THE JOURNAL OF
Egyptian Archaeology

VOLUME 70
1984

PUBLISHED BY
THE EGYPT EXPLORATION SOCIETY
3 DOUGHTY MEWS, LONDON WC1N 2PG
ISSN 0307-5133

THE JOURNAL OF
Egyptian Archaeology

VOLUME 70

PUBLISHED BY
THE EGYPT EXPLORATION SOCIETY
3 DOUGHTY MEWS, LONDON WC1N 2PG
1984

CONTENTS

LIST OF PLATES

OLD KINGDOM MODELS FROM THE TOMB OF IMPY: METALLURGICAL STUDIES

By R. MADDIN, T. STECH, J. D. MUHLY, *and* E. BROVARSKI

THE latest group of mastabas at Gîza is the complex of the Senedjemib family at the north-western corner of the Great Pyramid of Khufu (Cheops), which contained the well-known mastabas of Senedjemib Inti (G2370) and Senedjemib Mehi (G2378), who served kings Isesi and Unas of the late Fifth Dynasty as viziers and overseers of royal works. The two tombs, however, were only part of a great complex of the tombs of one family built around a large offering-court. Reisner cleared the site in 1912 and 1913 and discovered other tombs, including the mastaba of Nekhebu (G2381), which had been destroyed to its foundations, although many of its decorated blocks were found in the debris.[1] Nekhebu served Pepy I of the Sixth Dynasty, and constructed temples and dug canals for his royal master in Upper Egypt and the Delta.[2] Opposite the tomb of Nekhebu, Reisner came upon a sloping shaft closed with a great block of limestone that protected the unviolated burial of one of the sons of Nekhebu. The coffin was inscribed for two of the latter's sons but contained only one body, so it is impossible to determine which of the sons was buried there.[3] The alabaster head-rest found in the coffin itself, which supported the head of the mummy (MFA 13.2925), was inscribed for one son, Ibebi, but the broad collar of gold and faience beads (MFA 13.3086) at the neck of the mummy was inscribed with the name of the other son, Impy. In a wooden box in front of the coffin were jars and vessels of copper, model tables, tools, and dishes of copper, along with model quartz and slate vessels.[4] The burial was dated by a sealing of Pepy II on a jar to the late Sixth Dynasty.[5]

In an attempt to learn if the technological procedures by which the tomb models were made are representative of those used to manufacture utilitarian items, the study of seventeen tomb models—fifteen from Tomb G2381A—was undertaken. A sample was removed from each artefact with a diamond cut-off wheel and mounted

Acknowledgements. We are grateful to William Kelly Simpson, Curator of the Egyptian Section of the Boston Museum of Fine Arts, for his kindness in facilitating the analytical studies. Thanks also go to Bert van Zelst of the Analytical Laboratory in the MFA for analyses of two of the artefacts. We thank the Laboratory for Research on the Structure of Matter, University of Pennsylvania, for use of its facilities and access to its personnel, of whom the following are owed special debts: Asha Varma for elemental analyses, Alexander Vaskelis for photography, and Robert White for scanning electron microscopy.

[1] G. A. Reisner, 'New Acquisitions of the Egypt Department', *Boston, Museum of Fine Arts Bulletin* 11 (1913), 58 ff.

[2] Dows Dunham, 'The Biographical Inscriptions of Nekhebu in Boston and Cairo', *JEA* 24 (1938), 1 ff.

[3] *Pace* Reisner, op. cit. 59.

[4] Ibid., the contents of the tomb are shown in figs. 12–16 on pp. 59–61.

[5] Reisner and W. Stevenson Smith, *A History of the Giza Necropolis*, II (Cambridge, Mass., 1955), 54, fig. 54.

in cold-setting epoxy. The mounted specimens were ground and polished following standard metallographic procedures, and then etched with ammonium hydroxide. They were studied under the optical and scanning electron microscopes. Elemental analysis was by atomic absorption spectroscopy, except for model plate 13.3181 and vase cover 13.2981, which were by X-ray fluorescence spectrometry.

1. *Model Axe (Fourth–Fifth Dynasty) (03.1669) (see pl. VIII, 1)*

Elemental analysis (see Table I) shows that the copper used to make the axe was of high purity and in all probability unalloyed. The amount of tin is too small (0.38 per cent) to call this a deliberate alloy; the tin could have been introduced from the ore,

TABLE I. *Elemental analyses by atomic absorption spectroscopy of Egyptian models*

	Cu	Fe	Pb	Ag	Sn	Na	Ca	As
03.1669	99.35	0.48	n.d.	n.d.	0.38	0.69	0.10	—
03.1672	99.2	0.42	n.d.	n.d.	n.d.	0.26	0.12	—
13.2937	99.78	0.18	0.12	n.d.	n.d.	n.d.	n.d.	—
13.2943	99.24	n.d.	n.d.	n.d.	0.19	n.d.	n.d.	—
*13.2981	—	0.8	0.06	0.08	0.1–0.2	—	—	0.1–0.2
13.2987	99.48	0.22	n.d.	n.d.	n.d.	0.01	n.d.	—
13.3000	99.60	0.35	n.d.	n.d.	n.d.	0.08	n.d.	—
13.3063	98.98	1.08	n.d.	n.d.	n.d.	0.39	0.52	—
13.3074	99.32	0.44	n.d.	n.d.	n.d.	0.28	0.18	—
13.3181	—	0.3–0.4	0.1	0.3–0.4	0.1	—	—	0.005
*13.3244	99.63	0.15	n.d.	n.d.	n.d.	n.d.	n.d.	—

* Analysis by X-ray fluorescence (B. van Zelst)

although conglomerate tin–copper ores are extremely rare, or from the use of recycled bronze scrap. The latter possibility seems unlikely because there is little evidence for Egyptian bronze production in the Old Kingdom.[6] The presence of tin in this axe is therefore probably of the greatest importance for its potential in shedding some light on the types of ore sources being used. The small amount of iron could have come from an ore, e.g. chalcopyrite (although there is no indication that such an ore type was used in Old Kingdom Egypt), or from an iron-ore flux added to the smelt. Sodium and calcium come from corrosion products. Examination with the scanning electron microscope (SEM) confirmed the relative 'cleanness' of the metal and the presence of internal corrosion.

