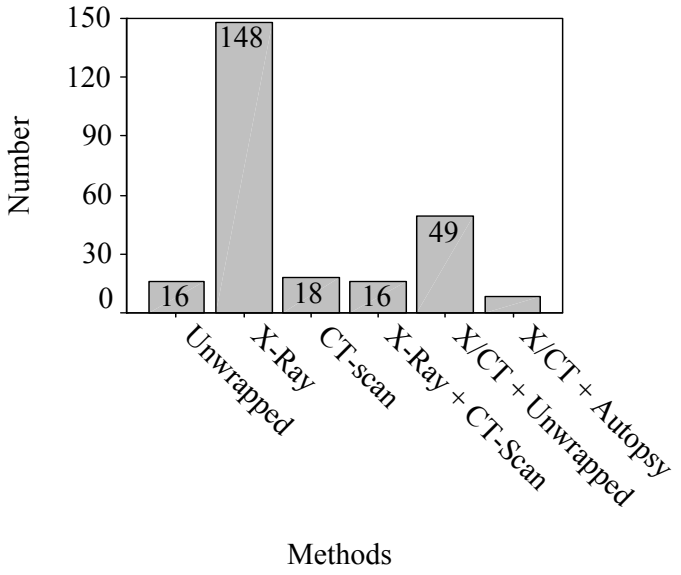


Figure 3: Methods used to analyze mummies

Of the 255 mummies, 129 did not have any identifying name, although two were identified by letters, one was called "younger woman" (Smith 1912:40), and one was called the Sulman mummy (Nelson 2002). Of the other 126, few of the mummies shared names with the exception of the Kings who were numbered in succession (i.e. Ramesses II). Sometimes, the names had different spellings as a result of translation from hieroglyphics.

Sex was determined by the researchers based on external anatomical features, the shape of the pelvis in x-rays and CT-scans, and the inscriptions on linens and coffins. The majority of the mummies in this study were males, as seen in Figure 4. Almost fourteen percent of the sample was labeled as uncertain because the source did not provide the information or because sex could not be determined by the researcher.

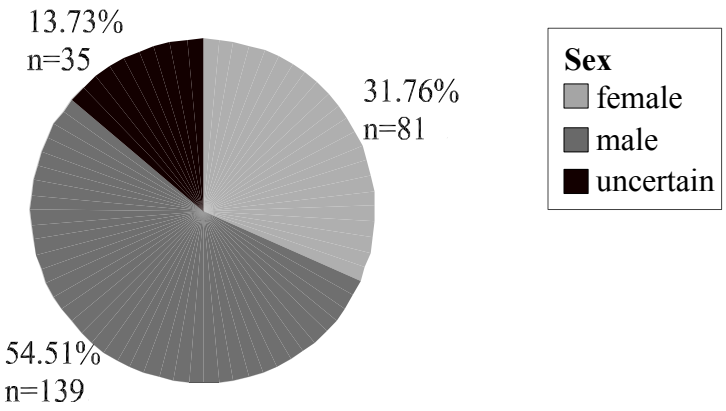


Figure 4: Composition of sample by sex

Ages given for the mummies included exact ages, number ranges, or descriptions such as adult or elderly. The average age of the Egyptians has been calculated as 27 for men and 22 for women (Strouhal 1992:254). When the high infant mortality is excluded from the calculation, the average age is 36 (Leca 1981:32). In comparison, the majority of the Royalty died between the ages of 20 and 50. When the Royal mummies were x-rayed, the ages calculated using modern techniques were approximately ten years older than the ages calculated by historians, although the reason for this discrepancy has not yet been explored in the literature (Strouhal 1992:254). Based on these studies, as well as by examining the data for natural breaks, the age classification presented in Table 5 was

applied to the mummies for analysis. The resulting frequency by age category of the sample is presented in Figure 5.

Table 5: Age classification used in analysis

Classification	Age range
Juvenile	0-14
Young Adult	15-24
Adult	25-49
Advanced Age	50+

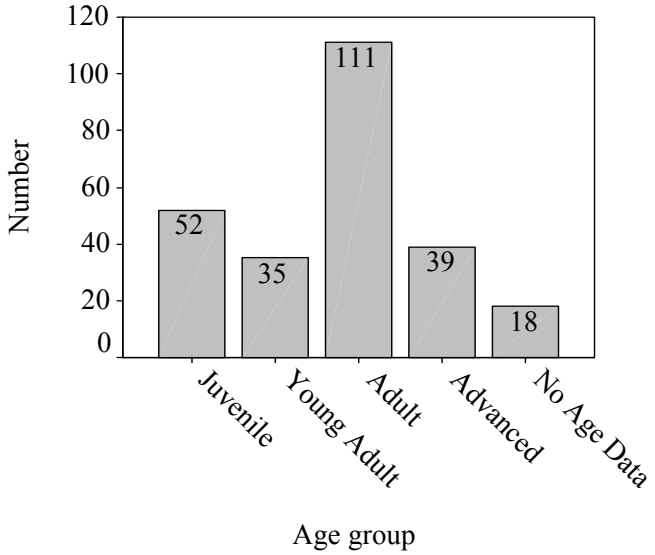


Figure 5: Age distribution of mummies in the sample

Only 36.5 percent of the sample, 93 mummies, had a known social class or position in society and the classes are presented in Table 6. Of these individuals with known class, all but 11.8 percent were Royalty, Upper Class or Priests and Priestesses. Some of these other individuals were workers for the Royal family. The two largest groups were Kings and Priests although when sex was taken into account, as presented in Table 7, the percents of Kings and Priests was about equal to the Queens and Priestesses.

While the Upper Class, the Working Class, and the 'Other' categories showed sex differences, the numbers of mummies in these categories was eleven, three, and eight, respectively, and are, perhaps, too small for further analysis.

Table 6: Composition of sample by social class

Class	Social class	Number	Percent
Royal	King	23	24.8
	Queen	11	11.8
	Prince	4	4.3
	Princess	1	1.1
	Royal relative	3	3.2
Upper	Upper class	11	11.8
Religious	Priest	20	21.5
	Priestess	9	9.7
Working	Working class	3	3.2
Other	Other	8	8.6
	Total	**93**	**100.0**

Table 7: Proportion of males and females by social class

Social class	Male		Female		Uncertain	
	Number	Percent	Number	Percent	Number	Percent
King/Queen	23	39.0	11	33.3	---	---
Prince/Princess	4	6.8	1	3.0	---	---
Royal Relative	2	3.3	1	3.0	---	---
Upper class	3	5.1	7	21.2	1	100.0
Priest/Priestess	20	33.9	9	27.3	---	---
Craftsperson	3	5.1	---	---	---	---
Other	4	6.8	4	12.1	---	---
Total (N=93)	**59**	**100.0**	**33**	**100.0**	**1**	**100.0**

The data were also examined for the period to which the mummies dated. Of the sample, 232 or 91.0 percent had this information and the results are presented in Table 8. Although the dates were recorded by dynasty or, in the case of the Kings, the year of their reign, for analysis purposes only the historic period was used. Few mummies, only 9.9 percent, predated the New Kingdom. The majority were from the New Kingdom, the Third Intermediate Period, and the Roman Period. As the Periods and Dynasties are not

of the same length, the number of mummies per period was divided by the number of years in that period. After this data transformation, the Third Intermediate, the Saite, and the Roman Periods had the majority of the mummies, but, again, few mummies were from before the New Kingdom.

Table 8: Composition of sample by historic period

Period	**Number**	**Percent**	**Number per 100 years**
Predynastic	8	3.4	0.5
Archaic	2	0.9	0.5
Middle Kingdom	8	3.4	2.9
Second Intermediate	5	2.2	2.3
New Kingdom	43	18.5	8.6
Third Intermediate	48	20.7	11.6
Saite	22	9.5	13.8
Late	14	6.0	7.7
Ptolemaic	26	11.2	8.6
Roman	56	24.2	13.1
Total	**232**	**100.0**	

Only 90 mummies had data on both historic period and social class, presented in Table 9. The Second Intermedidate period and the New Kingdom had the highest percentage of mummies with data on social class. In contrast, no mummies from the Predynastic and Archaic Periods had information on social class and few mummies from the Roman Period had a known social class. Most of the mummies from the New Kingdom were Royal (30 or 78.9 percent). While less than half of the mummies of the Third Intermediate Period had a known social class, those that did were predominantly from the religious class (13 or 61.9%). All other categories had less than five individuals and are too small for interpretation.

Table 9: Mummies of each historic period with data on social class

Period	Number of mummies in sample	Number of mummies with known social class	Percent
Predynastic	8	---	---
Archaic	2	---	---
Middle Kingdom	8	3	37.5
Second Intermediate	5	5	100.0
New Kingdom	43	38	88.4
Third Intermediate	48	21	43.8
Saite	22	4	18.2
Late	14	3	21.4
Ptolemaic	26	11	42.3
Roman	56	5	8.9
Total	**232**	**90**	**38.8**

The locations where the mummies were found are shown in Table 10. In order to consolidate the data for analysis, Egypt was divided into four geographic regions, North, Central, Thebes, and South, which can be seen on the map in Figure 2. In 51.8 percent of the sample, 132 mummies, the location where the mummy was found was not reported in the source or, more frequently, not recorded when the mummy was removed from its tomb. For those mummies of known provenience, the majority of the mummies were from the area around Thebes and the fewest were from the South. Within the area around Thebes, two caches are listed, Biban el Molouk and Deir el Bahri. These are the two caches of Royal mummies, the former found in 1898 in the tomb of Amenhotep I, and the latter found in 1881 in the tomb of Pinjudem. These two caches are important because they are concentrations of Royal mummies that were collected in one place for their protection. Other mummies were found in the Deir el-Bahri area but are separated from those found in the cache. Similarly, the Biban el Molouk cache is within the Valley of the Kings.

Table 10: Composition of sample by geographic location

Region	Location	Number	Percent
North	Fayum	6	4.9
	Gurob	1	0.8
	Hawara	11	8.9
	Saqqara	1	0.8
	Tarkhan	1	0.8
	Total	**20**	**16.2**
Central	Akhmin	10	8.1
	Assiut	4	3.3
	Beni Hasan	2	1.6
	Meir	4	3.3
	Rifeh	2	1.6
	Total	**22**	**17.9**
Thebes	Biban el Molouk cache	14	11.4
	Deir el-Bahri	4	3.3
	Deir el-Bahri cache	25	20.3
	Luxor	4	3.3
	Sheikh Abdu'l-Qurna	6	4.8
	Thebes	16	13.0
	Valley of the Kings	4	3.3
	Total	**73**	**59.4**
South	Gebelein	7	5.7
	Hissayeh	1	0.8
	Total	**8**	**6.5**
Total		**123**	**100.0**

When comparing the region and the period the mummies were from, as shown in Table 11, some interesting patterns emerge among the 123 mummies. The mummies in the North, presented in Figure 6, were dated predominantly to the Roman Period. The Central region had mummies that spanned more time periods with the majority in the Middle Kingdom and Ptolemaic Periods, as illustrated in Figure 7. Figure 8 shows that Thebes had mummies from the Second Intermediate Period onward, although the majority of the mummies were from the New Kingdom and the Third Intermediate

Period. The seven of the eight mummies found in the South were dated to the Predynastic and Archaic Periods and the remaining mummy was from the Ptolemaic Period, as shown in Figure 9. A Chi-square analysis shows a strong and statistically significant relationship between the period and location the mummies were from.

