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C. Wilfred Griggs

Marvin C. Kuchar

Scott R. Woodward

Mark J. Rowe

R. Paul Evans

See next page for additional authors

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Tombs under limestone. A layer of limestone running through this small hill was utilized as a natural roof for Greco-Roman tombs in the cemetery. Many of the artifacts pictured throughout this issue were recovered from tombs in this hill.

Seila Pyramid, east side. This Old Kingdom pyramid, located in middle Egypt, was built by Snefru, father of Khufu (Cheops). It is being excavated by the BYU team, some of whose members and workers are shown here.

Evidences of a Christian Population in the Egyptian Fayum and Genetic and Textile Studies of the Akhmim Noble Mummies

Scholars uncover hundreds of Egyptian burials and use cutting-edge techniques to unlock ancient Christian secrets. They also probe the puzzles surrounding royal as well as noble mummies.

C. Wilfred Griggs, Marvin C. Kuchar, Scott R. Woodward, Mark J. Rowe, R. Paul Evans, Naguib Kanawati, and Nasry Iskander

Since 1981, a team from Brigham Young University has been excavating in the Fayum in Egypt[1] at both an Old Kingdom Pyramid (the Seila Pyramid) and a Greco-Roman cemetery. The team has uncovered hundreds of unplundered burials in the cemetery, including two extremely significant pre-Christian burials, and the team's work has yielded new information about the lives of early Christians and ancient pharaohs in Egypt. Although the initial genetic and textile results were limited to a few significant conclusions about family relationships and material circumstances of those Christian burials, the cutting-edge research methods developed and employed proved to be very illuminating.

Because of the expertise the team developed in that effort, it was invited in 1992 by the Egyptian Antiquities Organization to do textile and genetic studies on the noble mummies from Akhmim and the Egyptian Royal Mummies. This article describes the major findings of the team's research to date.

The Seila Pyramid

From an inscription on one of two stelae found at the base of the east face of the Seila Pyramid, the team learned that the builder was Snefru, father of Khufu or Cheops. In addition to this pyramid, the

four built by Snefru at Dashur and the pyramid built at Meidum, which is tied to Seila by a virtually certain link in construction techniques and geographic relationship, bring the total known pyramids erected by Snefru to six. Temple artifacts, remains of a temple pavement, and pieces of a statue of a seated pharaoh are among the other noteworthy finds at the Seila Pyramid.[2]

Pre-Christian Burials in the Hill Tombs

The cemetery, which was used for burials from about 200 B.C. to about A.D. 800, covers approximately 125 hectares, or 309 acres. There are two small hills in the central part of the cemetery. Using a stratum of 6- to 8-inch-thick limestone running through one of the hills as a natural roof, ancient workmen carved twenty-two tombs, most containing multiple chambers for burials. Erosion of the tufa, or "dirty limestone," above the tombs has both altered and buried most of the original entrances to the ancient tombs, often leaving only a small entry hole visible in modern times. Virtually all of the tombs and their chambers in the hill had been plundered at some undefined period in the past, although it is possible that two Fayumic mummy portraits found near the turn of the century by two British archaeologists, Grenfell and Hunt, came from tombs in this hill.[3]

Miscellaneous Recoveries. Among the artifacts recovered from this plundered part of the cemetery were lamps (see p. 338), tools, face masks, and reed baskets, one containing a grain offering. There were also parts of human bodies, including a man with each finger wrapped individually with linen; gold leaf was placed over the linen where the fingernails would be. The body of a woman was also recovered, intricately wrapped with many layers of linen strips in a diagonal geometric pattern. In two tombs where human burials had been placed, we found a few mummified cats, but later we found one tomb entirely devoted to cat burials, and from it we removed 158 cats. Although we have not found evidence of a temple or cult center in the area, the cats may represent the goddess Bastet and may symbolize protection of the graves and of the dead.

Two Unplundered Burials. The BYU team recovered only two unplundered burials from the tombs in the hill; both had been placed below the floor level of the tombs in which they were

"Goldfinger." Each finger of this man's mummified hand was wrapped with linen, and gold leaf was placed over the fingernail areas. The hand was recovered from one of the plundered tombs.

Cat face. This linen cat face was placed over a real cat's head. Mummified cats in and near the pre-Christian human tombs may symbolize protection of the graves and their dead.

found. The first, dating from the early second century B.C., was a cedar coffin containing an adult male. One end of the coffin had been destroyed by rock and debris, probably at the time of burial. The body had been wrapped with forty-four layers of textiles, with no decorations or symbols on the clothing. The unusually high number of wrappings probably indicates the special status or wealth this man had in the community.

The other unplundered burial was in a heavy wooden coffin found at the rear of a tomb measuring 2.2 x 5 meters and about 2 meters high (the roof had collapsed some time ago). The burial chamber had been carved into the hill below the floor level of the tomb, and a ramp had been cut down to the door for access and later covered over to floor level. The door to the chamber was made of roughly dressed stones held in place by a hard cement. Behind the door and on the ground in front of the coffin was a small human burial, wrapped intricately in many layers of linen strips. X-ray analysis at the site and endoscopic study later at the Cairo Museum showed this burial to be a child, between six and eight years old. The body was compressed after death to the precise length necessary to span the width of the burial chamber.

An inscription on one end of the coffin identifies the person inside as the daughter of an Egyptian high priest and of a mother who was important in her own right; it also indicates the mother was beloved of her husband. The young woman in the coffin has a gold head covering which reaches to her shoulders and is covered with painted symbols of Egyptian religious beliefs. Four flower garlands are wrapped around the body, which was placed on a bed of flowers in the coffin, and a spray of flowers was placed in the linen wraps over the heart. The multiple-layered wrapping of linen strips covers a beautifully decorated breastplate, which extends from the shoulders to the knees. The breastplate, made of sheets of linen glued together and overlaid with a layer of plaster, is decorated with scenes and divinities from the Egyptian Book of the Dead. Dating by associated artifacts in the tomb (primarily pottery), writing style of the coffin inscription, and carbon-14 analysis established this burial at about 220 B.C. All datable materials in the hill tombs originate from the end of the third century B.C. to early in the first century A.D.

Coffin with mummy of a child. The body of a child, age 6–8, was compressed after death to fit the width of the chamber in which the coffin of an Egyptian high priest's daughter was placed.

Burials in the Cemetery's Shaft Tombs

To the northwest of the hill tombs are a number of tombs hewn in the limestone bedrock, and these tombs, which had not been previously disturbed, contain skeletalized burials. The manner of burial in the shaft tombs, which were usually sealed with a gypsum plaster cap, ensured the decomposition of all organic materials except the bones. When excavating a few of those tombs in 1981, we did not have personnel with the skills necessary to do complete pathology and other biological analyses of the burials, but such specialists were invited and participated in subsequent archaeological seasons.

Most of the cemetery consists of burials interred in the sand, usually without coffins, and layered four or five burials deep in shafts cut down through the sand to a depth of three to five meters. The burial shafts are all on a basically east-west orientation, with the slight directional differences likely accounted for by variations in the sun's amplitude from the summer to the winter solstice.

Direction of Burials. The oldest burials in each shaft were often, but not always, placed in a chamber cut slightly at an angle to one side or the other of the shaft, and the chambers were nearly always covered with roughly dressed rocks (see figure 1). The burials at the bottom of the shafts date from the first half of the second century B.C. to the first half of the first century A.D. In every instance, these burials were placed with the head to east and the feet to west in accord with the ancient Egyptian belief that the dead would rise from their graves and go to the west.