To manufacture this object, molten copper (more will be said about smelting and refining in the conclusions) was cast in a slab. The slab was then hammered into shape, with intermittent annealing at low temperatures to permit further shaping. Hammering and low-temperature annealing are indicated by sporadic annealing-

[6] J. D. Muhly, 'New Evidence for Sources of and Trade in Bronze Age Tin', in A. D. Franklin, J. S. Olin, and T. A. Wertime (eds.), *The Search for Ancient Tin* (Washington, DC, 1977), 45.

twins in the microstructure (see parallel bands with single grains in pl. VIII, 2). The low temperature of the annealing operation is deduced because the twins are not homogeneous throughout the sample and because strain-markings are still visible (see pl. VIII, 2, right side). (Strain-markings are created by hammering; when the object is annealed to soften the strain produced by cold-working and thus permit further working, the strained grains of metal recrystallize—the extent of the recrystallization depending on the time and temperature of the annealing operation. When the grains recrystallize, annealing-twins appear. Therefore, the presence of both annealing-twins and strain-markings in the microstructure indicates either incomplete recrystallization or recrystallization followed by further cold-working and no more annealing. Careful observation of the microstructure allows the determination of which case is applicable.) In sum, the axe was cast into rough shape, and repeatedly cold-worked and annealed to produce the final shape. If the axe were a functional implement, it would have been harder, and therefore more useful, in a less completely recrystallized condition. (The question of using models as indicators of the smith's skills will be addressed in the conclusions.)

2. *Model Adze (Fourth–Fifth Dynasty) (03.1672) (see pl. VIII, 3)*

Elemental analysis shows that the adze was made of copper of a high purity, with iron coming from the ore or the flux, and sodium and calcium from the corrosion products. SEM examination confirmed the purity and cleanness of the metal; no second-phase particles, which are concentrations of impurities insoluble in the molten metal, were visible.

The molten copper was cast into a thin slab and reduced 30 to 50 per cent by hammering. The strain-markings in the microstructure indicate that the slab was heavily cold-worked (see pl. VIII, 4); there is some slight evidence for recrystallization in a few annealing-twins. The fact that the object was left in the cold-worked state means that it could have been a useful tool, since this is the best way to achieve hardness in copper without alloying.

3. *Model Table, G2381A, Gîza (Sixth Dynasty) (13.2937) (see pl. VIII, 5)*

Elemental analysis again shows a copper of high purity; lead may result from some galena in the copper ore and iron from pyrite in the copper ore or from the use of chalcopyrite. The presence of these impurities was confirmed by SEM study, in which second-phase particles composed of various combinations of copper, iron, sulphur, and lead were detected.

The molten copper was cast into a slab and hammered into a sheet; the sheet must have then been repeatedly annealed to soften it so that the table could be constructed. The bending of the side-flaps of the sheet to form the legs and the joining of the edges of the legs required many different reheatings, which would account for the completeness of the recrystallization (see pl. VIII, 6). The opening in the legs would probably have been cut out (with a stone tool?), while the table was hot.

4. *Model Axe, Tomb of Impy (13.3066)*

The axe is too corroded for profitable study. Varying states of preservation of metal artefacts with similar compositions from the same archaeological environment are not unusual. The phenomena which produce corrosion are poorly understood. They may be affected by minor differences in the micro-environment of each artefact (e.g., soil, the action of water, decaying biological materials), and, in the absence of detailed analytical studies of the immediate physical surroundings of each object, cannot be defined.

5. *Model Adze, Tomb of Impy (13.3070)*

The adze is too corroded for profitable study.

6. *Model Tray, G2381A (13.3074) (see pl. VIII, 7)*

The copper was of high purity, with iron coming from the ore or the flux and sodium and calcium from the corrosion products. SEM study showed the presence of second-phase particles composed of copper, iron, and sulphur (see pl. IX, 1). Particles of such a composition are most likely to be unsmelted chalcopyrite or undissolved matte (matte is a waste product of the smelting of chalcopyrite ores, most of which is usually removed from the copper during smelting). The tray was made from a sheet of cast copper, which was cold-worked into shape and annealed for a short time. A short annealing time is indicated because recrystallization of the grains is incomplete, i.e. not all grains show annealing-twins.

7. *Model Vase, G2381A (13.3244) (see pl. IX, 2)*

The model vessel lacks its neck and flat rim. The vessel is the *ḥes*-vase, a ritual container for water or wine. Elemental analysis shows a copper of high purity. The amount of iron is smaller than in the other objects studied, a fact which indicates that either the copper was the product of an efficient smelt in which almost all of the iron oxide (Fe_2O_3) was slagged off, or the copper ore itself contained very little iron. The vase was cast to shape and was not worked after casting. This is proved by the typical dendritic structure (see pl. IX, 3), in the interstices of which are located the last components to freeze in the molten metal, i.e. the second-phase particles. The grain-size is large; therefore, the casting cooled slowly. The mould must have been made of clay, stone, or some other material with low thermal conductivity. SEM study showed that the second-phase particles are all non-metallic.