Table 11: Distribution of mummies by region and historic period

		North	Central	Thebes	South	Total
Predynastic	Number	---	---	---	6	**6**
	Percent	---	---	---	75.0	**4.9**
Archaic	Number	1	---	---	1	**2**
	Percent	5.0	---	---	12.5	**1.6**
Middle Kingdom	Number	---	8	---	---	**8**
	Percent	---	36.4	---	---	**6.5**
Second Intermediate	Number	---	---	5	---	**5**
	Percent	---	---	6.8	---	**4.1**
New Kingdom	Number	1	---	34	---	**35**
	Percent	5.0	---	46.6	---	**28.4**
Third Intermediate	Number	1	1	20	---	**22**
	Percent	5.0	4.5	27.4	---	**17.9**
Saite	Number	1	1	7	---	**9**
	Percent	5.0	4.5	9.6	---	**7.3**
Late	Number	---	1	1	---	**2**
	Percent	---	4.5	1.4	---	**1.6**
Ptolemaic	Number	---	9	2	1	**12**
	Percent	---	41.0	2.7	12.5	**9.8**
Roman	Number	16	2	4	---	**22**
	Percent	80.0	9.1	5.5	---	**17.9**
Total	**Number**	**20**	**22**	**73**	**8**	**123**
	Percent	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

$X^2 = 247.663$, Significance = .00, df = 27, Cramer's V = .819

The region where the mummies were found was also compared with the mummies' social classes. Sixty-five mummies had information on both social class and region as presented in Table 12. All of the Royal class and 85.7 percent of the Religious class were from the area around Thebes. Of the mummies of known social class found in the Thebes region, 69.1 percent were Royal and 21.8 percent were from the Religious

class. All the other categories had up to four individuals per category, preventing any meaningful interpretations.

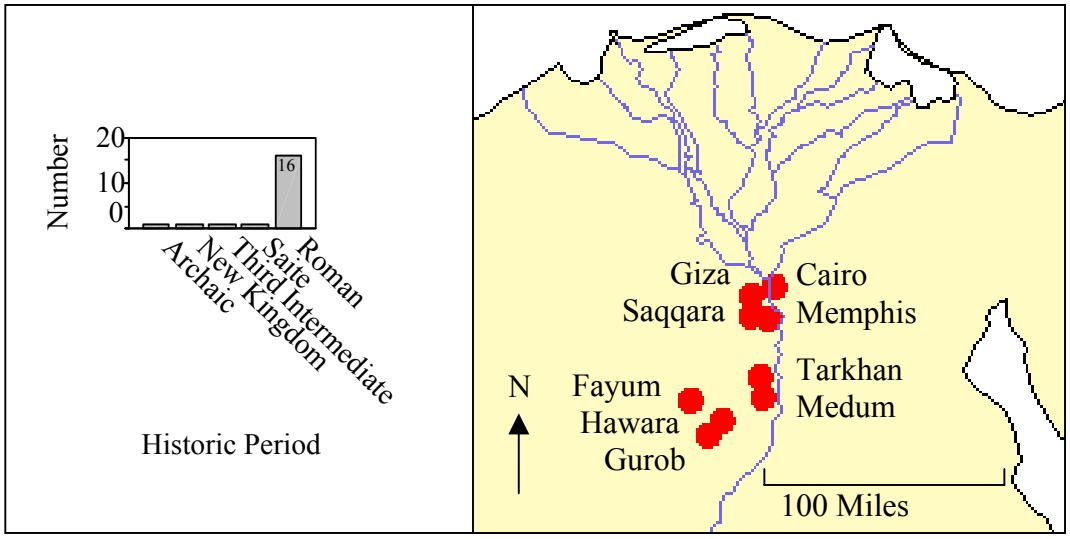


Figure 6: Map of Northern Egypt and the distribution of mummies by historic period

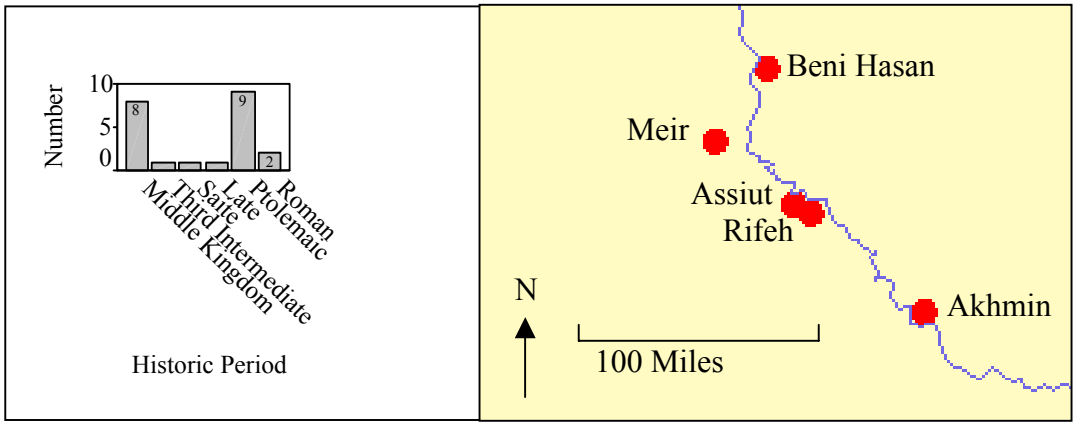


Figure 7: Map of Central Egypt and the distribution of mummies by historic period

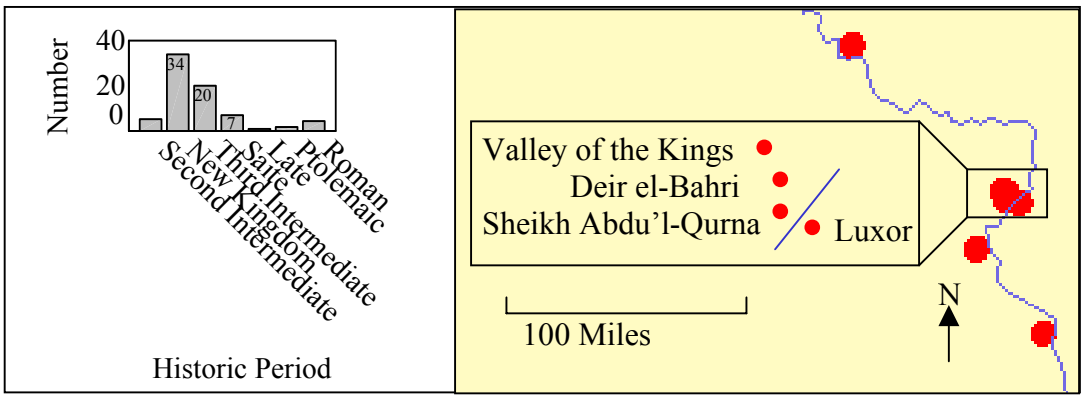


Figure 8: Map of Thebes area and the distribution of mummies by historic period

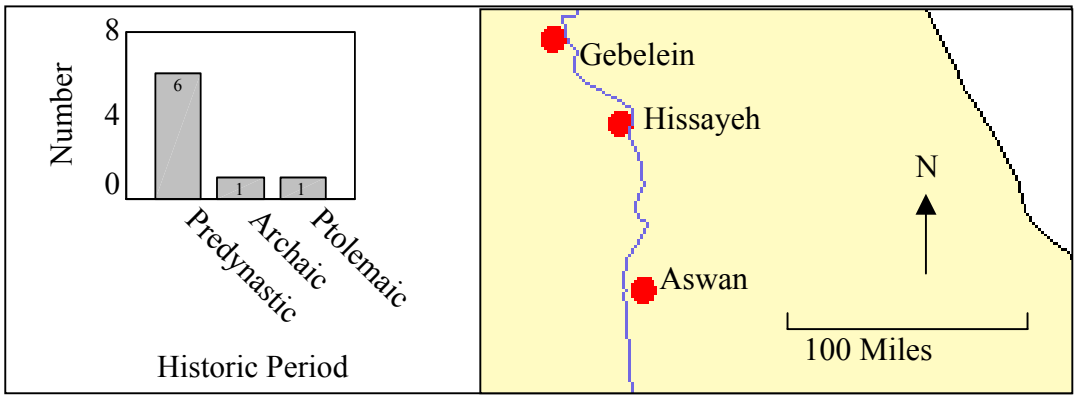


Figure 9: Map of Southern Egypt and the distribution of mummies by historic period

Table 12: Distribution of mummies by region and social class

		North	Central	Thebes	South	Total
Royal	Number	---	---	38	---	**38**
	Percent	---	---	69.1	---	**58.5**
Upper Class	Number	---	3	3	---	**6**
	Percent	---	37.5	5.5	---	**9.2**
Religious Class	Number	---	1	12	1	**14**
	Percent	---	12.5	21.8	100.0	**21.5**
Working Class	Number	---	---	2	---	**2**
	Percent	---	---	3.6	---	**3.1**
Other	Number	1	4	---	---	**5**
	Percent	100.0	50.0	---	---	**7.7**
Total	**Number**	**1**	**8**	**55**	**1**	**65**
	Percent	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Figures 10 and 11 show the number of mummies with coffins or cartonnage. Coffins were found more frequently than cartonnage, although, in some cases, the coffins belonged to an individual other than the mummy found inside. The cartonnage could be in the form of a full, coffin-like casing or in the form of several pieces: a mask, a pectoral, and/or a foot piece. Only 68 mummies had known information on the presence of both coffin and cartonnage. All but 20.6 percent had some form of coffin or cartonnage. Both a coffin and cartonnage were present in 44.1 percent while 35.3 percent had only one of a coffin or a cartonnage.

Of the mummies in this thesis, 60 individuals, or 23.5 percent, were found with amulets on or in the wrappings. When examining the mummies with amulets, 55.0 percent had postmortem damage and 45.0 percent did not. When compared with those mummies reported as plundered, 18.3 percent were plundered and 81.7 percent were not. Similarly, 18.3 percent of the mummies with amulets had embalming damage. Fifty-six mummies had information on both amulets and the date from which they came. The highest portion of the mummies with amulets was 46.4 percent in the Third Intermediate Period and indeed this is the only period where more than half the group had amulets (54.2 percent). Furthermore, 76.2 percent of the mummies with amulets were from the Thebes area but these mummies with amulets only comprise 21.9 percent of the mummies in Thebes. Finally, of the 93 mummies of known social class, no member of the Working Class had amulets, but 29.4 percent of the Royal Class, 20.6 percent of the Upper Class, 41.2 percent of the Religious Class, and 8.8 percent of the Other Class had amulets.

