

# MEDIEVAL POTTERY PRODUCTION AREAS NEAR RUSH GREEN, DENHAM, BUCKINGHAMSHIRE

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*Two pottery production areas discovered in the Alderbourne Valley during construction of the M25 in Buckinghamshire are described. Production commenced in the twelfth century or earlier, continued through the thirteenth with limited production in the fourteenth. At the southern, more extensive site, parts of three kilns and a fragment of a fourth were examined. Constant restructuring of the kilns indicates a progressive reduction in internal capacity. At the northern site there was plentiful ceramic but limited structural evidence. A short assessment of available clay and woodland resources is provided and comparisons made between the Denham kilns and their products, and others in the Chiltern region. Shared ideas between potting communities are apparent. A striking feature was the high proportion of hand-made vessels.*

## *Introduction*

The two sites near Rush Green, Denham, described in this report were amongst a series of archaeological features discovered in the course of a watching brief carried out during the construction of the 8-mile Buckinghamshire section of the M25. About 2 miles in Hertfordshire were also recorded. The work was carried out by Buckinghamshire County Museum with financial assistance from DoE. That the watching brief proved productive was in a large part due to the goodwill of many volunteers who provided active support during the early stages of route checking, carried out observation whilst earthmoving was under way, and provided further assistance during excavation.

The two sites discussed in this report are medieval pottery kiln sites, the northern of which was fairly limited in extent, and the southern more substantial. Neither site was accessible to private motor vehicles so all equipment required during the excavation had to be transported some distance manually from the nearest road.

The evidence for the date range during which the kilns were operational is discussed in detail

further on, but both sites were certainly functioning in the thirteenth century and there is clear evidence for earlier production. The land which the southern site occupied had been previously utilized during the prehistoric period, and this will be discussed elsewhere. There were also a few Roman sherds from the southern kilns and a piece of Roman roof tile from the northern.

The site records and finds are stored at Buckinghamshire County Museum, reference CAS 5241 (South) and 5242 (North), finds accessioned 416.1983 and 149.1983 respectively.

## *The Northern Kilns*

The northern site, which was adjacent to a small stream draining into the Alderbourne (Figs. 1-2 & 9), lay in the middle of the main carriageway of the M25 corridor (TQ 0180 8605). It was discovered by Mr P. Jones in a relief drainage ditch cut after woodland clearance had taken place in September 1982. Although the character of the site was apparent from finds and from an exposed section observed at the time of discovery, clay and tree roots dumped in the area meant that further investigation would be practical only if earth-

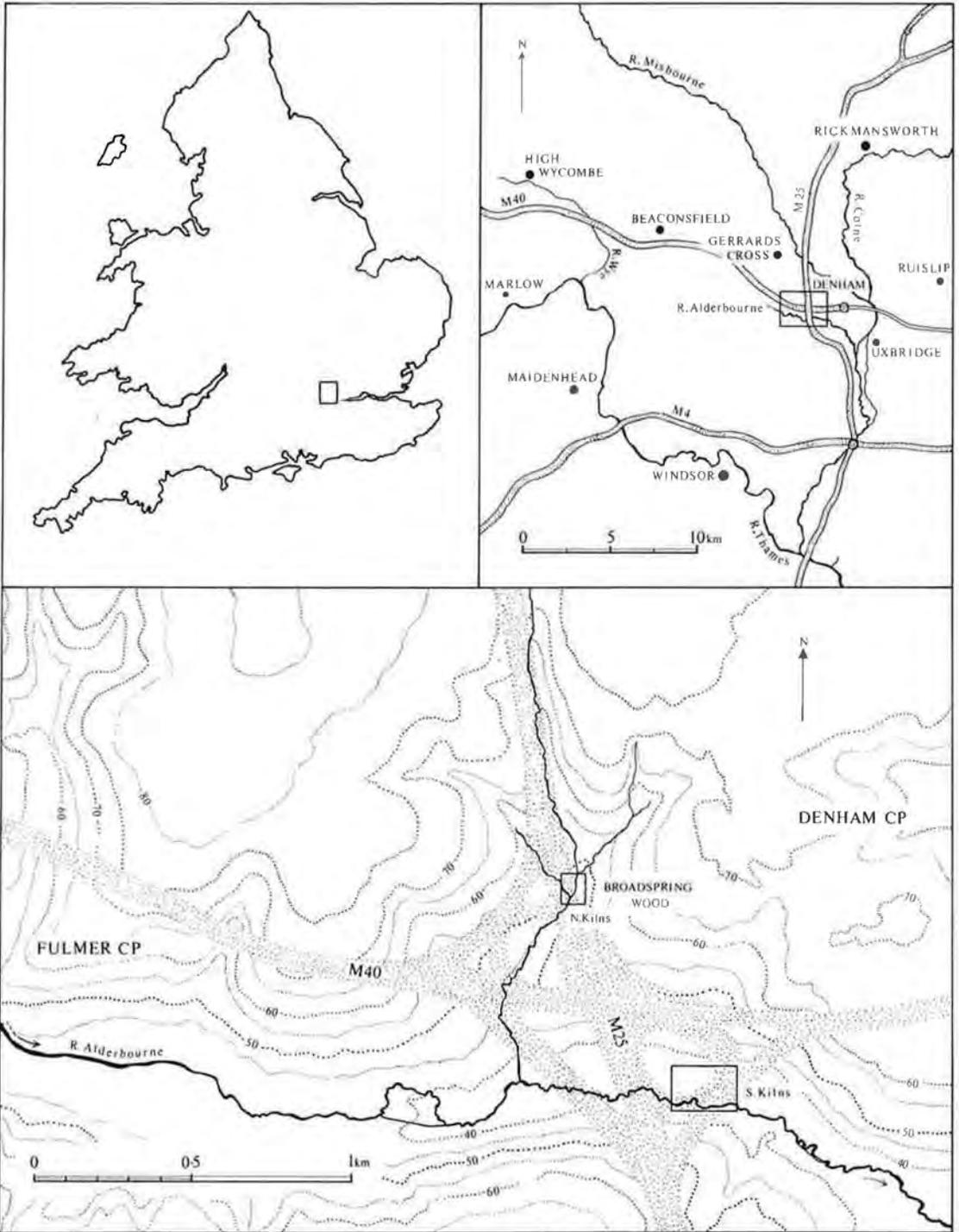


Fig. 1. Denham, Buckinghamshire: location of kiln sites.

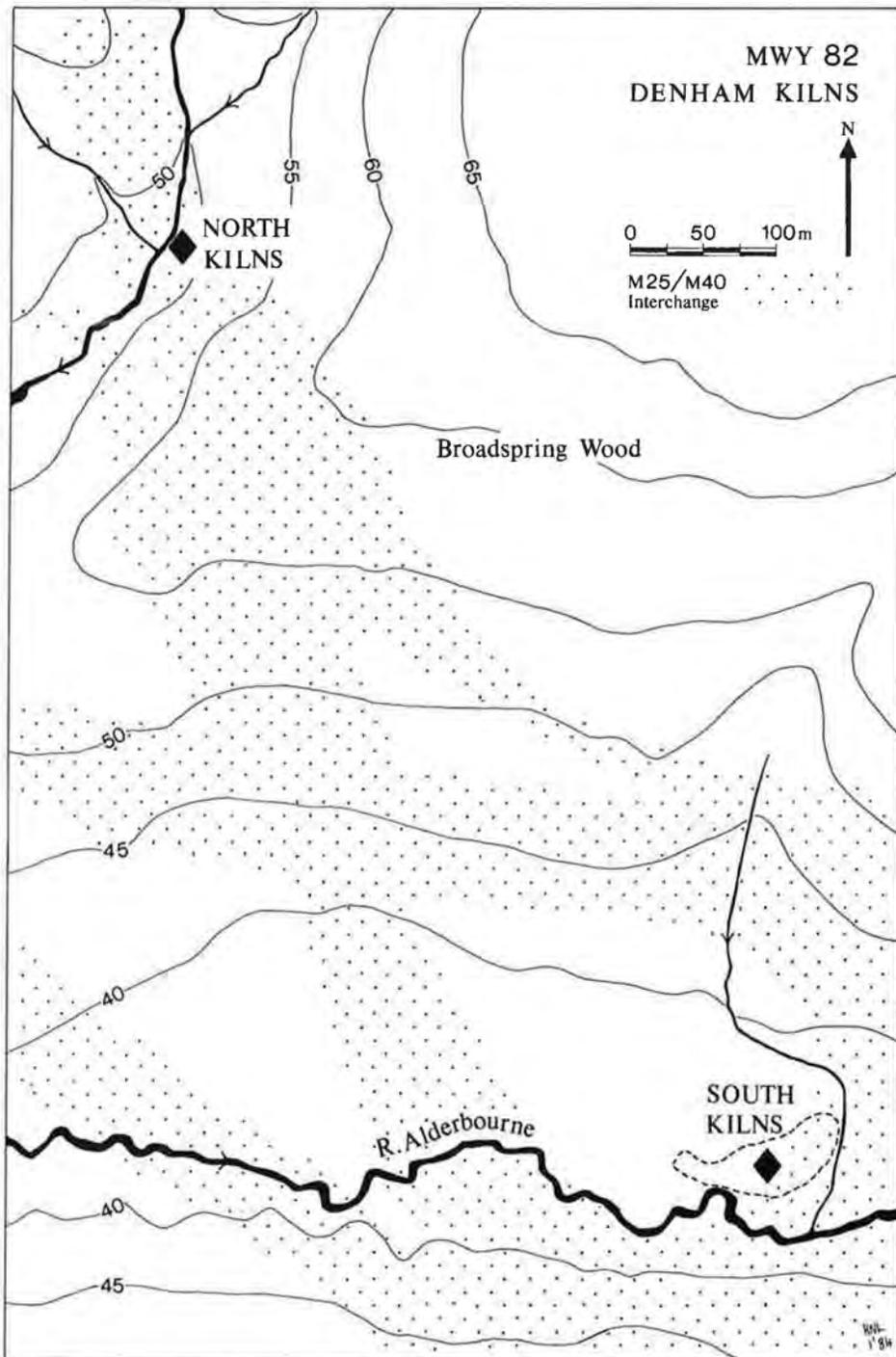


Fig. 2. Denham, Buckinghamshire; location of kiln sites.

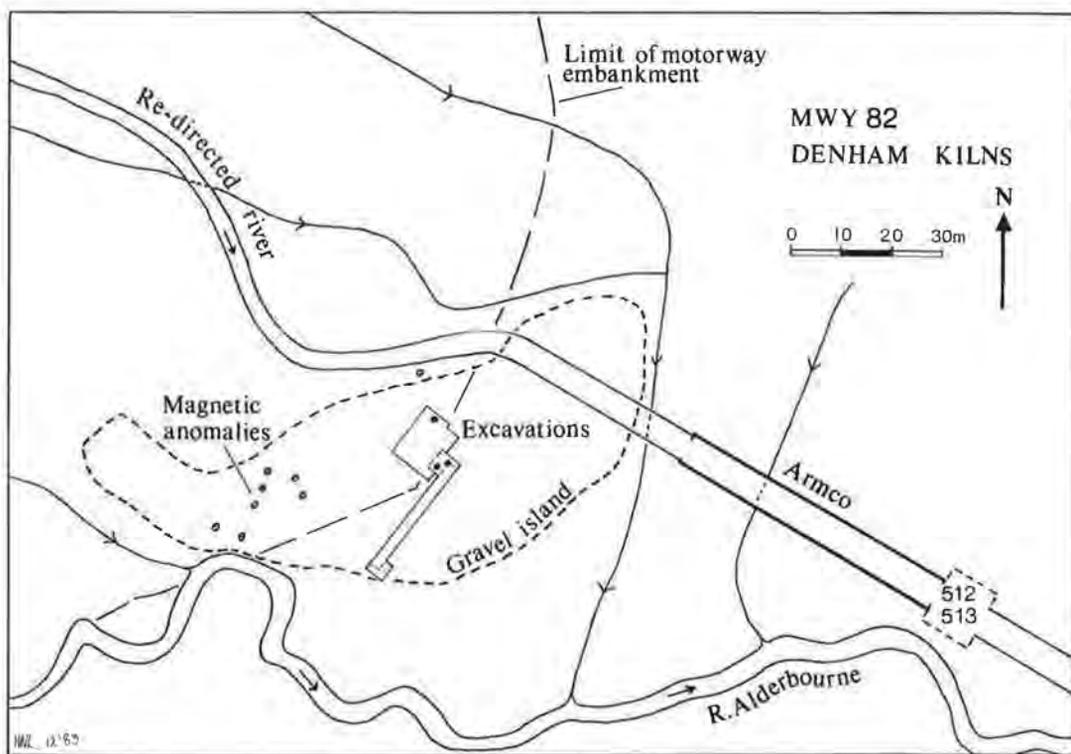


Fig. 3. Southern kilns excavated area, limit of sherd scatter and unexcavated anomalies.

moving machinery could be obtained. Unfortunately the site proved to be completely inaccessible to machinery throughout the winter of 1982–3 due to waterlogging of the entire construction project, and when the area eventually did dry out, through a failure of communication between subcontractors, the first piece of earthmoving to take place was construction of a haulage way that cut through the most significant part of the exposed section. Only a very limited excavation was subsequently practicable.

#### *The Southern Kilns*

The southern site (Figs. 1–3 & Pl. VII) which had lain undisturbed beneath permanent pasture on the floor of the Alderbourne valley (TQ 0220 8543), was discovered independently by Mrs H. Bridbury and by Buckinghamshire County Museum staff, in September 1982, and initially came to light as widely dispersed scatters of pottery. Due to the bad weather

which hindered the contractor's programme, it was possible to spend much of the winter of 1982–3 investigating this site, which also proved to be a pottery production area. However, resources available for the work were slender and there were considerable physical difficulties of access.

Although the Alderbourne valley floor itself is under pasture the valley sides and much of the immediate hinterland is wooded. The geology of the area is discussed below, but basically the valley was cut through London clay and has been subsequently partially infilled with mixed alluvial deposits. Some of these form 'islands' of gravel that emerge a little above the accompanying finer and less well drained alluvial deposits.

The southern kilns were situated on one of these islands, whose natural attraction was seen during the excavation of 1982–3 when the land

surrounding was at intervals under water. The deserted medieval village of Fulmer, which lies 1½ miles upstream, was sited on a similar island (Farley 1982).

In the report that follows, features relating to the southern and more fully excavated group are discussed first.

### *The Southern Kilns*

#### *Excavation Procedure*

That the southern site was a kiln site and not as initially suspected, domestic occupation was confirmed by excavation of a 26×2 m north-south trench dug one weekend with the help of the County Museum Archaeology Group and local volunteers (Fig. 4). Initially no features were encountered although plentiful pottery was recovered from the deep black topsoil and dark gravelly subsoil. However at the southernmost end of the trench, where the gravel soil gave way to clay on the edge of the gravel 'island', a considerable quantity of pottery came to light much of which lay in layers interspersed with alluvial silty clay. This pottery which included wasters had apparently been dumped at the edge of the gravel island where it became interleaved with alluvium deriving from winter flooding of the Alderbourne.

At the northern end of the trench a small amount of burnt clay was noted, and two extensions led to the discovery of kilns 1 and 2. Subsequently a magnetometer survey of the whole area was carried out by the Ancient Monuments Laboratory, DoE, which resulted in the location of kilns 3 and 4, of a clay pit to the north of these kilns, and other unexcavated anomalies (fig. 4). Phase 1 of the excavation in October-December 1982 completed the investigation of kilns 1 and 2, and phase 2 during January-February 1983 explored kilns 3 and 4 and the clay pit, which had by then been exposed by a channel cut to reroute the river Alderbourne.

Owing to heavy rainfall the motorway contractor found it necessary to cease earthmoving in the late autumn of 1982, but peripheral V-ditches continued to be dug. The course of one

of these would have destroyed kilns 1 and 2, but after discussion the ditch was rerouted slightly to the west to pass between kilns 1/2 and 3/4. Kilns 1 and 2 were later to be buried beneath the motorway embankment after having been back-filled with gravel. Kilns 3 and 4 lay a short distance west of the foot of the embankment in an undisturbed zone and the centre of the southern part of the M25/M40 intersection which will probably revert from grassland to woodland in future years.

The first phase of the excavation was intended to demonstrate the character of the site and no attempt was made to recover all of the ceramic. During the second phase, the excavation of kilns 3 and 4 (Fig. 5), total recovery of the ceramic was attempted. This was thought necessary on account of the depth of apparently featureless yet pottery-full soil that was present. After removal of the thick stone-free turf, c.0.20 m deep, which covered the site, there was a further 0.20 m depth of dark soil with plentiful pottery and a few flint pebbles before any features became visible. In places this dark soil was up to 0.40 m thick. No earthmoving machinery was employed at any stage and all of the pottery from the second phase of excavation was recorded in m<sup>2</sup>, and broadly in three-spit depths below ground level following removal of turf (A=0.20-0.24 m, B=0.25-0.29 m, C=0.30 m-natural), until underlying features were distinguishable. The aim of this approach was to attempt to identify relationships between ceramic type and dumping area over time.

The depth of topsoil on the site was certainly in part due to extensive human utilisation of the area, but the presence of a thick stone-free turf clearly demonstrates extensive resorting and that the area has lain undisturbed beneath pasture for a very long time. Apart from earthworms the main contributors to this resorting were moles, whose mounds were everywhere present on the surface.

#### *Kiln 1 (Figs. 6 & 7)*

In its final phase kiln 1 was a twin opposed-flue kiln with a central elongated oval pedestal of hump-back shape. The whole of the surviving interior, including part of both flues, had been

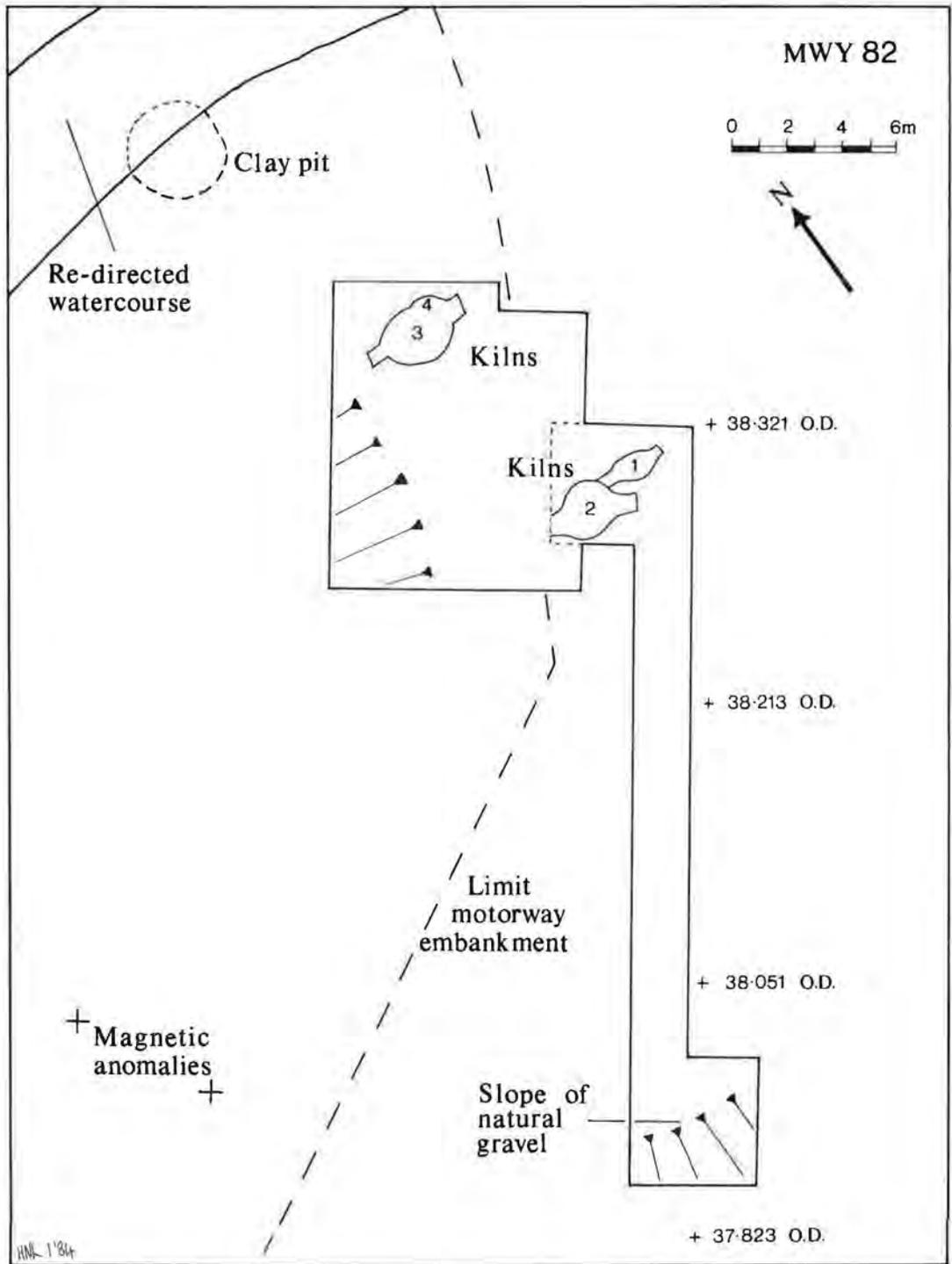


Fig. 4. Details of southern kilns excavated area.

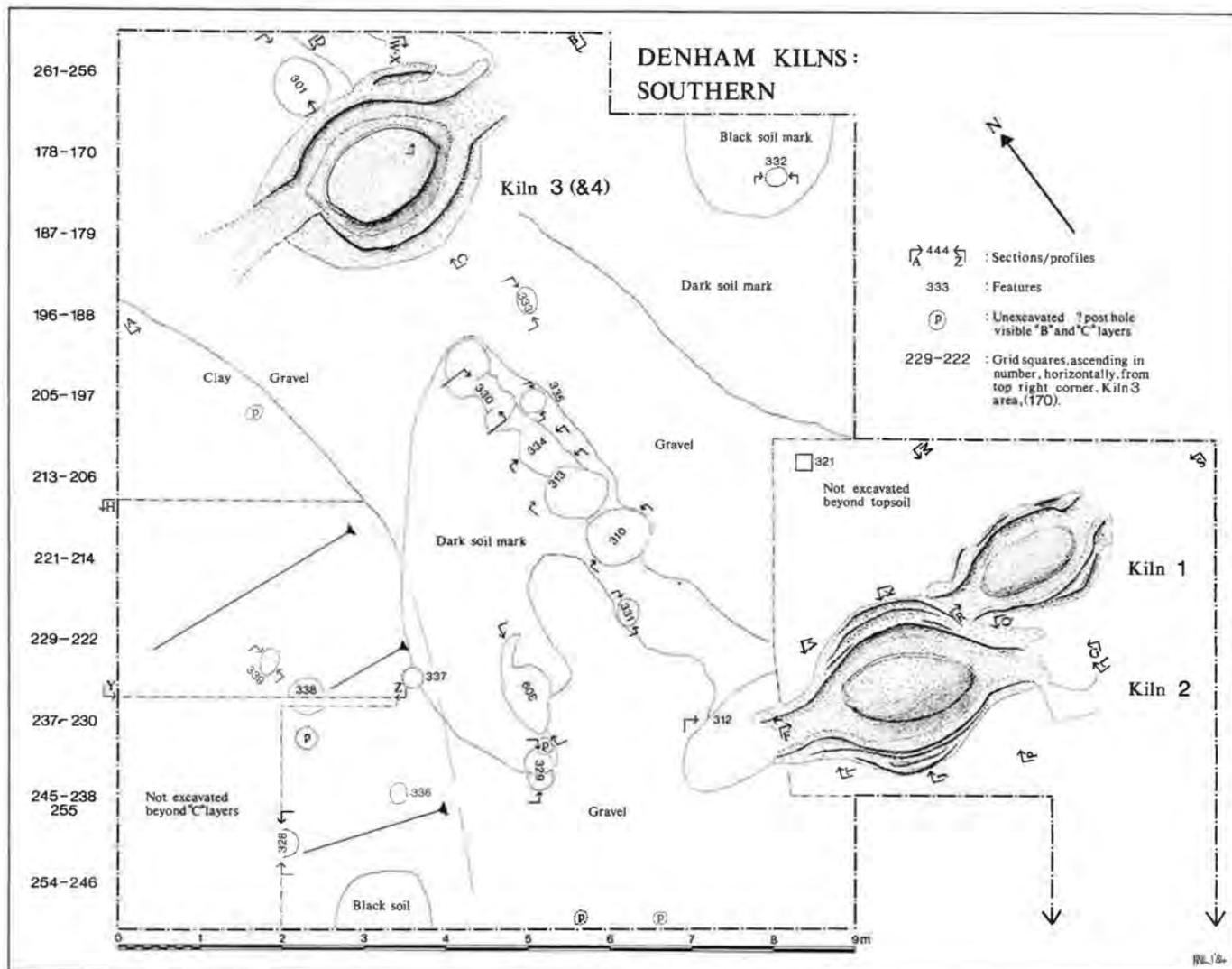


Fig. 5. Site plan, southern kilns.

faced with a layer of clay. The clay surface of this kiln and of the other kiln linings generally had been fired to a reduced grey colour to a depth of about 10 mm, whilst the clay beneath was an oxidized red. The final in-filling of kiln 1 (160) also consisted of amorphous soft reddish-orange clay, presumably the remains of the above ground kiln wall. However the fill at the eastern end of the pedestal adjacent to the eastern flue included an almost complete jug (163a, Pl. X, the only complete vessel from the site) an unusually large number of kiln bar fragments and hints of a box-shaped structure in fired clay. The whole suggests the deliberate blocking of the eastern flue at the final firing (167). A complete kiln bar lay on the floor in the throat of the western flue (160a, Pl. VIII).