8. *Model Adze G2381A (13.3080)*

The adze is too corroded for profitable study.

9. *Model Plate, G2381A (13.3181) (see pl. IX, 4)*

Elemental analysis, by X-ray fluorescence spectrometry, is consistent with that of the other samples in revealing a more or less pure copper. The cleanness of the metal was confirmed by scanning electron microscope study, in which very little second-phase material was detected.

The copper was cast into a thin slab and then hammered to reduce the thickness. An alternating series of hammering and annealing operations is indicated by the microstructure (see pl. IX, 5), in which annealing-twins are visible. The recrystallization is heterogeneous, a situation which probably results from a final phase of working in which deformation was heterogeneous; that is, the sheet was probably hammered into a wooden (?) mould, so that some areas required more working than others to take the shape. The plate was annealed after the final shaping, perhaps at a fairly high temperature (*c.* 500 °C) for a fairly long time (1–2 hours).

10. *Model Dishes, G2381A (13.3000) (one sample shown in pl. IX, 6)*

Elemental analysis shows a copper of high purity, containing a small amount of iron, which could have been introduced from the ore or an iron-ore flux. SEM study confirms the cleanness of the metal; there are very few second-phase particles. The second-phase particles which were detected are copper sulphide and copper–lead sulphide, non-metallic components which occurred as minor impurities in the ore.

The copper was cast into a thin slab, worked to reduce it in thickness (probably in a series of hammering and annealing operations), and given final shape by hammering into a wooden (?) mould. The heterogeneous deformation seen in 13.3168 etc. (no. 9) is also apparent here (see pl. X, 1); it is, in fact, possible that the model dishes and plates were made by the same smith from the same batch of copper. The similarities in material and manufacturing techniques indicate that the smith's metal-working skills were not accidental, but well understood and frequently practised.

11. *Model Vase-cover, G2381A (13.2981) (see pl. X, 2)*

Similar full-sized vases in the shape of truncated cones were made of red pottery and were used for ceremonial lustrations.[7]

Elemental analysis by X-ray fluorescence spectrometry reveals several impurities in concentrations greater than in the other samples. Arsenic, tin, and silver could result from remelted scrap or from some impurities in the copper ore. The iron could have several possible origins, as discussed above. SEM study showed a fairly clean copper with few second-phase particles.

The sample was removed from the side of the cover and included a piece from the side. Microscopic study suggests that the cover and the side were made from two separate pieces of worked and annealed copper (see pl. X, 3). The grain size in the two pieces is different; this variation could have been produced by different annealing times or temperatures. The grain size in annealed copper is determined by the amount of cold-hammering prior to annealing, the time at the annealing

[7] G. Jéquier, *Les Frises d'objets des sarcophages du Moyen Empire* (Cairo, 1921), 311.

temperature, and the temperature at which the annealing occurs. The variable over which the coppersmith had the least control was temperature, and it is therefore likely that the sheet having the larger grain size was heated to a higher temperature. The cover, therefore, must have been made by hammering together two sheets of copper. Since the interface between the sheets is corroded, it is difficult to determine how the joining was done.

12. *Model Blade, G2381A (13.3057)*

The blade is too corroded for study.

13. *Razor-blade, G2381A (13.3064)*

The blade is too corroded for study.

14. *Razor-blade, G2381A (13.3063) (see pl. X, 4)*

The end was originally rounded and the razor fastened by means of the projecting tang to a wooden handle. It closely resembles the razors set in a case in the wall paintings of the Dynasty III chapel of Ḥesyrēʿ,[8] and actual gold and silver razors found in the tomb of the mother of Khufu (Cheops).[9]

Elemental analysis shows that the copper used to make this blade was not as pure as that used for the other objects studied. The presence of 1.08 per cent iron may indicate a relatively inefficient smelt using either an ore containing pyrite and/or haematite, or an iron-oxide flux (or perhaps both). Careful smelting procedures would have resulted in the removal or exclusion of more iron. The few second-phase particles detected in the SEM study are composed of copper–iron sulphide, suggesting the use of a fairly well-weathered copper ore. The razor is, however, fairly heavily corroded and the relatively large amount of iron detected may simply result from the corrosion products.

To form the razor, the copper was cast into a thin slab and worked to the desired shape and thickness in a series of working and annealing operations. After the final shape was attained, the blade was annealed (see pl. X, 5), to the point of recrystallization as far as can be discerned; the corrosion limits the completeness of the observations. A fully annealed, and therefore soft, object would not be particularly useful as a razor. The apparent contradiction between 'function' and metallurgical state may be explained in several ways: (1) the blade was made specifically for funerary purposes and was not intended to be used (the size of this blade, 0.109 m in length, does not compel us to classify it as a 'model'); (2) after the final annealing, the edge was ground to sharpen it. The edges cannot be examined because of the advanced state of corrosion. In fact, the extent of the corrosion of edges provides indirect support for a honed edge, since the grinding would have made the edge more susceptible to corrosion than an unground edge. Honing an

[8] J. E. Quibell, *Excavations at Saqqara 1911–12* (Cairo, 1913), pl. 21.

[9] Reisner and Stevenson Smith, op. cit. 45, fig. 45, with pl. 40 a, c.

edge involved grinding with a stone or polishing with grit, the latter, in all probability, suspended in a liquid. By either method, the metal on the edges would have heavily deformed in metallurgical terms. The internal deformation, detectable microscopically, creates weak areas in the crystalline structure, which in many cases can be attacked by corrosive agents more readily than undeformed or lightly deformed specimens.