Beginning with the second half of the first century A.D., usually from the second burial layer up from the bottom of the shafts, all burials are reversed 180° in burial direction, with the head to west and the feet to east. This new burial direction continues without exception upward to the latest burials, which were placed in the cemetery close to the surface of the ground and date to approximately A.D. 800. The direction corresponds to early Christian beliefs that the resurrected Christ would return to the earth from the east and that the dead in Christ would rise from their graves to meet him. Because the rituals associated with death and burial tend to be among the most conservative in ancient cultures, such a radical change in

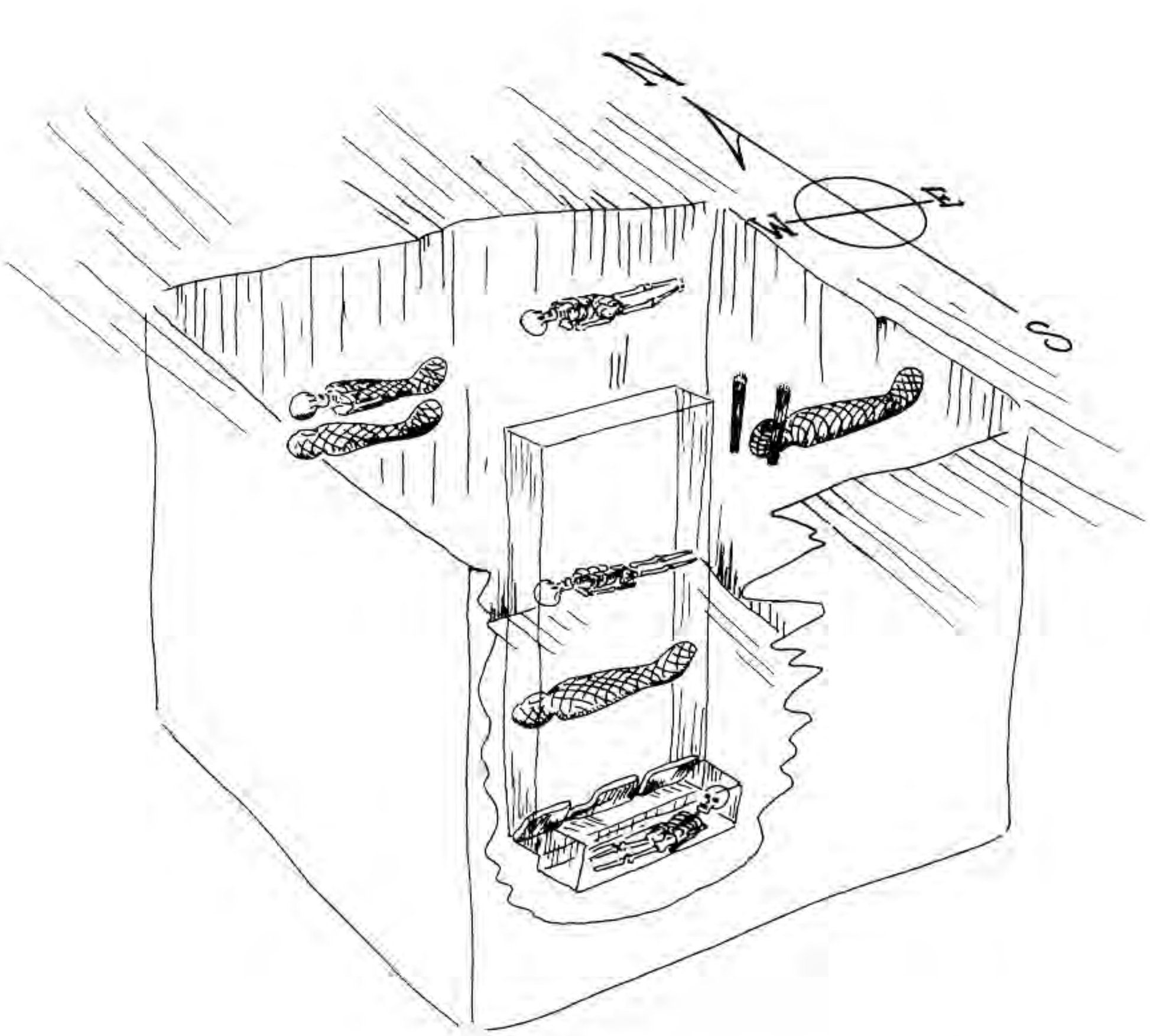


Figure 1. Diagram of a typical burial shaft. At the bottom of the shaft, the burials are oriented with the head to the east so that when the dead rise up they will be facing the west. From the second half of the first century, burials have a reverse orientation so that those dead will face east when they rise to meet the resurrected Christ. This shift in direction indicates a cultural change from Egyptian religious beliefs to Christianity. Figure drawn by William Revell Phillips.

burial procedure suggests a major cultural change in at least this part of the Fayum in the second half of the first century A.D.

A reversal in burial direction is but one of many evidences suggesting that this major cultural change was the arrival of the Christian faith in considerable strength (sufficient to influence all burials in this large cemetery immediately and completely for the next seven centuries or so). What cannot yet be determined—although the molecular biology studies reported below will show that such determination is imminently probable—is whether the arrival of Christianity came about through conversion of the local population or through the immigration of a large number of Christians who exerted considerable cultural influence on the local inhabitants.

Associated Objects. Virtually all of the pottery associated with the head-to-west burials are large wine amphorae and small wine drinking cups. Neither has been found with the head-to-east burials at the bottom of the shafts. The hundreds of amphorae and drinking cups found among the burials suggest that a graveside sacrament, a Eucharist service, was held for the deceased of the common faith, with the jars and cups put into the graves as tokens of religious unity with the dead.

Textiles. The quality and amount of cloth change dramatically from the head-to-east (pre-Christian) to the head-to-west (Christian) burials. The linen in the head-to-east burials is much coarser, the weave is not as tight or uniform, and no decorations or designs have been found in the textiles associated with those burials. In some instances, the material shows signs of wear under microscopic analysis, indicating the cloth had been previously worn or used.

In the head-to-west burials, both linen and woolen textiles have been recovered, and it is all of higher quality than the linen found with the head-to-east burials. Under microscopic analysis, team member Marvin Kuchar has been able to determine that none of the textiles in the head-to-west burials had been used or worn previously, for there are no broken or worn fibers, nor is there any fraying or lint, the latter of which begins to occur on this type of fabric during the first wearing. The observation that all of the burial clothing and shrouds associated with these burials are new and previously unused

means that a great deal of effort and expense went toward acquisition and preparation of clothing to be used only for burials. Preparations usually extended to intricately wrapping the burials with a two-colored ribbon in geometric patterns over the external linen shroud. But even simple shrouds without decoration were new and previously unused items.

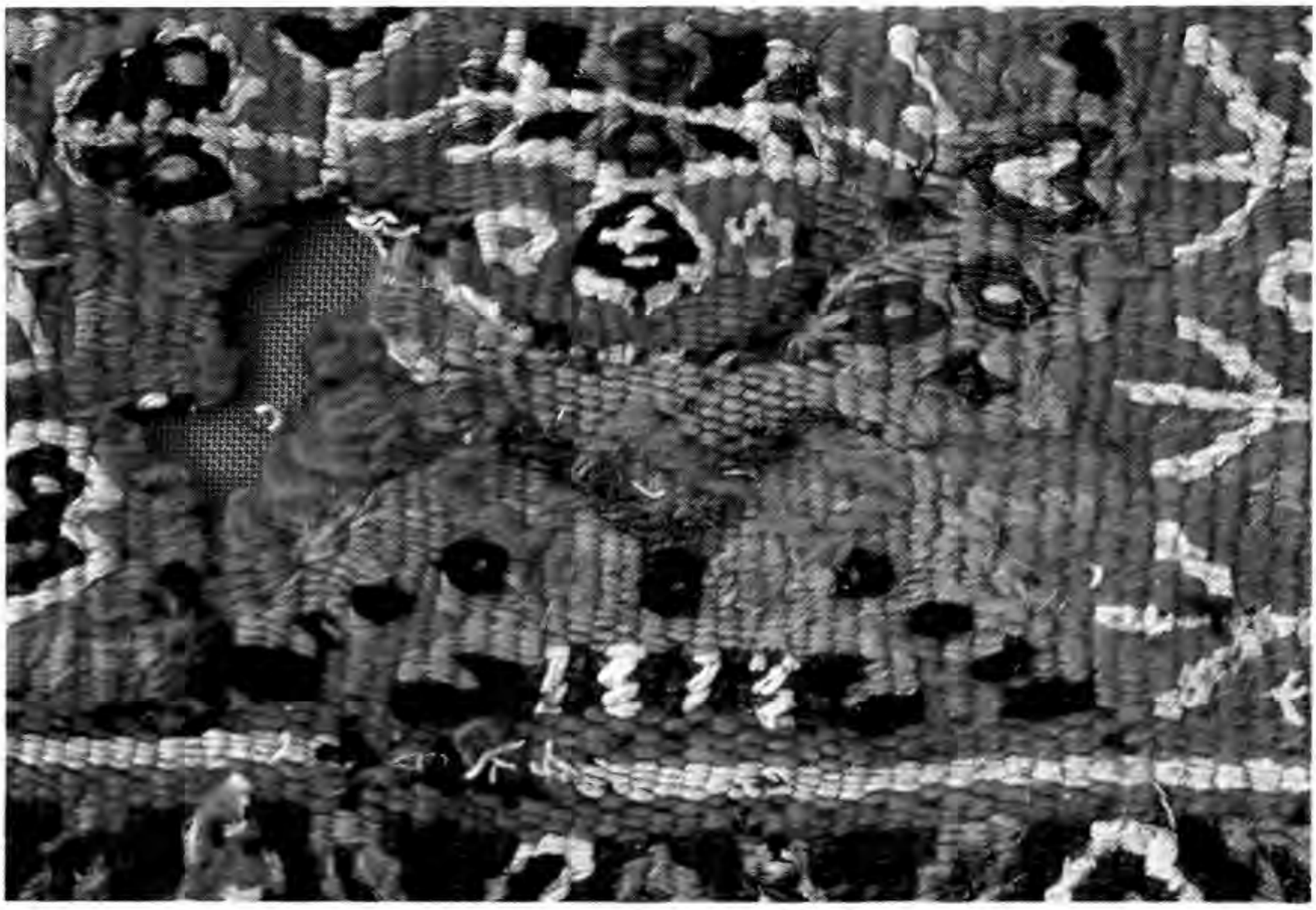
Clothing. In addition to the textiles being previously unused, the amount of clothing associated with the burials probably involved great expense and indicates the importance of appropriate attire for the deceased. The burials have from five to twenty-six layers of clothing, and many of the layers contain designs and symbols which likely have religious significance. One elaborate, but representative, burial which has twenty-six layers of clothing will be considered to illustrate the pattern of burial dress. The adult male was found buried beside an adult female, who had virtually the same number and types of caps, robes, and other clothing items. On the male's head were five knit caps, each with different designs knitted into it. All caps were made of three colors of woolen yarn and were of a loose-knit construction with a rolled edge.

