CHAPTER 4

REPORT ON THE 1983 EXCAVATIONS THE ANIMAL PENS (BUILDING 400)

Site supervisor: Ian Shaw

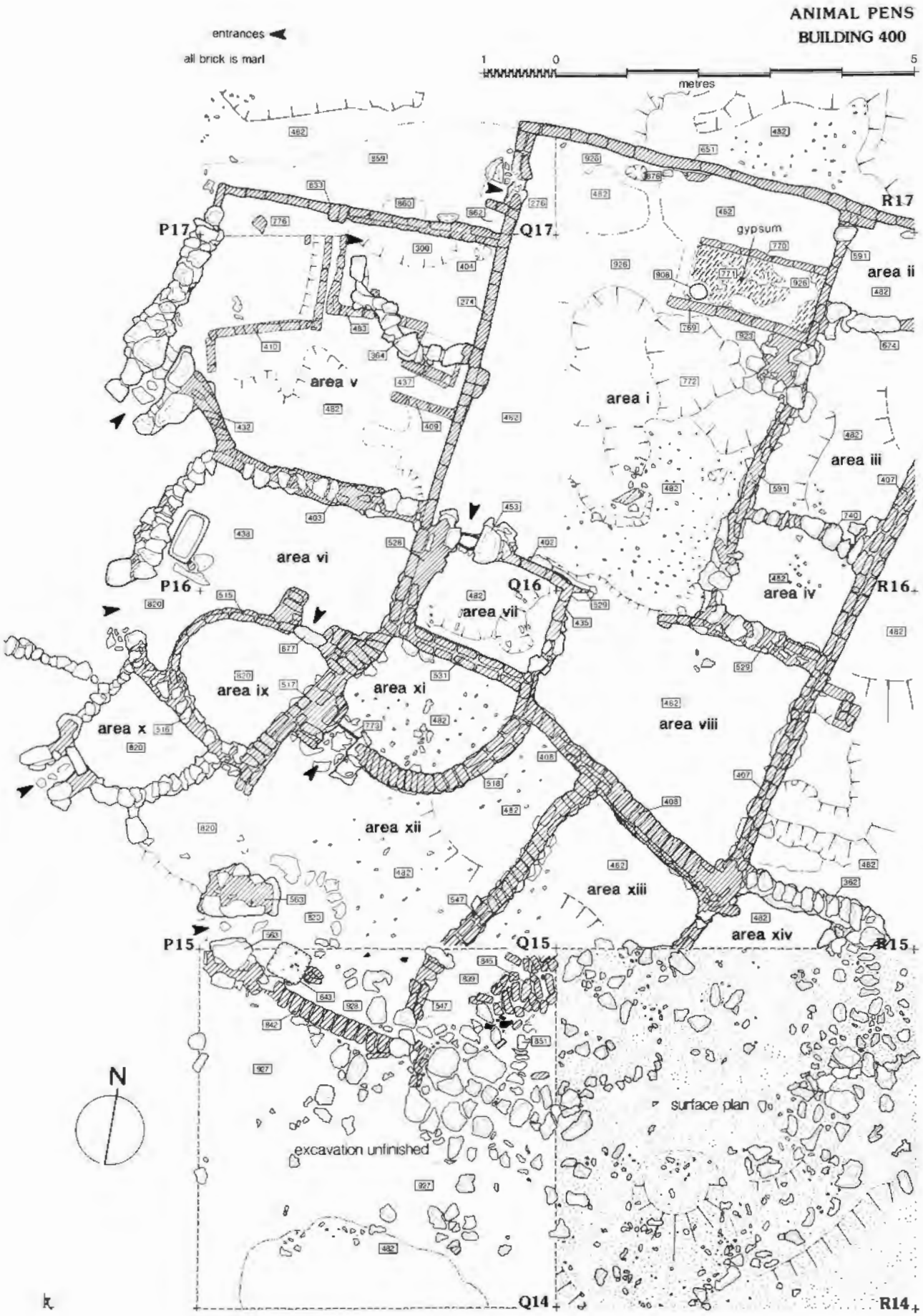
4.1 Introduction

During the season of 1981 a block of squares was excavated eastwards from Building 350, which had itself been largely exposed in the previous year (Kemp 1983: 10-12). The ground rises towards the eastern side of Building 350, and so does the depth of the ancient strata. Building 350 had been abandoned during the life of the village, and its walls had become buried beneath this accumulation of rubble and rubbish (see the photograph in Kemp 1983: Plate I.2). The upper surface of this accumulation was the same as that on which Chapel 450 had been built, and when stone walls were encountered at this level at the eastern edge of the excavation it seemed likely that they represented more chapels. An element of uncertainty was, however, created by the one part of this building level which was exposed. Its simplicity and tiny size, emphasised by the survival of the door lintel only 28 cm. above the floor, made it something very different from the neat and formally designed chapels discovered by Peet in 1921.

No further work was done here in 1982, but in the current season one complete work team was assigned to the area. By the end of the season most of the building had been exposed. The uncompleted parts are square S16 (which must contain the north-east corner of the building), and squares Q14 and R14 on the south. At the very end of the season the surface sand was removed from Q14 and the top of the building rubble planned. This revealed that the southern edge of the building runs across these squares, and that bedrock [482] lies beneath the surface sand at the southern edge. The plan (Figure 4.1) thus shows the greater part of the building, to which the number 400 has been allocated.

The plan also shows the site at the final excavation stage, with the floor deposits removed. Most of the walls were built on bedrock [482], and this is therefore the material that, on the plan, fills most of the rooms and yards. Along the west side, however, the bedrock dips below the wall foundations, which were laid on an accumulation of organic rubbish [438, 820] (cf. Figure 4.7). This has not been excavated since to do so would entail demolishing the walls, and it therefore forms the material of the floors in this part. When in use, however, all spaces were filled with a dark organic layer which formed a flat, uniform stratum over the site. Modern robbery had disturbed it in places,

[(Facing page). Figure 4.1. Plan of the Animal Pens, Building 400 (originals by I. Shaw)].


ANIMAL PENS
BUILDING 400
entrances
all brick is marl
1 0 5
metres
P17
Q17
R17
P16
Q16
R16
P15
Q15
R15
Q14
R14
gypsum
area i
area ii
area iii
area iv
area v
area vi
area vii
area viii
area ix
area x
area xi
area xii
area xiii
area xiv
N
surface plan
excavation unfinished

particularly along the eastern part, but where it was intact a greyish, mottled crust had formed over it, such as has been encountered over similar deposits in front of the Walled Village. It is almost certainly a product of weathering, and appeared not to have formed where the layer had been protected by rubble (see further Chapter 14). In the north-west corners of areas i and v small portions of the organic fill [776] were left unexcavated to supply a source of further soil samples in the future.