There had been previous restructuring of the kiln, reflected both in the pedestal and the walls. The final form of the pedestal was its fourth remodelling. Its original shape was smaller and lower, in fact merely a clay skim on a small mound of natural gravel which had been left standing proud when the perimeter flues were formed (section, Fig. 7). The walls of the kiln had been relined at least twice, as could be seen from the surviving fired clay surfaces (Fig. 6). Each relining would have the effect of reducing the interior capacity of the kiln as would the rebuilds of the central pedestal. This may be a significant feature in determining the working life of kilns of this character.

The western flue of kiln 1 had been truncated by the construction of kiln 2, but the eastern end was sufficiently intact to show that although there were hints of a shallow stoking area, whose base level was indicated near the kilns by a short stretch of fired clay surface, no clear indication of a defined limit to a stoking pit emerged from the adjacent dark mass of sherd-filled soil.

#### *Kiln 2 (Figs. 6 & 7)*

Kiln 2 was a larger structure than kiln 1 both in breadth and depth. It clearly replaced kiln 1 since its wall truncated the former's western flue. In all general respects however it was very similar, with an elongated oval pedestal, twin opposed flues and indications of frequent re-

lining. A quarter segment of the pedestal was excavated and a single section cut through the wall. The final remodelling of the pedestal (271) was distinctive in that instead of retaining the profile of a smooth dome as previously, the sides of its long axis now varied from the vertical to slightly dished.

The final infill of the kiln (162) consisted largely of masses of soft red or yellow clay, the red colour being the result of oxidation of the natural yellow. This infill is presumed to be the result of pushing the kiln wall inwards, but as with kiln 1 only a little hard-fired clay, which might indicate the character of the upper structure, was present.

There had been a number of modifications to the kiln during its working life, the final one being the fourth relining of the wall on the southern side (Pls. XI–XII), accompanied by a similar number of restructurings of the central pedestal, which as with kiln 1, commenced with a gravel mound defined by the perimeter flues. In each case clay was the rebuilding material. The continual remodelling of pedestal and wall would have reduced the interior volume of the kiln considerably. The distance between the side of the earliest pedestal and of the earliest wall would have been over a metre, which would have meant that initially it had a very substantial capacity.

The approximate extent of the western stoking area can be seen on Fig. 5; the eastern gives the same picture as in kiln 1, with no true stoke pit but a gentle ramp up from the level of the floor of the kiln. A slight fired clay surface spilled out as far as the throat of the flue and the whole then merged into the general dark earth surrounding all of the structures.

#### *Kiln 3 (Figs. 6 & 8, Pl. XIV)*

Kiln 3 had a less elongated form than kilns 1 and 2, the central pedestal being nearly circular in plan. Unlike the others there was no evidence that it had been remodelled although the depth of the red oxidized clay in its walls showed it had received reasonable use. The substantial central pedestal had a slightly dished upper surface and its sides were gently concave, except at the



Plate VII. Alderbourne Valley, Denham, looking north-east across the river, kiln site visible by fencing west of the Armco conduit.



Plate VIII. Denham kiln 1, foreground with kiln bar, cut by kiln 2 behind, looking west.



Plate IX. Denham kiln 1, kiln bar in western flue; flue cut by kiln 2.

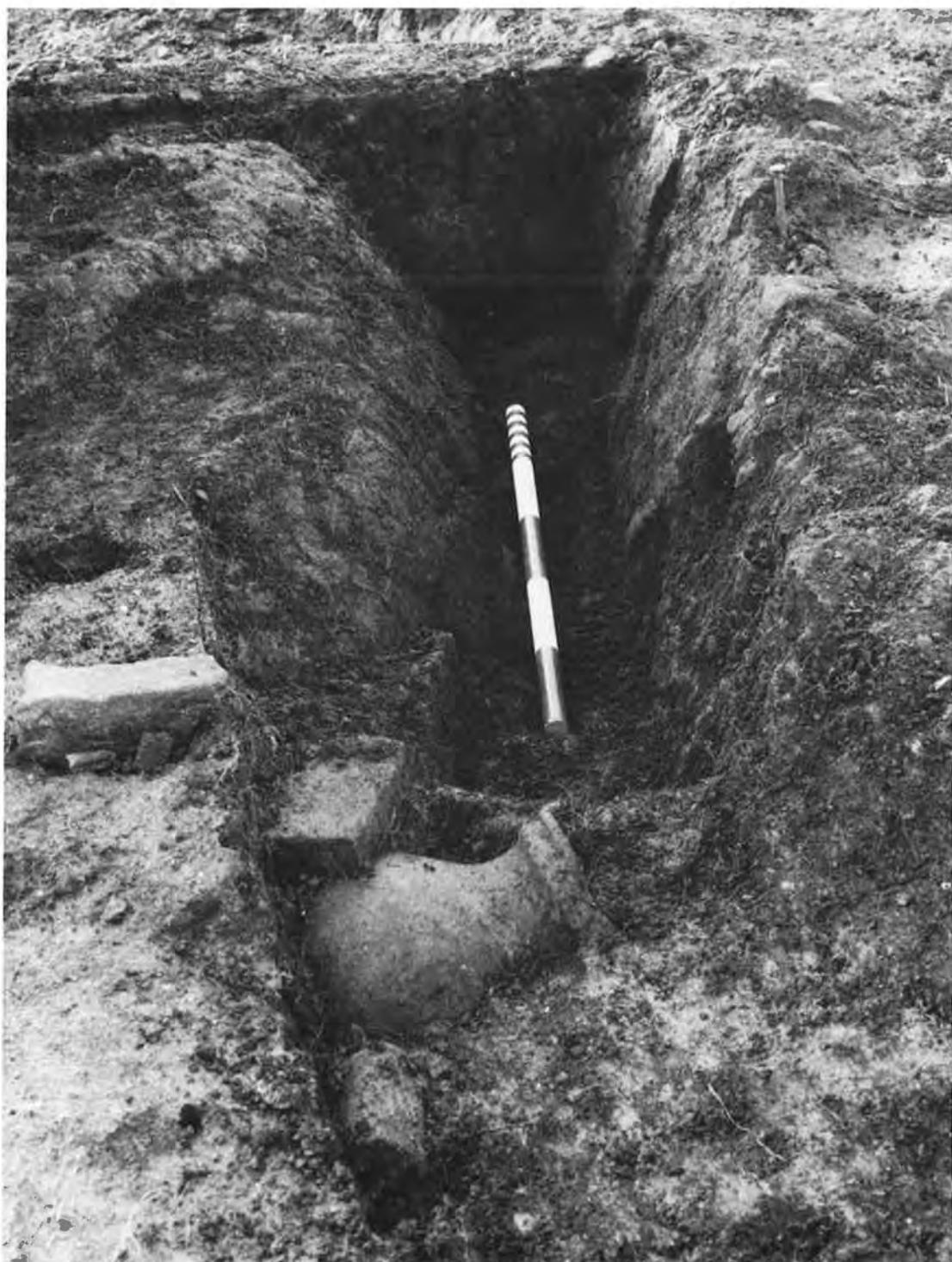


Plate X. Denham kiln 1 with jug in blocked eastern flue.

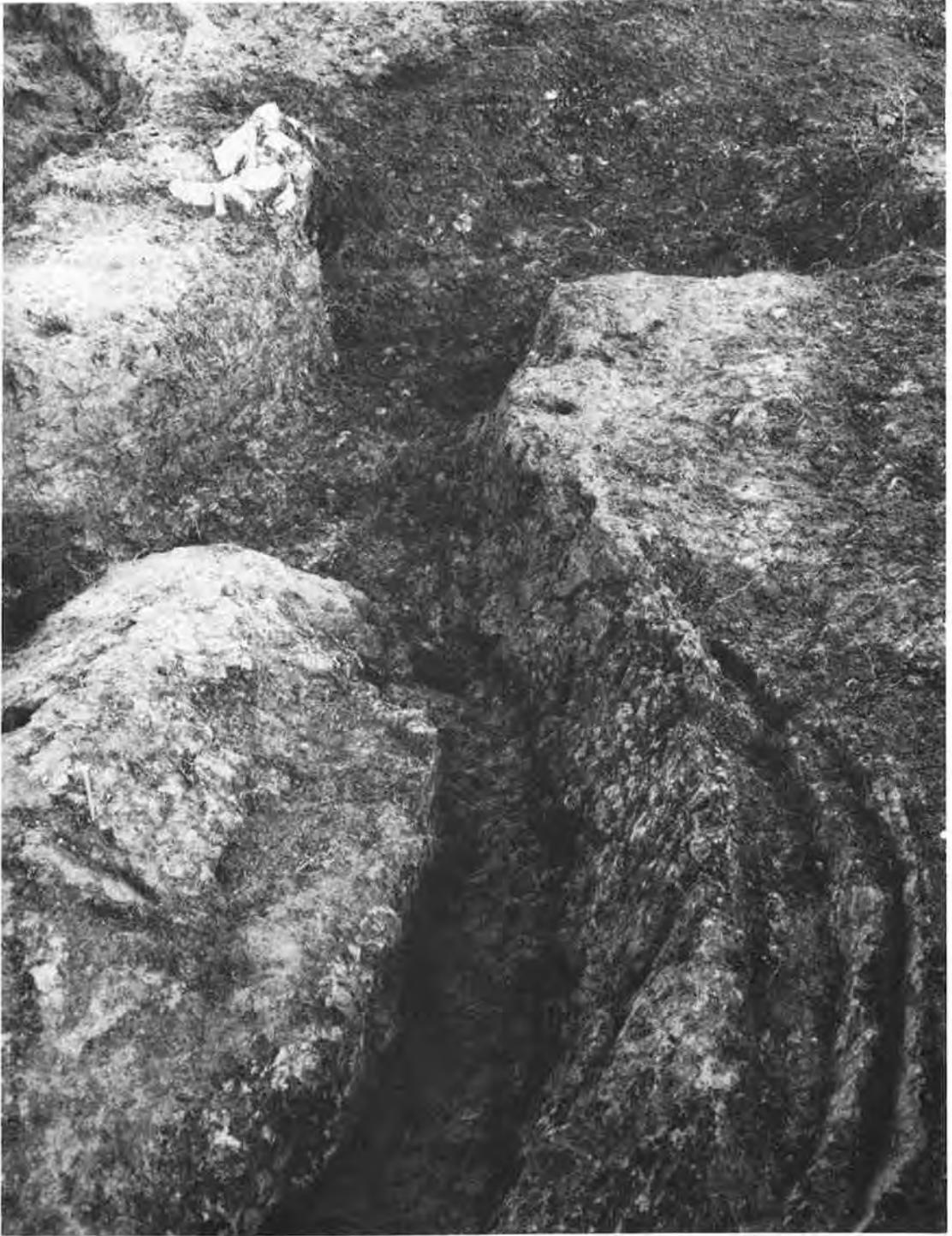


Plate XI. Denham kiln 2 looking towards eastern flue showing relining of southern kiln wall.

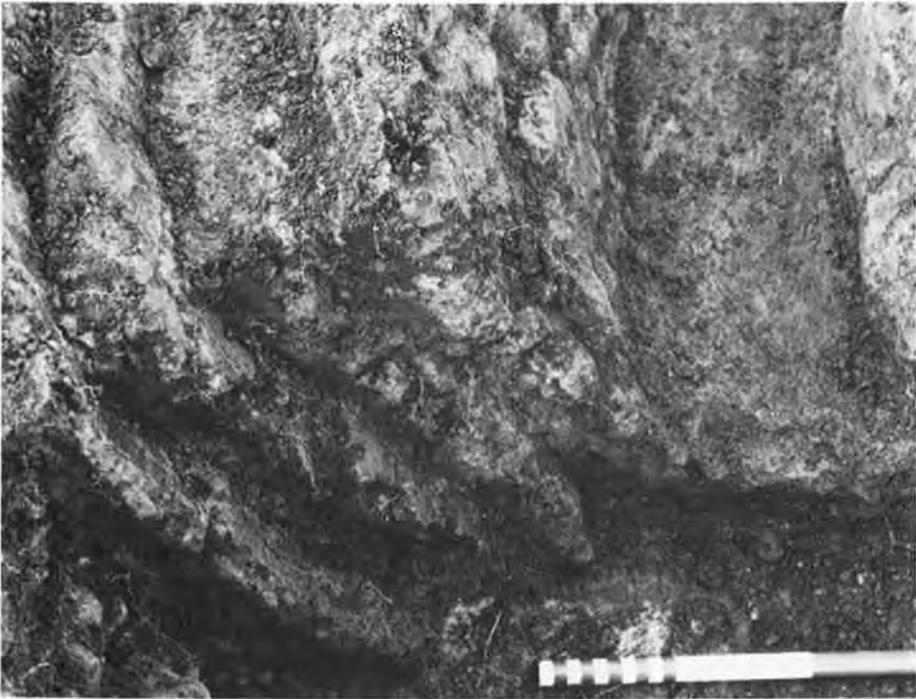


Plate XII. Denham kiln 2 looking west, stepped section through southern wall of kiln showing relining.

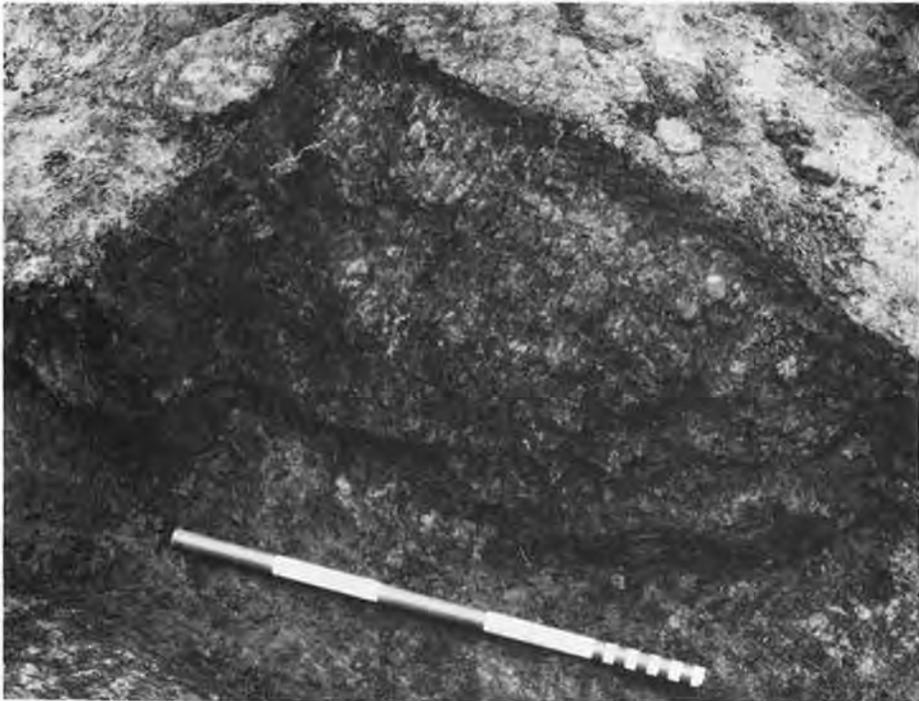


Plate XIII. Denham kiln 1, section of south-east quadrant of central pedestal exposing earlier pedestal beneath.



Plate XIV. Denham kiln 3 and fragment of 4, looking north-east.



Plate XV. Denham; backfilled clay pit filled with sherds, looking south.



Plate XVI. Shelter constructed with turf stripped from 100 sq. m.

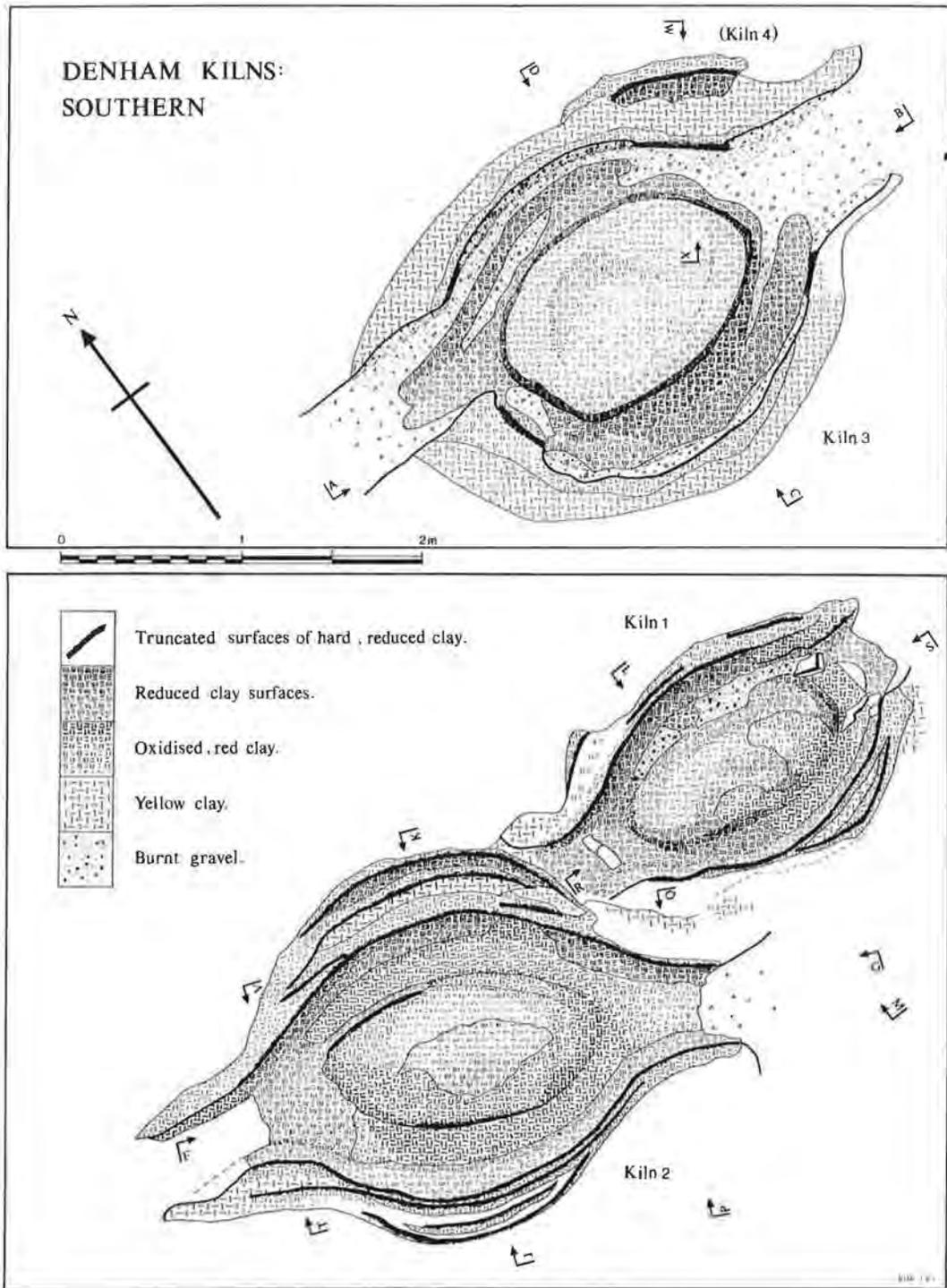


Fig. 6. Plan of southern kilns; kilns 3-4 (top), kilns 1-2 (bottom).

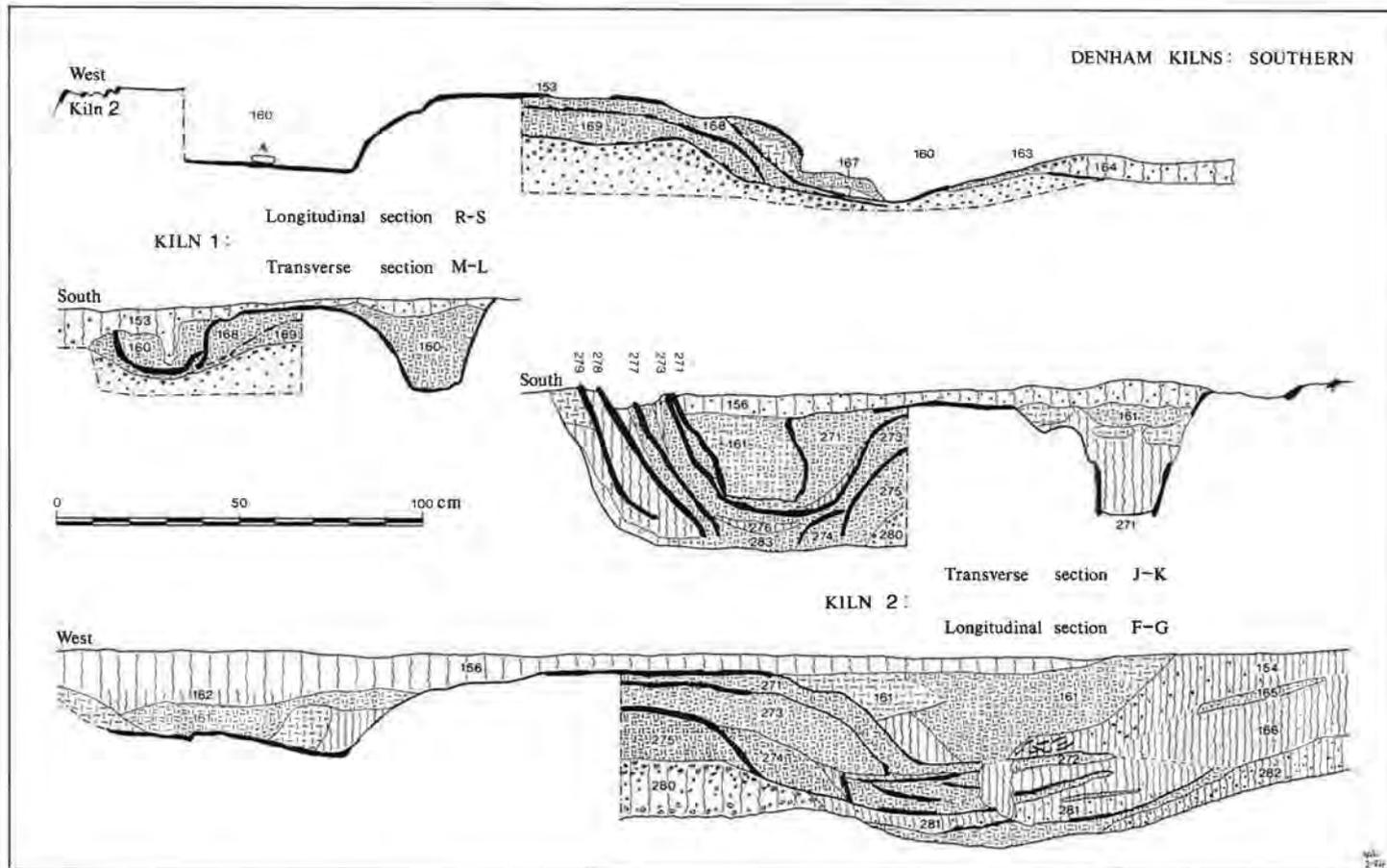


Fig. 7. Sections of southern kilns 1 and 2.