Many of the robes were woven from a dyed yarn of one color for the body of the robe and a different color for the collar and hem. One

Well-preserved burial with ribbons. After being dressed in numerous layers of clothing, the body was often covered with a linen shroud and wrapped with a two-color ribbon in geometric designs. This Christian burial, a woman, was simply interred in sand.

robe on this burial has a purple collar and a purple hem. Inasmuch as purple is the color of royalty or special privilege and could not be worn by the general populace in Egypt at this time, the purple is indicative of royal status in the life to come. Colors in some robes illustrate the high quality of dyes and weaving, and the quality of preservation is sometimes remarkable. Another robe has two wide panels extending over the shoulders and to the feet both in front and back, and the panels are filled with depictions of large animals, birds, insects, and plants. If the robe is suggestive of a creation scene or a heavenly paradise, it would support the hypothesis that each of the layers of clothing represents part of an extensive and complex ritual pattern associated with the passage from this life to the next.

Ten of the robes on this burial are plain linen garments, but the many strands of linen ribbon wrapped around the upper half of the body are gathered together into a complex knot. This knot is



Detail of a remarkably well-preserved robe. The dyes and weaving in this early Christian robe show the high quality found in some of the burial robes. The horned animal depicted here is on one of two long panels extending the full length of the robe and filled with numerous plants and animals. These decorated panels may depict a creation or paradise scene.

found on the left shoulder on two of the robes, and on the right shoulder of the remaining eight robes (see p. 272). The symbol of the sacred knot or bow is common in Egypt and elsewhere and may indicate sacerdotal, or priestly, authority.

The piece of clothing closest to the body is not usually well preserved, due to the destructive influence of fluids and chemicals remaining in the body. In this burial, as well as a few others, however, the woolen garment next to the skin is sufficiently well preserved for us to observe that small rosettes have been woven into the material in particular locations. There is one rosette over each breast and one on the right leg near the knee, but there is no corresponding rosette on the left leg. Across the lower abdomen, the material also has a hemmed slit about six inches long.

Considered all together, the various items of clothing, all previously unused and many containing symbols and designs, argue strongly for belief not only in an afterlife, but also for appropriate attire, most likely accompanied by or representative of a multifaceted

Aqua burial robe with purple collar. Purple, a color worn only by royal or privileged persons, may have denoted royalty in the life to come. This robe was recovered from the tomb of an early Christian man who lived in Middle Egypt.

and complex ritual process which would assure safe and successful passage into the realm of the divine.

Personal Belongings. Personal belongings are often found with the head-to-west burials, such as sandals, items of jewelry, combs, hairpins, and an ivory saltcellar (see p. 338). Although there is nothing of significant monetary value in the artifacts associated with the burials, the articles do have personal or sentimental value. One could even argue that the salt in the saltcellar has symbolic value, representing the religious beliefs or covenants of the individual.

A remarkably well-preserved pair of child's booties was found wrapped in a pair of adult's sandals; these artifacts were associated with a joint burial of a young adult woman and an infant. The booties are a three-color, Jersey-knit wool. This unusual technique occurs here approximately a millennium earlier than the date previously assigned by textile historians for its supposed invention on the Isle of Jersey.[4]

Garment with woven rosettes and hemmed cut. This early Christian garment was made of wool and was placed next to the body. The garment has a woven rosette over each breast, a hemmed cut on the abdomen, and a rosette above the right knee.

Inside the booties were numerous small items; it is not certain whether they are toys for the infant to enjoy in the next life or symbols of religious belief. For example, the three iron keys found there may represent access to the doors of the three heavens to which a Christian may aspire, as mentioned in the Coptic Gnostic Gospel of Philip.[5] Likewise, small wooden fish found with some burials may be nothing more than toys or models of the fish caught in Birket Qarun (the Fayum lake), or they may symbolize the Christian faith, since the Greek word for fish is an acronym for Jesus Christ, Son of God, Savior.

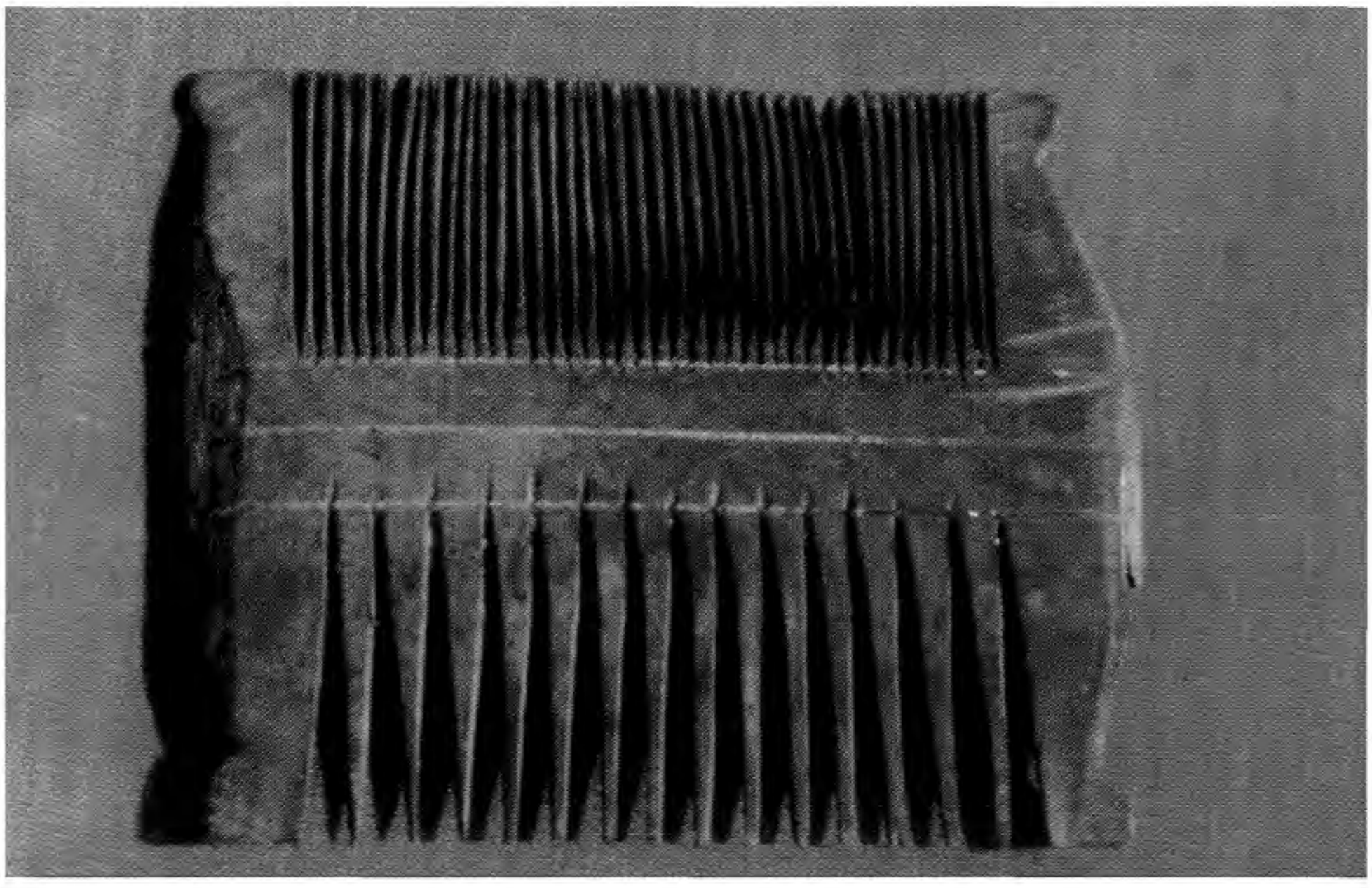
The intricate and involved process of burial preparation and dressing of the body may be adduced as evidence for religious symbolism in some associated artifacts, but the beautifully coiffed hairdos found on many of the women and other items of obvious sentimental value may argue for artifacts primarily reflecting family love and devotion toward a deceased relative or friend. Although artifacts placed in the graves do not reflect significant worldly wealth, the great cost of dressing a body in new and richly-decorated clothing demonstrates that no expense was spared in providing appropriate burials for family members and friends.

