NOTES ON 'HERTFORDSHIRE GREYWARE' VESSELS FROM RECENT EXCAVATIONS IN ST ALBANS, WITH PARTICULAR REFERENCE TO SIZE AND SHAPE AS DEMONSTRATED BY TWO NEW COMPUTER PROGRAMS

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Summary

The principal shapes, sizes and decorative techniques found in South Hertfordshire Greyware from recent excavations in St Albans are presented, using two new computer programs, 'POTCAP' and 'POTDRAW', to complement conventional illustration.

Introduction

Ten years of rescue excavation within the City and District of St Albans by the Field Section of the Verulamium Museum has resulted in the accumulation of a very large collection of medieval artefacts, currently under study, which includes a large quantity of medieval ceramics. By far the commonest type of pottery from the 12th to the 14th century deposits is South Hertfordshire greyware. Some preliminary results from the study of this ware, relating particularly to the sizes, shapes and decoration of complete vessels, are reported. The use of two simple computer programs for analysing size and shape is also described.

General remarks

1. Definition and dating of the ware

The term 'greyware' is used to refer to unglazed reduced pottery which is widespread not only in Hertfordshire but also throughout much of south-east England. Several kiln sites are known in Hertfordshire, most of them identified by finds of waster pottery rather than by kiln structures. Many of these were listed in a survey by D. F. Renn published in 1964. An updated version of this survey is currently in preparation by the Verulamium Museum. The ware is dated principally by reference to the sequences at Northolt Manor, Middlesex (Hurst 1961; Lancaster 1975), and the City of London (Vince 1985), for both of which sequences there is some independent evidence of dating. The important greyware deposits at Manor of the More, Rickmansworth, are dated largely by comparison with Northolt (Hurst in Biddle *et al* 1959). Greyware is found at Northolt in 13th and 14th century deposits, but the latter is believed by the excavator to be residual material. In the City of London greyware is found principally in deposits dated to the late 12th and the 13th centuries. At present the stratigraphic analysis of the more complex St Albans' sites, (Gentles Yard and Chequer Street), is incomplete, so that dating evidence from the town cannot yet be added to this picture, although nothing so far appears to contradict the traditional dating.

To avoid any possible confusion with other local unglazed medieval fabrics, the vessels referred to here as greyware are those made in an unglazed, hard, thin fabric. The term 'greyware' is justified in that the surfaces are usually an even grey colour, sometimes black or very occasionally brown or buff, but the core of the pot wall is usually lighter and often reddish in colour. It is possible that many of these pots were fired in an oxidising atmosphere and the surfaces darkened by reduction at the end of the firing or immediately after they were removed from the kiln. We have reproduced this effect experimentally by placing an oxidised pot heated in a gas-fired kiln to 900°C into a closed vessel full of smouldering sawdust for 5-10 minutes. The predominant inclusions are small, white, sub-angular quartz grains. Examination, under a small hand lens (X20 magnification), of the greywares separated by these broad visual criteria reveals differences in the size and quantity of the sandy inclusions which may allow their sub-division into discrete groups, when analysis using microscopic and chemical techniques has been completed. Although typical greyware is unglazed, at both the Chandlers Cross kiln and in the city of St Albans, pottery of greyware type but with large areas of dark-green glaze, has been found in small quantities.

These greywares can be distinguished from other unglazed, sandy wares found in St Albans which are believed to be earlier, both on stratigraphic grounds, and because of their association in some contexts with signif-icantly larger quantities than normal of Saxo-Norman 'shelly wares' or 'calcite-gritted wares'. The latter contain varying proportions of chalk and/or shell with sand. These latter wares are particularly well-represented on the recent excavations at St Albans Abbey (Biddle and Kjolbye-Biddle 1986). Small quantities of 'gritty wares', containing larger, angular inclusions, are also found.

This succession of wares in the town, similar to other sites in this area of south-east England, was initially outlined on the basis of material from excavations in the early 1970s by the Museum (C. Saunders and A.B. Havercroft 1978), and, with additions, has been confirmed by more recent work in the urban centre.

2. Sample available from St Albans

Although a very large quantity of pottery was recovered from the medieval town, initial processing, i.e. weighing and counting of sherds and reconstruction of vessels, resulted in only a very small number for which a complete profile was present or could be restored. However, published examples of complete vessels or profiles from other sites show that, although the St Albans greyware sample is small in absolute terms, it is large in comparison with samples from other published assemblages.