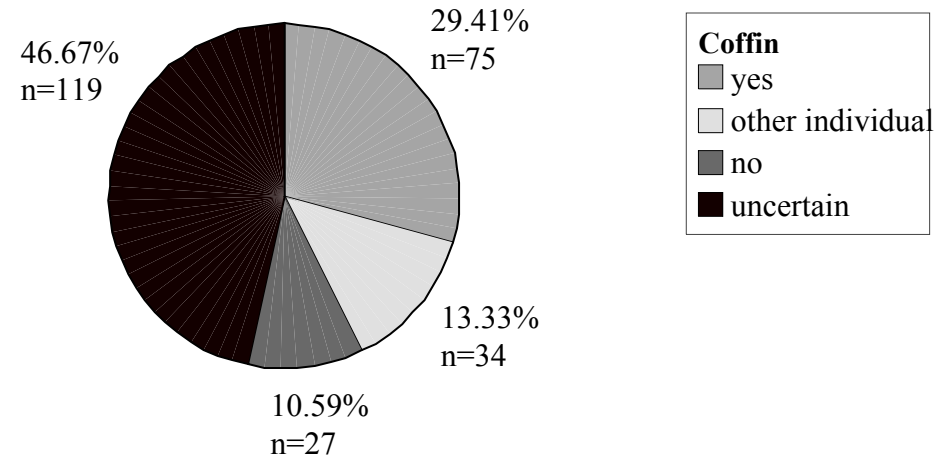


Figure 10: Presence of coffins with the mummies

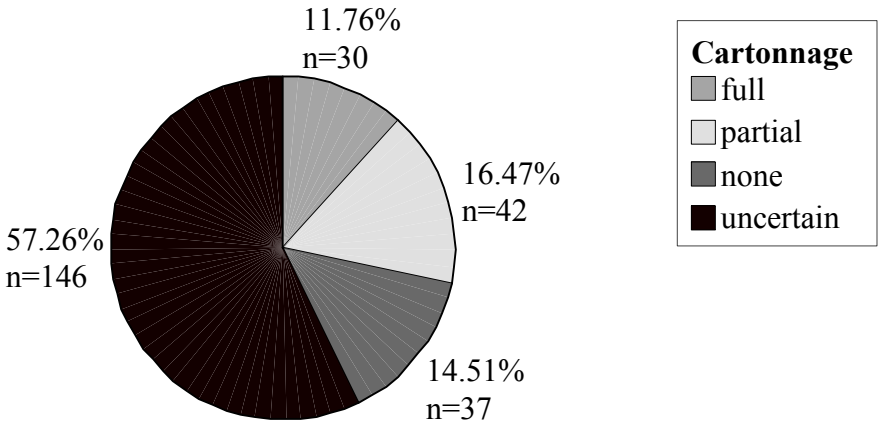


Figure 11: Presence of cartonnage with the mummies

Antemortem pathologies were present in 18.4 percent of the sample, or 47 individuals, and can be divided into four categories: congenital and developmental defects, evidence of infection, trauma, and other changes due to age and general progression of life. Most individuals had only one pathology. Congenital and developmental defects included *osteogenesis imperfecta*, *spina bifida occulta*, sacrilization, lumbarization, clubfoot, *pes cavus* or exaggerated arch of the foot, and

bowlegs, possibly from rickets. The infections as seen in both soft tissue and bone included guinea worms, smallpox, malaria, polio, a case of either schistosomasis or tuberculosis, and infections in the mandible, temporal, sphenoid, ear, and vertebrae. Healed fractures were most frequent in the pelvis but were also present in the cranium, humerus, radius, clavicle, sternum, ribs, and fibula. Two individuals were reported to have multiple fractures due to battle or an accident. Age-related pathologies were represented by osteoporosis, bipareital thinning, vertebral collapse, erosion or flattening of condyles as well as gall stones, sclerotic cysts, exostoses, calcification of arteries, herniated vertebral discs, and inguinal hernia. Finally, some pathologies of undetermined origin were present including scoliosis, a deformed hip joint, a lytic lesion on a parietal, and pathological changes to the rib.

The most frequent of the above listed pathologies were scoliosis and pelvic fractures which were observed in seven and five individuals, respectively. Postmortem damage was seen in 70.2 percent of the individuals with antemortem pathologies. Of these 33 cases, 10, or 30.3 percent, had postmortem damage in the same area as the antemortem pathology. The Pearson Chi-square analysis on the ante and postmortem damage produced a value of 0.765 and an asymptotic significance of 0.382. Therefore, Chi-square was not significant at the 0.05 confidence level.

Postmortem damage was present in 165 mummies, 64.7 percent of the sample. The postmortem damage was attributed to the embalmers in 34 individuals, comprising 21.7 percent of the damaged mummies. Similarly plundering was observed in 44 individuals. Of these plundered mummies, 37, or 22.9 percent, had postmortem damage while 7, or 7.8 percent, did not. Only one mummy had embalming damage and was

plundered. Finally, Tables 13 and 14 show that coffins and cartonnage were present in equal proportions among those mummies with postmortem damage and those mummies without.

Table 13: Incidence of postmortem damage for mummies with coffins

	Postmortem damage		**No Postmortem damage**	
	Number	**Percent**	**Number**	**Percent**
Yes	45	52.9	30	58.8
Other Individual	23	27.1	11	21.6
No	17	20.0	10	19.6
Total	**85**	**100.0**	**51**	**100.0**

Table 14: Incidence of postmortem damage for mummies with cartonnage

	Postmortem Damage		**No Postmortem Damage**	
	Number	**Percent**	**Number**	**Percent**
Full	16	24.6	14	31.8
Partial	26	40.0	16	36.4
None	23	35.4	14	31.8
Total	**65**	**100.0**	**44**	**100.0**

Table 15 illustrates that the majority of mummies of known social class had postmortem damage. In all classes except the religious class and those labeled 'Other,' more than 50 percent of the mummies were damaged. The upper class had the most postmortem damage, 81.8 percent, and the Royal class, the second most, 76.2 percent. Only 16.1 percent of the damaged mummies of known social class had embalming damage, shown in Table 16, while 51.8 percent had plundering damage. In addition, 84.4 percent of the Royal class had plundering damage; this was the highest percentage among the social classes. In contrast, only one of the royal mummies, 3.1 percent, had embalming damage. The Chi-square analysis shows a statistically significant relationship at the 0.05 level, between the social class of the individual and the presence of

postmortem damage, embalming damage and plundering damage. The relationship of plundering damage and location is strong but the other two relationships are of moderate strength.

Table 15: Incidence of postmortem damage per social class

	Postmortem Damage		**No Postmortem Damage**	
	Number	**Percent**	**Number**	**Percent**
Royal	32	76.2	10	23.8
Upper	9	81.8	2	18.2
Religious	10	34.5	19	65.5
Working	2	66.7	1	33.3
Other	3	37.5	5	62.5
Total	**56**	**60.2**	**37**	**39.8**

$X^2 = 16.408$, Significance = 0.003, df = 4, Cramer's V = 0.420

Table 16: Incidence of postmortem damage by cause per social class

	Embalming		**Plundering**		**Uncertain**		**Total**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Royal	1	3.1	27	84.4	4	12.5	32	100.0
Upper	4	44.4	---	---	5	55.6	9	100.0
Religious	3	30.0	1	10.0	6	60.0	10	100.0
Working	1	33.3	---	---	2	66.7	3	100.0
Other	---	---	1	50.0	1	50.0	2	100.0
Total	**9**	**16.1**	**29**	**51.8**	**18**	**32.1**	**56**	**100.0**

Embalming Damage: $X^2 = 11.929$, Significance = .018, df = 4, Cramer's V = .358
Plundering Damage: $X^2 = 52.536$, Significance = .000, df = 4, Cramer's V = .752

The periods were also examined for the proportion of postmortem damaged versus undamaged mummies and the results are presented in Table 17. All periods except the Saite Period had a majority of mummies with postmortem damage. Over 75 percent of the mummies in the Predynastic to Second Intermediate Periods had postmortem damage but the number of mummies in each of these periods was less than ten. The Roman Period had the highest level of postmortem damage excluding those periods already mentioned. The historic periods were further examined for postmortem

damage attributed to embalming and plundering, seen in Table 18. No postmortem damage from these two sources was reported in the Predynastic Period through the Middle Kingdom. The differences between these two sources of postmortem damage are primarily seen in the New Kingdom, which has the most plundering damage, and the Roman Period, which has the most embalming damage. All the other categories have ten or less individuals making analyses tentative. The results of Chi-square analysis do not show a statistically significant relationship at the 0.05 level of significance for the presence of postmortem damage. Embalming and plundering damage do show a statistically significant relationship with historic period. The relationship between plundering damage and historic period is stronger than the relationship between embalming damage and historic period.

Table 17: Incidence of postmortem damage per historic period

	Postmortem Damage		**No Postmortem Damage**	
	Number	**Percent**	**Number**	**Percent**
Predyanstic	6	75.0	2	25.0
Archaic	2	100.0	---	---
Middle Kingdom	7	87.5	1	12.5
Second Intermediate	4	80.0	1	20.0
New Kingdom	31	72.1	12	27.9
Third Intermediate	30	62.5	18	37.5
Saite	10	45.5	12	54.5
Late	9	64.3	5	35.7
Ptolemaic	13	50.0	13	50.0
Roman	44	78.6	12	21.4
Total	**156**	**67.2**	**76**	**32.8**

$X^2 = 15.571$, Significance = 0.076, df = 9

Table 18: Incidence of postmortem damage by cause per historic period

	Embalming Damage		**Plundering Damage**		**Unknown Source**		**Total**	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Predynastic	---	---	---	---	6	100.0	6	100.0
Archaic	---	---	---	---	2	100.0	2	100.0
Middle Kingdom	---	---	---	---	7	100.0	7	100.0
Second Inter-mediate	1	25.0	3	75.0	---	---	4	100.0
New Kingdom	---	---	22	71.0	9	29.0	31	100.0
Third Inter-mediate	9	30.0	7	23.3	14	46.7	30	100.0
Saite	1	10.0	---	---	9	90.0	10	100.0
Late	---	---	1	11.1	8	88.9	9	100.0
Ptolemaic	6	46.2	1	7.6	6	46.2	13	100.0
Roman	16	36.4	1	2.2	27	61.4	44	100.0
Total	**33**	**21.2**	**35**	**22.4**	**88**	**56.4**	**156**	**100.0**

Embalming Damage: $X^2 = 26.187$, Significance = .002, df = 9, Cramer's V = .336
Plundering Damage: $X^2 = 81.805$, Significance = .000, df = 9, Cramer's V = .594

When examining the proportion of postmortem damage by each region of Egypt, shown in Table 19, all regions had over 50 percent of the mummies with postmortem damage. The least amount of postmortem damage was in the Central region and the second least in the area of Thebes. All eight mummies from the South were damaged. Table 20 shows that while only fifteen mummies with embalming damage have a known provenience, embalming damage does seem to be more frequent among mummies in the North. In contrast, the mummies in the area around Thebes had more evidence of plundering than the other regions. For the Chi-square analyses of location versus postmortem damage, embalming damage and plundering damage, all are statistically significant at the .05 level but are only of weak to moderate strength.