Burial Density in the Cemetery

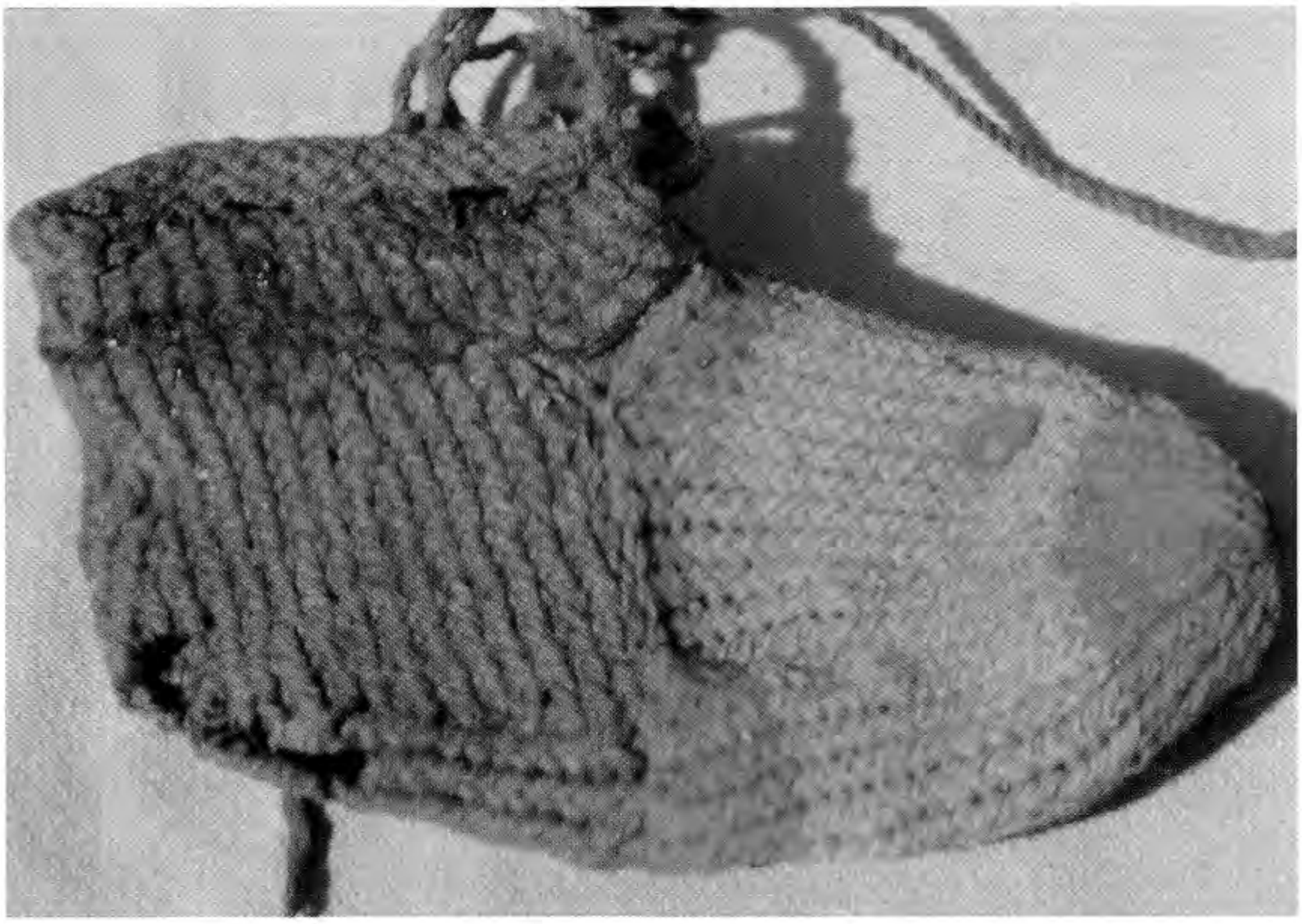
The burial density in the cemetery averages 1.62 burials per square meter for the excavated squares. The degree of density stems from numerous multiple or cluster burials. A few double burials consist of adults buried side by side as in the male-female couple mentioned earlier, or, more rarely, one may be on top of another. Most often, however, the multiple burials are comprised of an adult with one or more children placed beside or on top of the adult body.

When a subadult burial, age 16–18, is placed atop an adult female burial, age 25–30, we wonder both what family relationship there was between the two and how it was determined that the bodies should be buried together. When a small child is buried next to an adult, we wonder if they were related or if they were buried together simply because both deaths had occurred simultaneously. For years there was no way to determine which answer was correct, but BYU molecular biologists can now ascertain relationships by DNA analysis of ancient human remains, as is discussed below.

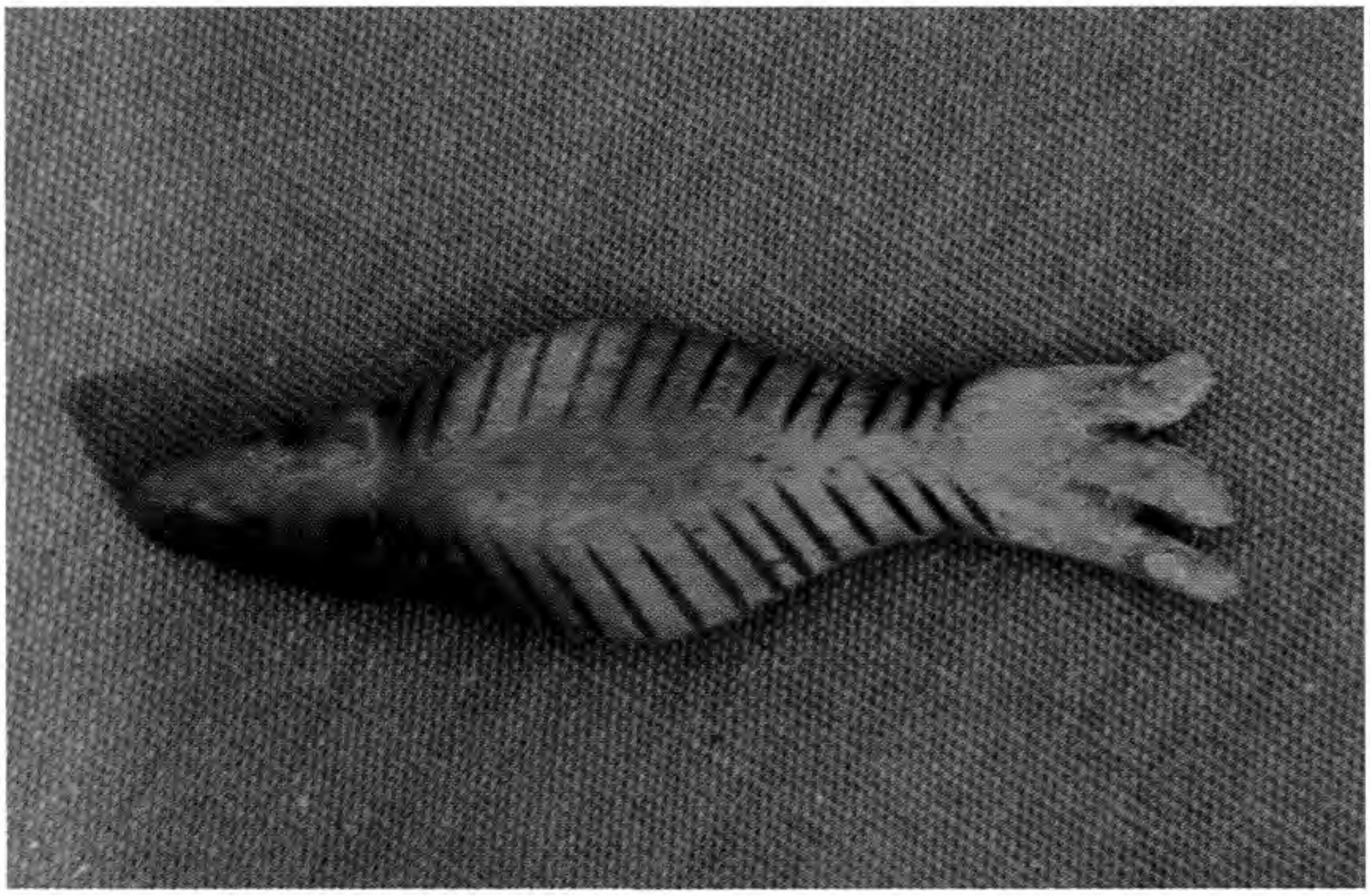
Ivory hair pins. The crown of each pin is individually designed. The imported ivory indicates active trade with distant cultures.