Table 1 gives a list of those sites considered to be of primary importance, mainly because of the quantity of material recovered and the quality of the stratigraphic evidence.

Site	Excavation dates
Belmont Hill	1980, 1982, 1984 (Holywell)
Chequer St	1980, 1981, 1982, 1984
College St	1982
Gentles Yard	1981, 1983
Hill St	1983
Orchard House	1982
Romeland	1978
St Peters Church	1981
St Stephens Church	1982, 1983, 1984
Waxhouse Gate	1980

Table 1. Recent excavations in St Albans which have produced medieval pottery

Table 2 gives the number of greyware vessels for which a complete profile is either available or can be validly reconstructed. None of the pots is entirely complete. It is a list rather than an indication of the true relative frequency of the different vessel forms. In addition to this small sample of complete profiles, there are also larger numbers of partial profiles, and of sherds diagnostic of a particular vessel form, e.g. jug lips, and a vast quantity of undiagnostic greyware sherds.

Form	Frequency	Estimated % of vessel present (range for all examples of the form)
Jars	20	20-75%
Pipkins	3	75-80%
Jugs	3	35-80%
Bowls	5	5-50%
Basin	1	37%
Total	32	

Table 2. Greyware vessels: complete profiles

Greyware from St Albans: vessel and rim forms and decoration

1. Vessel and rim forms

Eight forms - jug, jar, pipkin, bowl, basin, dripping dish, spouted bowl and cistern - represent the entire range of greyware forms recognised so far. Of these only the first five categories are represented by complete profiles. The cisterns and the spouted bowls can only be recognised from bungholes and spouts recovered as unattached sherds.

Most of these vessels appear to have been wheelthrown, with rilling marks on the upper body and turning marks on the base and lower wall. The walls are thin and even. The pots are generally poorly finished, with bulges, finger-marks and adhering scraps of clay still present. A few vessels have simple decoration on the rims, upper bodies, and base angle, but this is not common. Decoration of the handles of jugs, however, is very common indeed.

(1a) Jugs

The three complete jug profiles (Fig.1: 5, 6, 9) are of different sizes but a basic simple globular shape. Fragmentary jugs suggest the possibility of squatter and taller variations to this form (Fig.3: 36, 44). The jugs have short necks, pulled lips rather than spouts, and rims in various simple single or double forms. The three complete examples have diameters of 90mm (54.5%), 100mm (27.5%), and 130mm (16.5%). Handles are usually decorated, groups of thumb impressions are common around the usually sagging bases, and in addition there is sometimes decoration on the body.

(1b) Cisterns

Two bungholes (Fig.1: 1, 2), have been found, which could theoretically have come from either cisterns or from bunghole pitchers. A fragmentary vessel, of unusually large size and distinctive decoration (Fig.1: 3), has been reconstructed which does not resemble either jars or jugs but does have a shape very similar to the cisterns found in a later local glazed ware of the 14th and 15th centuries. These have bungholes of a type similar to one of the greyware examples. Furthermore, no feet or tubular spouts have so far been found in greyware in St Albans. It is probable, therefore, that there were greyware cisterns in use here. This would have interesting implications for dating, as cisterns are thought to be commonest at a rather later date than the *floruit* of greywares.

(1c) Jars and pipkins

The jars are of a similar basic shape (Fig.4: 64-66, 68), but they vary quite noticeably in the details of both body and rim outline. They are sometimes decorated (Fig.4: 64-66, 68, 70-73), sharing some, but not all, forms of decoration with jugs. The bases are sagging but there are no thumb impressions.

Fig. 1. Jugs and Cisterns: St Albans
1, 2: cistern bungholes
3: probable cistern decorated with roulette-stamped applied bands
4-9: jugs: 4, with thumb-pressed frill around neck;
7, with 'corrugated' decoration on body;
9, with angle on shoulder