The bedrock does not possess an even horizontal surface. It dips slightly down from north to south, the slope increasing in square P15. A low step had been cut across the mid-point of the site, and along it the main east-west dividing wall [403, 402, 529] had been built. The organic fill in the south-western corner [438, 820] probably also masks a cutting in the bedrock, perhaps the edge of a quarry pit, or even of the main quarry (cf. Figure 8.1).

The building materials used are the common combination of marl bricks and rounded stones set in marl mortar. There is possibly a chronological element in their employment. The stone walls occur primarily along the west side, where a degree of rebuilding had taken place on top of the bank of rubbish which had buried the eastern end of the earlier animal pens (Building 350). The change in material is very evident in the case of wall [402, 403] where stone had been used to rebuild an original brick wall. Wall [362] in the south-east corner of square R15 is another addition in stone. Over the rest of the building, where stone appears in the construction it is primarily as a foundation for a brick wall above. The greater dependence on stone may reflect the fact that, with the marl quarries now filled up, brick-making material was no longer readily available.

Where the site had escaped modern robbery, the rubble from the collapsed walls was found lying beneath the surface sand, and was planned separately, as is normal practice in the excavations. The amount of rubble was never very great, and although always too weathered to allow a precise count to be taken of the number of fallen courses, they probably regularly numbered less than ten. This would give a maximum height for the walls of less than a metre. The three semicircular pens had probably lost little of their original brickwork, and they stood to a maximum height of 82 cms. No trace of definite roofing material or of mortar containing impressions of roofing material was found. In one of the pens, area ix, a sheaf of grass was found in the sand filling, and it is to be presumed that the pens were covered in order to provide the animals with shade. But the coverings were presumably of grass or mats on poles, easily removable, and not structurally part of the building. In view of the small sizes of the entrances, it would have been necessary, too, for a man to be able to step over the wall to enter a pen, either to inspect the animals or to clean it out.

4.2 North-eastern sector (Areas i-iv, vii, viii)

This group of six areas forms a unity, with a single entrance in the north-west corner. The use of this entrance had produced a narrowing patch of

organic material [859] running west beside wall [833]. The entrance led to a yard measuring about 4.0 by 5.80 metres. Three small spaces on the east (nos. ii-iv), a larger one in the south-east corner (no. viii), and one of the pens (no. vii) probably opened directly from it. The yard itself had originally contained a small enclosure on its east side, consisting of a surrounding wall [769, 770] and a floor of marl plaster [926] over which a coating of gypsum plaster had been spread [771]. A pottery vessel [908] had been buried in one corner. Later, however, the walls had been demolished and the enclosure vanished beneath the organic accumulation in the yard.

Little can be said about the three small enclosures on the east. Their interiors had been partly dug out, but patches of the original floor showed the same organic content as was present elswhere in the building. A square of stones and mortar [923] built against the wall dividing area iii from the main yard [591] may represent a communal entrance to all three, but this is not sure. A similar lack of specific characteristics applies to the space in the south-east corner, area viii. Its northern wall [529] is built along a step cut in the desert surface. Towards the west end it has been destroyed by modern digging, at the point where an entrance is to be expected.

In the south-west corner lay a single animal pen (area vii), measuring 1.80 by 1.30 metres. This was built over a noticeable hollow in the bedrock [482]. The walls were built directly on bedrock, wall [402] following the edge of the same step against which wall [529] had been constructed. The square area so formed was then filled with rubbish, primarily ash and charcoal [426], to form the floor of the pen. The entrance was in the north-west corner, between two piers made from large stones [453] (Figure 4.2). The door width was 24.0 cms. Two parallel wooden poles were set across the threshold, with a maximum distance between them of 16.0 cms.

4.3 North-west sector (Area v)

This is the part which shows the most obvious signs of changes in layout. In its final stage it consisted of an irregular yard measuring about 3.80 by 3.50 metres. North and east walls [833, 274] were of marl brick, regularly laid; the western wall was of stone; the south wall was a mixture of an original wall of brick [432], and one where brick foundations had been built up with stones [403]. An organic deposit had accumulated over the floor, and on this an animal pen had been built in the north-east corner, measuring about 1.60 by 1.50 metres. It consisted of a single curving wall of stones [364]. Where the entrance would have been a modern pit [300] had destroyed the stonework.

The entrance to the yard lay in the west wall, and had been exposed in 1981 without its true nature being realised. It is really a passage between two stone walls, a mere 13 cms. across at its narrowest point. There are no signs of wooden poles having been laid across the bottom, but two stones separated by a gap occupy the same position. The other feature of interest belonging to the last phase was a neat shallow rectangular depression in the organic floor deposit, just beside the entrance. It measured 73 by 46 cms. and was