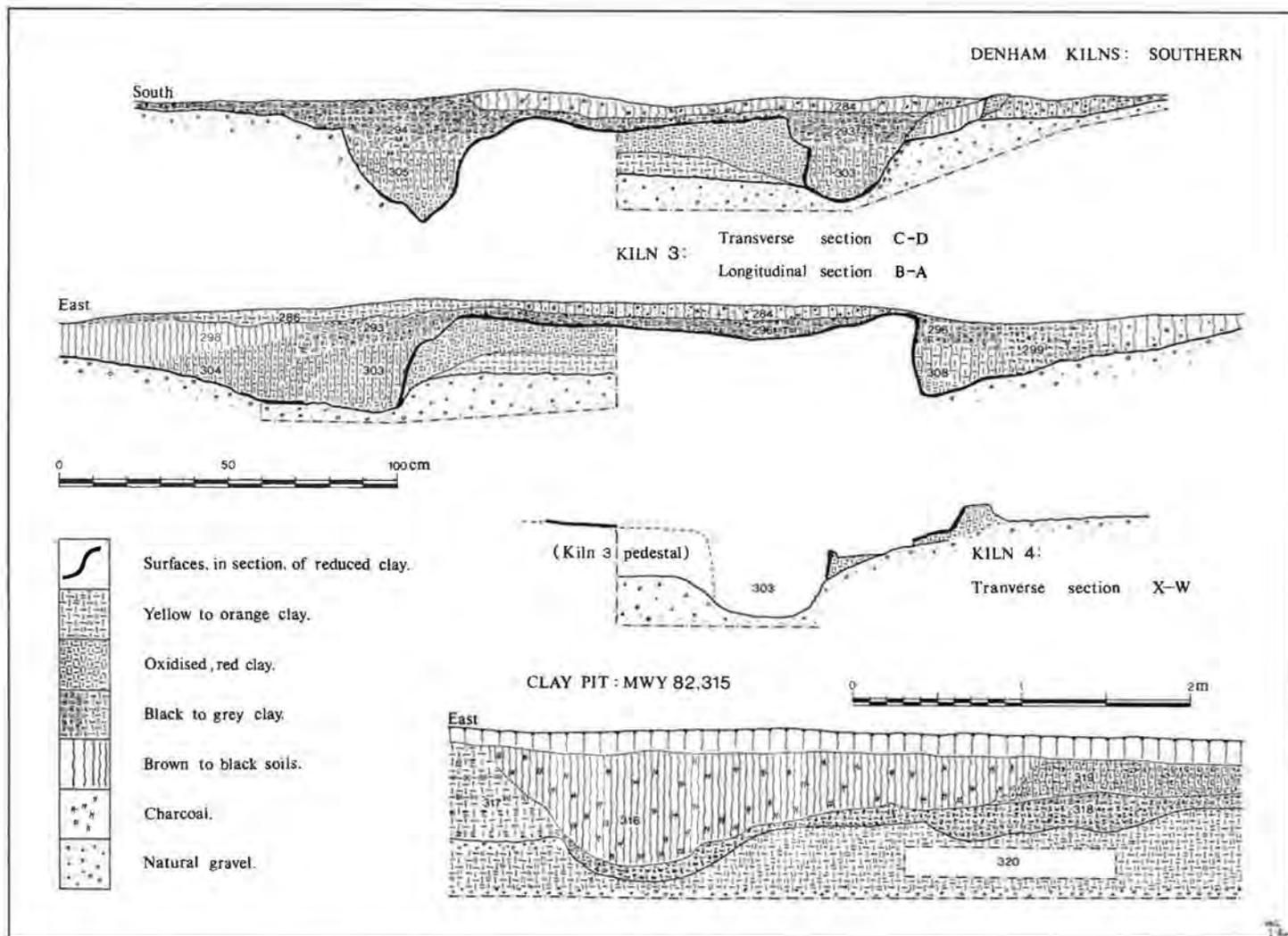


Fig. 8. Sections of southern kiln 3, and clay pit.

western end near the flue where the side was convex. The pedestal had been built from one mass of clay, built up on a small reserved area of gravel as in the other kilns. The fired clay surface of the walls, encountered in kilns 1 and 2, only survived in kiln 3 in patches, and the floors of the perimeter flues consisted largely of burnt natural gravel with a smear of fired clay surviving in a few places only, adjacent to the pedestal. The gap between the wall and pedestal was notably narrow at the western flue.

The western flue was largely intact but none of the original surfaces of the eastern one survived nor of its oxidised clay backing, so it was undoubtedly narrower when in use than is shown on the plan. Neither flue had a definable stoke pit, but as in kilns 1 and 2 a gentle slope led up to the stoke hole. Its fill was predominantly of yellow clay with some red, flecks of charcoal, and soil bands in the upper fill.

#### *Kiln 4 (Figs. 6 & 8)*

On the northern side of kiln 3 lay the remnant of an earlier kiln (322), which had been otherwise totally destroyed. The remaining piece consisted of the surface of a short length of wall and of perimeter flue floor with the usual reduced clay surface backed by red oxidized clay grading into yellow. Its base would have been considerably shallower than any of the other kilns and construction of kiln 3 would have destroyed the remainder. Its diameter is likely to have been similar to the others.

#### *Other Features*

A combination of modern drainage ditch recuts, the helpful activities of moles, and magnetometry enabled a very firm idea of the extent of the site to be gained (Fig. 3). The potters' activities were almost entirely restricted to the natural gravel outcrop previously described, roughly an area 3,300 sq. m, and the whole of this area produced plentiful pottery. The initial trial trench (Figs. 3 & 4) that exposed the interface between gravel and clay at the southern edge of the gravel outcrop shows this boundary to be a favourite area for tipping waste sherds which were here interleaved with alluvium from the Alderbourne. It is possible such sherd dumps might also have facilitated fording the river.

In the main area of the excavation where 110 sq. m was examined, traces of structures other than kilns were sought most carefully, but rarely did any features become apparent in the dense black pebbly soil lying above natural gravel. The principal feature that did emerge was a line of linked shallow scoops 0.10–0.15 m deep and 3.5 m long (330, 334, 313, 310, Fig. 5) forming an alignment between kilns 2 and 3. It seems probably that these indicate a simple structure relating to the function of both kilns. A dark soil stain, apparent during the final cleaning of the gravel surface, also appears to be related. The structure would be well placed to be a wood store for either kiln, or a pot drying area. It could perhaps have been an open-fronted shed, the shallow scoops indicating the position of its rear wall.

A readily available building material which could have been utilized on site but whose use would be untraceable in this particular environment would be turf. The remoteness and exposed nature of the site led its modern excavators to test turf as a building material for their own use. The turf shelter on Pl. XVII was constructed from the turf taken from an area 100 sq. m and although the problem of roofing the shelter was never seriously tackled, its walls comfortably accommodated five people. In the early nineteenth century families at Great Linford, Bucks, cultivating woad are said to have lived in turf houses (VCH 1908, 100).

The possibility that other structures existed elsewhere on site still of course remains, since the area excavated represents only approximately 5% of that utilized by the potters.

To the north of kilns 1 to 4 a clay pit (315, Pl. XV) was exposed in the southern side of a new channel for the river (Figs. 4 & 8); about 4 m long and 1 m deep, it was filled with loose soil and contained plentiful pottery. Samples of the clay into which it was cut were taken for study and are discussed further on.

#### *The Northern Kilns (Figs. 9–11)*

The circumstances of discovery of this site were outlined in the Introduction. The area it covered was relatively small but circumstances

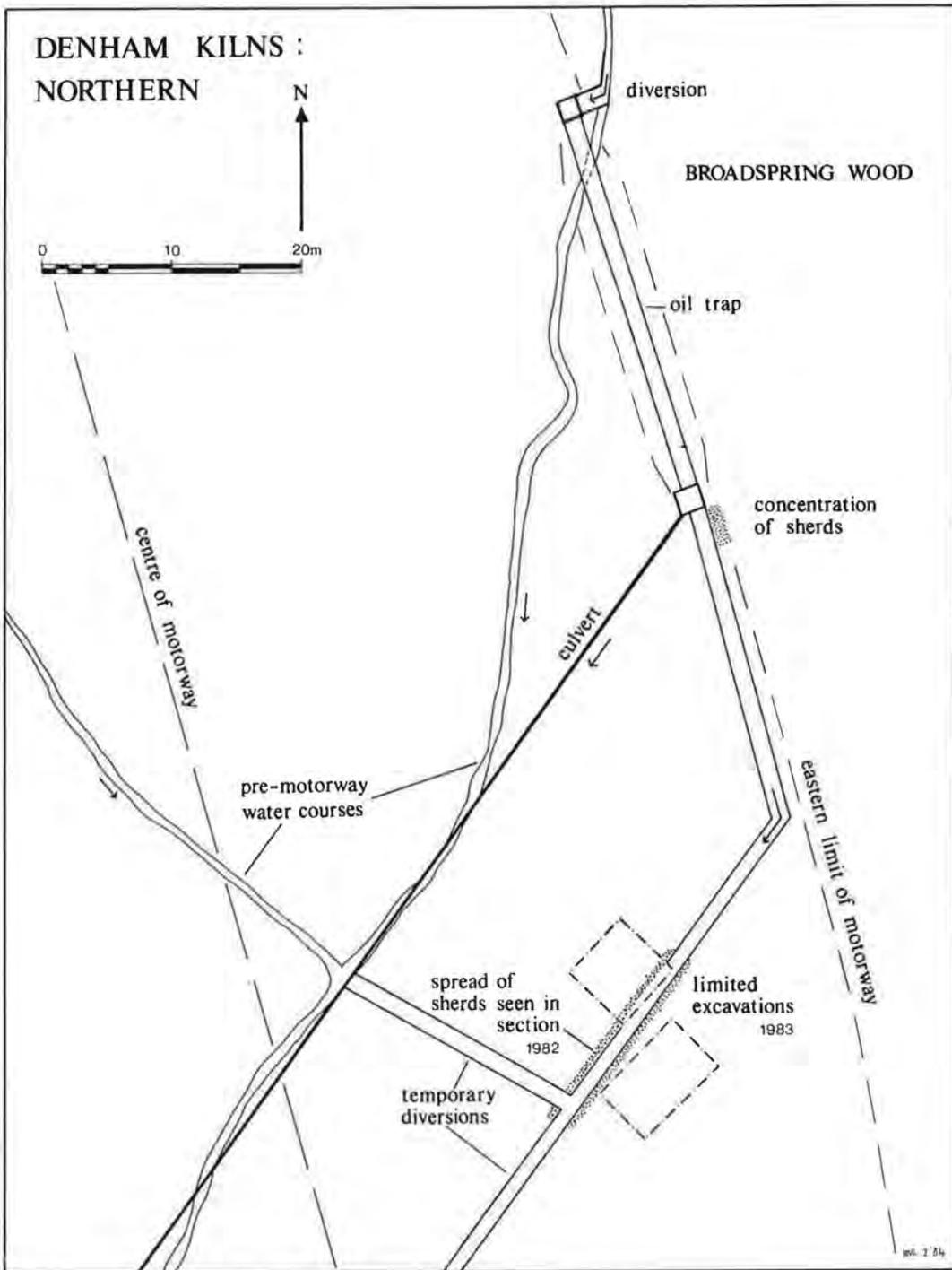


Fig. 9. Location of northern kiln.

DENHAM KILNS :  
NORTHERN  
MWY 82

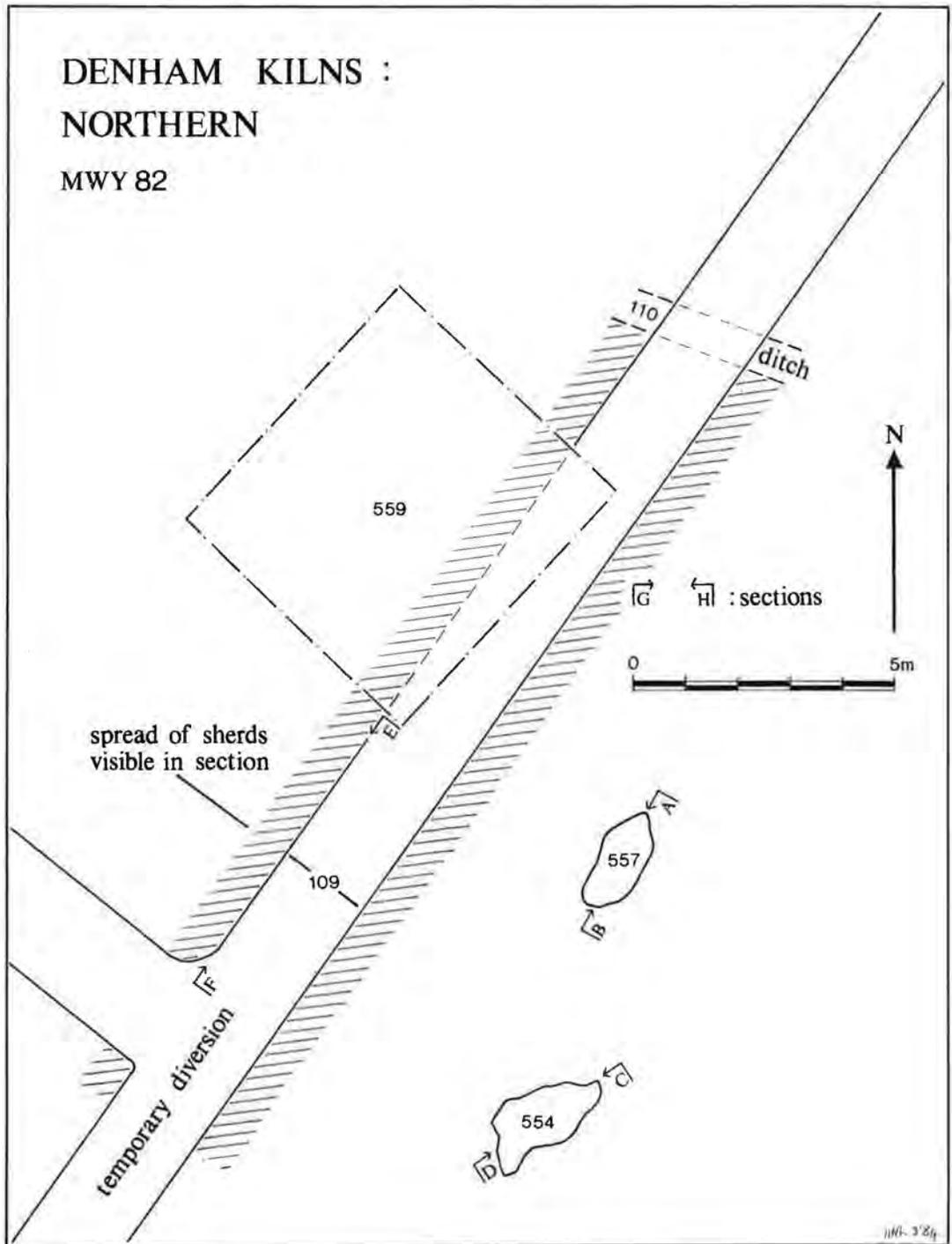
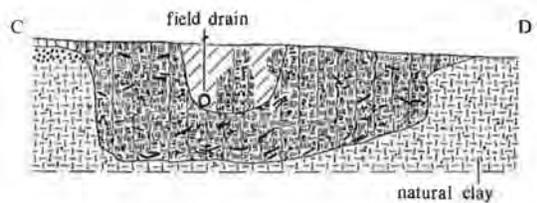
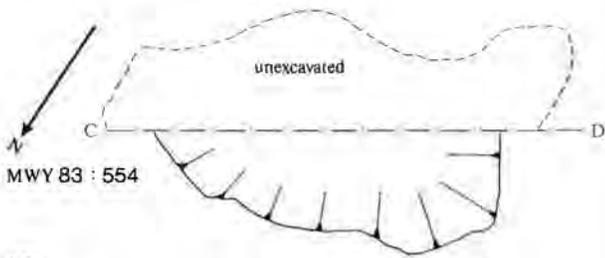
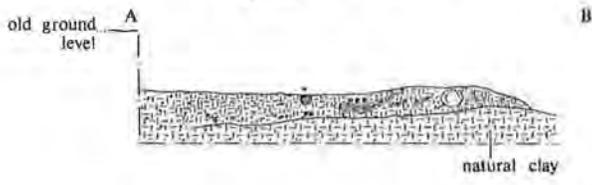
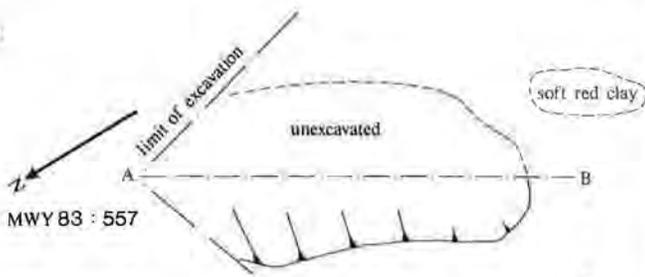


Fig. 10. Partially excavated and topsoil stripped area of northern kiln.

# DENHAM KILNS : NORTHERN

-  Modern disturbance.
-  Loam.
-  Black-grey clay.
-  Hard red clay.
-  Soft red clay.
-  Undisturbed yellow clay.
-  Charcoal, gravel.
-  Pot sherds.



MWY 82 : 109

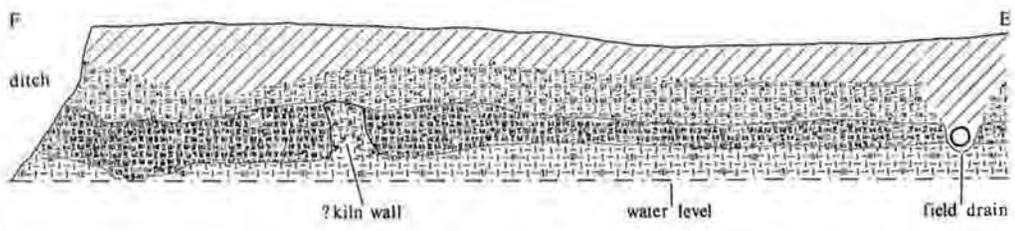


Fig. 11. Longitudinal section along drainage ditch with probable kiln wall, and other sections.

prevented complete investigation. The site lay in a tributary valley of the Alderbourne adjacent to a small stream and some 800 m north of the larger southern site. The valley had cut through the clayey sand and gravels into underlying weathered London clay. As discovered the site consisted of a layer of dark charcoal-flecked clay visible in the ditch section and containing plentiful pottery and flecks of burnt clay (109). The whole, which was just above the water level in the ditch, graded upwards from undisturbed clay and was itself sealed by a brown clay containing flint pebbles possibly of colluvial origin, and by material dumped during motorway construction. The principal deposit was 15 m long and terminated at a small ditch (110) which was probably of the same date as the activity on site. Sherds were also noted further north in the ditch section (Fig. 9) but excavation here produced only a handful more. The geographical extent of activity at this site was then fairly closely defined since nothing further was observed in adjacent ditches. The finds, which included kiln bar fragments, show clearly that it was a second kiln site. Visible in the drainage trench side before its unfortunate destruction (Fig. 11) was a short vertical section of yellow clay containing plentiful charcoal which may have been part of the wall of a kiln, but it was not excavated.

Further small-scale excavation in the area in 1983 examined two areas of burnt clay lying adjacent to the ditch and exposed by motorway machinery (Fig. 10). One of these (554) proved to be a small clay pit containing plentiful pottery, a piece of kiln bar and burnt clay fragments, that had been dug into the valley side just above the stream at a point where natural gravelly clay gave way to yellow clay. The other feature exposed (557) was more problematic. It had a level base, was too shallow to be a clay pit but contained much formless soft red-fired clay, charcoal, a burnt pebble and a modest amount of pottery but no evidence if *in situ* firing. It had clearly been sited close to a functioning kiln but does not seem to have formed part of one.

#### *Discussion of the Kilns*

The kilns themselves are all of the double-flue central pedestal variety which Musty clas-

sified as type 2c (Musty 1974), a common form in the region. Although only three, and part of a fourth, were examined on the southern site, magnetometry clearly suggests the presence of other kilns in the complex. They were wood-firing and, judging by the remaining charcoal, beech was the commonest wood used, followed by alder and oak (see on).

As has already been noted, each received extensive remodelling both of pedestal, perimeter flues and walls, indicating a reasonable period of use. Such remodelling would also have led to a considerable reduction in their capacity which may well have been a contributory factor in determining each kiln's lifespan. All were aligned roughly E-W, and were well positioned to utilize wind blowing up or down the valley. The slightly asymmetrical positioning of the pedestal relative to the firemouth, clearly visible in the plans of the three best-surviving kilns, as Steve Moorhouse kindly points out, would have been beneficial in encouraging a naturally occurring clockwise flame path. Kiln 1 had a deliberately blocked eastern flue.

There was little clue as to their superstructure except that each was filled with soft yellow or red clay, of the same character as that used in the linings and presumably derived from the upper walls. Hard fired clay, which might give a clue as to the form of the upper walls was fragmentary and less plentiful than might be expected. Some 36 kg was retrieved from the southern site as a whole, of which a third only (168 pieces) retained traces of a finished surface. Of these, 90 pieces had a convex surface and 78 a concave one. This gives no clear clue as to the character of the superstructure, but Bryant (1977) had demonstrated elsewhere that a very economical structure, and one certainly feasible at Denham, would be a roughly cylindrical shape open at the top, but sealed by sherds etc. at each firing. At Denham, turf faced with clay might be an economical walling medium; certainly no stone or flint was utilized. However it must be said that nothing resembling a clay 'plate', which has been suggested to be a possible indicator of clay-fired turf walling in Romano-British kilns, was found.

Fragments of kiln bar were present in most contexts, but, judging by the potential total present—20 bars at the southern site (see below)—they seem to have played a subsidiary role. The only intact bar was found across the neck of the west flue of kiln 1 (Figs. 6 & 7 and Pl. VII) which it scarcely spanned. Its length of 277 mm, if typical, would have been too short to span the gap between central pedestal and wall of any of the kilns, except in their final stages when relining had substantially reduced the gap. The siting of the intact bar suggests that they functioned as fire bars, supporting the burning wood in the throat of the kiln and allowing ash to drop beneath (Gregory 1977, 6–12). Some other method must have been used for bridging the wall–pedestal gap.

Peghole roof-tile was present in small quantities in most contexts on the southern site, some 424 pieces, generally fragmentary and weighing c. 18 kg, which would probably not constitute more than a few dozen complete tiles. At least half of these were in reduced colours strongly suggesting that they had been utilized in some way during the firing process. One function that tiles could have served would be in sealing the top of an open superstructure of the kind proposed by Bryant, or as general purpose spacers whilst packing the kilns. Only one piece had traces of glaze but this was apparently a self-fluxed piece.

The three kilns that were examined were probably operating in the thirteenth century. It is likely that kilns of earlier date remain within the substantial unexcavated area, although it is possible that the pre-thirteenth-century wares were fired in less readily detectable clamps, rather than in kilns.

### *The Products*

#### *Fabrics and Local Clay Sources*

The Alderbourne Valley is cut through Middle Thames Gravel formation and London Clay, occasionally penetrating into the underlying Reading Beds (Fig. 12). The valley itself is filled with Devensian Late glacial and Flandrian alluvial sediments (information kindly supplied by Mr J. Rose, Birkbeck College, London Uni-

versity), as boreholes and temporary sections show. These variable sediments consist of matrix and clast-supported cross-bedded gravels with beds of sand, silt and organic muds, typically overlain by silty clay with occasional gravel size clasts. In places gravel rises to the surface and it is on an outcrop of this gravel that the southern kilns are sited.

The northern site lies close to a junction of clay-bound sands and gravels, probably part of the Middle Thames Gravel Formation (Gibbard 1985, 20) and yellow weathered London Clay, which is cut into by the small stream system feeding the Alderbourne from the north.

It is not certainly known whether the northern potters were using the weathered London clay or a local patch of alluvial material; however the latter is more likely. The pottery and clays from the southern site have been more fully studied by Mr T. Royal-Dawson as part of an undergraduate dissertation at Leicester University. The remarks which follow are based on Mr Dawson's work with some additional comments on the ceramic.

Adjacent to the southern kilns was a pit (Figs. 4 & 8), dug into the alluvial clays adjoining the site, which had been backfilled with dark soil and a great deal of pottery. Presuming that the pit might have been a source of potter's clay, a sample of the adjoining clay was taken, and for comparison a single sample from an outcrop of London clay c. 200 m to the south and higher on the valley side. A number of thin sections of pottery were prepared, and the clay samples were also fired and then sectioned.