Table 19: Incidence of postmortem damage per geographic region

	Postmortem Damage		No Postmortem Damage	
	Number	**Percent**	**Number**	**Percent**
North	18	90.0	2	10.0
Central	13	59.1	9	40.9
Thebes	47	64.4	26	35.6
South	8	100.0	---	---
Total	**86**	**69.9**	**37**	**30.1**

$X^2 = 9.566$, Significance = .023, df = 3, Cramer's V = .279

Table 20: Incidence of postmortem damage by cause per geographic location

	Embalming Damage		Plundering Damage		Unknown Source		Total	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
North	8	44.4	1	5.6	9	50.0	18	100.0
Central	2	15.4	---	---	11	84.6	13	100.0
Thebes	4	8.5	28	59.6	15	31.9	47	100.0
South	1	12.5	---	---	7	87.5	8	100.0
Total	**15**	**17.5**	**29**	**33.7**	**42**	**48.8**	**86**	**100.0**

Embalming Damage: $X^2 = 17.713$, Significance = .001, df = 3, Cramer's V = .379
Plundering Damage: $X^2 = 30.404$, Significance = .000, df = 3, Cramer's V = .497

Finally, the postmortem damage was examined in relation to the region of the body the damage occurred. Table 21 shows that 69.7 percent of the damaged mummies were affected in the thorax region while the second most affected area was the cranium at 44.8 percent. The least affected area was the hands. The postmortem damage to the cranium, thorax, pelvis, arms, and legs was predominantly dislocations and fractures while the damage to the hands and feet was both dislocations and missing bones. The thorax, which had the highest percent of postmortem damage, had many dislocated and fractured ribs.

Table 21: Incidence of postmortem damage per body part

Body Part	Number	Percent of Damaged Mummies (N=165)
Cranium	74	44.8
Thorax	115	69.7
Pelvis	47	28.5
Arms	49	29.7
Hands	29	17.6
Legs	39	25.6
Feet	46	27.9

As shown in Table 22, the areas where postmortem damage occurred from embalming and/or plundering vary throughout the body. The mummies with embalming damage have 61.8 percent of the damage to the thorax while the next most affected area was the pelvis at 20.6 percent of the damage. In contrast, damage due to plundering affected the cranium and thorax the most. Furthermore, damage to the arms, hands and legs was almost exclusively due to plundering.

Table 22: Incidence of postmortem damage by cause per body part

Body Part	Embalming Damage		Plundering	
	Number	Percent	Number	Percent
Cranium	5	14.7	23	62.2
Thorax	21	61.8	22	59.5
Pelvis	7	20.6	8	21.6
Arms	3	8.8	18	48.6
Hands	1	2.9	9	24.3
Legs	3	8.8	9	24.3
Feet	7	20.6	11	29.7

The results presented in this chapter show some patterns in relation to the postmortem damage the mummies incurred and which mummies were more likely to have damage. These patterns are discussed in the following chapter.

CHAPTER 5: DISCUSSION

Before analyzing the data for patterns relating to damage, the demographic composition of the sample was examined. The sample was shown to have more males than females although this predominance cannot be explained in the literature. Furthermore, women had most of the same freedoms as men and could own property and dispose of it as they chose. Although women provided a dowry at marriage, they received certain considerations from their husbands and were entitled to divorce (Trigger et al. 1983:312). Women even ruled Egypt. For example, at the end of the XIX Dynasty, Queen Tawroset ascended the throne after her husband, Seti II, died and ruled for eight years until her death (Wente 1980a:146; 1980b:263).

The majority of the mummies were in the adult age group. Gray (1973:52) noted a similar observation after examining 193 mummies from various periods and finding few juveniles in the dynastic periods but many from the Roman period. No reason can be given for the lack of mummified juveniles although it may relate to burial customs or preservation.

The individuals' social classes were almost entirely limited to the Royal, Upper and Religious classes. The only exceptions were a son of a sistrum player in one of the temples, a son of a priest and house mistress, a steward, a chief treasurer, two house mistresses, a teacher, a sailor, a weaver, and a craftsman of one of the temples. Of these ten individuals, two were children of members of the Religious class and five worked in religious or royal houses. The lack of information on the lower classes is most likely the result of the lower classes not being provided with the inscribed linens and coffins as the wealthier would have been. A bias is present in the data in that mummies of higher class

tend to be wrapped with more care and decorations and are thus more desirable for collectors and museums. Furthermore, more money has been put into the archaeology, preservation, and research of the Royal mummies.

The majority of the mummies were from the New Kingdom, the Third Intermediate Period, and the Roman Period. Few mummies predated the New Kingdom, which is primarily the result of the poor preservation of mummies from these periods. The high number of mummies from the New Kingdom and the Third Intermediate relate both to the preservation of the mummies, as this period was the time when the embalming process was at its best, and to the bias in Egyptology to collect Royal and Upper class mummies.

With regard to the location where the mummies came from, 65 percent were from the Thebes area. A two-fold explanation explores this result. First, Thebes was a large city, even in ancient times, while the cities in central Egypt were generally small. Although the capital shifted many times between Memphis in the north and Thebes in the south, after the Second Intermediate Period, the center of power was predominantly in Thebes (Trigger et al. 1983:113-114, 171). Since this shift happened before the practice of mummification had been perfected and the preservation of mummies of this time is low, few mummies survive from the north. In addition, in order to prevent the tombs from being robbed, the tombs were built more secretly around Thebes as compared with the more conspicuous pyramids in the north. Second, more interest has been paid to the area around Thebes by the archaeologists and, thus, more mummies have been found for analysis.

A similar pattern between the location and rank of the mummies and between the time and rank of the mummies is seen in the data. All the Royal mummies and most of the Religious class were from the area around Thebes. Few mummies in the other regions of Egypt had a known rank, and, therefore, no interpretation can be made. Similarly, most of the mummies from the New Kingdom were Royalty, which is related to the caches of royal mummies made by the priests in an effort to protect the mummies. In contrast, few mummies from the Roman Period had a known rank, but this period was a time when mummification was accessible to everyone and large numbers of mummies have been found.

The majority of the mummies were found in a coffin although 24.8 percent were known to be in a coffin of another individual. This occurrence was the result of the mummies being put in coffins in the ancient times, particularly by the priests trying to restore and protect the mummies, as well as by antique dealers in more recent times putting mummies into empty coffins for sale to collectors. High levels of missing data were observed in examining the presence of coffins and cartonnage, 46.7 and 57.3 percent respectively. This lack of data is most likely due to the fact that the subject of the articles and books used in this study is the mummy itself and the sources did not always report on the funerary accessories present.

5.1 Damage

Antemortem pathologies were seen in less than twenty percent of the sample and few of the pathologies observed were life threatening. The presence of antemortem pathologies did not seem to increase the probability of postmortem damage as only 30.3 percent of the mummies with evidence of an antemortem pathology had postmortem

damage to the same region of the body. Of those ten cases with both ante and postmortem damage, in only two individuals was the damage probably related.

Six mummies had scoliosis as well as postmortem thoracic dislocations and, in two individuals, rib fractures. Five of these were from the Ptolemaic or Roman Periods while the sixth was from the XII Dynasty (Middle Kingdom). In addition, only the mummy from the Middle Kingdom had a coffin, while one had a full cartonnage and three had partial cartonnage. While it is possible that the scoliosis affected the articulations of the vertebrae and ribs, five of these six mummies were dated to the Ptolemaic and Roman Periods when rib disarticulations due to tight wrappings were not uncommon. This damage may not be related to the scoliosis.

Of the remaining four cases of both ante and postmortem pathologies, the mummy with osteoporosis also had fractures to the ribs, left humerus, and femora, as well as missing bones in the hands and feet. This mummy was from the late Predynastic and was found in a wicker basket but did not have any wrappings. In this case, the damage could be from the lack of protective coverings, as supported by the missing hand and foot bones.

Two mummies with both ante and postmortem damage had signs of antemortem trauma. One of these mummies was that of Tutankhamen who had a hematoma at the base of his cranium and a postmortem fracture to the back of his cranium resulting in a dislodged bone fragment. The postmortem damage has been attributed to the investigators in modern times who used chisels and knives to remove the mummy from its coffin (Brier 1998b:164-166). The antemortem and postmortem damage occurred in

different areas of the cranium, and no skeletal damage was associated with the injury to the base of the skull; thus, the two injuries are not likely to be related.

The other mummy with antemortem trauma, dated to the XXV Dynasty (Third Intermediate Period), was suggested to have been involved in an accident but lived long enough for some callus formation (Minninberg 2001:194). It is likely in this case that the rib and pelvic fractures weakened the thorax as the embalmers inserted rods for support, but the ribs were still dislocated due to tight wrapping (Minninberg 2000:62). That antemortem injury likely did increase the postmortem damage.

Finally, the mummy who had *osteogenesis imperfecta* was an infant from the XXII Dynasty (Third Intermediate Period) and was found in a full cartonnage case that was too big for the individual. Many of the bones of this individual were "disorganized" (Dawson and Gray 1968:14). The condition of *osteogenesis imperfecta* causes brittle bones prone to fractures, and it is possible that the bones fractured and disarticulated postmortem due to their fragile nature.

Interestingly, damage to the mummies did not seem to affect whether or not amulets were present although those mummies with evidence of plundering did not have amulets as frequently as non-plundered mummies. Although the data collected on amulets was not analysed in detail, some general observations were made. Amulets were found in all regions of the body as well as on the outside of the wrapping, among the wrappings, on the outside of body but under the wrappings, and inside the mummy, particularly in the abdominal cavity. These amulets included heart scarabs, pectorals, rings, bracelets, anklets, flank incision plates, and bead-nets with metal amulets attached. Materials used for the amulets and jewelry were metal, wood, stone and wax.

The presence or absence of coffins and cartonnage does not seem to have an effect on the incidence of damage. Coffins and cartonnage might provide some protection for the body, but much of the damage was due to the embalmers before the mummies were placed in the coffins, or due to plundering, in which case the coffin was opened and the body removed. In addition, mummies were placed back in coffins after they were damaged both by the priests who restored the bodies and in modern times by the individuals selling the mummies.

The majority of the mummies in this thesis show evidence of damage which can be attributed to four main sources: the embalming process, plundering, exposure over time, and handling and transportation in recent years. Different patterns of damage can be observed among these different sources of damage.

Embalming damage was seen in 34 individuals, or 21.7 percent of those mummies with damage. The damage caused by the embalmers can be placed into four categories: brain removal, the subcutaneous packing, altering the body to fit a case, and overly tight wrapping. In general, the damage caused by the embalmers involved dislocations although some fractures, amputations, and missing bones were observed. Additionally, the damage was generally found in the thorax and pelvis with the exception of damage to the cranium due to brain removal or to the feet and legs in order to make the body fit into a coffin.

Brain removal was usually done through the nose but, in some cases, the brain was removed through the foramen magnum at the base of the cranium (Iskander 1980:19). As explained in the chapter on methods, damage due to brain extraction via the nose was not included in this analysis. In order to perform the extraction through the

foramen magnum, the head was separated from the neck around either the first or second cervical vertebra. This procedure often resulted in the head being loose; in some cases, the cervical vertebrae were not replaced. One mummy in the sample had large holes in the cranium and the researchers attributed the holes to brain removal (Marx and D'Auria 1986). This method of brain removal was rare. Though this researcher has not encountered another similar incident, references to this method do exist (Iskander 1980:19).