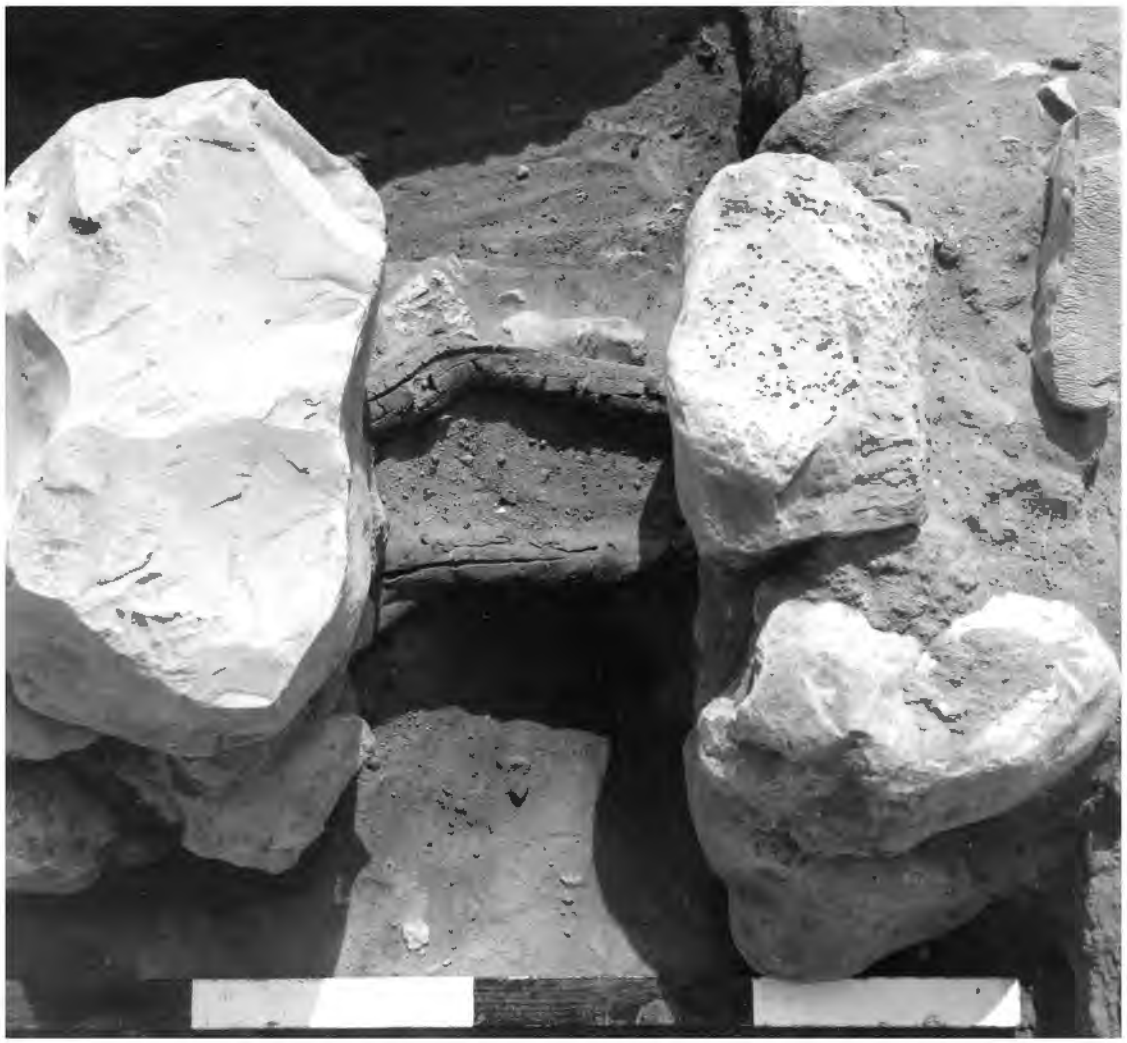


Figure 4.2. Animal pens, entrance to area **viii**, showing wooden poles.

approximately 10 cms. deep. The surrounding surface showed no sign of modern disturbance. By its size, neatness and position it can be identified without much doubt as the place where a limestone trough had stood, like the one found in place in the adjoining yard, area **vi**.

The earlier phase is difficult to understand. It is represented by three wall groups: the double right-angled length [410], the irregular enclosure [483] with projection [437], and the short piece of wall [409]. All were reduced to a single foundation course. From the general layout it would seem unlikely that these constructions were served by the existing entrance in the west wall, which may have been built only for the last phase of use.

4.4 South-west sector (Areas vi, ix, x)

This consists of two pen and yard units, the yard belonging to pen **x** having been largely destroyed by modern digging. The pair **vi** and **ix** represent the clearest configuration of the whole building (Figure 4.3). Together they

cover an area measuring about 3.0 by 3.50 metres. The courtyard was entered through a doorway on the west, partly destroyed by modern digging. Just beside it stood a limestone trough, measuring 70 by 25 cms., protected from the entrance by a stone slab.

Figure 4.3. Animal pens, view of areas **vi** and **ix**, looking south. Area **x** is in the background.

The animal pen occupied the south-eastern corner, and had been formed by a semi-circular wall [515], its brick courses sloping inwards slightly (Figure 4.4). Its dimensions are 1.60 by 1.70 metres. On the north, where it met wall [517], the doorway had been made between two brick piers. The lintel, a single unworked stone, was found still in place [877]. The exact size of the doorway is thus known: 35 cms. wide and 67 cms. high, subsequently reduced to 23 by three bricks laid across the threshold. These bricks had replaced a pair of wooden poles laid across the lower part of the doorway, the ends of which had been set in the brickwork of the jambs. The inner corners of the doorway had been rounded by wear presumably from the passage of animals. The contents of this pen were untouched.

The second pen in this sector (area **x**) was excavated in 1981. Whilst the rear wall [516] is of brick, the two other walls are of stone. Its dimensions are

Figure 4.4. Area ix, looking north-east, with partial brick blocking to the doorway removed. Note the hole in the thickness of the doorway where a wooden pole had been set.

1.50 by 1.40 metres. Projecting buttresses mark the entrance, and again the lintel, of a single stone, was found in place. The doorway measured 30 cms. wide and 28 high (cf. Kemp 1983: 12-13). The contents of the pen had been cleared out in modern times, but it had been built on top of an earlier accumulation of organic debris [820], which had also built up a little over the threshold of the entrance. A wall of rough stone construction runs out from the west wall of the pen. It extended beyond the limits of the plan in Figure 4.1, but had then been truncated by modern digging, which had turned over much of the hill slope lying to the west, or had sunk pits into the thick layers of rubbish. One of these pits occupies the south-east corner of square P15.

4.5 South sector (Areas xi-xiv)

Parts of these areas still lie in unexcavated or partly excavated squares. To judge from the plan of square Q14 showing surface sand removed, area **xiii** opened towards the south. The same must have been true for area **xiv**, which, from its construction, was a late addition to the complex.

Area **xii** is clearly the yard serving the animal pen, area **xi**. Its south-eastern corner appears clearly in the plan of square Q14. Its entrance [563] lay on the west, and was 28 cms. wide. No trace of wooden poles has been noticed. The west wall has been destroyed by modern digging, but seems to have been a continuation of wall [517], to judge from the projecting ends of broken bricks. The surface of the bedrock [482] slopes down to the south-west. As it approaches the doorway [563] it has dipped beneath the foundations, with the result that the western part of area **xii** was built on the existing accumulation of organic matter [820]. The semicircle of stones that protrudes through this layer across the entrance may possibly belong to an underlying structure. Just beside it, in square Q14, the first stage of excavation revealed a further shallow pit marking the original position of a stone feeding-trough [843] analogous to that found in area **v**. It measured 50 by 59 cms., and was 7-12 cms. deep.

The north-west corner of area **xii** was occupied by a further animal pen, area **xi**, measuring about 2.00 by 1.50 metres. It resembled the adjacent pen, area **ix**, in that it had been constructed by building a curving wall [518] across the corner, and where this wall met the dividing wall [517] buttresses had been built for the entrance [773]. This measured 34 cms. across. A single wooden pole laid across the threshold survived.