Wooden comb. Numerous hand-carved wooden combs, containing both large and fine teeth, illustrate both a concern for well-kept hair and a style of combs unchanged from ancient times to the present.



Child's bootie. This is one of two wool booties wrapped in a pair of adult sandals found near a young woman buried with an infant. The discovery of these tricolored, Jersey-knit booties has revised the history of textiles.



Small wooden fish. This model of a fish was found near one of the burials in the cemetery. It may be a symbol of the Christian faith, or it may be a child's toy, since there was an active fishing industry in the Fayum.

Beautifully coiffed hair. The elaborate arrangement of these red braids reflects the devotion and love this early Christian woman's family or friends felt for her as they prepared her body for burial.

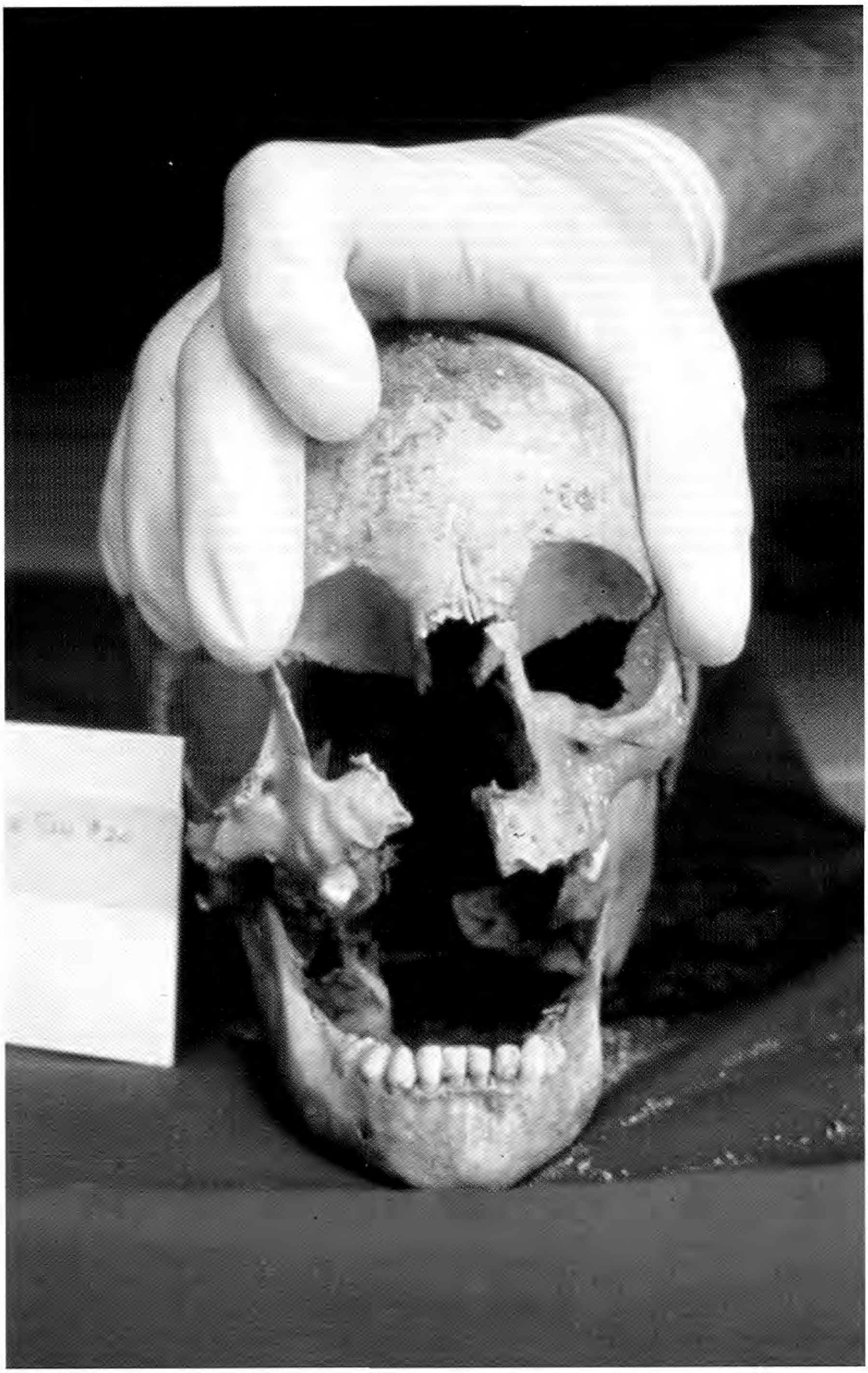
Results of Gross Pathology Studies

Gross pathology of the ancient human remains from the cemetery reveals both patterns and anomalies. Among the anomalies are fractures and deformities, an example of the latter being a cancerous bone extension of a femur into the pelvis. Diseases and accidents were clearly a normal part of life among this population. Biologists are studying both the visible and the genetic evidences of these ancient problems.

In the areas excavated during the 1992 season, we uncovered 142 burials, 58 of which were adults. The nearly 2-to-1 ratio of children to adults in the cemetery is not surprising, for infant and child mortality rates among this ancient population were naturally quite high, and they are still quite high today.[6]

What we did not expect to find from the examination of the burials was evidence of much physical violence. But among the adults, 24 percent died violently, as indicated by trephinations in the skulls caused by sharp objects such as swords, knives, or axes (see p. 312 for further examples of trephination). This figure is even more significant in light of the fact that nearly all of those violent deaths are found in strata corresponding to the third and fourth centuries A.D. The 31 adult burials in lower, earlier strata in these areas do not exhibit evidence of violent death, with one exception, and the same is true for the 8 adult burials in the strata datable from the fifth to the eighth centuries A.D., also with one exception. That is to say, there was one trephinated skull among the adult burials from the later centuries, and one also among the adult burials from the earlier centuries. The percentages of violent deaths among adults in these periods are 12 percent and 3 percent, respectively. The 24 percent figure for violent deaths among the adults found in the excavated areas now becomes 58 percent for the nineteen adults found in burials from the third and fourth centuries.

A major cause must be sought to explain the significantly higher percentage of violent deaths among this population in the third and fourth centuries A.D. Perhaps the persecutions of Christians during the reigns of Decius, Valerian, and Diocletian are the cause of these traumatic deaths.[7] This evidence of violent deaths from that era does provide the first published archaeological support for the historical accounts of persecutions of Christians in the later Roman Empire.



Skull with the face smashed. This early Christian teenager was 16–18 when he was killed in the third century after Christ. Of the adults buried during the third and fourth centuries C.E. in the cemetery excavated by the BYU team, 58 percent suffered violent deaths.

Despite our inability to determine with certainty the cause of the violent deaths in the cemetery, we are positive that those who suffered such deaths were not social and religious outcasts. They were not buried separately, and in fact are found in multiple or cluster burials, the same as those who exhibit no evidence of violent suffering or death. Furthermore, all of those who died by violent means were given the same care and preparation for burial as those who did not. Hair was carefully coiffed on a woman's head, for example, and items of personal or sentimental value were placed in the graves with these burials. Perhaps most significantly, all burials were dressed in the types of multilayered and symbolically rich burial clothing which we have previously discussed. If the burial direction and ritual clothing patterns are taken as evidences of Christianity, those who suffered violent deaths were buried as Christians.

Genetic Analysis of Ancient Burials in Egypt

An exciting new complement to the archaeological information gleaned from the physical examination of burials and artifacts is information buried within the antiquities themselves, specifically genetic information long preserved within the burials. Since this type of information in combination with a preserved written history and culture is unavailable in this form anywhere else in the world, these burials present a truly unique opportunity for comparative study and analysis.

Recovering information encoded in DNA from ancient human sources which are preserved by mummification and climates such as those found in Egypt is possible because of the stability of the DNA molecule. DNA analysis spells out the nucleotide sequence of small portions of genetic information specific to individuals and populations. The results can then be used to place the burials and mummies in the context of a human population subgroup, to identify gender, and to elucidate many other attributes of ancient populations. Further, this information allows comparisons regarding genetic diversity and genetic drift down through time.

Retrieving such information from its biological treasure house within mummies and converting it to knowledge about ancient history has been especially thrilling for the authors. This team, which

is a collaboration of BYU archaeological, molecular biological, genetic, and chemical scientists, has embarked on several molecular genetic projects specifically to establish familial relationships between burials in shared tombs in the ancient Fayum cemetery, to confirm genetic relationships in interesting legendary and historic royal lineages, to examine the presence and extent of common Mediterranean genetic diseases in ancient populations, and to analyze genetic drift in these populations down to the present. In addition, an archive of ancient tissue has been established at BYU for future genetic analysis in order to provide permanent access to this unparalleled source of biological and cultural information.