In a few individuals, the process of subcutaneous packing in order to maintain the shape of an individual's features resulted in damage. Ribs, particularly the first and second ribs, were dislocated although it is not certain if this was done by the embalmers in order to insert the packing material, or if the pressure from the material dislocated the ribs at a later time.

Another practice of the embalmers was to alter the mummy in order to make it fit its coffin or be wrapped more easily. Some of the mummies had dislocated and inverted feet while others had more drastic alterations including severing bones in order to shorten or lengthen the body. One of the best examples of this damage was a child mummy in the Field Museum of Natural History, Chicago. This child's arms were missing, the femora were fractured and the distal portions were missing, and the feet were cramped. All these alterations were done in order to fit the body in a coffin which was too small (Moodie 1931:23).

Finally, many mummies had damage as a result of being wrapped too tightly, which was the most frequent type of embalming damage in this thesis. In these cases, the thorax and pelvic regions were dislocated and bones jumbled or even fractured.

Sometimes, the mummification did not occur until the body was in a state of advanced decomposition. In these situations, the bones dislocated easily. This type of damage was especially common among the mummies of the Roman Period and in the North. Those mummies with known social class were almost exclusively from the higher classes and had little embalming damage, which was probably the result of the embalmers performing better mummification techniques on the mummies of the higher classes.

The damage attributed to plunderers and to handling and exposure appeared different from the embalming damage. Unfortunately, the types of damage attributed to these two sources had a similar appearance. To distinguish between damage due to plundering and to exposure, the trauma must be examined for color differences indicating ancient versus modern damage as well as damage to the linens and the presence of tool marks that would suggest plundering. Fractures were much more frequent as a result of plunderers and handling although disarticulations were present. Furthermore, entire limbs were severed, fractured or dislocated, and remained separate from the remainder of the body. These types of damage were more likely to be seen in the cranium, thorax, and the limbs, and the damage to the arms and hands was almost exclusively from these sources.

Plundering was seen most frequently in the New Kingdom in the area around Thebes. Of the mummies of known ranks, most plundering occurred to the Royal mummies. All three of these attributes are interconnected as the majority of the Royal mummies were found in Thebes and dated to the New Kingdom, and *vice versa.*

As shown, patterns did emerge in the damage to the Egyptian mummies, such as the affected regions of the body and the type of trauma due to the different sources of

damage. In contrast, antemortem damage did not appear to increase the incidence of postmortem damage. Additionally, the presence of casings did not appear to increase the protection of the mummy. Although not all the hypotheses of this thesis were supported by the data, the results provide useful insight on cultural and social practices in both ancient and modern Egypt.

CHAPTER 6: CONCLUSION

The patterns that emerged from this thesis showed that there were differences between the sources of damage, in particular the embalmers and the plunderers, the region of the body that was damaged, and type of damage that occurred. The postmortem damage attributed to the embalmers was primarily dislocations with some fractures and was observed in the thorax and pelvic regions. Conversely, the damage attributed to the plunderers included fractures, cut marks, dislocations and missing body parts, and was observed in all regions of the body, in particular the cranium and thorax.

Mummies of the New Kingdom were primarily from the area around Thebes and were from the upper classes. These mummies had a high frequency of plundering damage. In contrast, the mummies of the Ptolemaic and Roman periods were from North and Central Egypt, but were generally of unknown social class. These mummies had a high frequency of postmortem damage due to the embalmers. Thus, a relationship is observed between the type of damage and the historic period, geographic location and social class. No correlation is observed between the postmortem damage and the presence of antemortem pathologies, protective casings, or amulets.

Although mummification can preserve a body for several millennia, it is a popular misconception that these bodies are in pristine condition. The results of this study offer insight into the mummification process and the activities of the tomb robbers.

WORKS CITED

Adams LK. Conversation with author, 14 February 2003.

Andrews C. 1984. *Egyptian Mummies.* London: The Trustees of the British Museum.

Atlas of Ancient Egypt. 1894. London: Egypt Exploration Fund.

Aufderheide AC. 2003. *The Scientific Study of Mummies.* Cambridge: Cambridge University Press.

Bakry HSK. 1965. *A Brief Study of Mummies and Mummification*. Cairo: Al-Takaddum Press.

Bertoldi F and G Fornaciari. 1997. A Brief Study of Egyptian Mummification Techniques. *Paleopathology Newsletter.* 99: 10 – 12.

Bienkowski P. Email to author, 31 January 2003.

Bourriau J and J Bashford. 1980. Radiological Examination of Two Mummies of the Roman Era. *MASCA Journal.* 1: 168 – 171.

Brier B. 1998a. *TheEncyclopedia of Mummies*. New York: Facts on File.

Brier B. 1998b. *The Murder of Tutankhamen.* New York: Berkley.

Bridgeman CF. 1967. A Mummy Comes to Life. *Science on the March*. 47: 20-22.

Bucaille M. 1990. *Mummies of the Pharaohs.* New York: St. Marin's Press.

Budge EAW. 1894. *The Mummy: Chapters on Egyptian Funereal Archaeology*. Cambridge: Cambridge University Press.

Cockburn A, Barraco RA, Reyman TA and WH Peck. 1975. Autopsy of an Egyptian Mummy. *Science*. 187: 1155 – 1160.

Cockburn A, Barraco RA, Peck WH and TA Reyman. 1980. A classic mummy: PUM II. In Cockburn A and E Cockburn. (eds.) *Mummies, Disease, and Ancient Cultures*. Cambridge: Cambridge University Press. Pp. 52 – 70.

Cohen D. 1980. *The Tomb Robbers*. New York: McGraw-Hill.

Dannenfeldt KH. 1959. Egypt and Egyptian Antiquities in the Renaissance. *Studies in the Renaissance*. 6: 7 – 27.

Dannenfeldt KH. 1985. Egyptian Mumia: The Sixteenth Century Experience and Debate. *Sixteenth Century Journal.* 16: 163 – 180.

D'Auria S. 1988. Mummification in Ancient Egypt. In D'Auria S, Lacovara P, and C Roehrig (eds.) *Mummies and Magic: The Funerary Arts of Ancient Egypt*. Boston: Museum of Fine Arts. Pp. 14 – 19.

D'Auria S, Lacovara P, and C Roehrig (eds.). 1988. *Mummies and Magic: The Funerary Arts of Ancient Egypt*. Boston: Museum of Fine Arts.

David AR. 1979. A Catalogue of Egyptian Human and Animal Mummified Remains. In David AR (ed.) *Manchester Museum Mummy Project: multidisciplinary research on ancient Egyptian mummified remains.* Leeds: Manchester Museum. Pp. 1 – 17.

Dawson WR. 1927. On two mummies formerly belonging to the Duke of Sutherland. *The Journal of Egyptian Archaeology*. 13: 155-161.

Dawson WR and Gray PHK. 1968. *Catalogue of Egyptian Antiquities In The British Museum I: Mummies and Human Remains.* London: The Trustees of the British Museum.

Diener L. 1986. The Two Oldest Patients Ever Examined at the Karolinska Hospital in Stockholm – A Case Report. In David AR (ed.) *Science in Egyptology*. Manchester: Manchester University Press. Pp. 337 – 339.

Dyson SL. 1979. The Mummy of Middletown. *Archaeology.* 32: 57-59.

Dzierzykray-Rogalski T. 1986. Problems of Preservation of Ancient Mummies in Contemporary Egypt. In David AR (ed.) *Science in Egyptology*. Manchester: Manchester University Press. Pp. 91 – 93.

el Mahdy C. 1989. *Mummies, Myth and Magic in Ancient Egypt.* London: Thames and Hudson Ltd.

Fleming, SJ, Fishman B, O'Connor D, and D Silverman. 1980. *The Egyptian Mummy Secrets and Science.* Philadelphia: The University Museum, University of Philadelphia.

Gray PHK. 1966a. Embalmers' Restorations. *Journal of Egyptian Archaeology*. 52: 138 – 140.

Gray PHK. 1966b. Radiological Aspects of the Mummies of Ancient Egyptian in the Rijksmuseum van Oudheden, Leiden. *Oudheidkundige Medelin Gen uit het Rijksmuseum van Oudheiden te Leiden.* 47: 1 – 30.

Gray PHK. 1967. Two mummies of Ancient Egyptians in the Hancock Museum, Newcastle. *Journal of Egyptian Archaeology*. 53: 75 – 78.

Gray PHK. 1970. An Account of a Mummy in the County Museum and Art Gallery, Truro. *Journal of Egyptian Archaeology*. 56: 132 – 134.

Gray PHK. 1973. The radiography of mummies of ancient Egyptians. In Brothwell DR and BA Chiarelli (eds.) *Population Biology of the Ancient Egyptians.* London: Academic Press. Pp. 51-53.

Gray PHK and D Slow. 1968. *Egyptian Mummies in the City of the Liverpool Museum.* Liverpool: Liverpool Corporation.

Hamilton-Paterson J and C Andrews. 1978. *Mummies: Death and Life in Ancient Egypt*. Brattleboro, VT: Penguin Books.

Harris JE and KR Weeks. 1973. *X-Raying the Pharaohs*. New York: Charles Scribner's Sons.

Harwood-Nash DCF. 1979. Computed Tomography of Ancient Egyptian Mummies. *Journal of Computer Assisted Tomography*. 3: 768 – 773.

Hunt DR. Email to author, 1 May 2003.

Hunt DR and LM Hopper. 1996. Non-invasive Investigations of Human Mummified Remains by Radiographic Techniques. In Spindler K, Wilfing H Rastbichler-Zissernig E, zur Nedden D and H Nothdurfter (eds.) *Human Mummies: A Global Survey of their Status and the Techniques of Conservation.* Wein: Springer-Verlag. Pp. 16 – 31.

Ikram S and A Dodson. 1987. *Royal Mummies in the Egyptian Museum.* Cairo: The American University in Cairo Press.

Isherwood I, Jarvis H and RA Fawcitt. 1979. Radiology of the Manchester Mummies. In David AR (ed.) *Manchester Museum Mummy Project: multidisciplinary research on ancient Egyptian mummified remains.* Leeds: Manchester Museum. Pp. 25 – 64.

Iskander Z. 1980. Mummification in Ancient Egypt: Development, History and Techniques. In Harris JE and EF Wente (eds.) *An X-Ray Atlas of the Royal Mummies*. Chicago: The University of Chicago Press. Pp. 1 – 52.

Kemp BJ. 1967. The Egyptian First Dynasty Royal Cemetery. *Antiquity*. 41: 22 – 32.

Koller J, Baumer U, Kaup Y, Etspüler H and U Weser. 1998. Embalming Was Used In Old Kingdom. *Nature.* 391: 343 – 344.

Kristen KT and TA Reyman. 1980. Radiographic Examination of Mummies with Autopsy Correlation. In Cockburn A and E Cockburn. (eds.) *Mummies, Disease, and Ancient Cultures*. Cambridge: Cambridge University Press. Pp. 287 – 300.