15. *Model Chisel, G2381A (13.3060)*

The chisel is too corroded for study.

16. *Lower Part of an Incense-burner, G2381A (13.2943)*

To be used, the incense-burner would have had a liner of another material which would not conduct heat. The copper, as indicated by elemental analysis, is of high purity, with a small amount of tin (0.19 per cent). Such a quantity of tin does not prove that deliberate alloying was taking place; it may be present either because it was an impurity in the copper ore or because bronze scrap was being recycled. The absence of iron suggests that the copper was the product of a remelting operation, because successive recycling involves refining, and, therefore, the removal of iron. (In scrap recycling, if tin were present in only one or a few objects, it would be diluted by the addition of scraps made of unalloyed copper. It should also be noted that refining and remelting do not concentrate tin, but rather make the tin composition of the finished product more homogeneous.) This is the only piece studied which contains no iron; even the axe (03.1669, no. 1) contains some iron, as well as tin. The presence of tin in this object, therefore, suggests that some 'bronze' was being used in Old Kingdom, whether of the accidental variety as 03.1669, or of sporadic local production, or as the product of foreign trade.

The copper was cast into a thin slab and worked into a sheet through successive hammering and annealing operations (see pl. XI, 2). The body and base of the vessel were made of separate pieces of copper sheet, that forming the body apparently bent round to form a cylinder, with the edge joined by hammer-welding, and that forming the base bent up to form a lip into which the body was inserted. The body and base were probably then hammer-welded together.

17. *Punch or Blade, G2381A (13.2987) (see pl. XI, 3)*

Elemental analysis shows a copper of high purity. The cleanness of the metal was confirmed by SEM study, in which few second-phase particles were detected; those examined contained copper, iron, and sulphur, while a few also had some lead. These particles result from impurities in the copper ore. The object was cast and then heavily cold-worked (see pl. XI, 4). No annealing was done. The fact that the punch/blade was left in the cold-worked state shows that the smith was probably aware, in a pragmatic way, of the properties of copper. A stronger tool could have been produced only by alloying the copper, a process either unknown or little used in the Old Kingdom.

Conclusions

1. Technological Considerations

Of the seventeen objects of Old Kingdom date six were too corroded for study (3.3057, 3060, 3064, 3066, 3070, 3080). The following comments therefore relate to the eleven viable specimens.

The metal from which the objects were produced is quite pure, averaging over 99 per cent copper. The most significant impurity is iron. In the specimens which contain iron, except 13.3063, the iron concentration is small enough to justify the view that the copper ore is its most likely source. Many copper ores do contain iron, which can be removed by careful smelting and refining operations. An iron-ore flux in the smelt is another possible source for the iron, but the use of such a flux would probably have resulted in consistently higher iron contents.

The presence of tin in four objects also calls for explanation. Most analyses have indicated that Egyptian smiths were not producing bronze in the Old Kingdom; and low tin concentrations in 03.1669 (0.38 per cent), 13.2981 (0.1–0.2 per cent), and 13.3181 (0.1 per cent) support this observation since these amounts are too small to show deliberate alloying. Two possible sources for the tin are: (1) the use of a conglomerate copper ore containing tin as a impurity; (2) the use of remelted scrap, some of it bronze. The latter alternative is indicated for 13.2943 since it contained no other impurities; the resulting metal could have been well refined through remelting and drossing-off of impurities. The tin in 03.1669, 13.2981, and 13.3181 could have come from the ore or from scrap. The fact that there were bits of bronze scrap available to Egyptian smiths is significant, although it cannot be stated with certainty whether the bronze was acquired from abroad or resulted from the use of a conglomerate ore.

The clean condition of the copper (few impurities detected by elemental analysis, metallography, and scanning electron microscopy) indicates that it was being produced by an efficient smelting operation using a uniform ore; a refining operation must have followed the smelting. In refining, the copper was held molten under a solid, air-tight covering of dross or slag, which was removed. Since no second-phase particles of copper oxide were detected, the copper was cast into tight moulds, whether into ingot form or the blank from which the finished objects were made; the pouring of the molten metal itself was done in such a way that air was excluded.

It is interesting to speculate on the number of stages through which the copper passed from ore to finished object, and the different people involved in those stages. It seems likely that the copper was cast into an ingot form of some type after smelting. This raw copper may then have been purchased by smiths who refined it, sometimes extending the metal by the addition of scrap, and cast into shape. The skills of the smith are best seen in the treatments he gave the castings. He had at his disposal knowledge of the techniques by which copper can be worked—casting, hammering, annealing—and he appears to have understood the relationship between these metallurgical treatments and the properties of the finished objects. In cases in which strength and/or ductility were not needed, he simply cast the object to shape and did not work it (cf. vase 13.3244). For some pieces, the casting may not have been completely successful, so additional working and annealing were necessary in order to achieve the ideal form (probably table 13.2937—a shape difficult to achieve by direct casting; tray 13.3072, plate 13.3168, vase 13.2981, dish 13.3000, and vase 13.2943—these last two objects probably could have been made by direct casting, but nevertheless may have been worked to make them suitable for the smith and his customers). Two objects, adze 03.1672 and blade 13.2987, were left in the worked condition, the state in which they would be the hardest, and, therefore, have the maximum utility.