4.6 Interpretation

Building 400 consists essentially of five (or possibly six) basic components, each one comprising a yard within which stands a small pen, usually in a corner. The five definite pairs are areas **i/vii**, **v**, **vi/ix**, **x**, and **xi/xii**. The possible sixth may lie in the still uncompleted squares P14 and Q14. In three of the yards (areas **v**, **vi**, and **xii**) we have positive evidence that a stone trough stood there. The one part which does not conform to this pattern is the north-east sector, where the yard is larger than the others, and seems to serve three other small rectangular enclosures.

The grounds for identifying Building 400 as animal pens are reasonably certain. Even by ancient standards the doorways are tiny, particularly evident where the lintel survives in place (the two examples have heights of 28 and 67 reduced to 23 cms.). They seem suited only for animals. The floors were uniformly covered with a brown organic layer, rich in grain husks and containing many pieces of faecal material (coprolites). Three of the yards had contained stone troughs suitable for water or for food. But in addition to these specific points is a general one: the excavations of the past in the various parts of Amarna have provided a huge range of examples of house

plans. None resembles the plan of Building 400. Housing at Amarna is so uniform in basic layout that we can safely rule out the possibility that we are dealing with human dwellings, even of a most humble kind.

If these are animal pens, for what kind of animal were they intended ? The animal bone record immediately limits the possibilities (Chapter 11). Only three large mammals are represented in any significant quantities: cattle, goats and pigs. Cattle are clearly to be excluded by the consideration of size. In choosing between goat and pig, or, indeed, in considering any other possibility, it has to be pointed out that the distribution of animal bones is unlikely to be of assistance. It is a reflection of waste disposal habits rather than slaughtering on the spot. Relatively few bones of any kind were found in the floor deposits in and around the pens. Most bones come from the big rubbish deposits.

The most direct evidence that we have are the coprolites from the floor deposits. Several samples were carefully collected and brought back to Cambridge for study at the University of Cambridge Department of Clinical Veterinary Medicine. For comparative purposes samples were also collected and photographed of modern pig faeces in the village of el-Bayadiya.

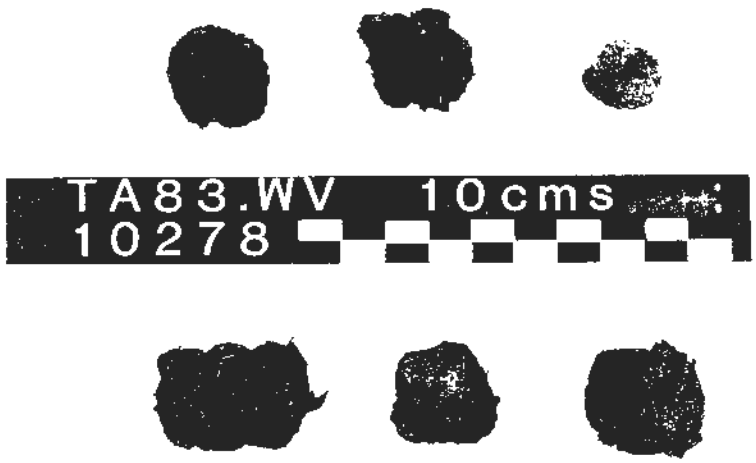


Figure 4.5. Coprolite specimens: ancient (above), sample **10278**; modern pig (below) from el-Bayadiya.

The coprolite samples have been subjected to two forms of examination at the University Department of Clinical Veterinary Medicine: immunological and parasitological. Whilst the former yielded no results (see the report, section 4.11, by W.P.H. Duffus), the latter has produced positive results. At the time of writing a full report is still in preparation, but a brief progress statement is provided in section 4.9. In two samples from the animal pens eggs resembling from the parasite *Ascaris* have been identified. One sample (**10278**) comes from the floor deposit in area **v**, the other (**10277**) from an undisturbed sand layer above the floor deposit in the area lying immediately outside and to the east of area viii. A third sample (**10288**), from intact floor deposit inside the pen, area **ix**, contained eggs like those of *Taenia*. *Ascaris* is specific primarily to humans and to pigs, whilst *Taenia* is the common tapeworm that lives in man, dog, cats and related carnivores, but not pig. At this point some account should be taken of the nature of the samples themselves. The latter, no. **10288**,

was really amorphous lumps of organically rich soil rather than coprolites proper. The other two, however, nos. **10278** and **10277**, were true coprolites. Sample **10278** consisted of three pieces, each one cylindrical and segmented. In Figure 4.5 they have been photographed beside modern pig faeces from el-Bayadiya. The similarity is obvious. Sample **10277** was a single, larger specimen. Its relatively large size may be the result of having been originally compressed by, for example, trampling. These remarks should be considered against the evidence of the animal bones, which limit the choice of animal to goat and pig. In several deposits over the whole Workmen's Village site small spherical coprolites have been found during excavation. These have all been rubbish deposits, except in the case of a floor deposit at site X1. A brief report on these coprolites is included in section 4.10. Despite a constant scrutiny and sieving of the deposits as they were excavated from Building 400 no goat-like coprolites were noted at all. At this preliminary stage in the investigation the coprolites from Building 400 would seem to be pig, with a lesser chance of them being human, but with the remains of human or perhaps dog faeces also present, possibly not in their original form.

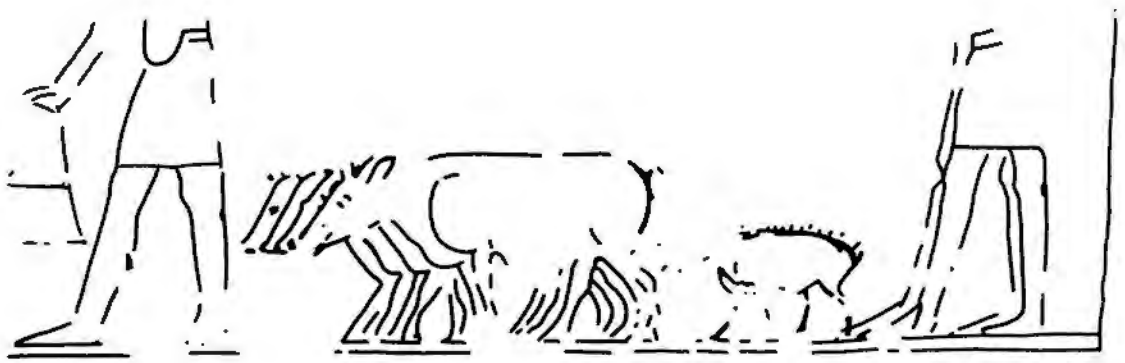
Considering the range of evidence, some of it circumstantial, we put forward as a working hypothesis that Building 400 is a group of pig pens.