Inclusions formed between 10 and 35% by area of all sections and a limited range was noted, 'the main mineral present being quartz with flint being common. Quartzite was also present, along with iron and some flecks of mica in some thin sections'. Taken on its own this showed similarity between both of the clays and the sherds. However textural analysis showed the London clay outcrop to be clearly distinguished by being densely filled with minute grains of quartz untypical of the alluvial clay

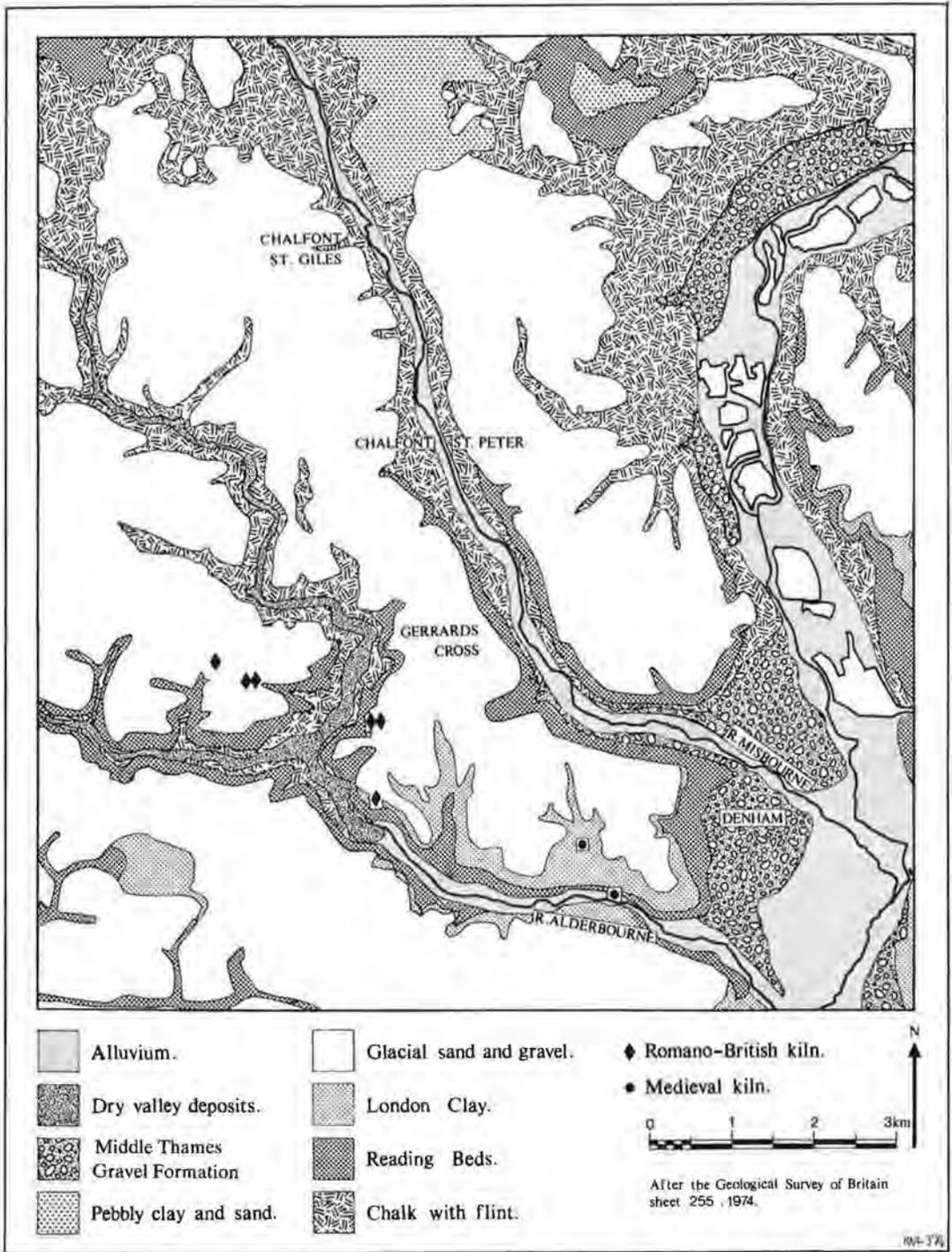


Fig. 12. Surface geology with known Denham kilns and known Roman kilns.

adjacent to the southern kilns which has a broader range of inclusions, reflected in the sherds and in a piece of kiln bar. Test firing of the London clay sample led to its exploding at low temperature unlike the alluvial clay which was satisfactorily fired to 1050 °C. Mr Dawson comments that the finer London clay could however have been used in the lining material of the kiln itself.

There seems little doubt that the adjacent pit was one direct source of potting clay. However, a sample from the same deposit was also provided for Mr R. I. Little of Camelot Pottery, Boscastle. After drying and removing coarser inclusions he commented that as far as throwing was concerned it was 'the worst potting clay I've tried to throw with in 28 years'; principally on account of its coarseness and low plasticity. He suggested it would however be suitable for hand-built ceramic, which appears to have been the dominant technique in use at Denham.

Deliberate weathering and clay preparation in general may, however, distance the final clay from its 'as dug' state considerably. Procedures for preparation of potting clay have been described elsewhere, and may include deliberate exposure to frost and subsequent storage under damp sacks (MacManus 1984) or drying followed by slipping and sieving (Bosworth 1982 and Nuttgens 1980). The former would be most economical of effort.

Although no absolute distinction was apparent between the fabric of the northern and southern products, flint fragments were generally more apparent in the northern group. The colour of the vast majority of sherds is varying shades of grey, normally light grey to light brownish grey within the range 10 YR 5/1 to 10 YR 7/3, indicating firing in a reducing atmosphere. Occasionally reddish hues are present. This was particularly apparent amongst material from the northern kilns where oxidation was generally more common. Sections are generally of even colour throughout and only occasional is a 'sandwich' effect visible.

#### *Archaeological Procedures*

There were some 97,097 sherds, nearly one

ton in weight, when both northern and southern sites are combined. The vast majority of these sherds came from the formless dark soil of the southern kiln site, on which an arbitrary 'spit' stratigraphy (ABC) by m<sup>2</sup>, described earlier, was imposed.

The amount of material recovered from formally 'stratified' deposits pales into insignificance beside this volume, so the pottery as a whole, so far as the accompanying catalogue is concerned, has been illustrated as one unit.

From the commencement of the programme of analysis an attempt was made to classify each sherd according to a range of characteristics, the whole being coded with a choice of 25 fields and entered onto the Museum's ICL terminal. The system used was based broadly on that developed by Maureen Mellor for the Oxfordshire Archaeological Unit. For many of the fields recorded the approach has proved extremely successful if laborious in the extreme, but in one significant area, namely that of rim shape, it became obvious that insufficient precision had been achieved in defining mutually exclusive groups, and this aspect of analysis has been less fully applied than would be wished. The rim classification presented in the ensuing figures derives principally from a resorting of selected material. Two conclusions may be drawn from this particular failure. Even within one medieval kiln group operating over a relatively short space of time, although the potters had a *general* concept of product purpose they had no great interest in the standardization of rim form from day to day. Forming a rim is the work of seconds and, particularly within groups such as cooking pots, the finer details of form may have only the loosest relationship to function. The subsequent act of classification is an attempt to insert formal divisions into what was in reality a fluid continuum; moreover divisions when created whilst quite apparent to one worker may not be easily replicable by others. The brief 'word pictures' of rim types which have been included in the following catalogue groupings are therefore intended to be little more than an *aide-mémoire*.

### *General Introduction to the Products*

The greater number of sherds by far was recovered from the southern kiln group (98.5%), but the following comments can be taken to be relevant to both sites unless otherwise specified.

The majority of sherds recovered at Denham were very small in contrast to experience at other kiln sites, and of the 97,096 recovered distressingly few were larger than 50 mm across. The average weight of sherd recovered was 7.7 g. This made attempts at reconstruction generally a waste of time. In view of the apparent lack of disturbance of the site this is hard to explain unless large wasters were systematically scavenged for some other purpose. Of the total sherds recovered 15,352 were rims, 8,027 parts of bases, 1,822 handles, and the remaining 71,896 body sherds or pieces otherwise classified.

Very few sherds (1.2%) have any slip or glaze finish, the majority being in various reduced shades of grey. All are hard and cannot be readily marked by a finger nail. Owing to their sandy content, sherds generally feel slightly harsh to the touch, but are not 'dusty' as some kiln products.

Direct evidence that the sherds are 'wasters' is rare in the extreme and is provided only by distortion of one or two of the larger pieces and by a glazed handle from topsoil (124) which has another sherd adhering. It should be stressed however that there is no evidence that the site was ever used as anything other than a kiln site; indeed half of a spindle whorl provides the only sign of any domestic activity.

Of the total sherds present it was possible to attribute 10.38% to a particular form. The range of forms produced during the life of the sites was limited. Among the *identified* sherds, the proportion attributed to each form was as follows:

|                       |       |
|-----------------------|-------|
| Jugs                  | 23.3% |
| Cooking Pots/Jars     | 54.9% |
| Bowls/Dishes/Skillets | 17.3% |
| ?Lids                 | 1.2%  |
| Curfews               | 3.2%  |
| Pedestal Lamps        | 0.04% |

It should be remembered that only approximately 5% of the production area identified on the ground was excavated. The attribution of a particular product to an individual kiln, in the absence of any *in situ* collapsed firings, is not feasible.

One important issue which was not totally resolved related to manufacturing technique. It is quite clear that a proportion of the vessels were hand-built and a proportion were thrown. Unfortunately in only a small percentage of cases was it clear macroscopically which of the two methods had been used, and then generally on larger pieces of which there were few. Vessels that were hand-built were apparent by the very slight irregularities in the wall thickness; wheel-made pots by evenness and by complexity of rim form, but rarely by throwing lines. The surface of sherds had usually degraded sufficiently to leave quartz grits standing proud and to remove the fine slurry which retains evidence for throwing on finer wares. The presence of occasional horizontal striations may not in itself be enough to prove throwing, since they could equally result from finishing a hand-built pot on a tournette. Certainly those that were hand-built were very competently made; and although it is probable that they were coil built there is never any evidence of horizontal separation of the rings. Where it has been possible to decide upon manufacturing technique for those pots illustrated here, this is noted in the appendix catalogue. The question of hand-forming is further discussed later.

### *Decoration and Finish*

The decorative techniques in use at Denham were of limited range, in common with other Chiltern potteries of the period. Only 1.2% of all sherds were slipped or glazed and the vast majority of such sherds come from jugs. There are no certain examples of glazed bowls or cooking pots, and even of identifiable jug sherds, glazed examples form a very small percentage. That it is necessary to use the term slipped *or* glazed is due to the fact that this finish often only survives as a white trace, and whilst on occasions this certainly is slip (trailed examples occur in contexts 208B and 208), in

other instances it may be decayed glaze—the soil is slightly acid at pH 6. In a few instances glaze is applied over a slip.

A rather larger proportion of sherds had one of two other simple forms of decoration or finish. The following percentages relate to decoration on the body of the vessel as distinct from its rim or base; of these 2.2% of sherds had thumbled strips applied either horizontally or vertically, and 3.2% showed evidence of combing/scoring or 'wiping'. It is thought that the latter percentage may be a slight underestimate since this feature was best seen when the sherd was wet, rather than at the subsequent classification stage. With the exception of a few other simple and rarely used techniques, such as stabbing, rouletting (6 sherds) or the deliberate raising of ribs or cordons, the entire repertoire of body decoration was represented by slips/glazes, combing/scoring or 'wiping', and applied thumbled strips.

Of these techniques, one should be further discussed, namely combing/scoring or 'wiping'. It was not always possible to distinguish between these techniques on small sherds, but it was clear that on some pieces a toothed comb was used, generally vertically on the wall of the pot, on others the surface seems to have been more roughly scored and on others 'wiped', perhaps with a handful of stiff vegetation. Wiping tended to be multidirectional. The distinction between the two basic methods is noted further on since 'wiping' seems to be an early trait. Although producing a decorative effect, both techniques may have been, at inception at least, a side effect of hand-building, combs and scrapers being commonly used to consolidate and even out the surfaces of such pots (Blandino 1984, 33, 49, 57 and Thomas 1982, 29).

A very small proportion of rims received additional treatment, either fingertipping (Fig. 17, 2–3) or stabbing (Fig. 21, 9). Handles were much more variously treated and are discussed further on.

#### *Pottery Forms*

##### *Jugs* (Figs. 13–16)

Some 23.3% (2347) of the *identifiable* sherds

from the site were attributed to jugs and 1.2% (1265) sherds of the *total* sherd assemblage had some form of glaze or slip. There is no satisfactory way that these figures can be combined to produce a realistic estimate of the percentage of vessels produced with glaze/slip, but they were undoubtedly very much a minority product. This may reflect both the period of production and possibly the relative coarseness of the available clay, which although it would take slip does not seem to have generally taken glaze alone well. Where glaze was used it was predominantly green-dark green, or more rarely yellowish. Slip, usually weathered, normally appears as an overall wash (Fig. 15, 1–2, 4 bases), or more rarely trailed (Fig. 16, 14). One answer to glazing problems seems to have been to glaze on top of slip.

Three jug sherds with circular grid stamps were recorded (Fig. 16, 17, 19, 23), but a note of caution should be sounded as to their production here, since also present were one or two pieces that were certainly products of the Brill/Boarstall industry (e.g. Fig. 20, 19–20) and the circular grid stamp is not an uncommon motif there (Farley 1982, fig. 4, 18).

There was considerable variation in rim form and little attempt at standardization was observable. For convenience those pieces illustrated have been grouped broadly into 'complex' rim profiles, those with a pronounced internal projection, with T-rims, or with simple rims, although during coding some eighteen varieties at least were detected. The commonest rims were simple or slightly squared. Vessel profile was rarely apparent owing to the generally small size of the sherds, but some clues may be gained from bases.

Although it was rarely possible to say with certainty which bases belonged to jugs and which to cooking pots or other vessels, of the 8027 base sherds identified 73% came either from sagging or flat bases with an obtuse-angled wall (Fig. 15, 5–8), a further 26.5% could not be classified, and of the remainder only 0.5% had splayed bases (Fig. 15, 1–4). This strongly suggests that the majority of vessels including jugs had a baggy form akin to the only complete

surviving example (Fig. 13, 1). Of identifiable base sherds 17% had evidence of additional finger or thumb impressions around the basal angle, either continuous or in groups. It is likely that a substantial proportion of these came from jugs.

The final aspect of jugs to be considered are their handles and spouts. A few spouts only were present, 56 being recorded although they are not always easy to detect amongst waster material. Pieces of 1822 handles were recorded, of which 1512 were certainly from jugs. This figure contributed 64% to the proportion of identified jugs. In view of the ease with which they can be recognized this figure, seen in proportion to the total sherd count of 97,097, may with care provide some clues as to the actual proportion of vessels present on site, a point that will be returned to.

All jug handles were apparently pulled. The method of attachment to the body is rarely clear and although a substantial proportion were simple luted on, a few were actually pushed through a hole cut in the neck (contexts 181A, 182A, 201B). In other instances a finger was pushed through from the inside of the neck into the body of the handle to secure the join.

Some 5.6% of jug handles had traces of glaze but only a few were also slipped; 8.8% had some kind of 'decoration'. The function of handle 'decoration', apart from enhancing grip on the jug, is to minimize the risk of the handle—the thickest part of the jug—exploding during firing. The Denham handles could broadly be divided into strap or rod section in the proportion 3:1. Some 15% of jug handles had been deliberately thumbbed in various ways after pulling. A larger proportion of all handles had been knife slashed or stabbed with a point. Some 60% of the total handles present on site had been treated in this way, with 21 variations of pattern being recorded, a few of which are shown here (Figs. 13 & 14). Sometimes this treatment was in addition to thumbing.

#### *Cooking Pots/Jars (Figs. 17–21)*

Problems with rim form classification referred to previously became particularly

apparent amongst 'cooking pots', the term loosely used here for the majority of necked vessels, and which included 54.9% of identifiable sherds. Some 5618 rims were attributed to cooking pots. Decoration, as previously discussed, was almost exclusively confined to combing or wiping and applied thumbbed strips, and to a relatively small proportion of the total population. Applied strips were however identified twice as frequently as was combing, although both did occur together. The dominant class present (2,402 rims: 42%) are to be found amongst the group described here as necked sub-angular (fig. 20, 1–18). This rises to 50% (3156 rims) if subsidiary groups with a square to rectangular profile are included. These, broadly speaking, have short upright necks or collars with a rim formed simply by turning the rim tip outwards. This movement by the potter tends to result in a slight depression or recess at the top inside edge. Those which have no 'neck', described here as 'simple everted', included 930 examples (16%: code 057), and are the next most dominant group. A proportion of these (for example Fig. 17, 1–3) are amongst the earliest products of the site and will be discussed further on. These generalizations apart however, further quantification would be inadvisable as has been previously discussed. In total, fourteen groupings have been presented in the accompanying drawings and a brief word picture given of each.

Apart from those previously mentioned, four specific types deserve note, the simple upright beaded-rim barrel form (Fig. 17, 9–10), the narrow necked heavy forms (Fig. 19, 6–8), an anomalous lid-recessed form (Fig. 22, 1–2), and bung-hole jars (Fig. 25, 12–13). Nine handles belonging to the barrel-shaped vessel were recorded. The form was also encountered at Fulmer DMV and is likely to belong to a fairly early production phase. The heavy form with narrow neck is clearly a jar rather than a cooking pot, it is robustly made and is likely to be for storage. No parallel has been found for the third form and its profile was difficult to establish. Its clear lid recess marks it out from all other vessels on the site. The fourth type, the bung-hole jar, is known only from four examples. In all cases additional clay has been used to model

the aperture, and it remains a possibility that this type may not be from bughole jars but from rather elaborate smoke vents on curfews.

Bases have been previously discussed in connection with jugs. It was rarely possible to be sure to which form they belonged and the two examples included here (Fig. 22, 7-8) simply reflect the most likely candidates.

#### *Bowls, Dishes, Skillets and Lids* (Figs. 23-5)

It was not always easy to identify bowls and dishes from rim alone, and rarely was there adequate depth of sherd to distinguish between them. They are here included in one group. Of the identifiable sherds 17.3% (1739) were attributed to these forms. None were certainly slipped or glazed. The dominant decoration by far was the horizontally applied thumbed strip. Some 26% (454) were treated in this manner whereas only 0.5% (9) had incised wavy lines (Fig. 24, 4) or other techniques. Few were combed. Rim forms were fairly simple, the majority projecting slightly inwards often in the form of a T-rim, which would have helped contain splashes when in use. A few only had pouring lips.

Skillets were indicated only by the presence of handles: no attempt has been made to distinguish skillets from handled bowls. Parts of sixteen hollow handles were identified (Fig. 24, 1-12) and a few strap handles (Fig. 22, 3-4) may be from vessels of this kind. A few feet (Fig. 22, 9-12) are probably from footed versions of skillets.

No lids have been illustrated. Although a small percentage (1.2%) of the identifiable sherds were classified as such, it is only the shallowness of the wall angle which distinguishes them from bowls.

#### *Curfews* (Fig. 26)

The presence of seven curfew handles encouraged further search amongst the material for vessels of this kind. Apart from their distinctive handles their presence has also been presumed where decoration was carried over onto the underside of bases, and in a few instances where the basal angle seemed to have

been finished in a manner over-elaborate for a jug. The presence of slashes on the angle of a base may also indicate a vessel of this kind.

#### *Pedestal Lamps* (Fig. 27)

These pieces have been classified as pedestal lamps on the basis that they match well the form of bases of more complete lamps from Thetford (Rogerson 1984, 158) and elsewhere. All are hand-modelled and they undoubtedly were produced on site. However it must be recorded that the identification has been disputed by others who feel they are more likely to be items of kiln furniture. Fragments of 13 were noted, and this is probably an underestimate.

#### *Intra-Site Distribution: Southern Kilns*

The plotting of finds by metre square provided the potential to examine intra-site distribution at the southern site; likewise the use of depth layers within the formless dark soil might also be expected to allow identification of local distributions. However, because of the number of pottery variables involved, even with the benefit of a computer this proved in reality a slow and unattractive analytical option. A second important factor was that a general pattern emerged of low density in the western and north-western third of the site, which included kiln 3, and in effect reduced from 103 to 70 the number of grid squares within which patterns might be sought. This proved too confined.

#### *Chronology*

As had been noted, the opportunities for internal dating of the products are limited and as will be discussed further on, available documentary references are too late. Central to the discussion must be an archaeomagnetic date obtained from the fired clay of kiln 3 by A. J. Clark of the Ancient Monuments Laboratory as follows: AML-865446, Rush Green, Buckinghamshire: Date AD 1240±20 at 68% confidence level. This is a perfectly acceptable date on archaeological grounds. There is good ceramic evidence that the site was being used for pottery production much earlier than this, but it need not have continued very much later.

The evidence for earlier production derives

from one form in particular, namely Fig. 17, 1, a cooking pot of which a number of pieces occur on both northern and southern sites. These hand-made pieces with simple outswept rims have fairly irregular wall thickness and pronounced random surface 'wiping', which can be contrasted with the more regular combing or scoring that occurs in typologically later pieces. Their fabric, in thin section, is undistinguishable from the main body of the ceramic from the site. Parallels for the form may be cited from Staines (Jones 1982), although not there closely dated, and they may be exactly matched from unstratified deposits at the manorial site of Fulmer a little further up the Alderbourne (Farley 1982, fig. 10, 1-2 and see below).

A cautious view of these pieces would be that they represent a twelfth-century phase of the industry; however, the surface wiping may be regarded as an aspect of the Saxon scratch-marked tradition which occurs on a range of southern English products, for example at Winchester (Biddle 1965, 255-6), and the authors lean towards a pre-twelfth-century date.

The fabric may be a local counterpart to the later Saxon shelly wares of Oxford and London (Mellor 1980, Vince 1984). In an earlier tradition also are the distinctive bead rim jars with sides perforated at the rim to form handles, occasionally stabbed on top (Fig. 17, 9-10; Farley 1982, fig. 7, 14 and fig. 10, 3). The form is seen in late Saxon calcareous fabrics at Northampton (Williams *et al.* 1985, fig. 31) and appears to be distinct from later 'handled' rims which occur in fully medieval contexts. Clearly, better dating must await the excavation of well stratified sequences in the area.

Scoring or combing as distinct from wiping was a common feature of the ceramic from Fulmer, frequently associated with cooking pots with fairly long upright necks often with fingertipping on the rim (Farley 1982, figs. 7-10). This form is also represented at Denham (Fig. 17, 11-12, Fig. 18, 1-3), although fingertipping is less common here. It seems likely that this group of wares may form the second phase of production. The dating of Fulmer was specu-

lative in the absence of reasonably dated local groups; however, on reflection, a twelfth-century or perhaps very early thirteenth-century-date may be appropriate. The distinction between 'scoring', perhaps with twigs, as against combing *may* mark yet a further chronological subdivision within this phase.

A third phase of production is marked by the abandonment of body combing and fingertip decoration on the rim, and the widespread use of thumbled applied strips. These seem particularly common on cooking pots whose 'square' trims indicate a thirteenth-century date (Fig. 20, 2). Bowls with horizontal thumbled strips (Fig. 23, 1-3; and Farley 1982, fig. 8, 2 and fig. 9, 2) may also be third phase but the common T-rim form may indicate an earlier start. It is a subjective impression that the majority of phase 3 wares are wheel-thrown.

Although it is stratigraphically clear that kiln 1 is succeeded by kiln 2, the ceramic from the backfill of the kilns cannot be reliably separated. The jug (Fig. 13, 1) which blocked a flue of kiln 1 could be twelfth-century, and a rim sealed within the second make up of the pedestal, similar to Fig. 18, 11 could also be of the same date. However, the fill of the kiln and its stoke hole includes Fig. 18, 14 and similar forms, and this fill, admittedly secondary in date, bears close similarity to that of kiln 2 which succeeds it. Kiln 2 contained three rims within its rebuilt pedestal including one similar to Fig. 20, 2 and other probably thirteenth-century types. From its fill came a similar jug to that from kiln 1 (Fig. 13, 5), the T-rim bowl (Fig. 23, 4) and cooking pot (Fig. 21, 10) which sit reasonably in the thirteenth century. Kiln 3 has the archaeomagnetic date, placing it in the mid thirteenth century, and pottery from its fill included T-rim bowls with applied strip and squared rims similar to Fig. 8, 6, but nothing datable from its structure. The fragment of the fourth kiln has no significant ceramic associated.

It seems likely that the kilns that were examined may correspond with 'phase three' of the production and that the earlier ceramic present derives either from kilns as yet unexamined, or that the less readily detectable clamp firing may

be present. Bungholes (Fig. 25, 12–13) are commonly considered not to have appeared in the region's repertoire before the fourteenth century, nor footed vessels (Fig. 22, 9–12), but the paucity of such pieces suggests a limited production by that date. The very small percentage of glazed/slipped wares present may be in the large part due to unsuitability of the clay, but the absence of such wares on any scale suggests a similar chronology.

Although there is far less material from the northern production site, the range of forms overall matches that from the southern and both kiln bars and lamps are also present here. However there is a greater proportion of forms likely to belong to the hypothetical 'second phase', in particular there are more long necked T-rim forms often with scoring on their bodies, a number of simple everted rims, but relatively few 'squared' rims which seem to characterise the later phase. It is also notable that the northern group had a greater proportion of oxidised wares.