2. *Applicability of Results to General Problem of Egyptian Copper Production and Working*

The objects analysed were, for the most part, from a tomb and some, if not all of them, were models. It is, therefore, pertinent to consider how model objects, perhaps made specifically for funerary or ceremonial reasons, reflect contemporary technology:

I. *Material*. The smith used the material, i.e. copper, most reasonable in the context of time in which he was working for the purposes which he wished to fulfil. Lead was also available, but would not have held up for objects made of sheet-metal, even in a funerary context. Gold and silver were being worked, but were much more expensive. The copper that the smith used must have been the same as that which served for all other kinds of objects—smelted in the same way from the same kind of ores, refined and cast as copper for any other purpose would have been.[10]

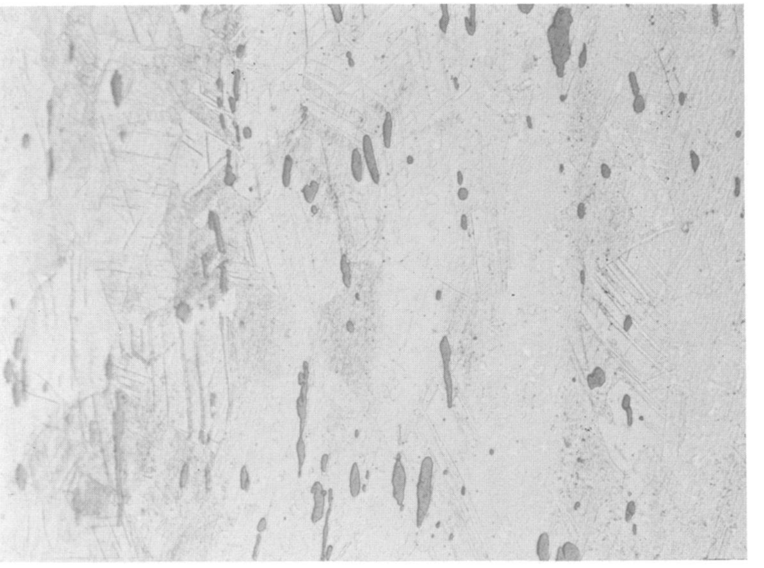
II. *Technology*. If the smiths had wished to make all the objects in the easiest way, they would have cast them and not subjected them to subsequent working. That most of the objects were worked indicates either the desire of the smith to have his object conform perfectly to his mental template of shape or the fact that most or all axes, for example, were made in the same way, whether they were specifically intended for the tomb or not. The techniques used to fashion the Old Kingdom pieces studied here are all those which were at that time available to a smith working with more or less pure copper—casting, cold- (or hot-) hammering, and annealing. These processes are also documented in the Fifth Dynasty Egyptian pictorial record.[11] Therefore, even a group of model objects provides information on metal-working techniques, because it demonstrates what were at least the minimum accomplishments of the smith. The questions which might be asked about metal tomb 'models'—were they made specifically for the tomb?; did this purpose affect the way the smith made the object?; were even tomb models made in the best way known in the anticipation of eventual use, when the deceased was reborn?—need only be mentioned here.

[10] On casting and crucibles see A. Nibbi, 'Some Remarks on Copper', *JARCE* 14 (1978), 59–66.

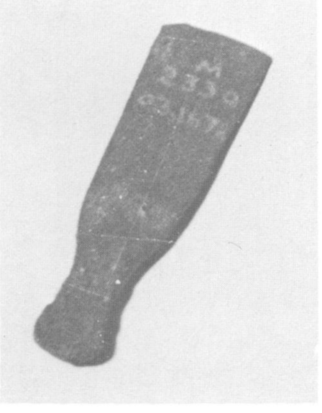
[11] J. Weinstein, 'A Fifth Dynasty Reference to Annealing', *JARCE* 11 (1974), 23–5.

Plate VIII

1. Model axe (acc. no. 03.1669)
Dynasty IV–V

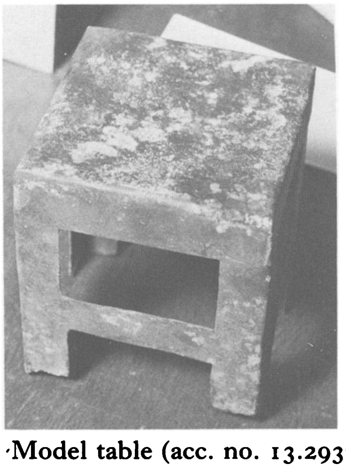


2. 03.1669, ×750



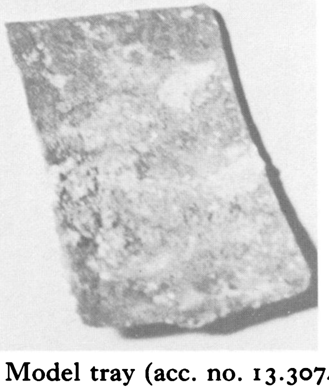
3. Model adze (acc. no. 03.1672)
Dynasty IV–V

4. 03.1672, ×300



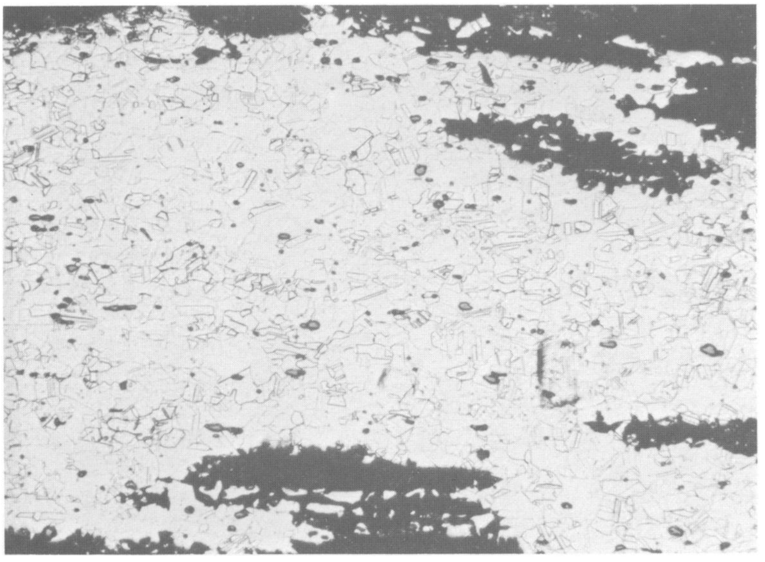
5. Model table (acc. no. 13.2937),
G2381A