4.7 The feasibility of Building 400 as pig pens

The following comments are based partly on literature (especially Hafez, Sumption and Jakway 1962; Williamson and Payne 1978: 541-594; Zeuner 1963: 256-271; and Epstein 1973: 313-372), partly on discussions with members of the University of Cambridge School of Clinical Veterinary Medicine (and in particular Dr. T. Alexander) and with Dr. A.J. Legge, of the University of London Department of Extra-Mural Studies, and partly on personal observations made in the company of Dr. Howard Hecker in a village in el-Minya province, el-Bayadiya, where large numbers of pigs are bred and reared (see also Chapter 11).

The ancient Egyptian pig seems to have resembled the pig that was common in Mediaeval and more recent times around the Mediterranean and in Europe: high-legged, ridge-backed, fat but with slender snout, having a dark and bristly skin (Figure 4.6; cf. Epstein 1971: 340-45; Zeuner 1963: 256-71; also Newberry 1928). The pig is an omnivorous animal, but whilst in some respects is in competition with man for food, it is also a very useful utilizer of the by-products of human food. In modern Cairo the communities who collect the street refuse breed pigs on the rubbish heaps on the edge of the city where they live (Haynes and El-Hakim 1979). The rubbish heaps adjacent to the animal pens at the Workmen's Village provide a small-scale analogy. They are also at home in an urban setting, having a strong homing instinct, enabling them to forage around houses and in streets untended. Physiologically the pig is a non-sweating species, very sensitive to changes in the climatic environment. In high summer temperatures pigs suffer stress from heat, and can even die from heat exhaustion. Shade and ample water are thus essential. These two factors are clearly of the utmost importance in considering the Workmen's Village environment. It is a south-facing site without natural shade, particularly exposed to the sun and to the hot summer winds from the

A



B

Figure 4.6. Ancient Egyptian pictures of pigs. A: from the Theban tomb of Amenemhet, no. 123; B: from the Theban tomb of Nebamun, no. 145. After Davies (1932): [57, 58], Figures 8, 9.

south. Pig-keeping at the Workmen's Village involved the initial investment of labour in building shelters, and added a separate water requirement to be met by those who supplied the village with water from the main city.

Pig-keepers over the centuries have also shown a marked preference for confining sows in individual maternity or farrowing pens just prior to parturition and during nursing, reflecting the sow's own nesting behaviour, and the need to protect young piglets which are particularly prone to suffer from draughts and cold. Modern winter temperatures at the site can fall almost to freezing-point at night, and the cold frequently persists throughout the day.

Of particular interest in the history of animal management are two Roman treatises on agriculture, by Varro and Columella. Both deal in some detail with

pig keeping. [1] Much space is devoted to breeding. Sows are said to produce a litter of a dozen or more, but good breeders limit them to eight, removing half the remainder when they have put on weight as the mother could not supply enough milk, and the whole litter would not thrive. It was possible to raise two litters per year, although pigs born in winter did not thrive. The farrowing pens, or sties, are described in detail (the following quotation is from Varro): "Each sow should have her separate sty in which to feed her pigs; because she does not drive away pigs of a strange litter, and so if they become mixed she deteriorates in breeding. [2] Her year is naturally divided into two parts, as she bears twice a year, being with young for four months and giving suck for two. The sty should be constructed about three feet high, [3] and a little more than that across, at such a height from the ground that if the sow when pregnant should try to jump out, she will not abort her young. The height of the pen should be such that the swine herd can easily look arouud it, to prevent the little pigs from being crushed by the mother, and be able to clean the bottom without trouble. The sty should have a door with the lower sill one and a third feet high, so that the pigs cannot jump over it when the mother leaves the sty."

The question of summer water requirement was not overlooked: "While thirst in the summer is pernicious to all quadrupeds, it is especially hurtful to pigs." Wallowing is recommended. "But if the nature of the district makes this impossible, drinking water should be drawn from wells and poured into troughs in generous supply; for, unless they are abundantly satisfied, their lungs become affected" (Columella).

Building 400 can be interpreted successfully from these descriptions and related considerations. The basic unit is a small peu inside a larger feeding yard supplied with limestone drinking trough. The average pen size is about 2 square metres (i.e. about 21.5 square feet). This compares reasonably well with the size suggested by Varro. The same is true for the estimated original height. The doorway size is obviously critical. As yet, however, the study of the skeletal elements recovered from the site has not reached the point where overall body dimensions can be estimated, and, in any case, the girth measurement is likely to remain particularly uncertain. Varro also describes a tall threshold to prevent piglets escaping whilst allowing the mother to enter and leave. This draws attention to the unusual thresholds of Building 400. All were floored with a mixture of stones or bricks, but in three cases (with two more in Building 350, areas **xxv** and **xxviii**, see Figure 4.7) two parallel wooden poles were also placed across at a modest height above the sill. The height of the poles is clearly less than that recommended by Varro, but it is possible that the nature of the obstacle deterred baby pigs from crossing it.

---

[1] Varro, *Res Rusticae* II.iv, especially 14-22; Columella, *De Re Rustica* VII, ix and x, both in the Loeb edition of Hooper and Ash 1934. Other English translations are Storr-Best 1912 and Harrison 1918. For general discussion see White 1970.

[2] This may not be a true diagnosis. Sows can, in fact, recognize their own litters by olfactory clues (Hafez, Sumption and Jakway 1962: 361).

[3] Columella says four.

Alternatively, the gap between the poles could have helped to support a piece of blocking of a different material, perhaps just a piece of brick. In the case of area **ix**, of course, a blocking of brick some **44** cms. high was actually found in place, replacing wooden poles originally set at a lower level (Figure 4.4).

One further observation needs to be made on pig behaviour as it relates to the site. The modern pig kept in purpose-built piggeries develops an insatiable desire to gnaw, and the consequences would quickly become apparent on wood, and even plaster. Yet there is no trace of gnaw-marks on the well-preserved poles across the doorways. The answer may lie simply in behavioural differences between pigs kept permanently captive and those allowed to roam freely, at least for part of the time. During the visit made to el-Bayadiya, where pigs wander through the streets untended and are kept by many households, no trace of this trait was noted, although it was looked for, and to the one owner questioned it was an aspect of pig behaviour foreign to him.

It seems reasonably feasible that pigs should have been kept in Building 400. If this was the case, we have a direct indication as to numbers. Since it is a characteristic of pig keeping that sows are isolated at time of birth, the probable total number of six pens (including the likely unexcavated one in squares Q and R14) implies six sows. Two litters per year with an average litter size of eight would yield an annual production of almost a hundred piglets. [4] To this calculation should be added a possible seventh pen kept in use from the ruin of Building 350 (area **xxiv**, see Figure 4.7 and section 4.8).