#### *General Comments on Output and Types*

Approximately 5% of the production area was examined. Calculation of waster rate is obviously fraught with difficulty. Musty (1974) accepted a rate of about 5% of the total production, and Nuttgens, a practising potter firing a wood-fired kiln for stoneware, records a rate varying between 1 and 15%, the former being for very small pieces and the latter for larger ones (Nuttgens 1980).

The conservative figure of 5% has been accepted in the calculations below, which attempt to give some idea of the total production of the site. Two approaches were used to determine actual vessels broken on site; they gave substantially different results. The first method depends on knowing the approximate weight of the finished product. Weighing a selection of complete twelfth/thirteenth-century jugs and cooking pots in the County Museum produced a mean of 1500 g for the former and 2000 g for the latter.

Therefore, total weight of sherds is 740147 g  $\div$  1500=493 jugs, or 740147 g  $\div$  2000=370 cook-

ing pots. The second method is based on rim percentages. The percentage of total rim circumference had been calculated for each rim present—there were 15,352 rims. The rim percentage had not however been entered into the database, so a rough 'average rim percentage' was calculated based on 180 examples, and not distinguishing between different classes of vessel. This showed that an 'average' rim represented 8.15% of a vessel's circumference; a 'complete' pot then =12.195 rim sherds. This gives 15,352 rims  $\div$  12.195=1,258.87 vessels present, a figure at least three times greater than the first calculation.

Instead of piling hypothesis on hypothesis to explain this disparity the most conservative figure will be accepted, namely 370 vessels. Taking the waster rate at 5%, this gives a production from the area excavated of 7,400 vessels, and from the total area of both sites of 148,000 vessels. This could however be an underestimate by a factor of at least 3 and possibly more.

#### *Catalogues*

##### *Pottery*

Figs. 13–27 show examples of the range of products from the kilns as a whole. The abbreviated catalogue gives the types of pottery shown in each figure, shows the context numbers in the same order as the illustrations, and includes comments only on sherds where detail may not be obvious on the drawings. A more detailed catalogue giving the coding of each piece is provided as an appendix, pp. 00–00. All of the illustrated sherds are unglazed unless indicated in the comments. The context numbers can be summarized as follows: northern kilns 109–110, 553–567, southern kilns all other numbers. Contexts 170–261 relate specifically to material recovered from gridded m<sup>2</sup> (see Fig. 5). The letters ABC following these numbers indicating topmost level downwards.

##### *Fig. 13—Jugs*

###### *1–10: Complex or cordoned rims*

163A, 137, 151, 109, 282, 139, 138, 109, 109, 109

1. From blocked flue of kiln 1, handle plugged at rim.
3. Stab marks.
4. Slip/glaze.
6. Shallow scored lines.

###### *11–15: Inturn at lip*

557, 151, 166, 152, 139

11. Stabbing inside neck through into handle.

###### *16–18: T-rim*

194, 222B, 139

19-23: *Strong eversion or bead at lip*

137, 138, 261B, 232, 309

22. Slip and traces of dark green glaze.

Fig. 14 – Jugs and Handles

1-7: *Jugs with simple rims*

141, 565, 109, 313, 151, 176A, 310

2. Handle heavily luted with traces of socket in neck.

5. Stabbing in FT impression.

6. Coarse grooving of handle with knife cuts.

8-14: *Handles with circular or ovoid section*

149, 225A, 215C, 217C, 284, 227C, 120

8. Over-generous luting at base of handle.

9. Handle plugged, white slip, clear green glaze.

10. Traces of slip/glaze.

11. Possibly from 'cauldron'.

12. Stab holes in FT impressions.

15-18: *Handles with flat or 'strap' section*

15. Thumbbed then knife cuts.

16. Thumbbed then stabbed.

18. Twin incised zig-zag with knife slashes at edge.

Fig. 15 – Jug bases

225, 260, 251A, 216B, 195, 232A, 124, 120, 154

1. White slip on ext. and base.

2. White slip on ext. and base.

4. Traces of white slip on ext. and base.

6. Knife slashes on angle, could be a curfew base.

9. Dark green glaze on edge of FP impressions.

Fig. 16 – Decorated Sherds

1-13: *Unglazed from ?jugs, cooking pots etc.*

252, 183A, 138, 180C, 109, 252B, 109, 242, 144, 252C, 243B, 252C, 180A

1. Colander or perforated bowl.

2. Dec. raised with finger-nail.

3. Combing on jug neck?

4. Narrow tooth comb.

5. Stabbed cordon.

6. Knife slashes ? base.

7. Wiping ? base.

8. ? Accidental weathered surface.

9. Combing and strip ? cook pot.

10. Combing and applied strip ? cook pot.

11. Narrow comb ? jug.

12-13. Combing.

14-23: *Glazed, from jugs*

215C, 310, 309, 242, 251A, 244B, 174B, 251A, 223C, 291

14. Trailed white slip, ? glazed.

15. Yellow glaze on narrow comb and comb stabbing.

16. Brill product, green glaze on iron slip, strip and rosette.

17. Three circular grid stamps, yellowy-white glaze.

18. Very deteriorated green glaze on slip ? Brill.

19. Two circular grid stamps and scored line, dark green glaze as 17.

20. Yellow green glaze on narrow comb and comb stabbing as 15.

21. Yellow glaze on erratic slip.

22. Traces of dark green glaze on fine comb.

23. Brown-mauve glaze on two circular grid stamps.

Fig. 17 – Cooking Pots

1-8: *Simple everted rim*

215A, 313, 215B, 138, 182A, 215B, 188A, 160

1. Wiped finish.

2. Wiped finish, finger tip dec on rim.

8. Two applied strips with FP, worn.

9-10: *Handled with bead rim*

242B, 215B

9. Rim loop applied ? ovoid stabbing on top.

10. Rim loop applied, square stab marks.

11-12: *With neck and slight T-rim*

554, 109

Fig. 18 Cooking Pots

1-3: *With neck and T-rim*

565, 565, 565

1-3. Combing.

4-16: *Rim tip overhanging interior*

172C, 242A, 209A, 139, 282, 197, 556, 565, 565, 109, 160, 109, 137

5. Combing.

8. Combing.

13 & 15. Grooving on rim top.

Fig. 19 – Cooking Pots

1-4: *Rim tip overhanging interior*

109, 191C, 565, 565

3. ? Combing below cordon.

5-10: *Hollow or cupped rim*

206, 239, 141, 160, 138, 140

6-8. Are heavy vessels probably intended as storage jars with lids.

9. Has a perforation through the rim.

11-12: *Unclassified*

139, 141

11. ? Rim angle.

Fig. 20 – Cooking Pots

1-18: *With necks and sub-angular/rectangular eversion*

140, 151, 222, 141, 152, 198, 141, 135, 140, 151, 109, 206A, 173B, 152, 152, 135, 198, 172A

2. Slightly distorted in firing.

19-20: *Variant of above*

152, 206

19-20. The forms are similar to Brill, in Denham fabric.

Fig. 21 — Cooking Pots

1-5: *Misc. variant*

176B, 188A, 138, 193A, 318

3. Distinct groove on rim top.

6-8: *Misc. variant*

172, 172A, 173B

8. See Farley 1982, figs. 10-13.

9-10: *Misc. variant*

309, 154

9. As Fig. 7, 6-8, probably a storage jar, stabbing on rim.

11–12: *Misc. variant*  
151, 192A  
12. Combing.

13–14: *Misc. variant*  
172A, 139

Fig. 22 – Miscellaneous including feet, handles, bases

1–2: *With gallery and stab decoration*  
173, 234B

1–2. Unusual vessels with a gallery.

3–4: *Handles ? skillet*  
154, 208A

3. Angle uncertain.

5–6: *Miscellaneous*  
151, 206

5. Wavy line ext. and both faces of rim.

7–8: *Typical cooking pot bases*  
208B, 312

7. Grouped thumb marks.

8. Combing inside.

9–12 *Feet*  
213C, 227C, 243C, 216B

9. Vertical knife marks and then stabbing.

12. Stab marks.

Fig. 23 – Bowls and Dishes

1–6: *With T-rim*  
141, 151, 138, 161, 218B, 140

5. Combing ? diameter.

6. Stabbing on rim.

7–13: *With variant T-rim*  
171C, 134, 172C, 139, 171C, 139, 139

Fig. 24 – Bowls and Dishes

1–3: *Everted/bevelled inner lip*  
?, 179A, 154

4. Stabbing on rim not shown.

4–9: *Rim overhanging interior*  
149, 161, 173B, 291, 172C, 151

7. Combing ? a lid or bowl.

10–12: *Hollow handle*  
216C, 325, 218

11. Roughly modelled with tapering hole.

Fig. 25 – Bowls, Jar, Bungholes etc.

1–2: *Bowls variant*  
135, 138

3–4: *Bowls variant*  
109, 109

3. Sooting on surface.

5–9: *Bowls miscellaneous*  
201C, 139, 138, 222, 137

5. Combing on rim top and sides.

7. Applied rim loop.

10–13: *Miscellaneous, including bungholes and footing*  
151, 136, 220, 186B

10. A unique piece, in Denham fabric but ? date.

12. ? Separately formed bunghole.

13. Applied spout, scored and stabbed.

Fig. 26 – Curfews

1–6: *Curfews and reconstruction drawing*  
208A, 208B, 124, 230, 154, 312

1. Handle plugged ?, grouped slashes.

3. Knife slash on apex.

6. Combing.

Fig. 27 – Lamps

1–8: *Lamp bases and stems*

228C, 120, 202B, 149, 558, 152, 194C, 138, 215C

### *Kiln Bars*

Nineteen pieces of kiln bar were found on the northern site and eighty on the southern (Fig. 28). One complete bar (Fig. 28, 1) came from kiln 1 of the southern kilns, its length being 277 mm. The total length of all the measurable pieces from the southern kilns was 3.8 m, which would give a minimum of 13.75 'bars', but in fact there were 40 'ends' giving 20 bars. The mean width was 65.4 mm. At the northern site there were 8 'ends' and a total bar length of 1.19 m which could give 5 bars. The mean width was 67.5 mm. As the bars taper slightly, clearly the 'mean' width is likely to represent a point half way along the taper.

Kiln bars came in small quantities from contexts associated with kilns 1–3 of the southern group, but the vast majority of pieces came from soil levels above or from the southern dump area. Within the grid squares, kiln bar fragments were evenly distributed, their presence being as common away from the kilns as with them. The illustrated bars come from the following contexts:

1–4. Kiln 1, 160.

5. Topsoil, 253.

6. Kiln 2, 282.

7. Topsoil, 219B.

8–9. Riverside dump, 151.

### *Stone*

Apart from burnt flint, which was present in small quantities, the only alien rocks present were three small fragments of ironstone, and a few pieces of burnt quartzite pebble, probably derived from the valley infill deposits. There were no hones or fragments of quernstone. There were a number of struck flints including blades which will be considered elsewhere.

### *Metal*

From topsoil a plano-convex lead disc of 240 g. Iron finds from stratified deposits were sixteen nails and three pieces of horseshoe (not illustrated).

### *Charcoal*

145 charcoal samples from the kiln sites (117 from the southern site, 28 from the northern) were examined by Anne Miles. It was not possible to identify fourteen of them. Her identification of the charcoal from both sites was:

|  |     |
|--|-----|
| <i>Fagus</i> species (Beech)                             | 47  |
| possibly <i>Fagus</i> species                            | 2   |
| <i>Alnus</i> species (Alder)                             | 32  |
| possibly <i>Alnus</i> species                            | 5   |
| <i>Quercus</i> species (Oak)                             | 31  |
| possibly <i>Quercus</i> species                          | 3   |
| <i>Betula</i> species (Birch)                            | 1   |
| <i>Fraxinus</i> species (Ash)                            | 2   |
| <i>Salix</i> sp. (Willow) or <i>Populus</i> sp. (Poplar) | 2*  |
| possibly <i>Salix</i> sp. or <i>Populus</i> sp.          | 1   |
| <i>Acer</i> species (Sycamore or Maple)                  | 1   |
| Unidentified shrub                                       | 1   |
| Members of the Rosaceae/fruit tree family                |     |
| – possibly <i>Prunus</i> species (Cherry)                | 3** |

\* It is impossible, even on a good timber sample to separate these two timbers.

\*\* The members of the fruit tree family are very difficult to distinguish between.

An attempt was made by considering the ring diameter of each piece to distinguish wood from branches as against main trunk. The proportion was 42:33.

Estimates of the amount of wood required for a firing vary and are dependent obviously on kiln capacity etc., but a practising potter (firing stoneware) uses approximately 500 kg (Nuttgens 1980), and experimental work has called for between 250 and 450 kg (Musty 1974). Gregory (1977, 6) cites a consumption of 1–1½ tons of wood for a kiln of 3–5 m<sup>2</sup>: this capacity may be more directly comparable with Denham whose floor areas would be around 3 m<sup>2</sup>.

It is interesting to note that, drawing on Chiltern woodland, the potters appear to have used roughly equal quantities of beech, ash and alder, whereas potters at Brill with access to Bernwood forest used substantial quantities of oak, with only minor amounts of elm and other woods (Yeoman, this volume). The ready availability of beech in the Chilterns during the Middle Ages was noted also at the moated site of Chalgrove, Oxon. (Bond 1986, 152). The commonly held belief that the later furniture industry was responsible for much Chiltern beech woodland is clearly no longer tenable.

However, to what extent accidents of survival, availability, and deliberate selection may affect this preliminary picture is hard to say. Detailed survey of the wood nearest to the southern site, Gossams Wood was carried out by Doris and Harold Waterton in 1984. They found that in terms of species present, silver birch was the dominant tree (560 large trees), followed by oak (220), then coppiced hazel (100), with numbers of alder (50) cherry, holly, grey poplar, hawthorn, maple, wild service, crab apple, sycamore, mountain ash, and ash (1) present in decreasing order. Beech surprisingly was absent; however a preliminary survey of Gladwins Wood (formerly Nutters Grove, see Fig. 29) a short distance to the north showed mature beech to be present here.

### *Other Ceramic, etc.*

Half of a ceramic spindle whorl of elongated hemispherical section from stratified levels (216c) not illustrated. From topsoil, clay pipe stems, post-medieval bottle glass, an eroded ? eighteenth-century coin, etc. The presence of peg-hole roof tile has been noted previously in discussion of the kilns.

### *Bone*

Only two fragments of bone were recovered from stratified deposits and one from topsoil. The near absence of bone may be due to the slight acidity of the soil (pH 6), or imply a totally non-domestic usage of the site.

## *Discussion*

### *Historical Background to the Site*

The landscape reconstruction of Fig. 29, showing the Alderbourne Valley, is based largely on two late eighteenth century maps but probably gives also a not unreasonable impression of the medieval landscape. It is landscape dominated by woodland, pasture and heath with arable land largely confined to the north-eastern sector. Two nucleated settlements are present, Fulmer and Denham, but dispersed farmsteads, some ancient, are common. The valley floor is devoted to meadow along its length. The field which contained the southern kiln, known as Cocks Mead, lies adjacent to a former trackway described as 'the way to Alderbourne' on a map of 1690 (Bucks Record Office D/W/98) and 'old lane' on the 1843 Tithe Map. The track passed by Rush Green, then through woodland, and roughly linked Denham and Fulmer. The northern kiln lay on the edge of woodland. The kilns could have been worked by inhabitants of several parishes. Both sites lie on the western extremity of Denham parish, the northern being sited almost exactly on the parish boundary between Denham and Fulmer, and the southern being beside the Alderbourne, which is the boundary between Denham and Iver. The industry was therefore, whether by choice or chance, in a marginal situation where it could potentially exploit the resources of more than one manor. The eastern extent of the southern site as indicated by sherd scatter was clearly defined by a stream which marked the limit of Cocks Mead.

So far as documentary records are concerned only those of Denham have been searched and

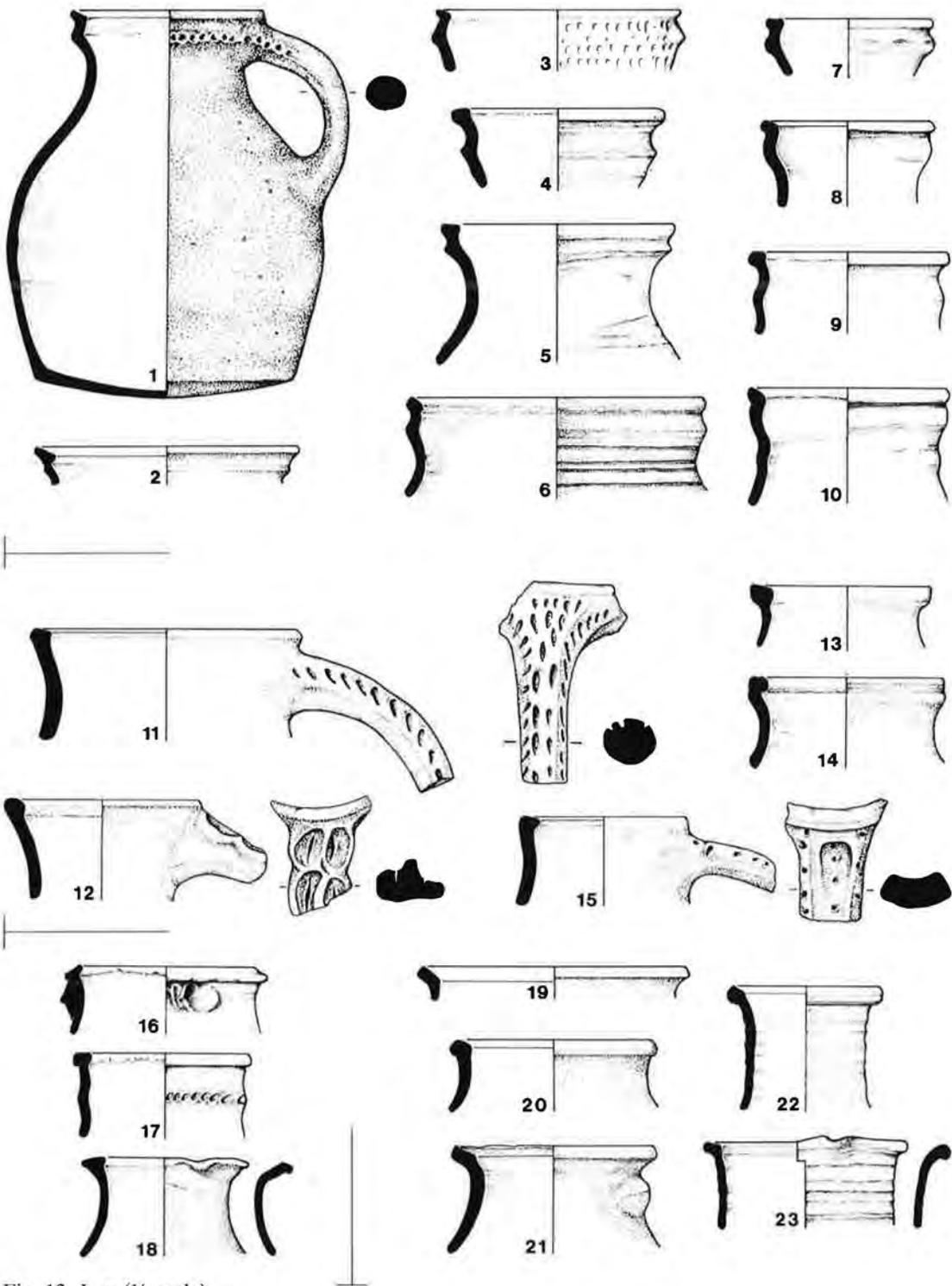


Fig. 13. Jugs (1/4 scale).

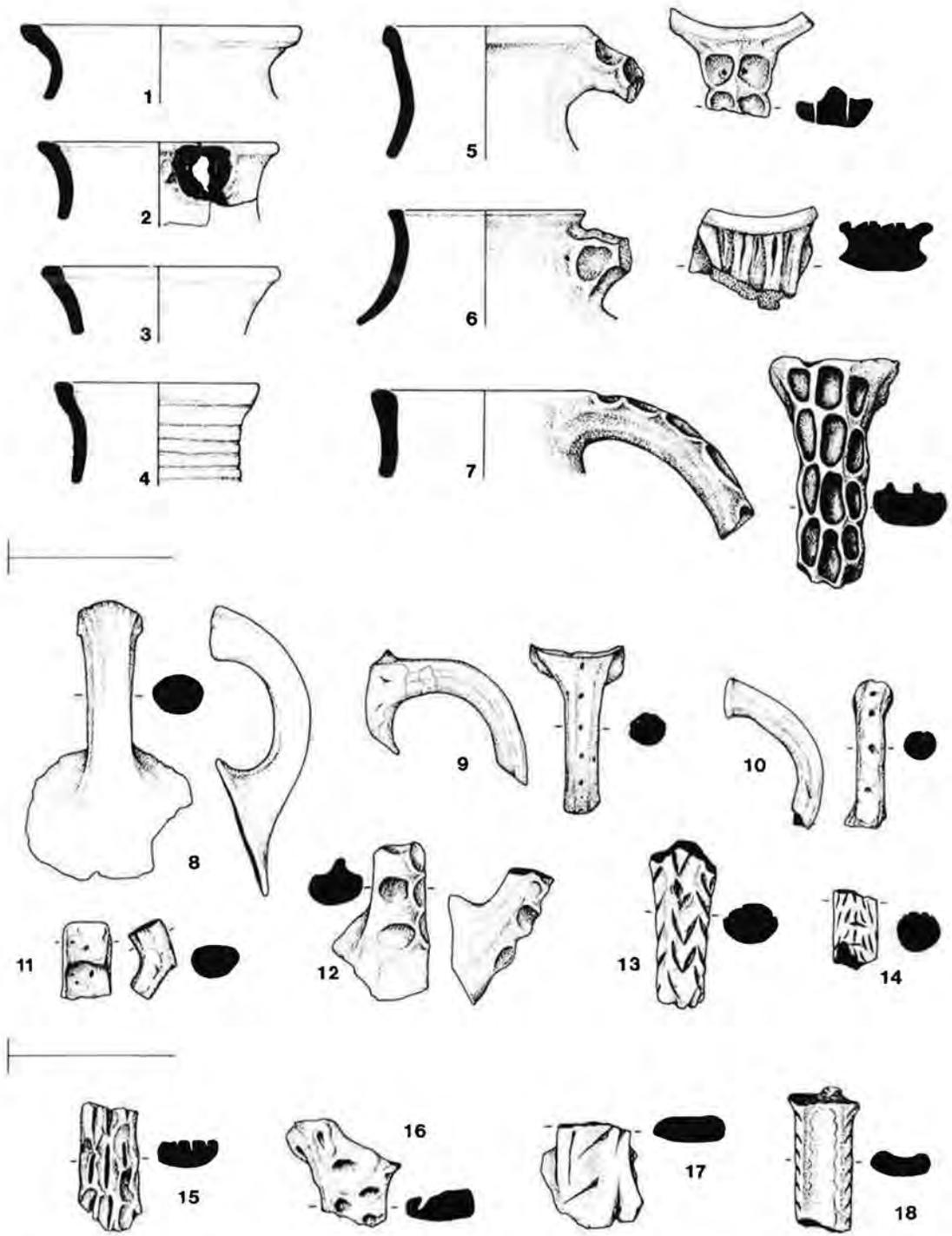


Fig. 14. Jugs ( $\frac{1}{4}$  scale).

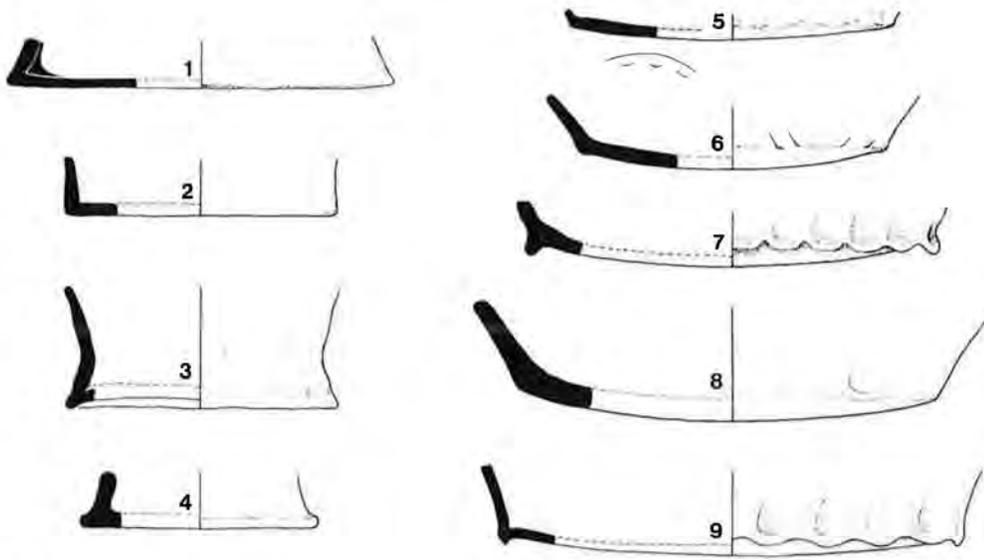


Fig. 15. Bases ( $\frac{1}{4}$  scale).