6. 13.2937, ×150

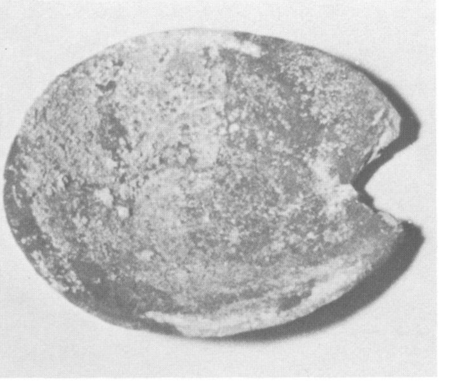


7. Model tray (acc. no. 13.3074),
G2381A

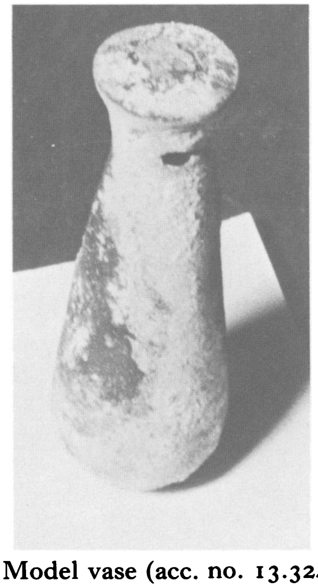
OLD KINGDOM MODELS



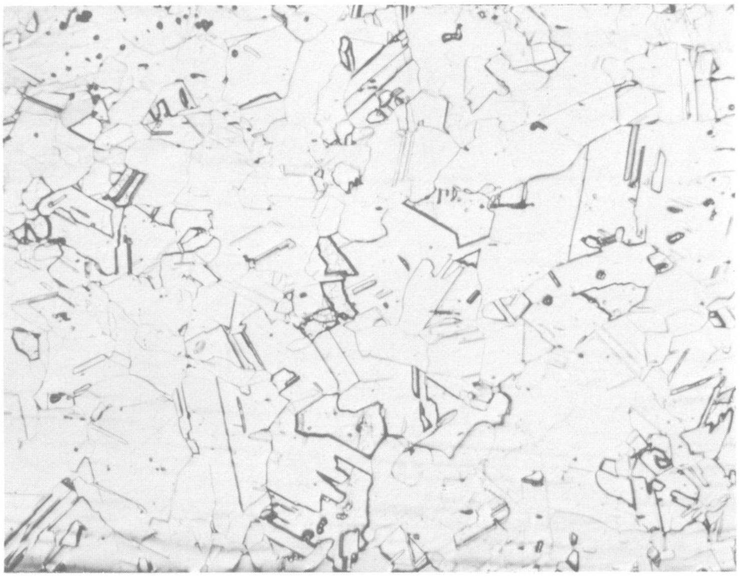
1. 13.3074, ×300



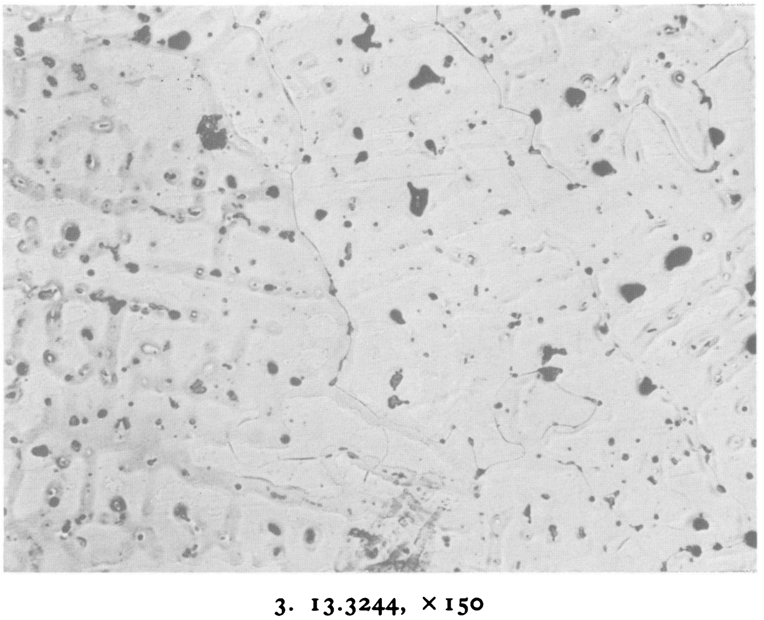
4. Model plate (acc. no. 13.3181), G2381A



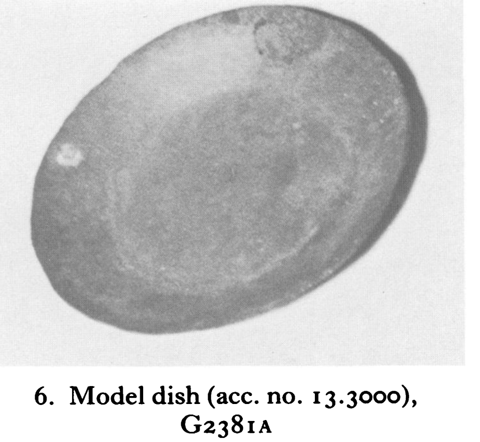
2. Model vase (acc. no. 13.3244), G2381A