This type of research began in the late 1980s, when Allan C. Wilson, professor of biochemistry at the University of California–Berkeley, pioneered methods for extracting and amplifying mitochondrial DNA from ancient human remains. In 1990, Wilson, who had heard of the hundreds of human burials which the Egyptian Archaeology Project had recovered from the Fayum cemetery, proposed that he become part of the excavation team, since the excavation promised to provide the single greatest source of materials in the world for the study of ancient human DNA.

After Wilson announced his intentions, some BYU molecular biologists also pursuing DNA research expressed their own interest in participating in this new application of a developing science. Information was exchanged between Wilson and the BYU biologists until Wilson's untimely death in July 1991. The Gulf War of 1991 prevented the team from obtaining the first tissue and bone samples for extracting and amplifying DNA from the Egyptian burials until the 1992 excavating season.

In the meantime, Professor Scott Woodward of BYU had been perfecting procedures for amplifying ancient DNA, both from mitochondria and from cell nuclei. Wilson had previously used only soft tissue as the source of ancient DNA, and he had concentrated on amplifying mitochondrial DNA because of its relative abundance in human cells compared to nuclear DNA. However, Woodward and his colleagues have since demonstrated that teeth, and to some extent other bones, not only preserve ancient DNA better, but also are less susceptible to contamination than are soft tissues.

During a visit to Egypt in August 1992, Professor Wilfred Griggs showed Dr. Nasry Iskander, director of conservation and preservation in the Egyptian Antiquities Organization, the preliminary results of the DNA analysis of some twenty burials from the Fayum cemetery. Dr. Iskander asked Griggs if the BYU team would be interested in doing the same kind of study on the Egyptian Royal Mummies. During the fall of that year, Iskander further reported to Griggs the discovery by Dr. Naguib Kanawati and his colleagues of a number of Eighth Dynasty mummies near Akhmim, and during the 1993 excavation (January–March), the BYU team was accompanied by Iskander and Kanawati to the Abydos Temple, where the mummies are stored and where samples were carefully extracted for DNA analysis.

During the 1992 and 1993 excavating seasons, the BYU team, at the invitation of the Egyptian Antiquities Organization, sampled mummies in the Fayum cemetery, the pharaohs of the historically problematic and genetically interesting Eighteenth Dynasty (1550–1307 B.C.) from the Royal Mummy Collection in the Cairo Museum, and mummies in a First Intermediate Period (Eighth Dynasty, c. 2000 B.C.) tomb near Akhmim. The team's development of the technique of fiber-optic endoscopy to sample inside mummies without unwrapping them allowed collection of priceless samples for genetic analysis and archiving which would not have been otherwise possible.

DNA Analysis of Burials in the Fayum Cemetery

DNA analysis of individual burials in the Fayum cemetery has provided evidence of some close ancient relationships, of the presence of genetic diseases, and of a lack of close family marriages among those buried there. We have asked the question whether any of this biological evidence sustains our previously stated hypothesis that the ancient Fayum cemetery was a Christian burial ground. Preliminary data may support this idea. Ancient Roman census records from the area and period indicate that the common population was practicing a high level of brother-sister marriages. If this were the case, we should be able to see evidence of such marriages in the genes of the burials. In the burials at the lower levels of the cemetery (pre-Christian), we see some evidence that this type of

marriage may have occurred. However, when we reach the upper levels that represent Christian burials, the data reflect what we would expect from a population that did not encourage brother-sister marriages.

In the cemetery are also several cases where two or more individuals were buried in very close proximity, suggesting a family burial plot. Tests on some of these cases confirm that one of the groups represents a family. This finding now opens new questions for investigation. As the common practice was to bury people within twenty-four hours of their death, this family probably died together. Was this common death the result of an accident or possibly disease? These are questions that can be addressed in future studies.

DNA Analysis of the Akhmim and Royal Mummies

The Akhmim mummies may be the best example that will ever be available to demonstrate the success and importance of biological sampling and ancient DNA analysis. They provide an opportunity to examine genetically the family relationships suggested by ancient documentary evidence with respect to associated burials. The six mummies buried in tomb 1 at Akhmim were easily construed by their outward appearance, manner of burial, and coffin inscriptions, to involve three generations in a closely related family. The family seemed to involve a grandfather (Hffi Sr.) and grandmother (Jnt-Sn), their son (Sm't) and his wife (Hwjt), and two children of the son (Hffi and an unnamed child).

Preliminary studies of DNA sequence data from both mitochondrial and nuclear genes in these six mummies suggest that Hwjt and Hffi are not related to a northern European population. Additionally, Sm't, Hffi, and the unnamed child belong to a single extended family which does not display the genetic characteristics of a disease often found in this population (see figure 2). Analysis is now being extended to include many other genes, including those determining sex and other physical characteristics. The BYU team is confident that the genetic relationships between these mummies can then be conclusively confirmed or refuted.

For example, through genetic analysis, Hwjt (the middle generation female) has been shown to be closely maternally related to

Hffi, one of the children. This relationship was established by the sequence identity of the mitochondrial DNA D-loop hypervariable regions from both individuals (see figure 3). Mitochondrial DNA is strictly maternally inherited, and the hypervariable D-loop regions mutate relatively rapidly because there is no evolutionary pressure to conserve the unused sequences. Therefore, sequence identity in the D-loop region indicates relatively close maternal relatedness, while nonidentity rules out close maternal relationship. In addition, examination of a highly variable nuclear gene from one member of each generation of this putative family has yielded results consistent with the idea that they belong to the same family.

Another very powerful tool that the analysis of DNA has produced is the ability to determine, without question, the sex of an ancient individual. This led to some surprises. The body found in the coffin of Hffi Sr., originally thought to be a male both by name and from the appearance of the burial face mask, was determined to be female by DNA analysis. Also, the body in the coffin of Jnt-Sn, whose burial mask and coffin inscription indicate female gender, was shown to be male upon DNA analysis.

Other genealogical questions can also be considered and answered using DNA analysis. A very striking example of this is the team's ongoing investigation of the familial relationships among the Egyptian Royal Mummies. A number of mummies discovered at the end of the last century had been recognized as kings and queens of the Eighteenth Dynasty and were identified as such. Reexamination of these mummies by other scientists using X-ray and cephalometric measurement, however, had brought the original identifications into question. We now have the ability, using DNA analysis, to determine without question the correct genealogical relationships between family members of this royal dynasty. We have been able to extract and amplify DNA from three of the ancient pharaohs, which represents the initiation of a project which will take many years to complete.

Textile Analysis of the Akhmim Mummies

In addition to the bone and tissue samples taken from the Akhmim mummies, the team obtained some small fragments of