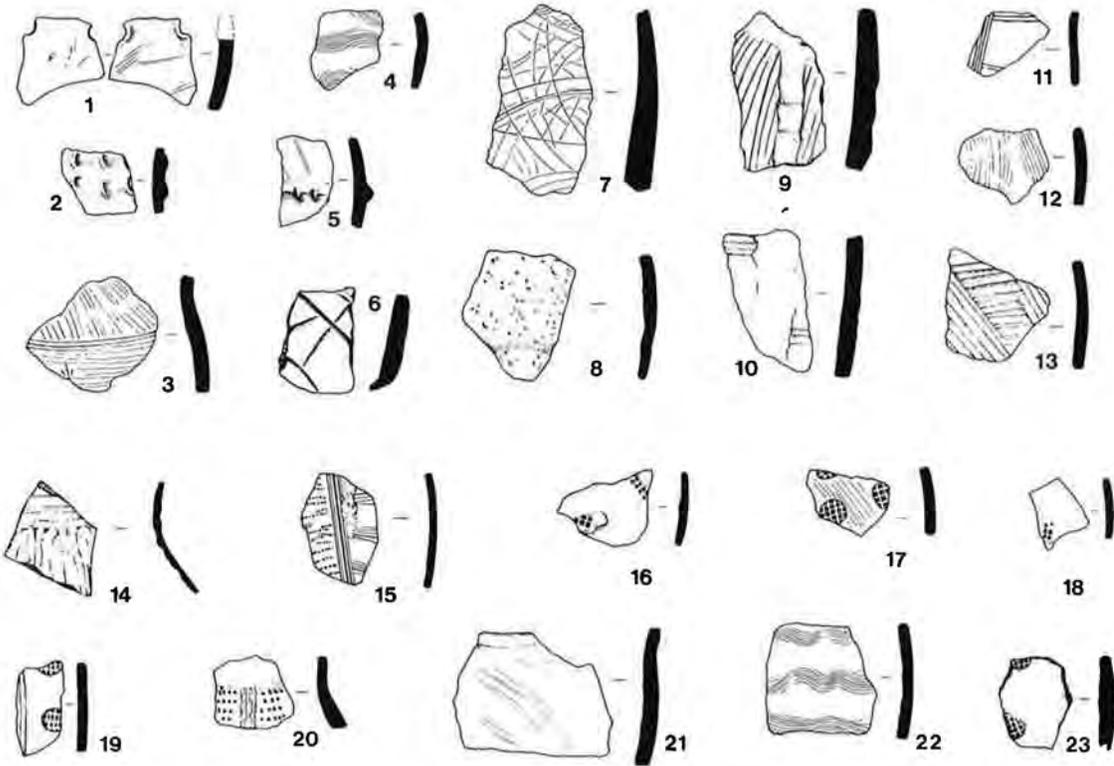


Fig. 16. Sherds glazed, slipped, etc. ( $\frac{1}{4}$  scale).

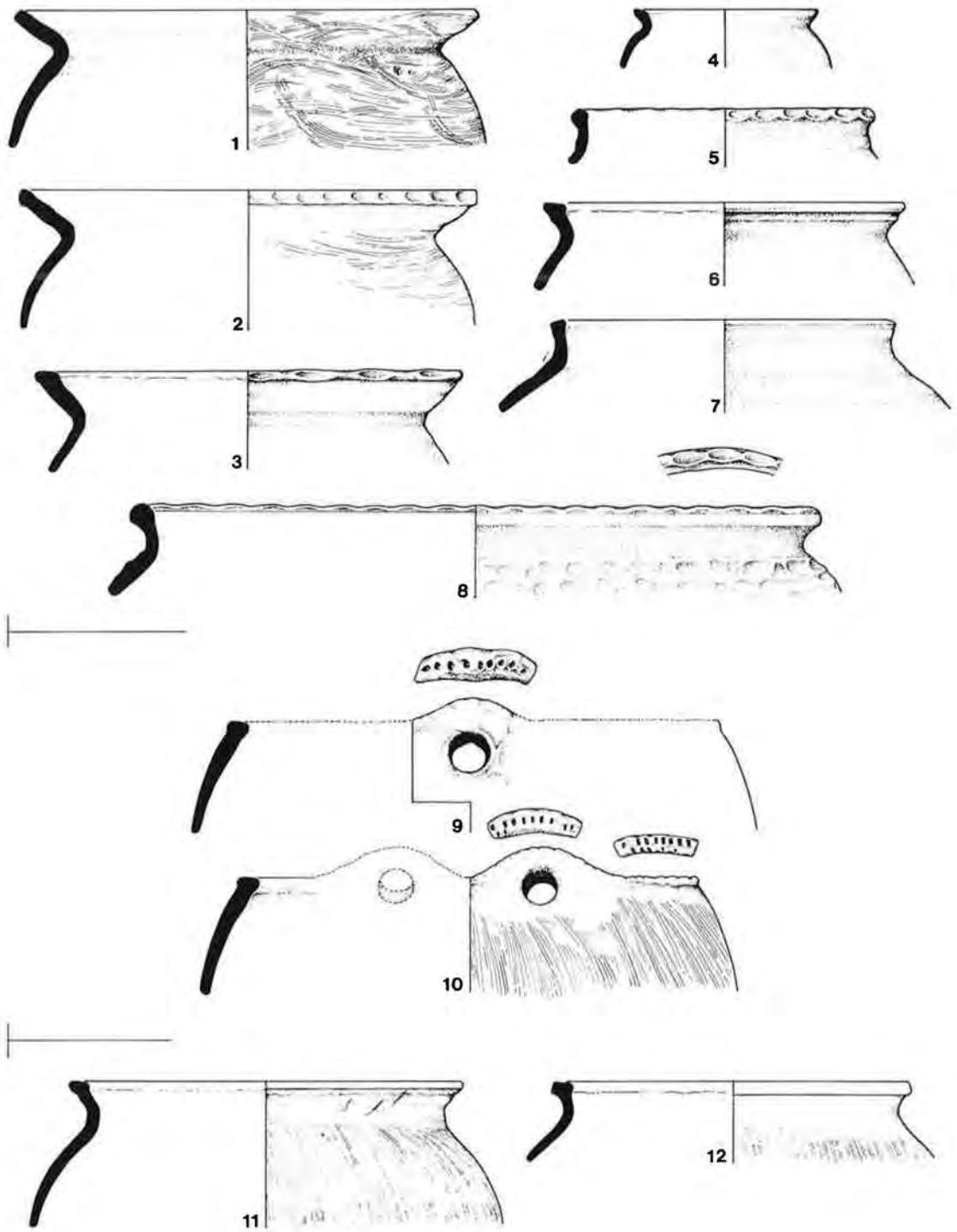


Fig. 17. Cooking pots (1/4 scale).

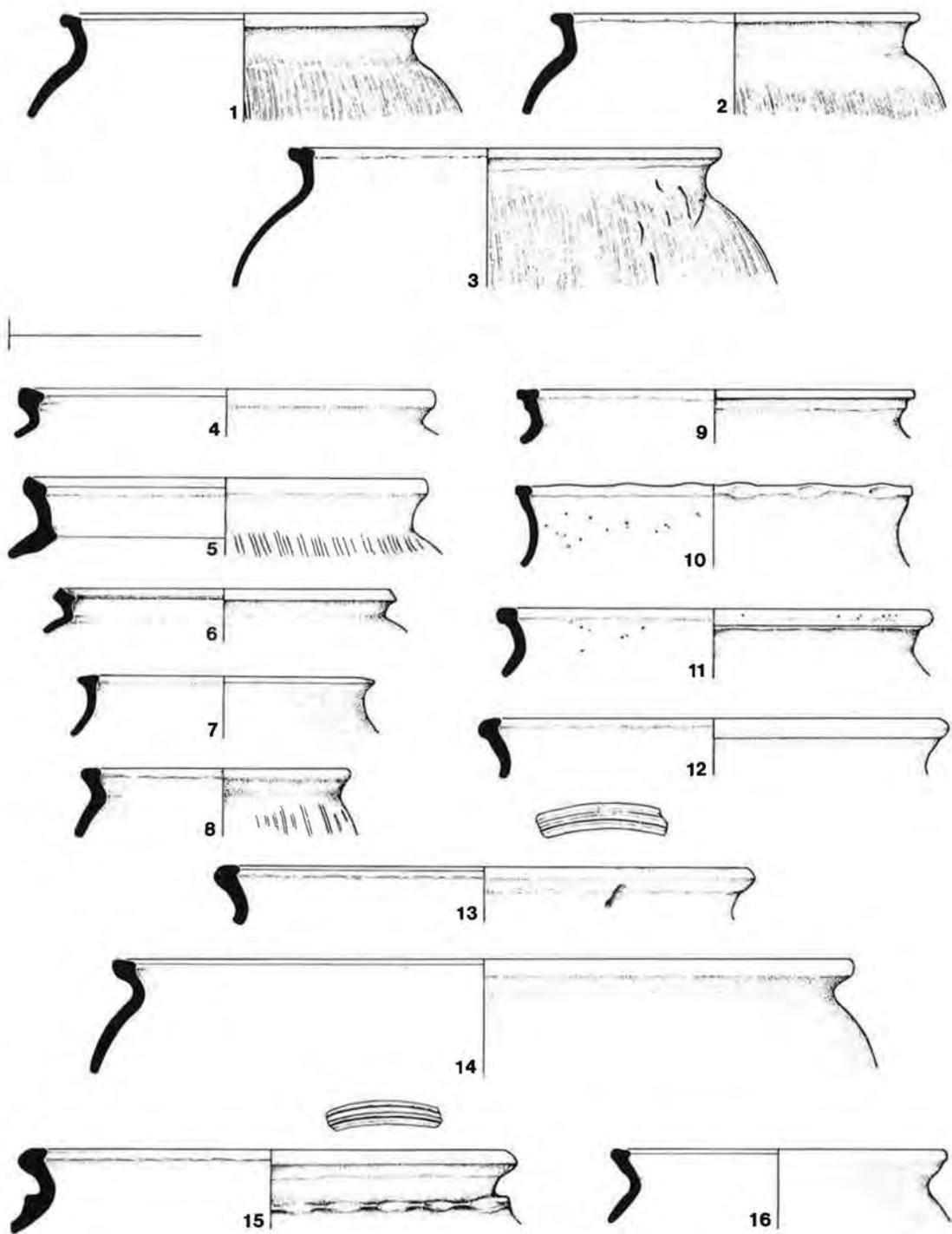


Fig. 18. Cooking pots (1/4 scale).

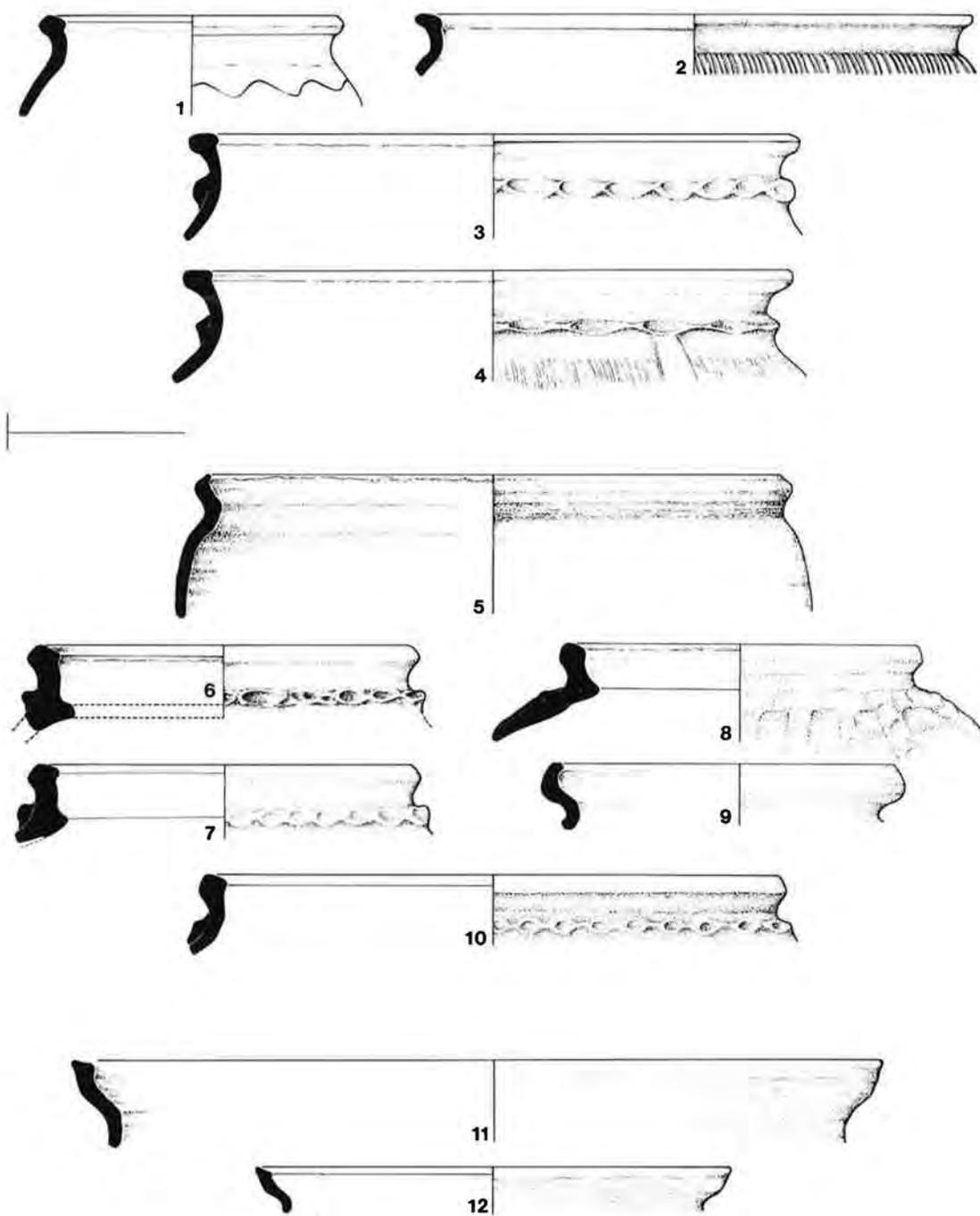


Fig. 19. Cooking pots and jars ( $\frac{1}{4}$  scale).

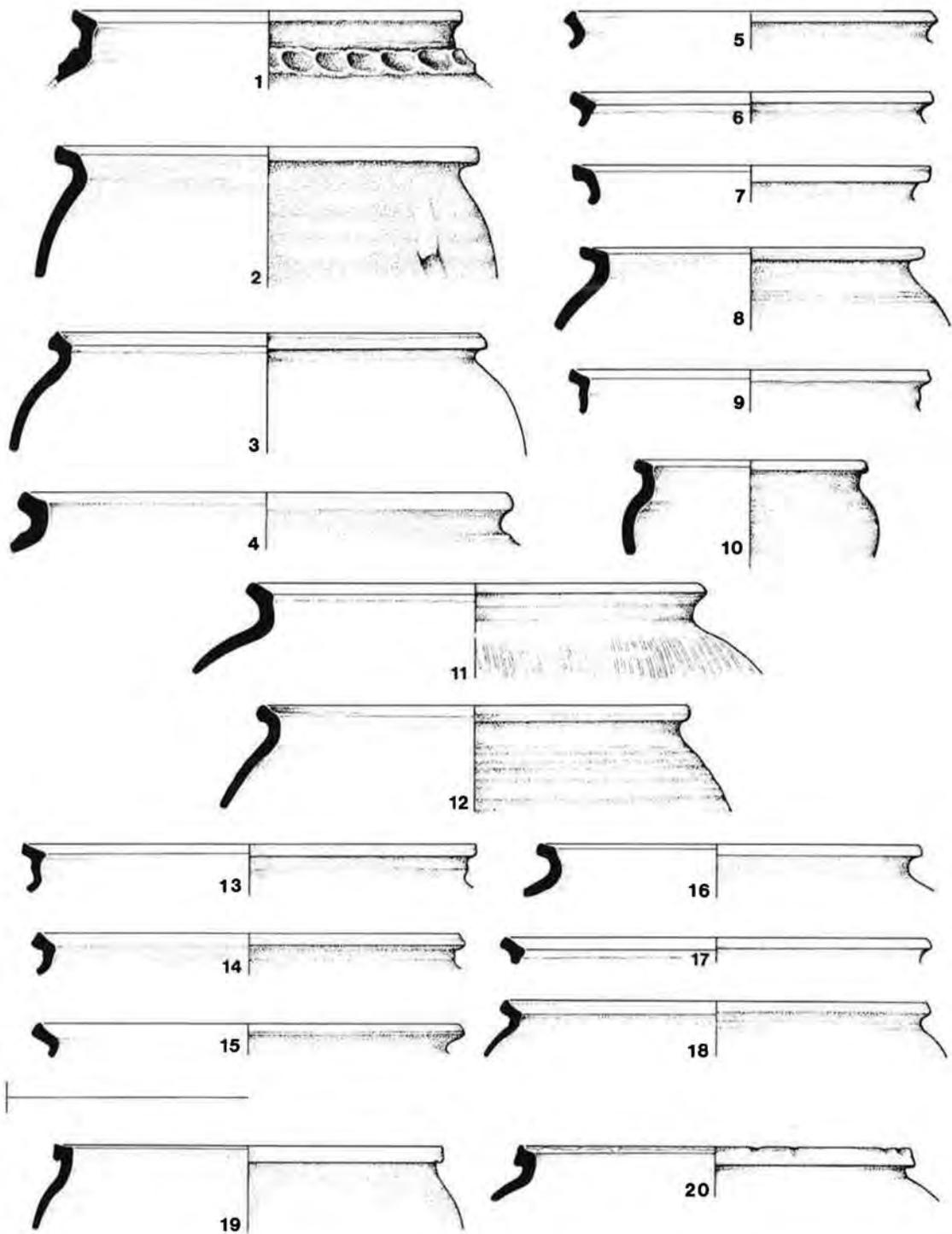


Fig. 20. Cooking pots ( $\frac{1}{4}$  scale).

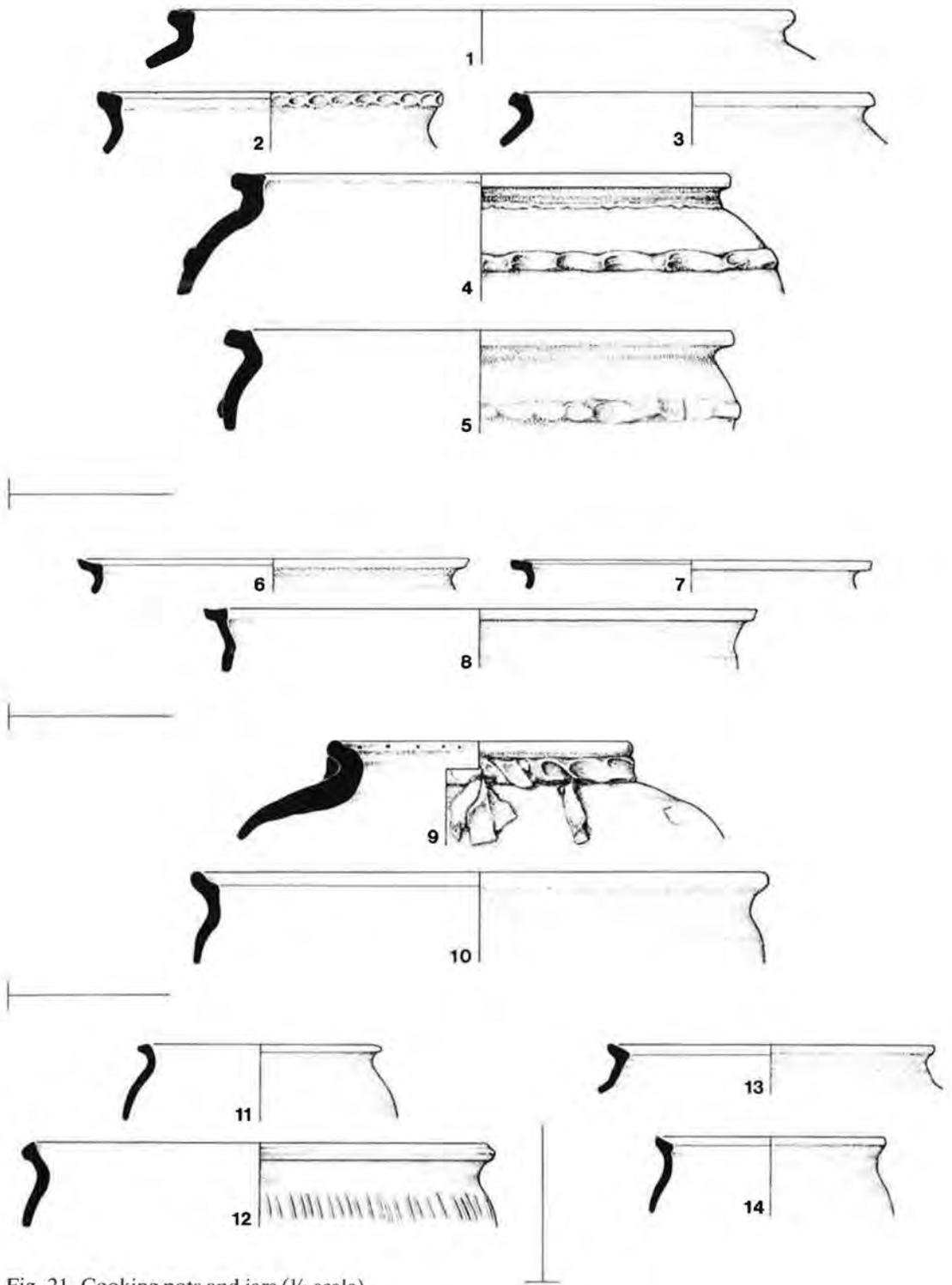


Fig. 21. Cooking pots and jars (1/4 scale).

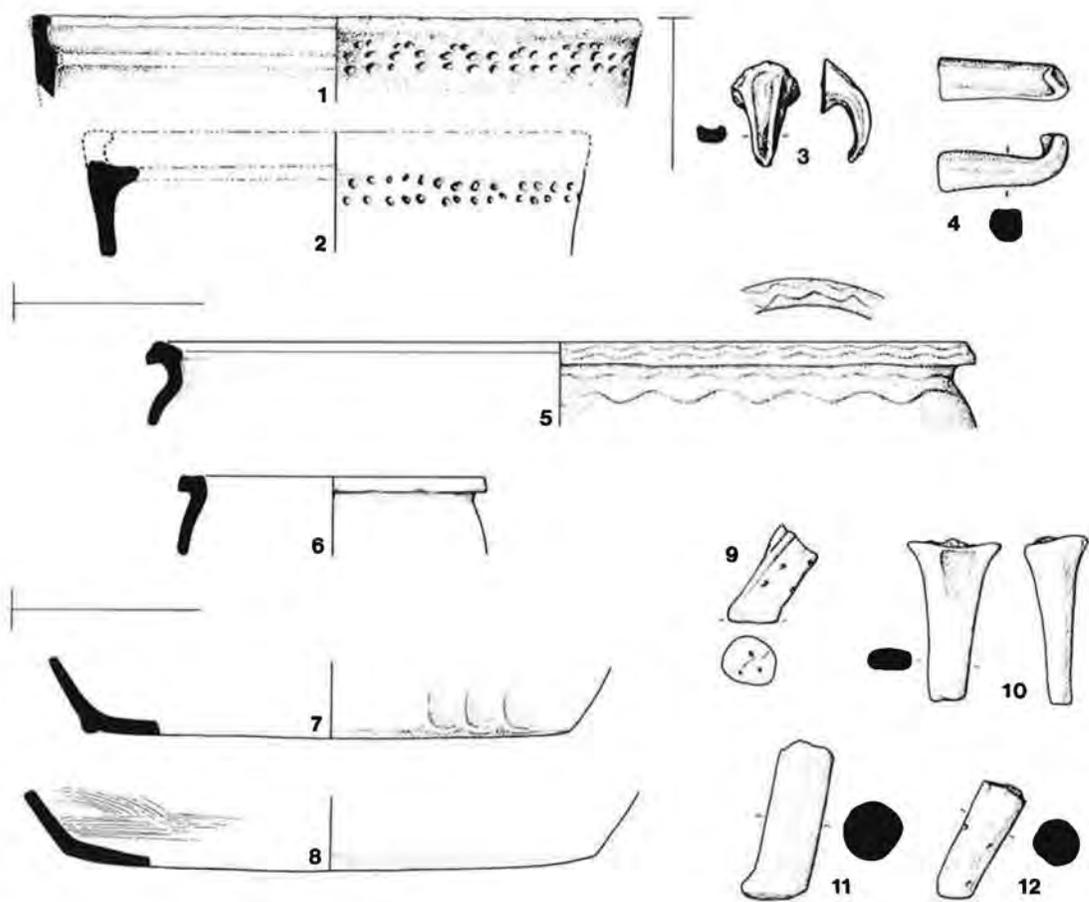


Fig. 22. Miscellaneous forms ( $\frac{1}{4}$  scale).