Krogman WM and MJ Baer. 1980. Age at Death of Pharaohs of the New Kingdom, Determined from X-Ray Films. In Harris JE and EF Wente. (eds.) *An X-Ray Atlas of the Royal Mummies.* Chicago: University of Chicago Press. Pp. 188 – 233.

Langone J. 1984. X-raying Egyptian Mummies. *Discover*. 5(11): 68 – 72.

Leca AP. 1981. *The Egyptian Way of Death: Mummies and the Cult of the Immortal*. Garden City, NY: Doubleday and Company, Inc.

Leek FF. 1969. The Problem of Brain Removal During Embalming by the Ancient Egyptians. *Journal of Egyptian Archaeology*. 55: 112 – 116.

Lombardi GP. 1999. *Egyptian Mummies at Tulane University: An Anthropological Study.* Master's thesis, Tulane University, New Orleans.

Lucas A. 1962. *Ancient Egyptian Materials and Industries*. Revised by JR Harris. London: Edward Arnold, Ltd.

Manniche L. 1987. *City of the Dead: Thebes in Egypt*. Chicago: The Universtiy of Chicago Press.

Marx M and SH D'Auria. 1986. CT Examination of Eleven Egyptian Mummies. *RadioGraphics* 6: 321 – 330.

Miller WM. The Theban Royal Mummy Project. Retrieved December 2003, from http://members.tripod.com/anubis4_2000/mummypages1/intro.htm

Millet NB, Hart GD, Reyman TA, Zimmerman MR and PK Lewin. 1980. ROM I: Mummification for the Common People. In Cockburn A and E Cockburn. (eds.) *Mummies, Disease, and Ancient Cultures*. Cambridge: Cambridge University Press. Pp. 71 – 84.

Minninberg DT. Conversation with author, 30 July 2003.

Mininberg DT. 2000. A 25th-dynasty vehicular accident. *KMT: Modern Journal of Ancient Egypt.* 11: 60 – 69.

Mininberg DT. 2001. The Museum's Mummies: An Inside View. *Neurosurgery*. 49: 192 – 199.

Moodie RL. 1931. *Roentgenologic Studies of Egyptian and Peruvian Mummies.* Chicago: Field Museum of Natural History.

Moss CM. 1985. Scanning Ancient Egypt. *Science '85*. 6(1): 82 – 84.

Murray MA. 1910. *The Tomb of Two Brothers*. Manchester: Manchester Museum Press.

Nelson A. Conversation with author, 24 October 2003.

Nelson A. 2003. The Virtual Mummy Media Page - The Sulman Mummy. http://hal.ssc.uwo.ca/media/virtual/index.htm

Notman DNH. 1986. Ancient Scannings: Computed Tomography of Egyptian Mummies. In David AR (ed.) *Science in Egyptology*. Manchester: Manchester University Press. Pp. 251 – 320.

Parsche F and G Ziegelmayer. 1986. Munich Mummy Project – A Preliminary Report. In David RA (ed.) *Science in Egyptology.* Manchester: Manchester University Press. Pp. 81 – 86.

Peck WH. 1980. Mummies of Ancient Egypt. In Cockburn A and E Cockburn. (eds.) *Mummies, Disease, and Ancient Cultures*. Cambridge: Cambridge University Press. Pp. 11 – 28.

Pringle H. 2001. *The Mummy Congress: Science Obsession, and the Everlasting Dead*. New York: Penguin.

Reid H. 2001. *In Search of the Immortals: Mummies, Death and the Afterlife.* New York: St. Martin's Press.

Rösling FW. 1993. Possible Future Directions of a Bioanthropology of Ancient Egypt. In Davies WV and R Walker (eds.) *Biological Anthropology and the Study of Ancient Egypt.* London: British Museum Press.

Seipel W. 1996. Research on Mummies in Egyptology. An Overview. In Spindler K, Wilfing H Rastbichler-Zissernig E, zur Nedden D and H Nothdurfter (eds.) *Human Mummies: A Global Survey of their Status and the Techniques of Conservation.* Wein: Springer-Verlag. Pp. 41 – 45.

Smith GE. 1912. *The Royal Mummies*. Catalogue general des antiquités égyptiennes du Musée du Caire, Nos. 61051-61100. Cairo: Service des antiquités de l'Egypte.

Smith GE and WR Dawson. 1924. *Egyptian Mummies*. London: Allen and Unwin.

Sluglett J. 1980. Mummification in Ancient Egypt. *MASCA Journal*. 1: 163 – 167.

Strouhal E. 1992. *Life of the Ancient Egyptians.* Norman: University of Oklahoma Press.

Trigger BG, Kemp BJ, O'Connor D and AB Lloyd. 1983. *Ancient Egypt: A Social History*. Cambridge: Cambridge University Press.

Vahey T and D Brown. 1984. Comely Wenuhotep: Computed Tomography of an Egyptian Mummy. *Journal of Computer Assisted Tomography.* 8: 992 – 997.

Wente EF. 1980a. Genealogy of the Royal Family. In Harris JE and EF Wente (ed.) *An X-Ray Atlas of the Royal Mummies*. Chicago: The University of Chicago Press. Pp. 122 – 162.

Wente EF. 1980b. Age at Death of Pharaohs of the New Kingdom, Determined from Historical Sources. In Harris JE and EF Wente (ed.) *An X-Ray Atlas of the Royal Mummies*. Chicago: The University of Chicago Press. Pp. 122 – 162.

Whitehouse WM. 1980. Radiologic Findings in the Royal Mummies. In Harris JE and EF Wente (eds.) *An X-Ray Atlas of the Royal Mummies*. Chicago: The University of Chicago Press. Pp. 286 – 327.

White JEM. 1970. *Ancient Egypt: Its Culture and History.* New York: Dover Publications, Inc.

APPENDIX: MUMMIES USED IN ANALYSIS

Museum	Museum ID	Sources	Exclude
British Museum, London	32751	Dawson and Gray 1968:1	
British Museum, London	32752	Dawson and Gray 1968:1	
British Museum, London	32753	Dawson and Gray 1968:2	
British Museum, London	32754	Dawson and Gray 1968:2	
British Museum, London	32755	Dawson and Gray 1968:3	
British Museum, London	32756	Dawson and Gray 1968:3	
British Museum, London	52887	Dawson and Gray 1968:4	
British Museum, London	57353	Dawson and Gray 1968:4	
British Museum, London	52888	Dawson and Gray 1968:4-5	Excluded
British Museum, London	40924-7	Dawson and Gray 1968:5	Excluded
British Museum, London	46631	Dawson and Gray 1968:6	
British Museum, London	23425	Dawson and Gray 1968:6	
British Museum, London	29574	Dawson and Gray 1968:7	
British Museum, London	48971	Dawson and Gray 1968:7	
British Museum, London	22939	Dawson and Gray 1968:8	
British Museum, London	30720	Dawson and Gray 1968:8-9	
British Museum, London	22812B	Dawson and Gray 1968:9	
British Museum, London	6660	Dawson and Gray 1968:10	
British Museum, London	25228	Dawson and Gray 1968:10-11	
British Museum, London	6681	Dawson and Gray 1968:11-12	
British Museum, London	29577	Dawson and Gray 1968:12	

Museum	Museum ID	Sources	Exclude
British Museum, London	6662	Dawson and Gray 1968:12-13	
British Museum, London	6697	Dawson and Gray 1968:13	
British Museum, London	41603	Dawson and Gray 1968:13-14	
British Museum, London	6669	Dawson and Gray 1968:14	
British Museum, London	6682	Dawson and Gray 1968:14-15	
British Museum, London	22814C	Dawson and Gray 1968:15	
British Museum, London	15654C	Dawson and Gray 1968:15-16	
British Museum, London	6666	Dawson and Gray 1968:16	
British Museum, London	6673	Dawson and Gray 1968:16-17	
British Museum, London	6692	Dawson and Gray 1968:17	
British Museum, London	32052C	Dawson and Gray 1968:17-18	
British Museum, London	24957	Dawson and Gray 1968:18	
British Museum, London	6676	Dawson and Gray 1968:18-19	
British Museum, London	20744	Dawson and Gray 1968:19-20	
British Museum, London	6696	Dawson and Gray 1968:20	
British Museum, London	6699B	Dawson and Gray 1968:20-21	
British Museum, London	6659	Dawson and Gray 1968:21	
British Museum, London	29581	Dawson and Gray 1968:22	
British Museum, London	6716	Dawson and Gray 1968:22	
British Museum, London	6718	Dawson and Gray 1968:23	
British Museum, London	29578	Dawson and Gray 1968:23	

Museum	Museum ID	Sources	Exclude
British Museum, London	6694	Dawson and Gray 1968:23-24	
British Museum, London	6680	Dawson and Gray 1968:24	
British Museum, London	29776	Dawson and Gray 1968:24-25	
British Museum, London	20650	Dawson and Gray 1968:25	
British Museum, London	29778	Dawson and Gray 1968:26	
British Museum, London	6679	Dawson and Gray 1968:26-27	
British Museum, London	29782	Dawson and Gray 1968:27	
British Museum, London	20745	Dawson and Gray 1968:27	
British Museum, London	29777	Dawson and Gray 1968:28	
British Museum, London	6665	Dawson and Gray 1968:28-29	
British Museum, London	6717	Dawson and Gray 1968:29	
British Museum, London	6957	Dawson and Gray 1968:29	
British Museum, London	54052	Dawson and Gray 1968:30	
British Museum, London	6713	Dawson and Gray 1968:30	
British Museum, London	6711	Dawson and Gray 1968:30-31	
British Museum, London	54053	Dawson and Gray 1968:31	
British Museum, London	13595	Dawson and Gray 1968:31-32	
British Museum, London	21809	Dawson and Gray 1968:32	
British Museum, London	6712	Dawson and Gray 1968:32	
British Museum, London	6709	Dawson and Gray 1968:32-33	
British Museum, London	6707	Dawson and Gray 1968:33	

Museum	Museum ID	Sources	Exclude
British Museum, London	6704	Dawson and Gray 1968:33-34	
British Museum, London	6714	Dawson and Gray 1968:34-35	
British Museum, London	21810	Dawson and Gray 1968:35	
British Museum, London	22108	Dawson and Gray 1968:35-36	
British Museum, London	24800	Dawson and Gray 1968:36	
British Museum, London	29783A	Dawson and Gray 1968:36-37	
British Museum, London	29783B	Dawson and Gray 1968:36-37	
British Museum, London	29783C	Dawson and Gray 1968:36-37	
British Museum, London	29783D	Dawson and Gray 1968:36-37	
British Museum, London	6715	Dawson and Gray 1968:37	
British Museum, London	30362	Dawson and Gray 1968:37-38	
British Museum, London	30363	Dawson and Gray 1968:38	
British Museum, London	30364	Dawson and Gray 1968:38	
British Museum, London	54055A	Dawson and Gray 1968:38-39	
British Museum, London	54055B	Dawson and Gray 1968:38-39	
British Museum, London	6723	Dawson and Gray 1968:39-40	
British Museum, London	29588	Dawson and Gray 1968:40	
British Museum, London	52889	Dawson and Gray 1968:40	Excluded
British Museum, London	54051	Dawson and Gray 1968:40	Excluded
Metropolitan Museum of Art, New York	99.3.5	Minninberg (personal communication, July 30, 2003); Mininberg 2001	