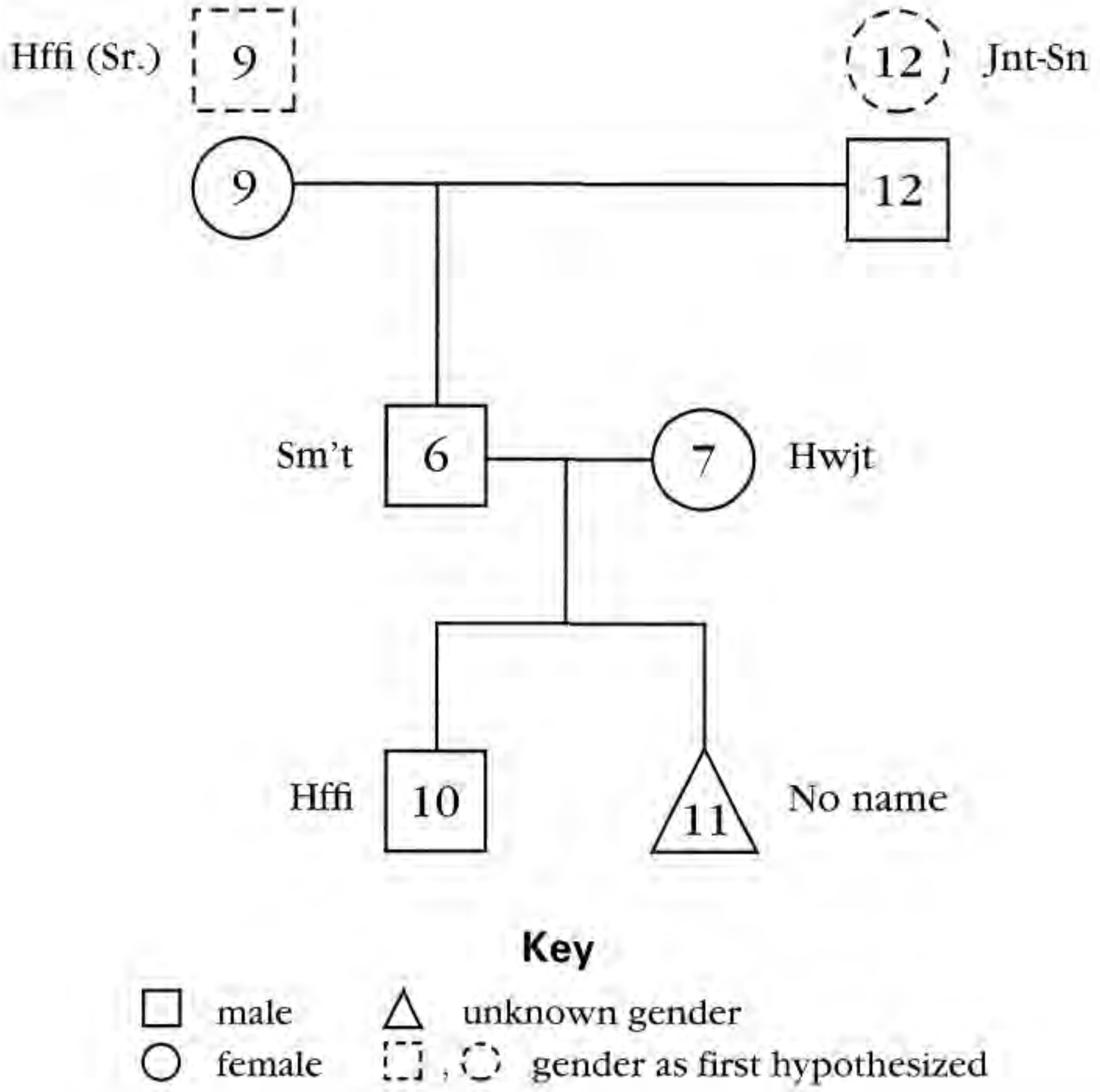


Figure 2. Probable genetic relationship between the Akhmim tomb 1 mummies. Face masks and inscriptions indicated that Hffi Sr. was male and Jnt-Sn was female, but DNA analysis revealed that their gender was just the opposite. The numbers are the BYU team's designation of the mummies for DNA analysis.

```
          16,209                                                                16,251
            |                                                                     |
R. S.     TA CAGCAATCAA CCCTCAACTA TCACACATCA ACTGCAACTC C
Hwjt      __ _T_______ __T_______ A_TGT__C__ ___T_____ _
Hffj      __ _T_______ __T_______ A_TGT__C__ ___T_____ _

          16,340                                                                16,398
            |                                                                     |
R. S.     A TTACAGTCAA ATCCCTTCTC GTCCCCATGG ATGACCCCCC TCAGATAGGG GTCCCTTG
Hwjt      _ _________GT _______G__ ___GT_____ _______T___ _____P_____ ________
Hffj      _ _________GT _______G__ ___GT_____ _______T___ _____P_____ ________
```

Figure 3. Sequenced portions of mitochondrial DNA from Hwjt (mummy 7) and Hffi (mummy 10) from Akhmim tomb 1. The mummy sequences are significantly different from the reference sequence (R. S.) of Anderson and others, which is of northern European origin. The identical sequences for Hwjt and Hffi indicate they are maternally related. (Nucleotides which are identical to the reference sequence are indicated by [_]. The nucleotide designated P was a purine, either A or G.)

material which were lying on the bottom of some of the wooden coffins. Professor Marvin Kuchar has analyzed these materials and has also been able to study some aspects of the textiles based on photographs he took during the sampling process. The fabric analysis indicates that the family of mummies in tomb 1 had access to high-quality textiles. None of the burial cloths Kuchar observed was of poor quality or of cheap manufacture, indicating that the persons buried were wealthy or of religious or political importance. In fact, the cloth used with Jnt-Sn is some of the finest recorded in antiquity, being of the order of 55 x 15 to 47 x 14 threads per centimeter and only 0.13 mm thick.

Fabric from Hffi Sr. and Jnt-Sn had been finished with a rolled edge whipstitched to hold it together. All of the cloth is made of flax fiber; no indication of wool or protein fiber was found in any of the samples. This finding is consistent with the report of Herodotus (II:81), who states that the Egyptian religion forbade a body to be buried with woolen garments. The brown stains in the cloth of Hffi and no name indicate that burial procedures in these two instances differed somewhat from those of the other Akhmim burials. The stains were probably from body fluids, suggesting that the bodies were not mummified.

The false wigs of the mummy masks were also composed of flax and were pigmented or dyed on the ends. In addition, the wigs of Hffi Sr. and Jnt-Sn were impregnated with resin to give them stiffness. Differences in the wig materials indicate two different sources or manufactures. The small flax yarns used in one of the false wigs also show great skill in spinning.[8]

Conclusion

The large cemetery in the Egyptian Fayum is yielding much information relating to the culture of the population which inhabited this area for approximately a millennium, from at least the third century B.C. There is clear evidence of a major cultural revolution sometime during the latter half of the first century A.D., resulting in a reversal of burial direction, new patterns of clothing or dressing the deceased for burial, and the placing of particular kinds of artifacts in the graves. We identify this cultural change with the arrival of

Christianity during the first century A.D., and we propose that there are archaeological evidences here for some of the beliefs and practices of these early Christians. We also recognize that our work raises many questions concerning the nature and extent of the Christian faith in the Fayum at the time of these burials and during the succeeding centuries.

Moreover, analysis of genetic materials and textile fabrics by using the latest scientific technologies is rapidly developing into an important new field of research at Brigham Young University, demonstrating the value of modern molecular tools for the study of ancient history. Already, this research has yielded new information about the lives of ancient pharaohs and of early Christians in the land of the Nile. These research methods should significantly assist in uncovering treasures of information buried in the sands and museums of Egypt, particularly those buried within the biological antiquities themselves. Information gleaned through DNA analysis, coupled with the written records and archaeological materials available from ancient Egypt, opens windows to ancient history that, amazingly, were built into the walls that separate the present from the past.

Further results are steadily emerging, disclosing information that has been packed away in the fabrics and DNA molecules of humans who lived millennia ago. Who were these people? What were they like? How did they live? How were their families interrelated? What were the genetic effects of intermarriages? What struggles did they face? These and many other questions may find new and intriguing answers as genetic and other analyses of ancient burials in Egypt continue.

C. Wilfred Griggs is Professor of Ancient Studies at Brigham Young University; Marvin C. Kuchar is Professor of Clothing and Textiles at Brigham Young University and is a member of the excavation team; Scott R. Woodward is Associate Professor of Microbiology at Brigham Young University; Mark J. Rowe is Professor of Food Science and Nutrition at Brigham Young University; R. Paul Evans is Assistant Professor of Zoology at Brigham Young University; Naguib Kanawati is Professor of Egyptology at Macquarie University, Sydney, Australia; and Nasry Iskander is Director General of Conservation and Preservation in the Egyptian Antiquities Organization (EAO) and Director of the Royal Mummy conservation project. An earlier version of this article was presented as the Brigham Young University–Hawaii Presidential Lecture in November 1992.

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NOTES

All the figures in this article are used courtesy of the BYU Egyptian Archaeological Project.

[1] The Fayum is a governorate located south of Cairo.

[2] For further information, see C. Wilfred Griggs, *Excavations at Seila, Egypt* (Provo, Utah: Brigham Young University Religious Studies Center, 1988).

[3] Bernard P. Grenfell and Arthur S. Hunt, *Egyptian Exploration Society Archaeological Reports* 10 (1900-1901): 4-7, and 11 (1901-2): 2-5.