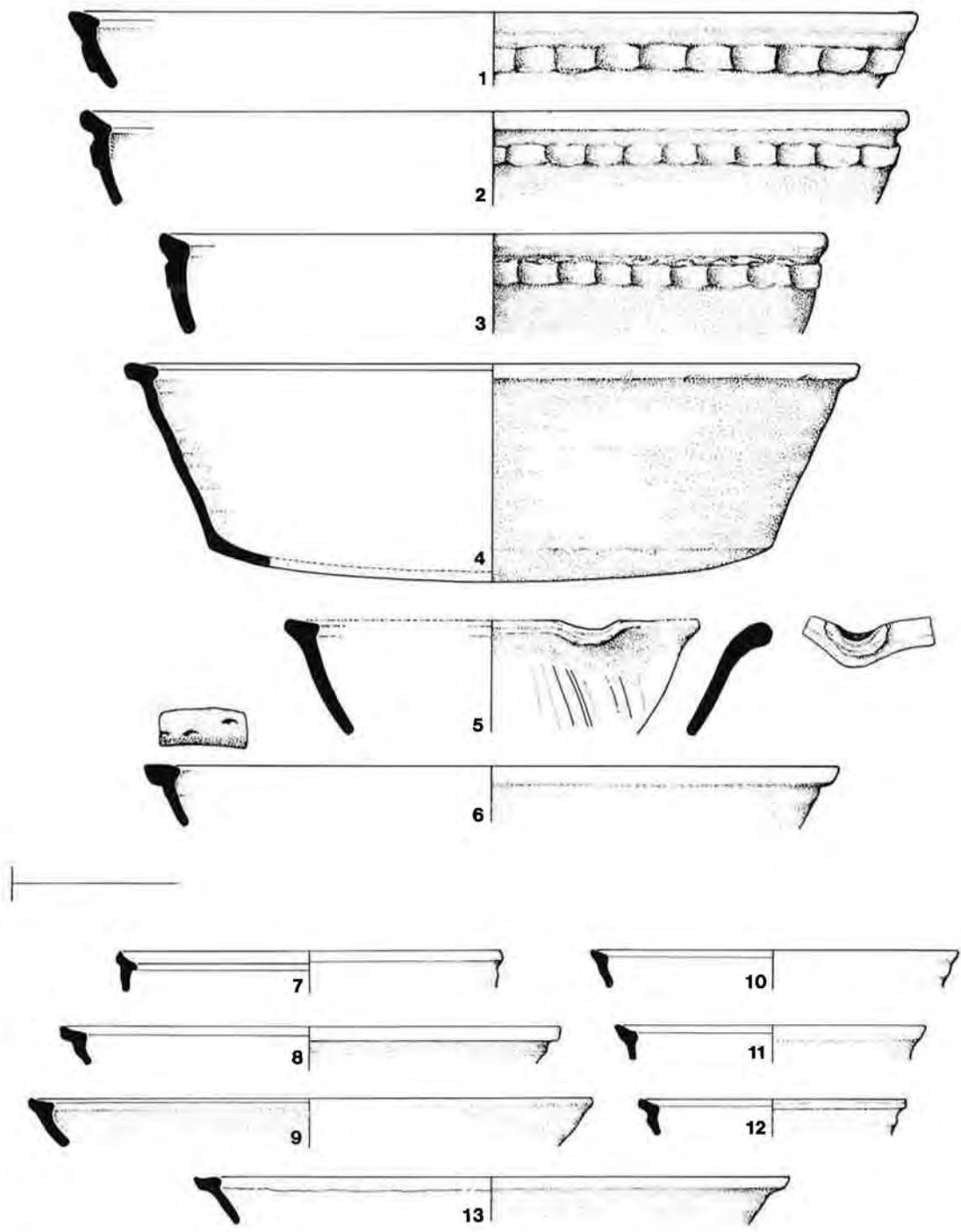


Fig. 23. Bowls (1/4 scale).

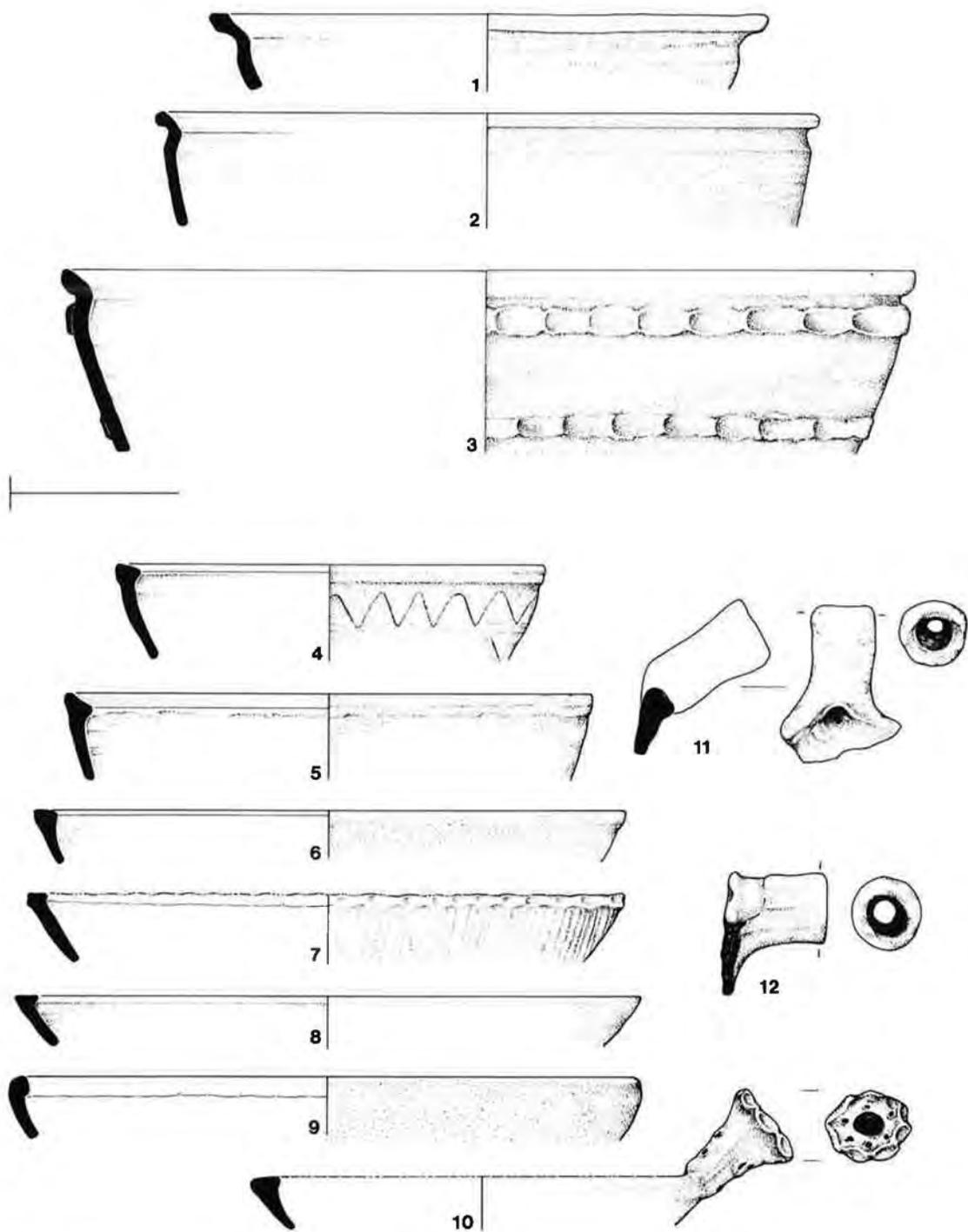


Fig. 24. Bowls and skillets ( $\frac{1}{4}$  scale).

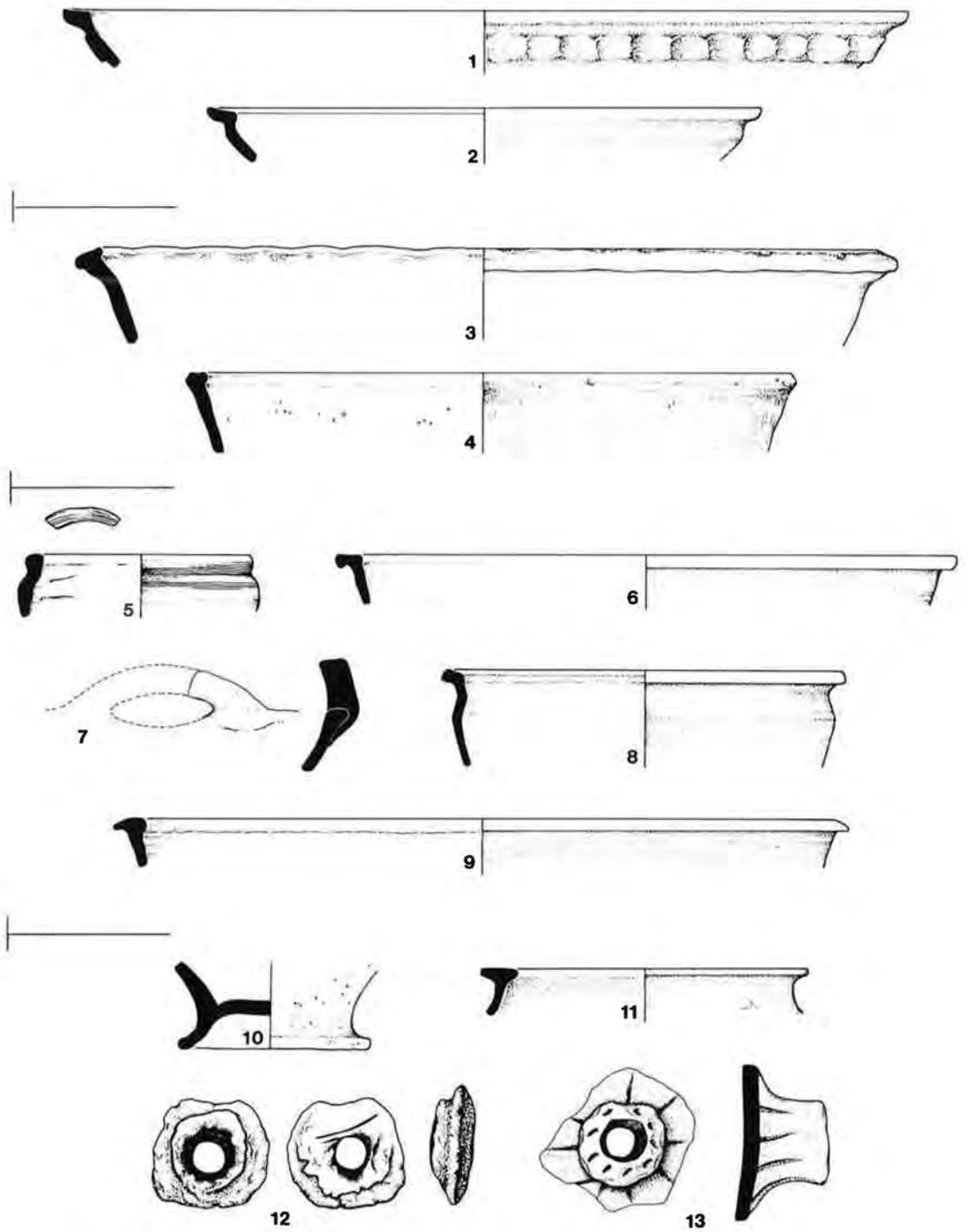


Fig. 25. Bowls and miscellaneous forms ( $\frac{1}{4}$  scale).

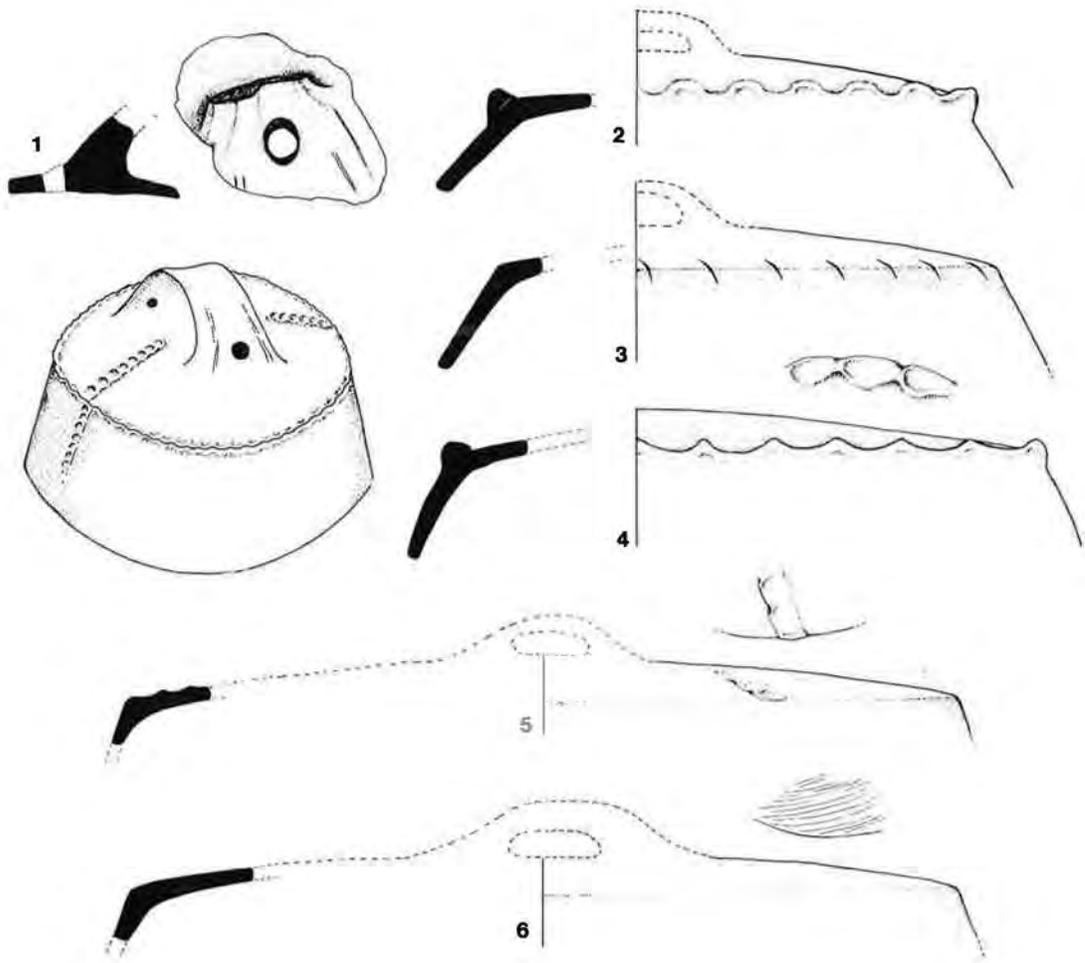


Fig. 26. Curfews ( $\frac{1}{4}$  scale).

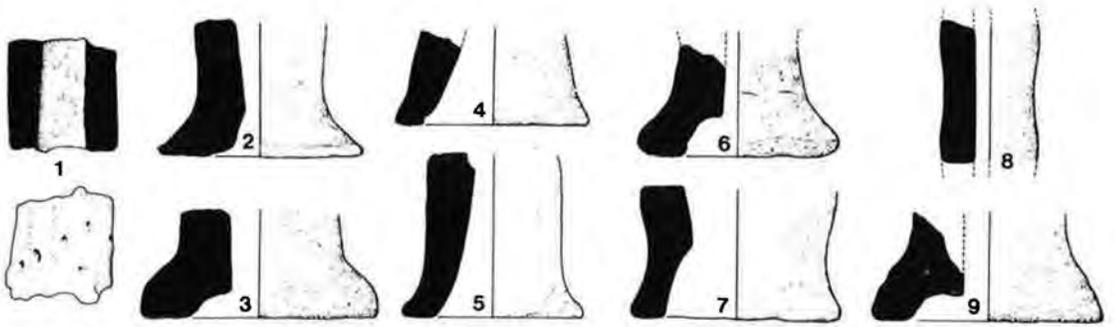
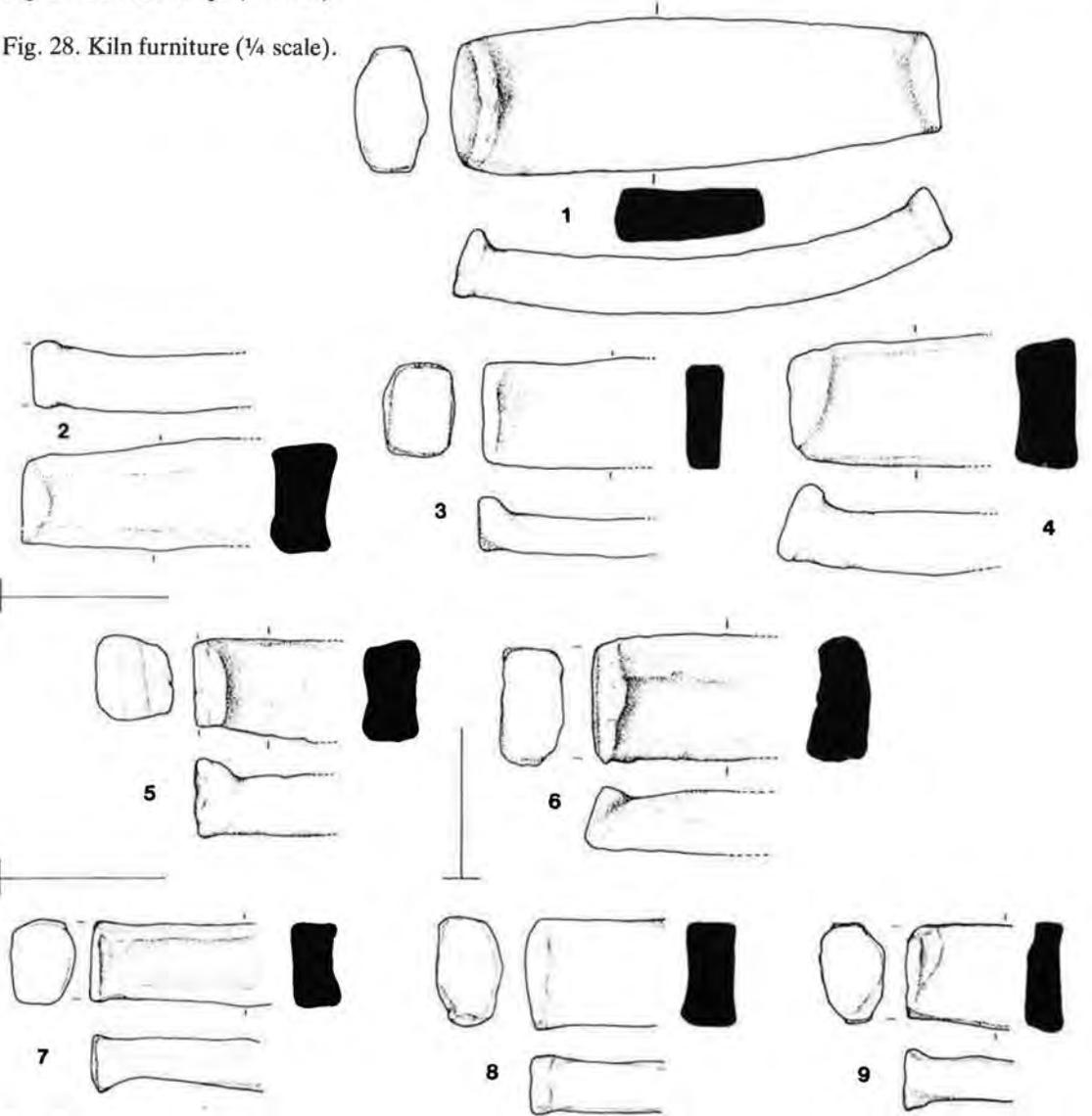


Fig. 27. Cresset lamps (1/4 scale).

Fig. 28. Kiln furniture (1/4 scale).



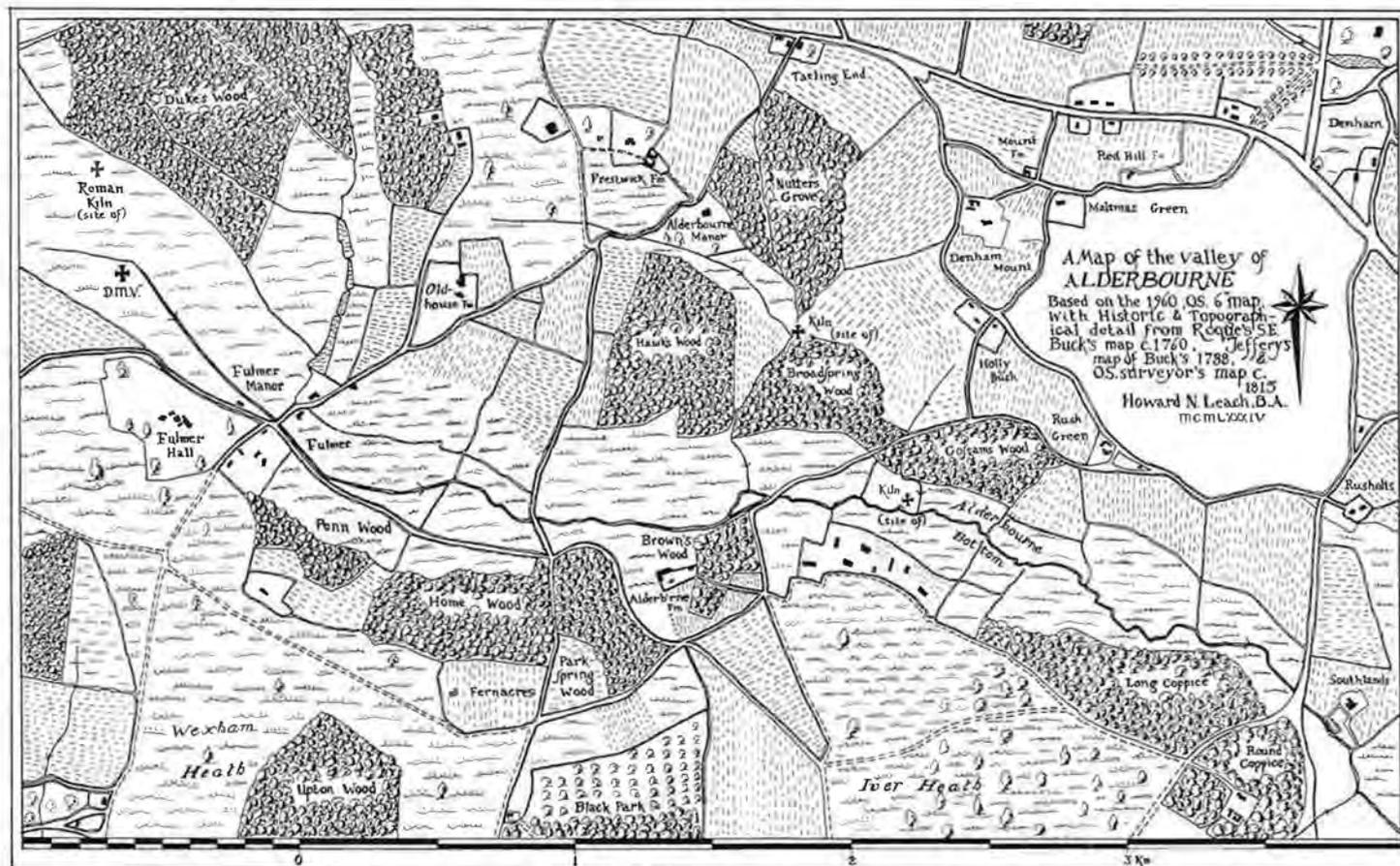


Fig. 29. Land use in the Alderbourne valley in the eighteenth century, showing also the sites of the Denham kilns and of Fulmer DMV.

thanks are due to Mr C. Le Messurier for this task. He reports that the name John Le Potter occurs in AD 1335, in a seventeenth-century abstract of the court rolls, which series begins in 1325. William Le Potter appears the year after. In 1348-9 no fewer than twenty-nine deaths are recorded during the Black Death including that of John. In the latter half of the century John's son Henry figures, as does William and then Phillip also described as le Potter. The surname continues in the parish well into the fifteenth century (Lathbury 1904, 143, 145); however none can certainly be connected with the land on which the excavated kilns were sited.