The realities of pig breeding, however, should be considered in the light of comments kindly supplied by **Dr. T. Alexander** of the University of Cambridge Department of Clinical Veterinary Medicine:

"The very best of modern piggeries only *rear* 23 or 24 pigs per sow per year, and this with highly prolific sows and three week weaning. Most modern piggeries in the United Kingdom achieve only 18-20 pigs/sow/year. In the U.S.A. the average is lower, i.e. 13-15. In ancient Egypt they would not have weaned the piglets before 8-12 weeks and would be unlikely to average more than 1.5 litters per year and 6-8 pigs *reared* per sow, i.e. 9-12 pigs reared per sow per year (the mortality soon after birth would have been high).

However, sows were only kept in individual isolation (until recently) during suckling, i.e. for 8-12 weeks plus 1 week prior to farrowing, thus 9-13 weeks in all. So at 1.5 litters/sow/year, one sow would occupy a pen for only 15-20 weeks per year, i.e. one pen would serve about 2.5 sows, so 6 pens could serve 15 sows if efficiently organized.

---

[4] Haynes and El-Hakim 1979: 104 write, concerning the refuse collectors of modern Cairo (the Zabaline): "In two years the species bred by the Zabaline produce four or five litters ranging in number from eight to twelve shoats. After eight months, when the pigs weigh approximately 40 kilograms each, they are sold."

On these assumptions they could have reared about 135-180 pigs per year. I think they are unlikely to have been so efficient. I imagine that sows would be barren without them realising it for a long time, or would abort, or would die in late pregnancy or at farrowing. I doubt if they would have reared more than 100 pigs per year - which is what you wrote but for different reasons."

What market did they serve ? We know from the range of bones at the Workmen's Village that pig was almost certainly eaten by the villagers. The few examples of pig prices in the Deir el-Medina ostraca give values of between three and five ***deben***, roughly twice the value of a goat or sheep (Janssen 1975: 177-78, 525). It would thus probably have been worthwhile also to have supplied them to the main city. Yet if they did so, the numbers involved would have been trivial in relation to the size of the city as a whole. Unfortunately, we do not yet know if pig occurs in the faunal debris from the main city. This must wait until the expedition transfers the site of its excavations to a suitable location there. The architectural plans of the previous excavations appear not to contain any obvious counterpart to either Building 350 or 400. Their uniqueness, however, could reflect the particular social conditions of the Workmen's Village, which led to a greater degree of communal activity. The traces of pig-keeping by individual families in the main city might take a less distinctive form.

There is one further consequence of identifying Building 400 as having been animal pens. It may explain the origin of the upper midden deposit in the main quarry (Kemp 1983: 12 [Phase VII]; Chapter 6 below). This is composed of alternating deposits of dusty sand and compacted beds of chaff and fine straw. This could be the record of periodic cleansing of the animal pens, although until expert botanical examination has been carried out this should be regarded as only an hypothesis.

4.8 The relationship between Buildings 350 and 400

Building 350 was discovered and partially excavated in 1980 (Kemp 1981). More was dug in the following year (Kemp 1981). Two parts remain unexcavated: the eastern edge, where it runs beneath the western edge of Building 400; and a southern continuation in squares O14 and P14, which, to judge from surface indications, is not likely to be very substantial. Little attempt was made at the time of discovery to interpret it, and it is only really from the excavation of Building 400 that essential clues have appeared. The building is itself divided into two parts by the deep chambers in square N17, which were partly filled with rubbish when the building was erected. To the west lies a discrete block of chambers and yards; on the east a more open and irregular series of enclosures (Figure 4.7).

The relationship with Building 400 can be pursued under two headings: chronology and function.

Chronology: as previously noted, the two buildings overlap in squares P15 and P16. In terms of the excavation, the overlap is defined in the section which runs north-south across the middle of these two squares. This shows at the south end Building 350 lying well below the ground level on which Building