Museum	Museum ID	Sources	Exclude
Metropolitan Museum of Art, New York	11.50.15	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	12.182.131	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	12.182.132	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	19.3.208	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	19.3.208	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	86.1.35	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	26.3.11	Minninberg (personal communication, July 30, 2003); Mininberg 2000; Minninberg 2001	
Metropolitan Museum of Art, New York	20.4	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	12.182.48	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	86.1.52	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	86.1.51	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	11.155.5	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	11.139	Minninberg (personal communication, July 30, 2003); Mininberg 2001	
Metropolitan Museum of Art, New York	25.3.219	Minninberg (personal communication, July 30, 2003); Mininberg 2001	

Museum	Museum ID	Sources	Exclude
Metropolitan Museum of Art, New York	Seabury Mummy	Minninberg (personal communication, July 30, 2003); Mininberg 2001	Excluded
Manchester Museum, Manchester	21470	David 1979:1; Isherwood et al. 1979:29; Murray 1910	
Manchester Museum, Manchester	21471	David 1979:1; Isherwood e. al. 1979:29; Murray 1910	
Manchester Museum, Manchester	3496	David 1979:1; Isherwood et al. 1979:29	
Manchester Museum, Manchester	9354	David 1979:1-5; Isherwood et al. 1979:30	
Manchester Museum, Manchester	1976.51a	David 1979:5; Isherwood et al. 1979:30	
Manchester Museum, Manchester	10881	David 1979:5; Isherwood et al. 1979:30-31	
Manchester Museum, Manchester	1777	David 1979:5; Isherwood et al. 1979:31	
Manchester Museum, Manchester	5053a	David 1979:5; Isherwood et al. 1979:31-32	
Manchester Museum, Manchester	1766	David 1979:6; Isherwood et al. 1979:34-35	
Manchester Museum, Manchester	1767	David 1979:6; Isherwood et al. 1979:34	
Manchester Museum, Manchester	1768	David 1979:6; Isherwood et al. 1979:32	
Manchester Museum, Manchester	1769	David 1979:6; Isherwood et al. 1979:33-34	
Manchester Museum, Manchester	1770	David 1979:6; Isherwood et al. 1979:32; Tapp 1979	
Manchester Museum, Manchester	1775	David 1979:6; Isherwood et al. 1979:35	
Manchester Museum, Manchester	2109	David 1979:6; Isherwood et al. 1979:33	
Manchester Museum, Manchester	9319	David 1979:6; Isherwood et al. 1979:33	
Manchester Museum, Manchester	20638	David 1979:6; Isherwood et al. 1979:34	
City of Liverpool Museums, Liverpool, England	M 14047	Gray and Slow 1968:6-10	
City of Liverpool Museums, Liverpool, England	M 13997	Gray and Slow 1968:10-16	
City of Liverpool Museums, Liverpool, England	1953.72	Gray and Slow 1968:16-21	

Museum	Museum ID	Sources	Exclude
City of Liverpool Museums, Liverpool, England	M14003	Gray and Slow 1968:21-22	
City of Liverpool Museums, Liverpool, England	1955.4	Gray and Slow 1968:22	
City of Liverpool Museums, Liverpool, England	16.4. 1861.1	Gray and Slow 1968:22-28	
City of Liverpool Museums, Liverpool, England	13.10. 1911.25	Gray and Slow 1968:28-32	
City of Liverpool Museums, Liverpool, England	M13996	Gray and Slow 1968:32-35	
City of Liverpool Museums, Liverpool, England	M14000	Gray and Slow 1968:35	
City of Liverpool Museums, Liverpool, England	M13998	Gray and Slow 1968:35-36	
City of Liverpool Museums, Liverpool, England	M13994	Gray and Slow 1968:36	
City of Liverpool Museums, Liverpool, England	13.12. 1905.34	Gray and Slow 1968:38-49	
City of Liverpool Museums, Liverpool, England	1967.60	Gray and Slow 1968:50-56	
City of Liverpool Museums, Liverpool, England	1956. 22.79	Gray and Slow 1968:56	
City of Liverpool Museums, Liverpool, England	M14050	Gray and Slow 1968:56	Excluded
City of Liverpool Museums, Liverpool, England		Gray and Slow 1968	Excluded
City of Liverpool Museums, Liverpool, England		Gray and Slow 1968	Excluded
City of Liverpool Museums, Liverpool, England		Gray and Slow 1968:66	
Rijksmuseum van Oudheden, Leiden	1	Gray 1966b:1-2	
Rijksmuseum van Oudheden, Leiden	2	Gray 1966b:3-4	
Rijksmuseum van Oudheden, Leiden	3	Gray 1966b:4-5	
Rijksmuseum van Oudheden, Leiden	4	Gray 1966b:5-6	
Rijksmuseum van Oudheden, Leiden	5	Gray 1966b:6-7	
Rijksmuseum van Oudheden, Leiden	6	Gray 1966b:7-9	

Museum	Museum ID	Sources	Exclude
Rijksmuseum van Oudheden, Leiden	7	Gray 1966b:9-10	
Rijksmuseum van Oudheden, Leiden	8	Gray 1966b:10-11	
Rijksmuseum van Oudheden, Leiden	9	Gray 1966b:11-12	
Rijksmuseum van Oudheden, Leiden	10	Gray 1966b:12-13	
Rijksmuseum van Oudheden, Leiden	11	Gray 1966b:13-14	
Rijksmuseum van Oudheden, Leiden	12	Gray 1966b:14-15	
Rijksmuseum van Oudheden, Leiden	13	Gray 1966b:15-16	
Rijksmuseum van Oudheden, Leiden	14	Gray 196b6:16-17	
Rijksmuseum van Oudheden, Leiden	15	Gray 1966b:17-18	
Rijksmuseum van Oudheden, Leiden	16	Gray 1966b:18-19	
Rijksmuseum van Oudheden, Leiden	17	Gray 1966b:19-20	
Rijksmuseum van Oudheden, Leiden	18	Gray 1966b:20	
Rijksmuseum van Oudheden, Leiden	19	Gray 1966b:21	
Rijksmuseum van Oudheden, Leiden	20	Gray 1966b:22	
Rijksmuseum van Oudheden, Leiden	21	Gray 1966b:22-23	
Rijksmuseum van Oudheden, Leiden	22	Gray 1966b:23-24	
Rijksmuseum van Oudheden, Leiden	23	Gray 1966b:24-25	
Rijksmuseum van Oudheden, Leiden	24	Gray 1966b:25-26	
Rijksmuseum van Oudheden, Leiden	25	Gray 1966b:26	
Rijksmuseum van Oudheden, Leiden	26	Gray 1966b:26	
Rijksmuseum van Oudheden, Leiden	27	Gray 1966b:26-27	

Museum	Museum ID	Sources	Exclude
County Museum and Art Gallery, Truro, England		Gray 1970:132-134	
Hancock Museum, Newcastle, England	1	Gray 1967:75-77	
Hancock Museum, Newcastle, England	2	Gray 1967:77-78	
Buffalo Museum of Science		Bridgeman 1967:20-22	
Field Museum of Natural History, Chicago	31736	Moodie 1931:20-22	
Field Museum of Natural History, Chicago	30021	Moodie 1931:22	
Field Museum of Natural History, Chicago	105214	Moodie 1931:22	
Field Museum of Natural History, Chicago	30004	Moodie 1931:22-23	
Field Museum of Natural History, Chicago	30003	Moodie 1931:23	
Field Museum of Natural History, Chicago	111469	Moodie 1931:23	
Field Museum of Natural History, Chicago	111522	Moodie 1931:23	
Field Museum of Natural History, Chicago	30025	Moodie 1931:23	
Field Museum of Natural History, Chicago	30017	Moodie 1931:24	
Field Museum of Natural History, Chicago	30009	Moodie 1931:24	
Field Museum of Natural History, Chicago	111520	Moodie 1931:24	
Field Museum of Natural History, Chicago	105215	Moodie 1931:24	
Field Museum of Natural History, Chicago	30007	Moodie 1931:25	
Field Museum of Natural History, Chicago	30000	Moodie 1931:25	
Field Museum of Natural History, Chicago	30010	Moodie 1931:25	
Field Museum of Natural History, Chicago	30011	Moodie 1931:25	
Field Museum of Natural History, Chicago	30018	Moodie 1931:25-26	

Museum	Museum ID	Sources	Exclude
Field Museum of Natural History, Chicago	30023	Moodie 1931:26	
Tulane University, New Orleans	1	Lombardi 1999	
Tulane University, New Orleans	2	Lombardi 1999	
Louisiana Arts and Science Center, Baton Rouge	MG64.1.1-9	Museum Records	
Louisiana Arts and Science Center, Baton Rouge	00.3.1 A-C	Museum Records	
Philadelphia University Museum	I	Kristen and Reyman 1980	
Philadelphia University Museum	II	Cockburn et al. 1975; Cockburn et al. 1980; Kristen and Reyman 1980	
Philadelphia University Museum	III	El Mahdy 1986:94; Kristen and Reyman 1980; Reyman and Peck 1980	
Philadelphia University Museum	IV	El Mahdy 1986:96; Kristen and Reyman 1980; Reyman and Peck 1980	
Detroit Institute of Arts	I	Kristen and Reyman 1980	Excluded
Royal Ontario Museum, Toronto, Canada	I	Harwood-Nash 1979; Kristen and Reyman 1980; Millet et al 1980	
Royal Ontario Museum, Toronto, Canada		Harwood-Nash 1979	
Stockholm's Museum of Mediterranean and Near Eastern Antiquities, Sweden		Diener 1986	
Stockholm's Museum of Mediterranean and Near Eastern Antiquities, Sweden		Diener 1986	

Museum	Museum ID	Sources	Exclude
Indianapolis Children's Museum, Indiana		Vahey and Brown 1984	
Minnesota Mummy Project - Minneapolis Institute of Arts	MIA I	El Mahdy 1986: 80; Moss 1985; Notman 1986	
Minnesota Mummy Project - Science Museum of Minnesota	SMM	Moss 1985; Notman 1986	
Minnesota Mummy Project - Minneapolis Institute of Arts	MIA II	Moss 1985; Notman 1986	
Minnesota Mummy Project - Minneapolis Institute of Arts	MIA III	Notman 1986	
Bristol Museum		El Mahdy 1986	
Chatham-Kent Musuem, Ontario		Nelson 2003	
Girton College and the Fitzwilliam Museum, Cambridge, England		Bourriau and Bashford 1980	
Girton College and the Fitzwilliam Museum, Cambridge, England		Bourriau and Bashford 1980	
Munich Egyptological Museum	As 73b	Parche and Ziegelmayer 1986	
Munich Egyptological Museum	As 12d	Parche and Ziegelmayer 1986	
Munich Egyptological Museum	As 1627d	Parche and Ziegelmayer 1986	
Cairo Museum, Egypt	6342 (61051)	Bakry 1965:20-21; Harris and Weeks 1973; Ikram and Dodson 1997:22; Krogman and Baer 1980; Miller 2003; Smith 1912:1-6; Whitehouse 1980	