5. 13.3181, ×150

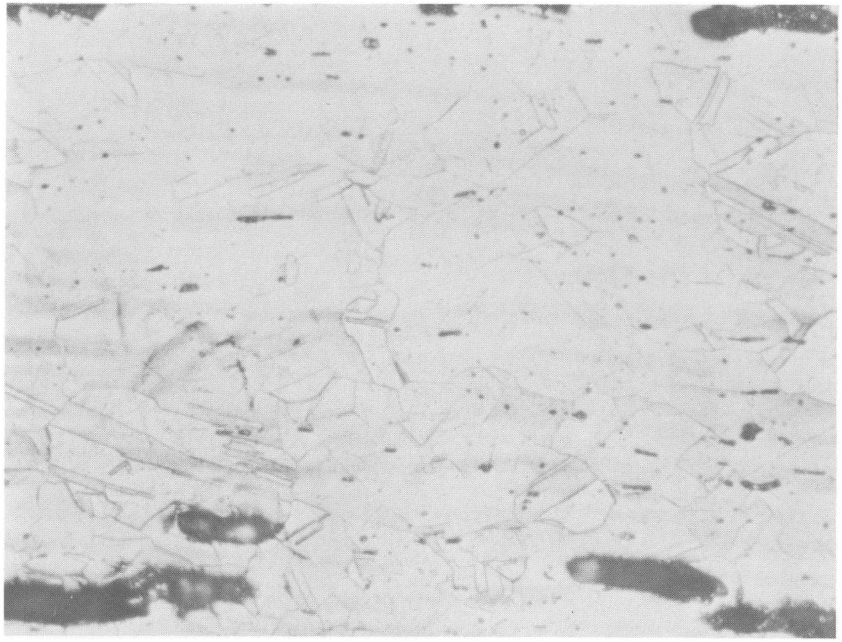


3. 13.3244, ×150

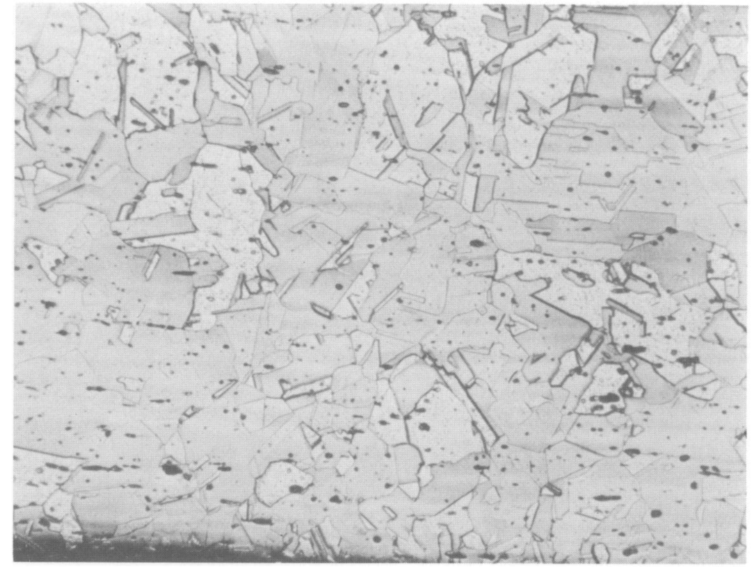


6. Model dish (acc. no. 13.3000), G2381A

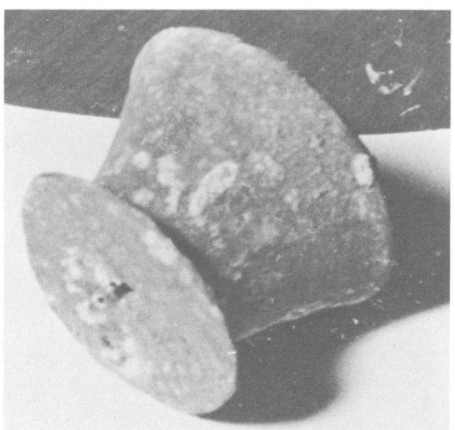
OLD KINGDOM MODELS



1. 13.3000, ×300

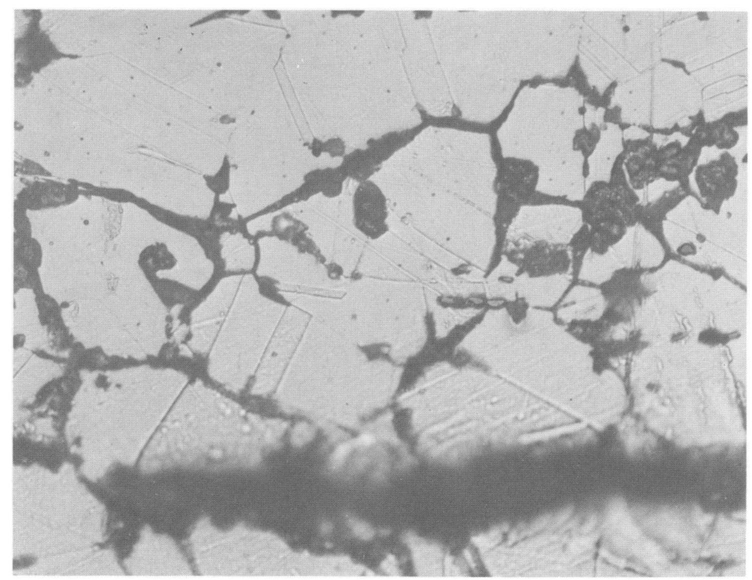


3. 13.2981, ×100



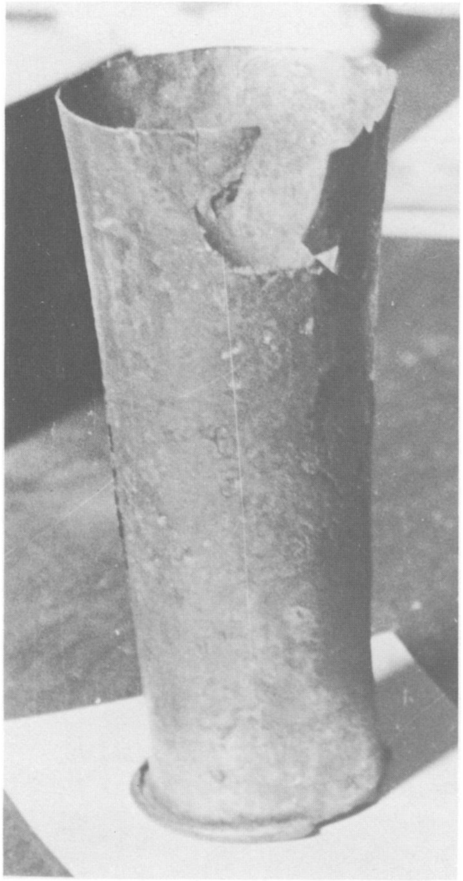