#### *Requirements of the Potters*

Both kiln sites were well placed to exploit the three principal potting resources, clay, wood and water. The excavation produced evidence for one possible building, but only about 5% of the total area utilized was examined. Working potters would need at minimum a shed for production, an area for drying pots and protecting them from frost, probably a clay store, possibly a wood store and certainly a store for finished products. The possibility that turf could have been used as a building material has been previously referred to, but looking to another and later tradition, it may be noted that the Chiltern wood turners (bodgers) were adept at producing effective temporary seasonal shelters which would leave almost no archaeological trace. Such structures in a similar context have also been well documented for the Weald (Armstrong 1978, 31-40).

So far as distribution of products is concerned, they may well have been carried by pack animals, but both sites in any case lay within striking distance of an established cross-country road which would make travel by cart practicable.

The paucity of domestic refuse from the site does suggest the potters themselves lived elsewhere. Although it cannot be proven that the work was seasonal, it would certainly be economical to work when pots could be more easily dried and were free from the risk of being frosted.

#### *Competing Kilns and Distribution (Fig. 30)*

Much of the material produced by the Denham potters bears a family resemblance to products of other Chiltern potteries, and to some extent also to those of other south-east England potteries using clay whose primary inclusions are quartz grains, such as at Limpsfield in Surrey (Prendergast 1973), and a number of Kentish sites. Few potteries however have the early phase material present at Denham.

Denham's nearest neighbours, so far as is known, were Camley Gardens, Maidenhead (Pike 1965-6), Pinner, Middlesex (Sheppard 1977) and Chandlers Cross, Herts (Neal 1976, material in Verulamium Museum). All are attributed to the thirteenth century. Although for various reasons none of these sites are yet fully in print it is fairly clear that a potter from one group of kilns could have moved to another with relative ease, and indeed may have done so. Specific links include; at Camley Gardens rim fingertipping, applied thumbed strips, hollow handled skillets, and use of slip; at Pinner the general cooking pot form with use of thumbed strips, stabbed and slashed jug handles, and stabbed bowl rims; and at Chandlers Cross stabbed and slashed handles, applied strips, very occasional use of glaze, and general cooking pot form.

One aspect of Denham potting which although partly chronological clearly also reflects a specific sub-regional distribution, is that of combing or scoring, the successor to 'wiping'. This is reported to be present at Camley gardens but is not present at Chandlers Cross, nor on medieval ceramic in general from St Albans, one of the principal market centres for the eastern Chilterns (pers. comm. A. Turner Rugg), nor is it mentioned in the preliminary Pinner Report. At present Denham appears to represent the eastern limit of a technique widely used in the western Chilterns. A summary of the distribution of related wares in that region has been given by Hinton (1973).

It might be worth mentioning at this point that a tentative archaeomagnetic date within the thirteenth century was deduced for the

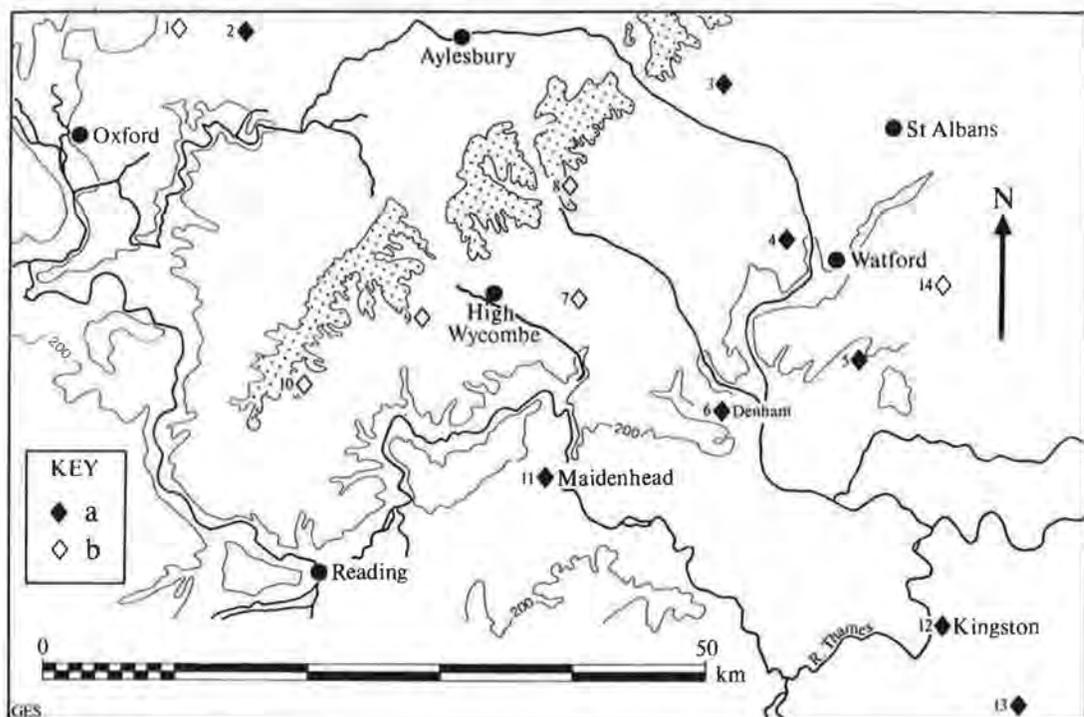


Fig. 30. Medieval pottery kilns in the Western Chiltern/Thames Valley area, showing (a) excavated kilns and (b) kilns known from documentary sources and/or from presence of wasters. Land over 600' stippled. 1, Boarstall. 2, Brill. 3, Nettleleden. 4, Chandlers Cross. 5, Pinner. 6, Denham. 7, Tylers Green, Penn. 8, Potter Row, Great Missenden. 9, Bolter End. 10, Nettlebed. 11, Camley Gardens. 12, Kingston. 13, Cheam, 14, Elstree.

Camley Gardens kiln by the Oxford Research Laboratory for Archaeology. However, the ceramic suggests that kilns earlier than this date were in operation here. A. J. Clark reports that, using the latest calibration curve, the archaeomagnetic result is more closely compatible with a later twelfth/early thirteenth-century date.

In addition to stylistic links, kiln forms were closely related across the region. At Camley Gardens, where opposed-flue kilns with central pedestal were also used, the potters had, as at Denham, left a reserved area to form the central pedestal and then daubed it over (Pike 1965-6, 22). At Chandlers Cross precisely the same kiln form was used, of similar dimensions, and there was evidence for lining the chamber with clay and rebuilding of the central pedestal. At this site part of the flue arch survived. At Pinner there was likewise a central oval pedestal, but

apparently the kiln had only one flue.

Other Buckinghamshire Chiltern pottery kilns operating in the medieval period are known or suspected at Potter Row, Great Missenden: at Penn (possibly late medieval) and Bolter End near High Wycombe. A considerable quantity of thirteenth-century ceramic found at Ley Hill near Chesham some years ago, which subsequent finds show to lie adjacent to a fifteenth-century pottery kiln, could indicate a further location. From the seventeenth century onwards a number of other kiln sites are known in the region, mainly from documentary evidence.

Owing to broad similarities in form between the different potteries, and in the absence of more detailed work on their commonly shared quartz-rich fabrics, of the kind advocated by

Streeten (1982), discussions of kiln product distribution are fraught with difficulties. The general issue of distribution has been considered in some detail by Moorhouse (1981, 109–141 and 1983, 45–87). However one indisputable market for Denham products was the manor of Fulmer, a little further up the Alderbourne valley at which almost the whole range of Denham products can be recognized including an actual waster (Farley 1982, fig. 8, 12). It was proposed in the report on that site that the hall excavated at Fulmer was that of the de Pynkeney family who also had a park there, and which passed to Hugh le Despenser around 1300 and later was to be acquired by Edward II. It was a site of some importance. One point of particular interest arising from the excavation was evidence for earlier activity on the site, indicated by sherds at that time identified as Saxon-Norman (Farley 1982; fig. 9, 11 and fig. 10, 1–3). These sherds are also identical to those present in some quantity at the Denham kiln site and proposed to be twelfth-century or earlier.

Apart from the Fulmer site, no large south Buckinghamshire ceramic assemblages have been published, and on the northern fringe of the Chilterns, other factors come into play, particularly the influence of the Brill–Boarstall industry. Stratified deposits have however been published from neighbouring areas in Middlesex, at Northholt (Hurst 1961) and at Staines (Jones 1982). At Northholt broad parallels for Denham may be found amongst the late twelfth/early fourteenth-century groups, principally on grounds of form. At Staines, several of the fabric groups, in particular MGA, MFI and MGB, fall well within the Denham range. The first apparently includes a Denham 'bowl' (Fig. 25, 1; Jones 1982, fig. 7, 168), with internal smoke-blackening suggesting that it was in fact another curfew. Several rim forms in this group provide reasonable matches. Perhaps of greater interest is the Staines fabric MFI which as has been noted earlier also provides close parallels in form with the Denham twelfth-century or earlier group (Fig. 17, 1–3). Clearly the publica-

tion of other assemblages from the region, and more detailed work on the fabric would provide a more satisfactory picture.

#### *Acknowledgements*

The writers are grateful to the M25 engineers, Sir William Halcrow and Partners, the main contractor Tarmac, and the land owners Mr and Mrs J. W. Keen.

Mr P. Jones kindly drew attention to the northern site and Mrs H. Bridbury assisted with recognition of the southern. The Department of the Environment funded a watching brief during M25 construction and English Heritage kindly funded much of the post-excavation work. On site, much gratitude is due to Hal Dalwood, Christine Jones, and members of the County Museum Archaeological Group and the Gerrards Cross Local History Society who toiled through both snow and stream to reach the site. Ancient Monuments Laboratory staff kindly performed the same trek. Subsequently members of Buckinghamshire County Museum Archaeological Group washed and sorted all the ceramic and did sterling service at the computer, as did Margaret Bull, Veronica Carey, Grace Scrimgeour and others. All the coding was undertaken by the second author who also drew most of the plans. Mary Evans drew all the ceramic and Grace Scrimgeour assisted with final tidying up on several fronts. Pam Russell and Pauline Misseldine kindly translated pages of scribbled text into type. A number of individuals contributed specialist advice, Roger Little, Anne Miles, Tom Royal-Dawson, Anne Woods and Jim Rose amongst them. The authors are extremely grateful for their assistance, and also for that of Doris and Harold Waterton who gathered information on local woodland, and Colin le Messurier who provided historical documentation.

Finally, thanks are due to Maureen Mellor and Steve Moorhouse for commenting on the draft; the authors gratefully accepted many points and churlishly rejected but a few.

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## APPENDIX: FULL CATALOGUE OF ILLUSTRATED SHERDS

Every sherd from the site has been coded. Sixteen descriptive fields were available for coding, and in practice up to twenty-three variables within each of these fields. A copy of the coding manual is available at cost on request from Buckinghamshire County Museum. The data was first entered onto some 630 coding sheets and then onto an ICL DRS 120 computer, the sorting programme being kindly written by

E. J. Bull. Although in general the coding system, which was based on that developed by Maureen Mellor for the Oxford Archaeological Unit, worked well, the rim form classification developed for Denham proved in practice to have been too subjective and although included in the catalogue only broad use has been made of it in the final analysis.

Information is presented below in the following order: figure number and context number; archive drawn number; coding numbers \*/\*/\*/\*/; colour; hand-made or wheel-thrown.

Colour is indicated by combinations of the following letters: L – light; D – dark; M – mid; G – grey; W – white; B – brown; R – reddish; Bu – buff. Where manufacturing technique is apparent this is indicated as follows: T – thrown; ?T – probably thrown; H – hand-built; ?H – probably hand-built.

*Fig. 13*

|     |      |     |                           |
|-----|------|-----|---------------------------|
| 1.  | 163A | 159 | 046/061/011/055/body dec. |
| 2.  | 137  | 100 | 046/066/149/RG            |
| 3.  | 151  | 88  | 046/061/149/006/R         |
| 4.  | 109  | N15 | 046/050/149/MG            |
| 5.  | 282  | 22  | 046/069/149/RG/?T         |
| 6.  | 139  | 50  | 046/061/DG                |
| 7.  | 138  | 84  | 046/050/150/MB            |
| 8.  | 109  | N16 | 046/057/MG                |
| 9.  | 109  | N 1 | 046/059/RG/T              |
| 10. | 109  | N17 | 046/057/LG                |
| 11. | 557  | N25 | 046/068/081/019/014/RG    |
| 12. | 151  | 158 | 046/065/023/112/LG        |
| 13. | 166  | 148 | 046/061/GB                |
| 14. | 152  | 125 | 046/061/RG                |
| 15. | 139  | 136 | 046/061/073/114/014/MG    |
| 16. | 194  | 36  | 046/061/149/014/MGR       |
| 17. | 222B | 28  | 046/068/153/MG            |
| 18. | 139  | 54  | 046/052/099/DG/?H         |
| 19. | 137  | 102 | 046/058/DG                |
| 20. | 138  | 60  | 046/065/GB                |
| 21. | 261B | 7   | 046/058/081/014/MG/?T     |
| 22. | 232  | 2   | 046/069/083/143/154/DG    |
| 23. | 309  | 29  | 046/060/099/154/MG        |

*Fig. 14*

|     |      |     |                               |
|-----|------|-----|-------------------------------|
| 1.  | 141  | 109 | 046/060/LG                    |
| 2.  | 565  | N24 | 046/065/016/MG/?T             |
| 3.  | 109  | N 2 | 046/057/MG/?T                 |
| 4.  | 313  | 5   | 046/050/081/018/MG            |
| 5.  | 151  | 138 | 046/065/083/114/MG/?H         |
| 6.  | 176A | 137 | 046/057/074/112/014/MG        |
| 7.  | 310  | 42  | 046/060/007/014/RG            |
| 8.  | 149  | H16 | 046/055/015/R                 |
| 9.  | 225A | H 1 | 046/055/113/084/017/DG        |
| 10. | 215C | H11 | 046/055/178/011/113/014/015/R |
| 11. | 217C | H12 | 046/081/RG                    |
| 12. | 284  | H 4 | 046/078/113/017/DG            |
| 13. | 227C | H 2 | 046/055/110/017/MGB           |
| 14. | 120  | H 7 | 046/055/134/LG                |
| 15. | 209C | H 6 | 046/073/112/RG                |
| 16. | 139  | H 9 | 046/073/132/MG                |
| 17. | 252B | H 5 | 046/073/124/015/RG            |
| 18. | 218A | H 8 | 046/073/147/107/016/RG        |

*Fig. 15*

|    |      |     |                             |
|----|------|-----|-----------------------------|
| 1. | 225  | B17 | 046/012/178/011/123/DG core |
| 2. | 260  | B21 | 096/012/169/R, core R       |
| 3. | 251A | B10 | 096/012/DG/T                |

|    |      |     |                        |
|----|------|-----|------------------------|
| 4. | 216B | B 9 | 096/012/169/DG/T       |
| 5. | 195  | B28 | 096/011/040/025/RG     |
| 6. | 232A | B 2 | 006/011/136/MG         |
| 7. | 124  | B27 | 046/049/137/MG         |
| 8. | 120  | B13 | 096/011/138/R, core G  |
| 9. | 154  | B18 | 096/011/178/010/137/DG |

*Fig. 16*

|     |      |     |                            |
|-----|------|-----|----------------------------|
| 1.  | 252  | S23 | 005/020/R                  |
| 2.  | 137A | S 8 | 096/020/156/MG             |
| 3.  | 138  | S12 | 096/020/024/LG             |
| 4.  | 180C | S 7 | 096/020/147/MG             |
| 5.  | 109  | S19 | 096/020/018/151/MG         |
| 6.  | 252B | S 4 | 006/019/081/018/DG         |
| 7.  | 109  | S 1 | 046/050/149/MG             |
| 8.  | 242  | S21 | 096/020/MG                 |
| 9.  | 144  | S 5 | 095/024/148/BG             |
| 10. | 252C | S14 | 096/020/024/148/LB         |
| 11. | 243B | S16 | 096/020/024/MG             |
| 12. | 252C | S13 | 096/020/024/LG             |
| 13. | 180A | S15 | 096/020/024/MB             |
| 14. | 215C | S99 | 096/020/164/DG             |
| 15. | 310  | S18 | 096/020/098/169/024/054/RG |
| 16. | 309  | S 9 | 096/020/084/123/034/152/W  |
| 17. | 242  | S20 | 096/020/084/159/169/DG     |
| 18. | 251A | S 6 | 096/020/082/011/123/034/W  |
| 19. | 244B | S10 | 096/020/083/169/024/159/DG |
| 20. | 174B | S11 | 096/020/084/168/018/034/DG |
| 21. | 251A | S 3 | 096/020/179/177/DG         |
| 22. | 223C | S17 | 096/020/147/DG             |
| 23. | 291  | S 2 | 096/020/171/169/159/DG     |

*Fig. 17*

|     |      |     |                            |
|-----|------|-----|----------------------------|
| 1.  | 215A | 10  | 095/057/023/BG             |
| 2.  | 313  | 4   | 095/057/141/023/BG         |
| 3.  | 215B | 16  | 095/057/141/MG             |
| 4.  | 138  | 59  | 095/057/MG                 |
| 5.  | 182A | 58  | 095/065/141/LMG            |
| 6.  | 215B | 17  | 095/067/R                  |
| 7.  | 188A | 120 | 095/059/MG                 |
| 8.  | 160  | 74  | 095/057/GB                 |
| 9.  | 242B | 15  | 090/050/093/002/014/RG     |
| 10. | 215B | 14  | 096/050/093/024/034/014/RG |
| 11. | 554  | N 7 | 095/065/024/RG             |
| 12. | 109  | N23 | 095/064/024/RG             |

*Fig. 18*

|     |      |     |                   |
|-----|------|-----|-------------------|
| 1.  | 565  | N21 | 095/065/024/MG    |
| 2.  | 565  | N20 | 095/065/024/MG    |
| 3.  | 565  | N10 | 095/061/024/RG    |
| 4.  | 172C | 130 | 095/068/RG/T      |
| 5.  | 242A | 27  | 095/069/024/MG/?T |
| 6.  | 209A | 13  | 095/069/MG/T      |
| 7.  | 139  | 78  | 096/061/RG/T      |
| 8.  | 282  | 23  | 095/068/024/MG    |
| 9.  | 197  | 34  | 095/069/149/RG    |
| 10. | 556  | N18 | 095/061/141/R/?H  |
| 11. | 565  | N14 | 095/061/RG/?T     |
| 12. | 565  | N13 | 095/061/RG/T      |
| 13. | 109  | N12 | 095/061/135/144/R |
| 14. | 160  | 73  | 090/066/MB/T      |

15. 109 N11 095/095/061/135/144/R/?T  
 16. 137 101 095/061/RB

*Fig. 19*

1. 109 N22 095/061/147/MG/?T  
 2. 191C 32 095/072/023/RB  
 3. 565 N 5 095/065/148/150/RG/?T  
 4. 565 N 6 095/061/150/LGR/?T  
 5. 206 37 096/058/018/MG/?T  
 6. 239 11 092/069/150/MG  
 7. 141 110 092/058/135/MG  
 8. 160 75 095/065/148/BG/?T  
 9. 138 68 095/058/024/MG/T  
 10. 140 97 095/064/135/MG  
 11. 139 77 096/058/MG/T  
 12. 141 92 096/067/RG

*Fig. 20*

1. 140 107 095/058/135/RG/T  
 2. 151 52 095/058/RB  
 3. 222 38 095/058/DG/T  
 4. 141 94 090/051/R  
 5. 152 126 095/058/RG  
 6. 198 20 096/069/MG  
 7. 141 93 002/051/LG  
 8. 135 119 095/065/DG  
 9. 140 98 096/058/149/MG  
 10. 151 111 095/057/MG  
 11. 109 N22 025/064/024/G  
 12. 206A 30 095/065/154/DG  
 13. 173B 113 090/051/MG  
 14. 152 123 095/058/DG  
 15. 152 124 095/058/MG  
 16. 135 118 095/058/MG  
 17. 198 21 096/069/DG/T  
 18. 172A 134 095/069/DG/T  
 19. 152 122 095/058/GB  
 20. 206 18 095/071/DG

*Fig. 21*

1. 176B 56 095/067/MGB/?T  
 2. 188A 121 095/068/141/BG  
 3. 138 66 095/058/MG  
 4. 193A 26 095/069/135/MG  
 5. 318 1 095/069/135/LG  
 6. 172 132 091/069/DG/T  
 7. 172A 133 095/068/DG/T  
 8. 173B 114 090/069/MG/T  
 9. 309 35 095/058/135/148/002/MG  
 10. 154 71 095/058/RG/T  
 11. 151 81 095/057/LG  
 12. 192A 31 095/057/024/145/LG  
 13. 172A 135 095/067/DG  
 14. 139 76 096/058/MG

*Fig. 22*

1. 173 99 096/069/006/RG  
 2. 234B 25 096/063/006/RG  
 3. 154 H 3 096/081/MG  
 4. 208A H10 096/088/RG  
 5. 151 46 096/062/147/146/MG

6. 206 19 095/071/BG  
 7. 208B B24 096/011/139/RG  
 8. 312 B23 096/011/024/MG  
 9. 213C B 7 008/015/006/RG  
 10. 227C H17 008/015/LG  
 11. 243C B 6 008/015/RG  
 12. 216B B 5 008/015/006/DG

*Fig. 23*

1. 141 95 007/058/RB  
 2. 151 72 002/051/MG/?T  
 3. 138 82 002/058/135/MG  
 4. 161 61 007/066/LMG/?H  
 5. 218B 40 090/051/059/024/BG  
 6. 140 108 090/051/162/RG  
 7. 171C 140 091/069/DG/T  
 8. 134 127 007/058/DG/T  
 9. 172C 129 091/069/MG  
 10. 139 89 007/051/149/DG/T  
 11. 171C 141 091/069/MG  
 12. 139 90 007/051/149/MG  
 13. 139 51 090/051/MDG

*Fig. 24*

1. ? 63 007/055/LGB/T  
 2. 179A 49 007/057/MG/T  
 3. 154 69 090/055/135/MG/T  
 4. 149 131 090/050/147/RG  
 5. 161 62 007/051/MG/?H  
 6. 173B 115 090/069/MG  
 7. 291 3 090/067/141/024/LG  
 8. 172C 128 091/066/LG  
 9. 151 65 090/061/RGB/?H  
 10. 216C 41 096/062/MG  
 11. 325 H14 096/062/MG  
 12. 218 H15 096/062/MG

*Fig. 25*

1. 135 64 002/052/135/DG  
 2. 138 83 002/058/MG  
 3. 109 N 8 002/051/141/DG  
 4. 109 N 9 002/051/024/RG  
 5. 201C 9 090/060/158/018/DG  
 6. 139 48 090/054/018/MG/?T  
 7. 138 86 007/093/057/MG  
 8. 222 39 007/062/149/DG/?T  
 9. 137 47 007/051/G/?T  
 10. 151 B 4 096/016/MG  
 11. 136 43 096/051/W/T  
 12. 220 S22 096/098/RG  
 13. 186B ? 096/098/018/RG

*Fig. 26*

1. 208A H13 006/073/018/MG  
 2. 208B B25 006/139/RB/?H  
 3. 124 B26 006/136/MG  
 4. 230 B 1 006/011/139/RG  
 5. 154 B19 006/139/LG  
 6. 312 B22 006/049/024/BG

*Fig. 27*

|         |     |                |
|---------|-----|----------------|
| 1. 228C | B 8 | 013/014/006/RG |
| 2. 120  | CL2 | 013/016/R      |
| 3. 202B | CL4 | 013/016/DG     |
| 4. 149  | CL3 | 013/016/RG     |

|         |     |            |
|---------|-----|------------|
| 5. 558  | N26 | 013/016/RG |
| 6. 152  | CL1 | 013/016/DG |
| 7. 194C | CL6 | 013/016/R  |
| 8. 138  | CL5 | 013/R      |
| 9. 215C | CL7 | 013/016/R  |

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