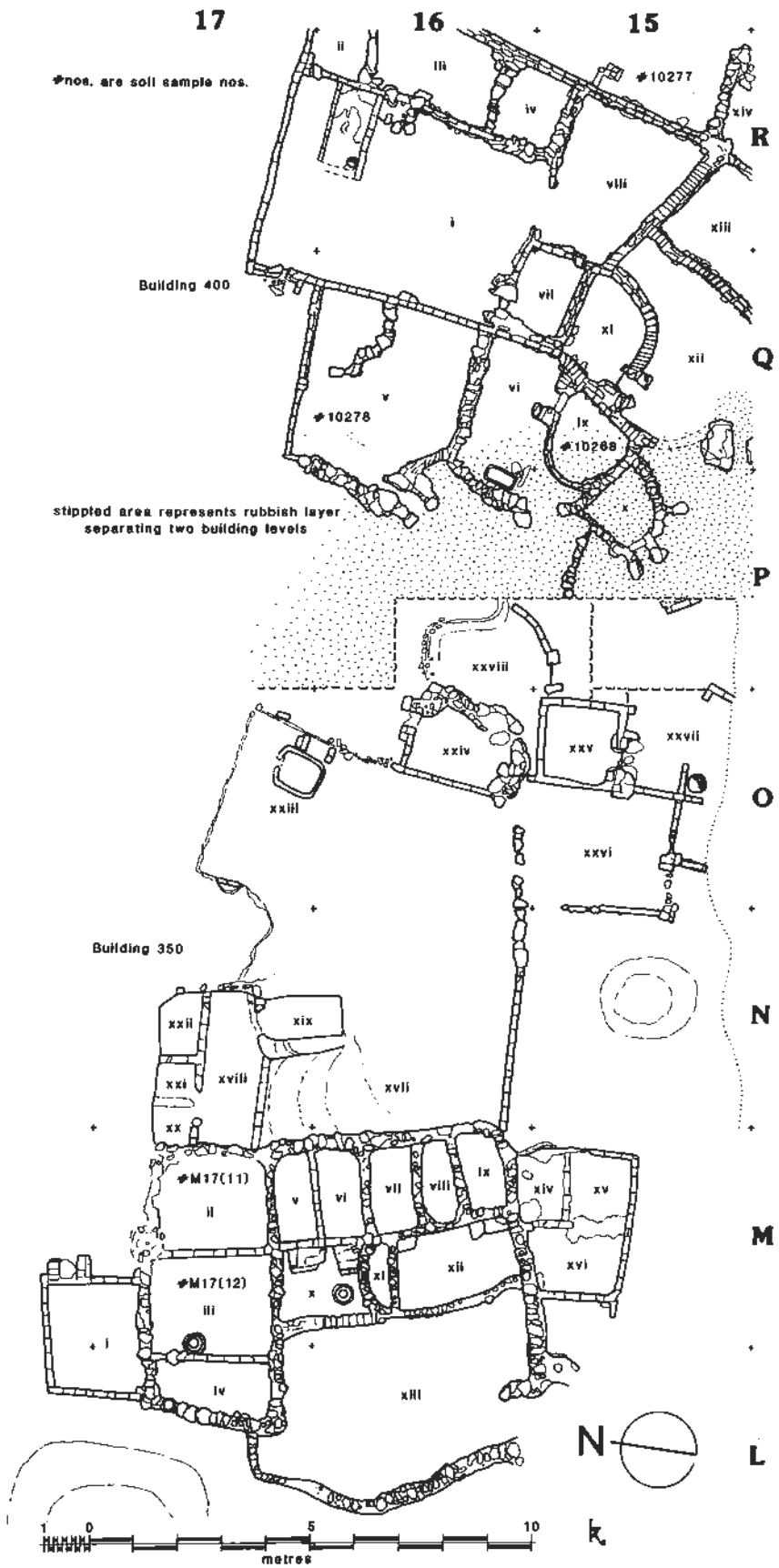


Figure 4.7. Outline plans of Buildings 350 and 400.

400 stands (Kemp 1983: Plate I.2 is a photograph of this section). At this point the floor of Building 350 is not bedrock, but organic debris which is probably the fill of a quarry pit, possibly the edge of the main quarry itself. As the section runs northwards, bedrock appears and then rises partly by natural slope and partly by a low vertical step until the two ground levels merge together. The vertical step in the bedrock is probably the same one that emerges in Building 400, and into which an east-west dividing wall was built (see section 4.1 above).

As already noted, Building 400 is not itself a chronological unity. Parts of it, mostly distinguished by a greater reliance on stone as building material, are additions or alterations to the original nucleus. As far as one can see, all of the nucleus stands on bedrock. It is not possible to tell at present if the nucleus was built at the same time as Building 350 or afterwards. The place where the two buildings would join is precisely where the later additions are built over the accumulation of rubbish burying the eastern end of Building 350. It is possible that future excavation in squares P and Q14 may expose the join. In the meantime one can note certain points against and in favour of the proposition that originally both were built together.

The most telling point in favour is simply that the nucleus was built largely of brick. If it was built at a late stage in the site's history, bricks should have been as scarce as they were when the additions and alterations were made. Furthermore, both buildings utilised the same low east-west step in the rock as a support for walls. The main point against is the lack of congruence between the two buildings, but this could be a consequence of the irregularity of the ground caused by the initial quarrying activities.

On balace it seems preferable to regard the eastern half of Building 350 and the nucleus of Building 400 as originally contemporary, with the additions to the latter replacing the pens lost by the decision to abandon them and bury them beneath a bank of rubbish.

It should also be noted that the pens in Building 350 are themselves not all of the same date. The one labelled as area **xxiv** on Figure 4.7 is later than areas **xxv** and **xxviii**, and, it should be noted, utilises stone for one of its walls. This part had unfortunately been badly dug over in modern times, but it is possible that what happened was that this pen was retained after the destruction of the rest of Building 350, one of its walls being rebuilt from rubble. If this were so, then it would become an isolated seventh pen of the Building 400 group.

Function: the eastern part of Building 350 contains two small rooms which have the form of entrance characteristic of the pens in Building 400: wooden poles set across the threshold. One of the pens (area **xxv**) was square, the other (area **xxviii**) partly rounded, its other walls having been lost by modern digging and by the ancient rebuilding of area **xxiv**. This latter can be taken as a third pen, its narrow entrance having been denuded almost to the ground. Other walls may have enclosed yards, but the pattern is hard to discern because the southern part is still not excavated, and to the north the ground was partly dug over and partly exposed to ancient activity in front of

Chapel 561/450. Nevertheless, the proximity of and similarity to Building 400 are strong reasons for seeing this part of Building 350 serving the same purpose as Building 400, namely the keeping of pigs.

These reasons do not, however, apply with the same force to the western part, which posseses a different configuration. Unfortunately, much of the original contents had been removed, and the floors partly dug over, some of this activity having taken place anciently. It is hard, in the light of the discovery of Building 400, not to see this collection of little rooms as also intended for animal raising. But at present we have no helpful evidence which we can relate to the main part, i.e. areas **v** to **xvi**, except to note that the various small chambers on the east and south sides (areas **v-ix**, and **xiv-xvi**) had been thickly coated with gypsum plaster over walls and floor, like parts of Building 523 (see Chapter 2.8).

For the northern part of Building 350, comprising areas **ii** to **iv**, we have one piece of direct evidence. This comes from the same preliminary analysis of soil and coprolite samples reported in section 4.9. In addition to the ones from Building 400, eight samples from Building 350 were submitted, all from areas **ii** to **iv**. In two samples (from square M17, level (12), and square M17, level (11)) several eggs like those of *Taenia* spp have been identified, the eggs of the common tapeworm. The two deposits from which the samples came lay contiguously, filling areas **ii** and **iii**. Indeed, the dividing wall between the two areas was built on top of an initially continuous layer of this deposit. The deposit was basically sandy, but rich in organic material, mostly straw or grass, which gave it a bristly feel. It appeared sometimes to be congealed into large lumps. Other rubbish also occurred within it, including sticks and chips of wood, pieces of rope, dom-nuts, the cases of large beetles, and sherds. Some of the sherds were heavily encrusted with the deposit, as if it had been deposited wet. A similar deposit filled area **iv** to the top of its walls, reaching a depth of 65 cms.

The discovery that this material contains fairly numerous tapeworm eggs means that the deposit may have contained a good deal of human excrement. The implications of this are not altogether clear. Could the areas have been a latrine? The west wall of area **iv**, which overlooked a depression in the ground where a quarry pit had been filled in, was constructed of large pottery jars, which could presumably have acted as a drain. But a broader range of samples is needed before this suggestion can be given much weight. It does draw attention, however, to one aspect of the villagers' behaviour that we are ignorant of: excretion.

4.9 Examination of the archaeological samples supplied by Barry J. Kemp from the Tell el-'Amarna site, by **C.R. Donald** , Senior Technician, Parasitology, University of Cambridge Department of Clinical Veterinary Medicine

Preliminary investigation has revealed the presence of what are believed to be parasite eggs in five of the fourteen samples supplied.