2. Model vase cover (acc. no. 13.2981), G2381A

4. Razor blade (acc. no. 13.3063), G2381A

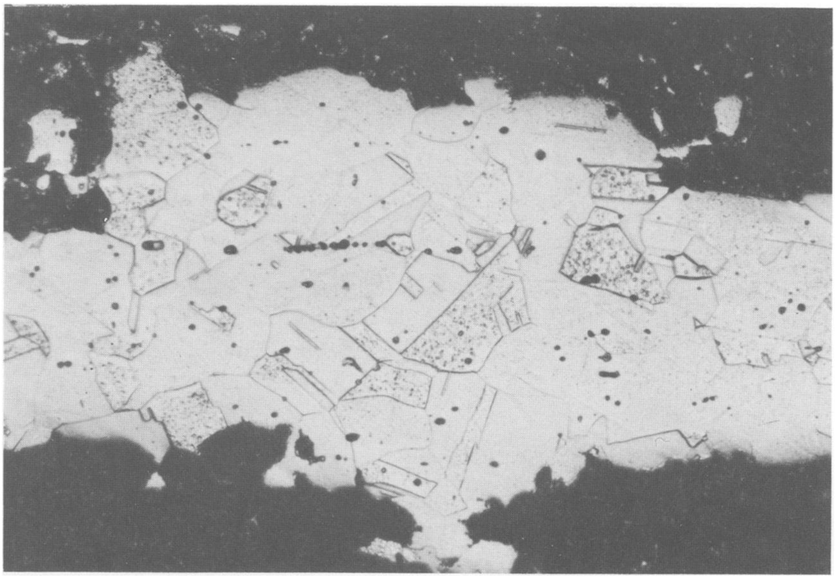


5. 13.3063, ×750

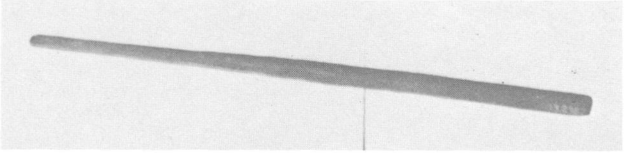
OLD KINGDOM MODELS



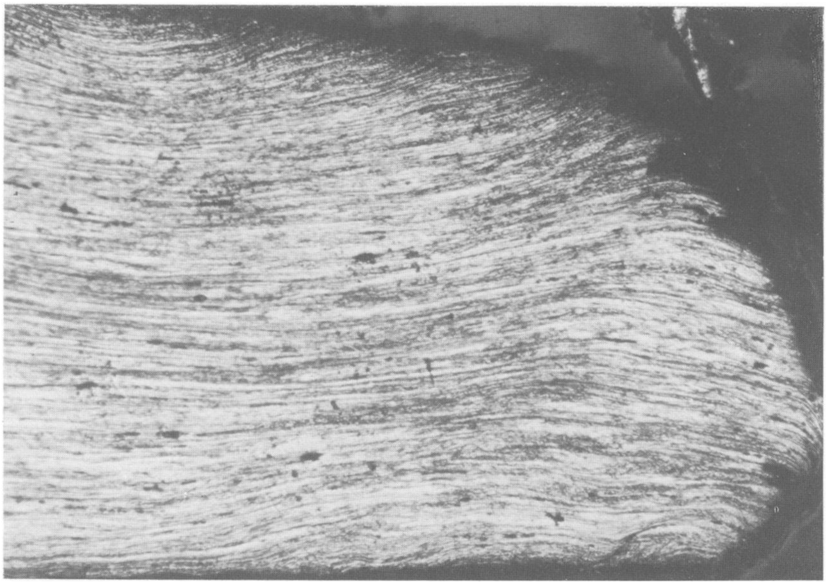
1. Model vase (acc. no. 13.2943), G2381A



2. 13.2943, ×300



3. Blade (acc. no. 13.2987), G2381A



4. 13.2987, ×150

OLD KINGDOM MODELS