Museum	Museum ID	Sources	Exclude
Cairo Museum, Egypt	6343 (61057)	Bakry 1965:21-22; Harris and Weeks 1973; Ikram and Dodson 1997:24; Krogman and Baer 1980; Miller 2003; Smith 1912:15-18; Whitehouse 1980	
Cairo Museum, Egypt	6344 (61058)	Bakry 1965:22; Harris and Weeks 1973; Ikram and Dodson 1997:26; Krogman and Baer 1980; Miller 2003; Smith 1912:18; Whitehouse 1980	
Cairo Museum, Egypt	6345 (61065)	Bakry 1965: 23; Harris and Weeks 1973; Ikram and Dodson 1997:28; Krogman and Baer 1980; Miller 2003; Smith 1912: 25-28; Whitehouse 1980	
Cairo Museum, Egypt	6346 (61066)	Bakry 1965:23-24; Harris and Weeks 1973; Ikram and Dodson 1997:29; Krogman and Baer 1980; Miller 2003; Smith 1912:28-31; Whitehouse 1980	
Cairo Museum, Egypt	6347 (61068)	Bakry 1965:24-25; Harris and Weeks 1973; Ikram and Dodson 1997:30; Krogman and Baer 1980; Miller 2003; Smith 1912:32-36; Whitehouse 1980	
Cairo Museum, Egypt	6348 (61069)	Bakry 1965:25-26; Harris and Weeks 1973; Ikram and Dodson 1997:32; Krogman and Baer 1980; Miller 2003; Smith 1912:36-38; Whitehouse 1980	
Cairo Museum, Egypt	6349 (61073)	Bakry 1965:26-27; Harris and Weeks 1973; Ikram and Dodson 1997:33; Krogman and Baer 1980; Miller 2003; Smith 1912:42-46; Whitehouse 1980	
Cairo Museum, Egypt	L4 (61074)	Bakry 1965:27-28; Harris and Weeks 1973; Ikram and Dodson 1997:36; Krogman and Baer 1980; Miller 2003; Smith 1912:46-51; Whitehouse 1980	

Museum	Museum ID	Sources	Exclude
Cairo Museum, Egypt	61075	Bakry 1965:28-31; Harris and Weeks 1973; Ikram and Dodson 1997:37; Miller 2003; Smith 1912:51-56; Whitehouse 1980	
Cairo Museum, Egypt (Mummy still in tomb)		Brier 1998: 164-174; Harris and Weeks 1973; Ikram and Dodson 1997:38; Miller 2003; Whitehouse 1980	
Cairo Museum, Egypt	6350 (61077)	Bakry 1965:31-32; Harris and Weeks 1973; Ikram and Dodson 1997:39; Krogman and Baer 1980; Miller 2003; Smith 1912:57-59; Whitehouse 1980	
Cairo Museum, Egypt	6351 (61078)	Bakry 1965:32-33; Harris and Weeks 1973; Ikram and Dodson 1997:40; Krogman and Baer 1980; Miller 2003; Smith 1912:59-65; Whitehouse 1980	
Cairo Museum, Egypt	6352 (61079)	Bakry 1965:34-35; Harris and Weeks 1973; Ikram and Dodson 1997:41; Krogman and Baer 1980; Miller 2003; Smith 1912:65-70; Whitehouse 1980	
Cairo Museum, Egypt	6353 (61080)	Bakry 1965:35-36; Harris and Weeks 1973; Ikram and Dodson 1997:43; Krogman and Baer 1980; Miller 2003; Smith 1912:70-73; Whitehouse 1980	
Cairo Museum, Egypt	6354 (61081)	Bakry 1965:36-37; Harris and Weeks 1973; Ikram and Dodson 1997:42; Krogman and Baer 1980; Miller 2003; Smith 1912:73-81; Whitehouse 1980	
Cairo Museum, Egypt	6355 (61083)	Bakry 1965:37-38; Harris and Weeks 1973; Ikram and Dodson 1997:45; Krogman and Baer 1980; Miller 2003; Smith 1912:84-87; Whitehouse 1980	
Cairo Museum, Egypt	6356 (61084)	Bakry 1965:38-39; Harris and Weeks 1973; Ikram and Dodson 1997:46; Krogman and Baer 1980; Miller 2003; Smith 1912:65-70; Whitehouse 1980	

Museum	Museum ID	Sources	Exclude
Cairo Museum, Egypt	6357 (61085)	Bakry 1965:39-40; Harris and Weeks 1973; Ikram and Dodson 1997:47; Krogman and Baer 1980; Miller 2003; Smith 1912:65-70; Whitehouse 1980	
Cairo Museum, Egypt	6358 (61086)	Bakry 1965:40-41; Harris and Weeks 1973; Ikram and Dodson 1997:48; Krogman and Baer 1980; Miller 2003; Smith 1912:92-94; Whitehouse 1980	
Cairo Museum, Egypt	6359	Bakry 1965:41; Harris and Weeks 1973; Ikram and Dodson 1997:49; Krogman and Baer 1980; Miller 2003; Whitehouse 1980	
Cairo Museum, Egypt	6360 (61055)	Bakry 1965:41-42; Harris and Weeks 1973; Ikram and Dodson 1997:25; Krogman and Baer 1980; Miller 2003; Smith 1912:13-14; Whitehouse 1980	
Cairo Museum, Egypt	6361 (61063)	Bakry 1965:42; Harris and Weeks 1973; Krogman and Baer 1980; Miller 2003; Smith 1912:21-22; Whitehouse 1980	
Cairo Museum, Egypt	6362 (61052)	Bakry 1965:42-43; Harris and Weeks 1973; Ikram and Dodson 1997:27; Krogman and Baer 1980; Miller 2003; Smith 1912:6-8; Whitehouse 1980	Excluded
Cairo Museum, Egypt	6363 (61087)	Bakry 1965:43-44; Harris and Weeks 1973; Ikram and Dodson 1997:50; Krogman and Baer 1980; Miller 2003; Smith 1912:94-98; Whitehouse 1980	
Cairo Museum, Egypt	6364 (61088)	Bakry 1965:44-45; Harris and Weeks 1973; Ikram and Dodson 1997:53; Krogman and Baer 1980; Miller 2003; Smith 1912:98-101; Whitehouse 1980	

Museum	Museum ID	Sources	Exclude
Cairo Museum, Egypt	6365 (61090)	Bakry 1965:45-46; Harris and Weeks 1973; Ikram and Dodson 1997:52; Krogman and Baer 1980; Miller 2003; Smith 1912:101-104; Whitehouse 1980	
Cairo Museum, Egypt	6366 (61093)	Harris and Weeks 1973; Ikram and Dodson 1997:56; Miller 2003; Smith 1912:106-107; Whitehouse 1980	
Cairo Museum, Egypt	56 (61056)	Harris and Weeks 1973; Ikram and Dodson 1997:23; Smith 1912:14-15; Whitehouse 1980	
Cairo Museum, Egypt	69 (51191)	Harris and Weeks 1973; Ikram and Dodson 1997:23; Miller 2003	
Cairo Museum, Egypt	71 (51190)	Harris and Weeks 1973; Ikram and Dodson 1997:22; Miller 2003	
Cairo Museum, Egypt	R1 (61070)	Harris and Weeks 1973; Ikram and Dodson 1997:22; Miller 2003; Smith 1912:38-39	
Cairo Museum, Egypt	R39 (61082)	Harris and Weeks 1973; Ikram and Dodson 1997:44; Miller 2003; Smith 1912:81-84	
Cairo Museum, Egypt	97 (61097)	Harris and Weeks 1973; Miller 2003; Smith 1912:112-114; Whitehouse 1980	
Cairo Museum, Egypt	60153	Miller 2003; Smith 1912: 8-11	
Cairo Museum, Egypt	61054	Miller 2003; Smith 1912:11-13	
Cairo Museum, Egypt	61059	Smith 1912:18	
Cairo Museum, Egypt	61060	Miller 2003; Smith 1912:19	Excluded
Cairo Museum, Egypt	61061	Miller 2003; Smith 1912:19	

Museum	Museum ID	Sources	Exclude
Cairo Museum, Egypt	61062	Miller 2003; Smith 1912:20-21	
Cairo Museum, Egypt	61064	Miller 2003; Smith 1912:22-25	
Cairo Museum, Egypt	61067	Miller 2003; Smith 1912:31-32	
Cairo Museum, Egypt	61092	Ikram and Dodson 1997:54; Miller 2003; Smith 1912:38-39	
Cairo Museum, Egypt still in tomb	61071	Miller 2003; Smith 1912:39-40	
Cairo Museum, Egypt still in tomb	61072	Miller 2003; Smith 1912:40-42	
Cairo Museum, Egypt	61076	Miller 2003; Smith 1912:56-57	Excluded
Cairo Museum, Egypt	61082	Miller 2003; Smith 1912:81-84	
Cairo Museum, Egypt	61091	Miller 2003; Smith 1912:105	Excluded
Cairo Museum, Egypt Qasr el Einy Medical Facility		Miller 2003	
Cairo Museum, Egypt	61094	Ikram and Dodson 1997:55; Miller 2003; Smith 1912:107	
Cairo Museum, Egypt	61095	Miller 2003; Smith 1912:107-109	
Cairo Museum, Egypt	61096	Miller 2003; Smith 1912:109-111	
Cairo Museum, Egypt	61098	Smith 1912:114-116	
Cairo Museum, Egypt	61099	Smith 1912:116	Excluded
Cairo Museum, Egypt	61100	Smith 1912:116	Excluded
Michael C. Carlos Museum, Atlanta	#199.1.4	Miller 2003	
Museum of Royal College of Surgeons		Dawson 1927	
Museum of Royal College of Surgeons		Dawson 1927	
Museum of Fine Arts, Boston		Langone 1984; Marx and D'Auria 1986	
Museum of Fine Arts, Boston		Langone 1984; Marx and D’Auria 1986	

Museum	Museum ID	Sources	Exclude
Museum of Fine Arts, Boston		Marx and D'Auria 1986	
Museum of Fine Arts, Boston		Langone 1984; Marx and D'Auria 1986	
Museum of Fine Arts, Boston	1	Marx and D'Auria 1986	
Museum of Fine Arts, Boston	2	Marx and D'Auria 1986	Excluded
National Museum of Natural History, Washington, D.C.	126790	Hunt and Hopper 1996	
National Museum of Natural History, Washington, D.C.	381234	Hunt and Hopper 1996	
National Museum of Natural History, Washington, D.C.	385664	Hunt (personnal communications, May 1, 2003); Hunt and Hopper 1996	
National Museum of Natural History, Washington, D.C.	381235	Hunt (personnal communications, May 1, 2003);Hunt and Hopper 1996	
Wesleyan Univerisity, Middletown, Connecticut		Dyson 1979	

VITA

Ellen Salter-Pedersen was born in Edmonton, Alberta. She graduated from Concordia University College, Edmonton, with a Bachelor of Arts degree in music and French and from the University of Alberta, Edmonton, with a Bachelor of Science in biological sciences and Spanish. Ellen plans to continue her studies in anthropology.