The samples were examined by placing 1-2 grammes of material in a 15 ml test tube and adding 2-3 mls of weak soap solution, just enough to cover the

sample. This was left to soak for two hours and stirred occasionally. The tubes were then filled with a concentrated sugar solution (density at 15°C : 1.12) and centrifuged at 1500 rpm for five minutes. Using a glass rod with a flattened end the surface material was removed from the tube and placed on a slide for microscopic examination. This is a qualitative method and does not accurately reflect the numbers of eggs in the samples.

TABLE 4.1. Parasite egg identifications (for locations see Figure 4.7).

1. Samples positive for eggs resembling *Ascaris* spp.
   10277 TA83.WV R15 [427]
   10278 TA83.WV Q16 [405]
   Mean size (µm) 64.2 x 52.5
   Range (µm) 62.5-67.5 x 50-55
   Ascaris suum (pig))
   Ascaris lumbricoides (man)) 50-80 x 40-60 um

2. Samples positive for eggs resembling *Taenia* spp.
   TA80.WV M17 (11)
   TA80.WV M17 (12)
   10288 TA83.WV Q15 [455]
   Mean size (µm) 39.5 x 34.2
   Range (µm) 33.7-42.5 x 32.5-36.2
   Taenia solium)
   Taenia saginata) 35-40 x 30-35 um

Eggs resembling those of *Ascaris* species which had lost the outer mammilated coat were found in two of the samples, one being seen in sample **10277** from square R15 [427] and two in sample **10278** from square Q18 [405]. Three samples contained eggs like those of *Taenia* spp, even to the extent that radial striations were observed in the thick outer coat. Fifteen of these eggs were seen in a sample from M17 level (12), nine in a sample from M17 level (11), and two in sample **10288** from square Q15 [455]. The dimensions of both types of eggs (Table 4.1) were within the recognised size ranges for the respective genera.

It is not possible to identify the species of either egg with certainty. However, if the first species is indeed *Ascaris* it would almost certainly be in the faeces of man or pig. Although on rare occasions egg-bearing infections of this parasite have been seen in lambs, they have always occurred in relation to pre-existing heavy pig infections. The ascarid species of dog, cat, cattle and horse all produce somewhat larger eggs.

Eggs like those of the second type are produced by tapeworms of the family Taeniidae. The adult egg-bearing worms are commonly found in man, dog, cat and related carnivora, but not in pig. *Taenia solium* and *Taenia saginata*, the tapeworms of man, have their intermediate stages, infective to man, in pigs and cattle respectively.

It is tempting to suggest that analysis of the dietary components of the coprolites might provide further information about their species of origin.

However, it must be likely that a considerable overlap would occur between the relevant hosts in each case, viz. man and pig *(Ascaris)*, and man and dog *(Taenia)*.

It is intended in the near future to apply a more sensitive technique and perhaps also a quantitative method to the samples. It is also hoped to obtain a second opinion either at The British Museum or the Commonwealth Bureau of Helminthology, St. Albans.

4.10 Appendix: analysis of coprolite sample from Site X1

In the report on the 1979 excavations it was stated (Kemp 1980: 9-10) that in one group of small rooms animals had been kept, for within the floor deposits were numerous droppings from sheep or goats. A small sample was submitted for analysis to **Dr. Geoffrey Hosey** of the Bolton Institute of Technology, Science Department, who has kindly furnished the following report. With the ancient coprolites were also submitted samples of modern sheep and goat droppings collected in the village of el-Hagg Qandil for comparison.

TABLE 4.2. Coprolite measurements

Mean length = 0.66 mm
Variance = 0.012
Mean breadth = 0.54 mm
Variance = 0.006
Comparison with modern goat (mean length = 1.129 mm, var = 0.042)
d = 10.254, $p<0.001$
Comparison with modern sheep (mean length = 1.322 mm, var = 0.036)
d = 15.180, $p<0.001$
i.e. coprolites significantly smaller than both modern samples

TABLE 4.3. Analysis of coprolites

Epidermal fragments present, expressed as percentage (mean of three subsamples):

Lolium temulentum	69%
Phoenix dactylifera	16%
Juncus acutus	5%
Indeterminate dicotyledon	6%
Indeterminate	4%

Lolium is a grass, apparently a common weed of wheatfields. *Phoenix* is the date palm. Both are positive identifications. There appeared to be fragments of a dicotyledon present (as judged by the venation pattern) but I have no Egyptian material for identifying these.

It might be noted that amongst dicotyledonous plants already identified from ancient Egypt is *Ceruana pratensis*, which was reported early in the 19th century to be used in Upper Egypt as animal fodder (Greiss 1957: 99-101, 153). *Lolium*, more commonly known as "darnel", is discussed by Täckholm and Drar (1941: 307-11), where other ancient occurrences are listed, including one from Deir el-Medina, and attention is drawn to its toxic properties. On this latter point, Dr. Hosey writes that *Lolium* is itself not toxic, "but like many such grasses it is susceptible to infection with ergot, a fungus which lives in the grass flower heads, and which can be fatal if eaten by many animals. The plants are, nevertheless, eaten and if uninfected then cause no harm to the animal. Even if affected, they may not be fatal."

It might be noted that these species belong to the cultivation, not to wadi-floor vegetation. Animal fodder must have been one more commodity brought regularly from the main city.

4.11 Report of an immunology test applied to coprolites, by **W.P.H. Duffus.** Department of Clinical Veterinary Medicine, University of Cambridge.

1. We used a test called the Enzyme linked immunosorbant assay (ELISA). This is one of the most sensitive antibody binding assays available.

2. We extracted your samples by means of shaking and ultrasonication using phosphate buffered saline (PBS) as diluent.

3. We then concentrated the extract (after centrifuging to remove all debris).

4. The ELISA was done to check for the presence of any pig immunoglobulin ("antibody") in the faecal extract. This is rather a "long shot" as not only are the levels of immunoglobulins low in faeces but they may well have been denatured.

5. We used an affinity purified and specific rabbit anti-pig immunoglobulin as the catching antibody, followed by the sample, followed by an enzyme labelled (Horseradish peroxidase) rabbit anti-pig immunoglobulin. Finally the substrate ABTS (Azino-di-(ethylbenzthiazoline sulphonic acid) diammonium salt) was added to quantify the reaction.

6. Various other items of equipment, chemicals, etc. are also used, but any more detail would complicate the description even further.

7. Suffice it to say that we found no evidence of pig immunoglobulin. My own opinion is that they were probably pig faeces, but the small amount of specifically pig immunoglobulin that might have been there has been denatured to an extent we cannot detect it.