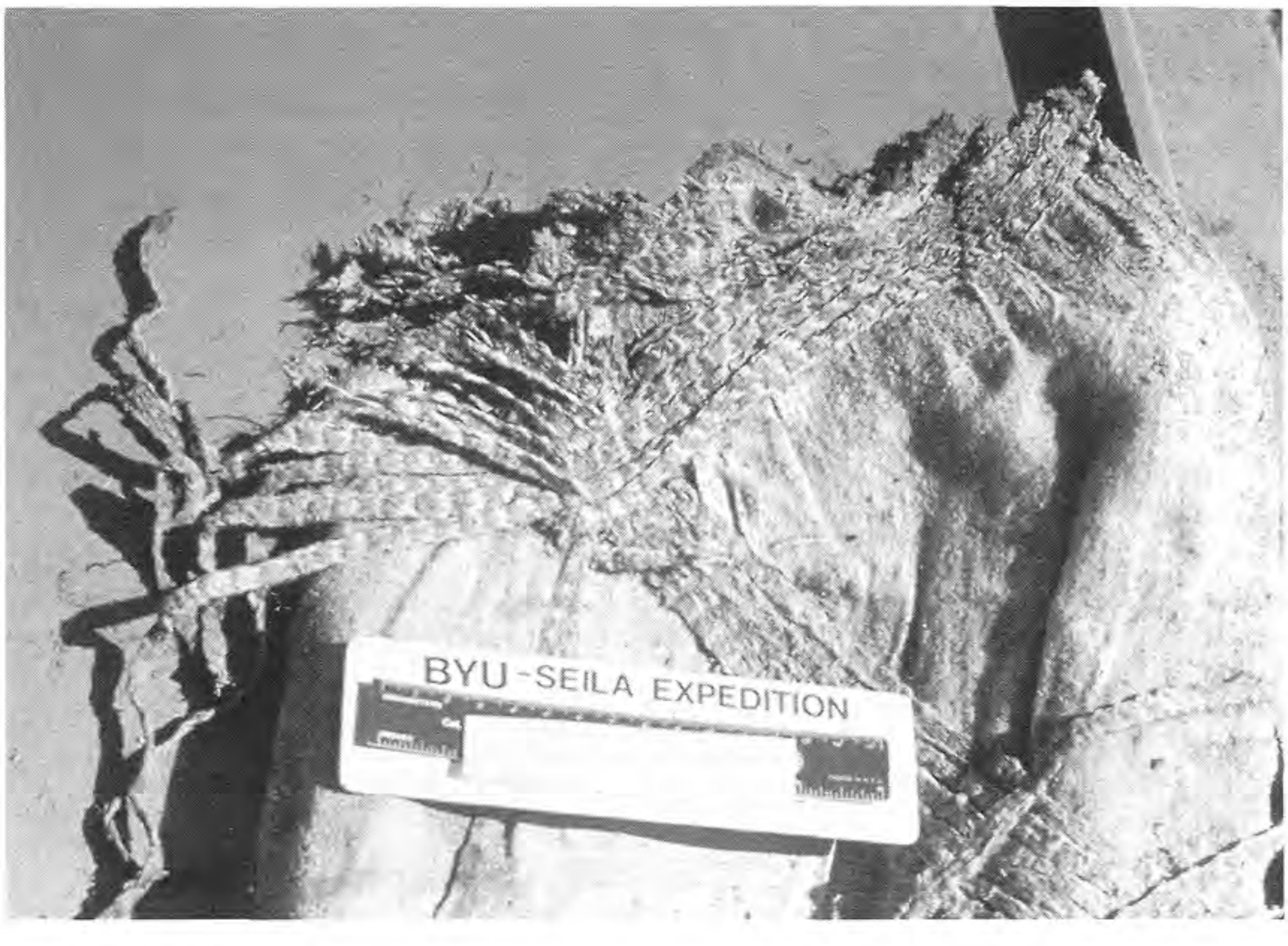
[4] *New Encyclopedia Britannica,* 15th ed. (Chicago: Encyclopedia Britannica, 1993), 11:435.

[5] Gospel of Philip 69:15-70:5.

[6] Eugen Strouhal, *Life of the Ancient Egyptians* (Norman, Okla.: University of Oklahoma, 1992), 19-22; National Research Council, *The Estimation of Recent Trends in Fertility and Mortality in Egypt* (Washington, D.C.: National Academy Press, 1982), 11-18.

[7] For a historical account, see C. Wilfred Griggs, *Early Egyptian Christianity: From Its Origins to 451 C.E.,* 2d ed. (Leiden: E. J. Brill, 1991).

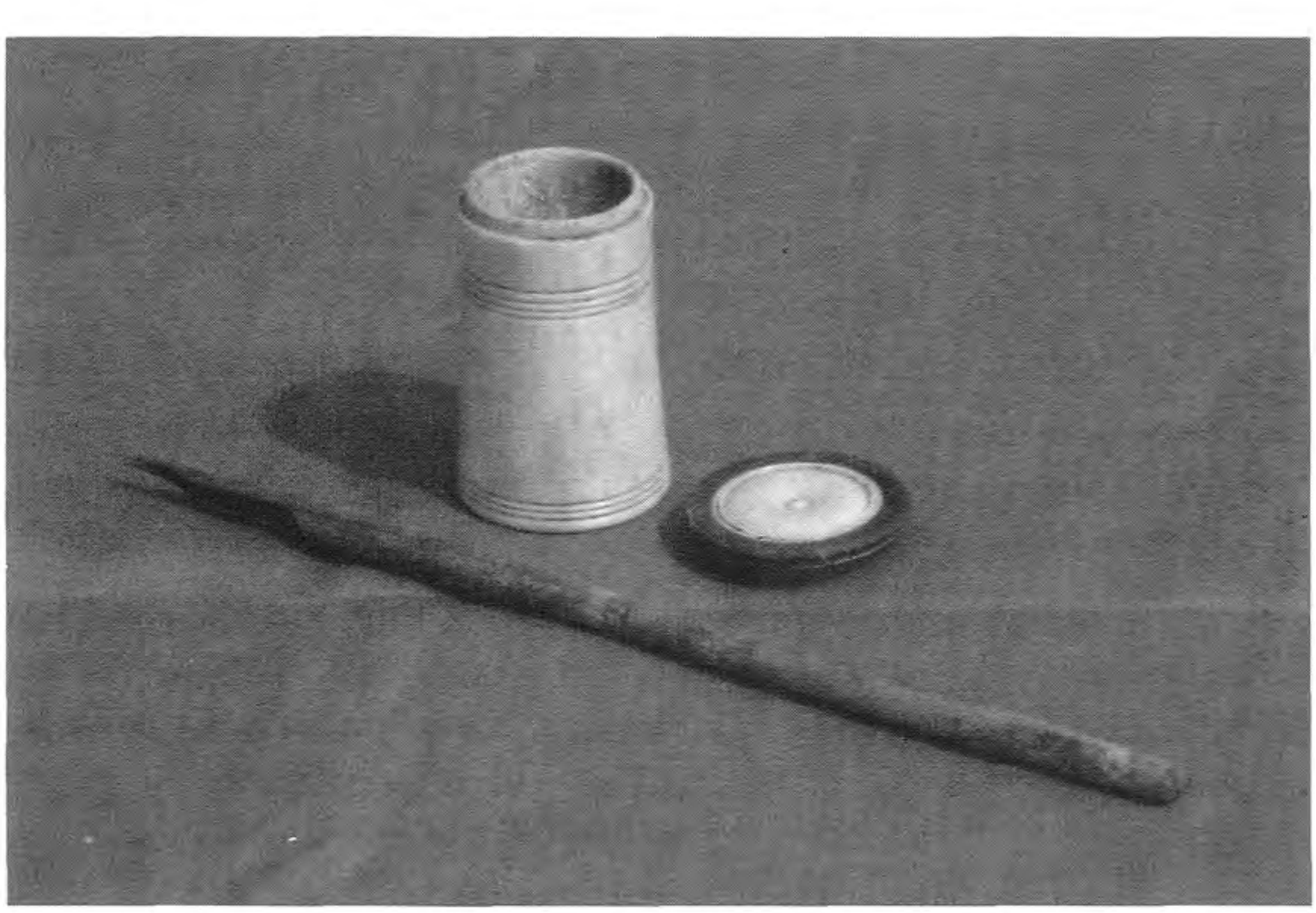
[8] For more details, see C. Wilfred Griggs, R. Paul Evans, Marvin C. Kuchar, Mark J. Rowe, and Scott R. Woodward, "The Genetic and Textile Analysis of the Akhmim Mummies," forthcoming in a technical report from The Australian Centre for Egyptology at Macguarie University, Sydney, Australia.



Robes with ribbons tied on shoulders. Early Christian burials with multiple layers of clothing often include one or more robes with linen strips wrapped around the upper half of the body and gathered into a knot on either the left (top) or, more commonly, on the right shoulder (bottom). These robes were among ten like them placed on the same burial. The knots may indicate priestly authority.

Tree of life. The tree of life symbol is very common in both Egyptian and Jewish-Christian culture. It occurs in burial robes from the Egyptian Fayum cemetery with and without birds (as here) to suggest the owner will partake of the fruit of eternal life. Courtesy of BYU Egyptian Archaeological Project.

Oil Lamp. This ceramic lamp, which was recovered from a relatively large tomb excavated by a BYU archaeological team, likely provided light for those interring the burials and artifacts. The lamp was crafted during the Egyptian Ptolemaic era. Courtesy of BYU Egyptian Archaeological Project.



Reed Pen and Ivory Saltcellar. The reed pen, which has a split nib, was typical of the Late Egyptian era. The saltcellar may have had religious significance to the early Christians in Egypt. Courtesy of BYU Egyptian Archaeological Project.

Inscription on a coffin. Reading from the middle to the left, the father of the girl is identified as a priest in the Egyptian religion of the time. Reading from the middle to the right, the girl's mother is said to be the Lady of the House and beloved of her husband. Courtesy of BYU Egyptian Archaeological Project.