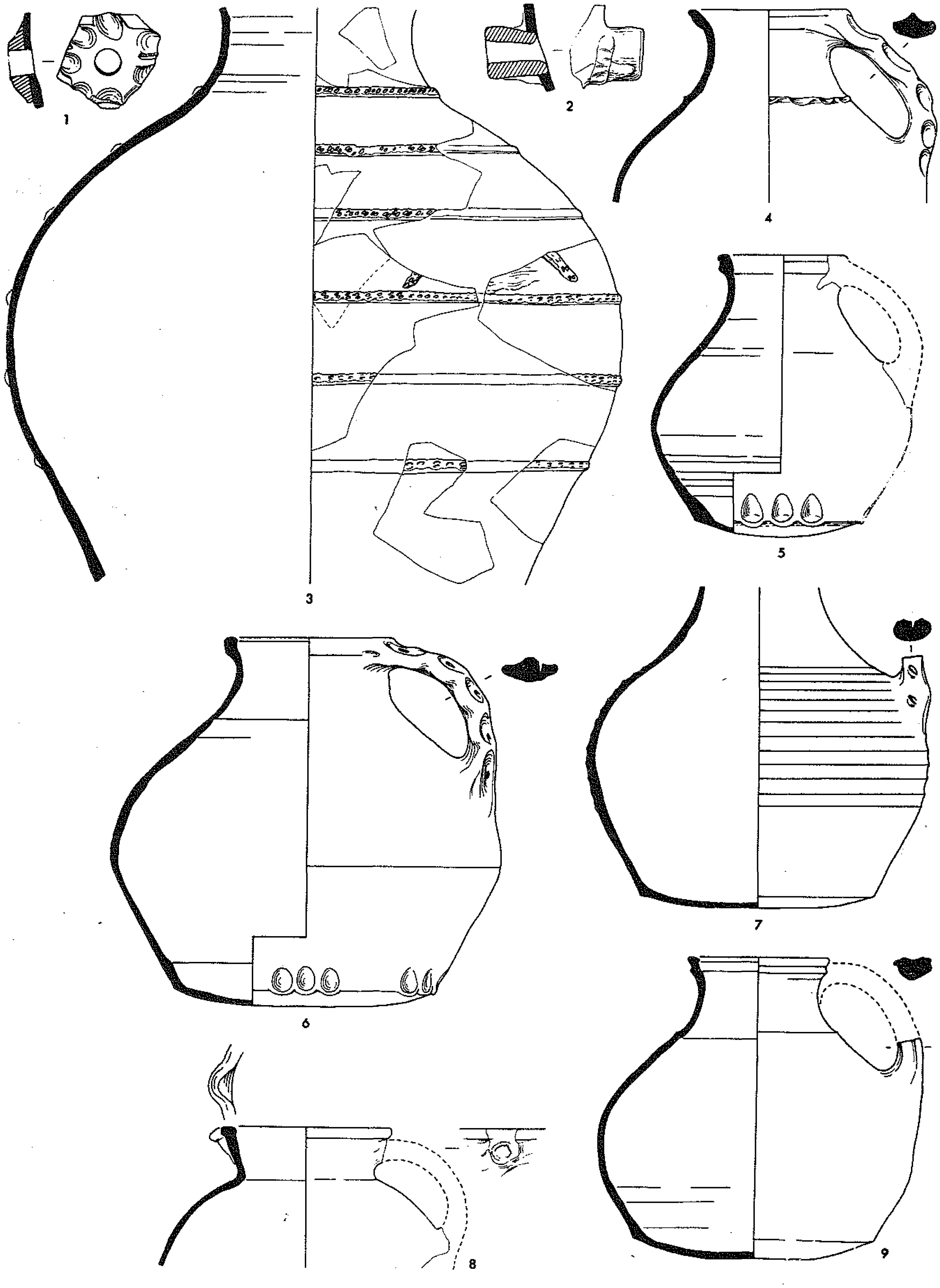


Fig. 1

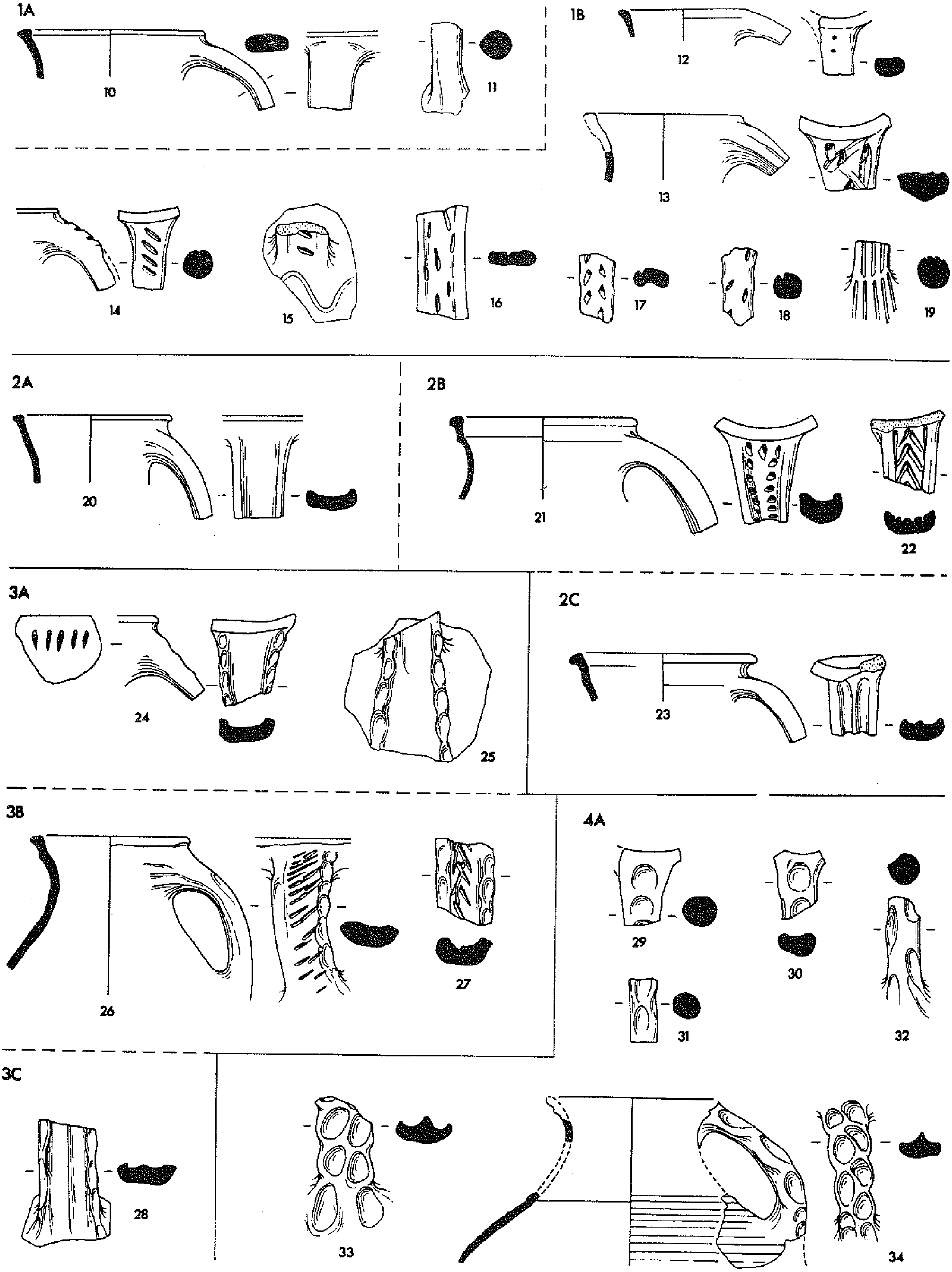

1A
10
11
1B
12
13
14
15
16
17
18
19
2A
20
2B
21
22
3A
24
25
2C
23
3B
26
27
4A
29
30
31
32
3C
28
33
34

Fig. 2

The pipkins are similar to the jars in shape but have (or had) handles (Fig.4: 67, 69; Fig.6: 74-76). Small pots with handles terminating in a hook are normally termed 'ladles', and an example of such a vessel with a complete handle has been recovered from a rubbish pit in the city centre (Montague-Puckle 1973). None has feet and no fragments of feet or unattached knobs have so far been recovered, but one pipkin has a group of thumb impressions at the base just below the handle.

On some of the jars and pipkins there are obvious external sooting marks, while others, without being heavily sooted, are darker on the external than on the internal surface. This strongly suggests their use as cooking pots as well as storage vessels. Figure 5 shows the rim forms of the jars and pipkins, which are all of a simple everted type. The most obvious variation is between shallow, simple, everted, rims (Fig.5: 1A, 1B, 1C), and deep or 'necked' rims (Fig.5: 2A, 2B, 2Misc). Within these two broad divisions, minor variations occur, some of them recurring with sufficient frequency to constitute a definite sub-type: some rims are square in outline, others are round, whilst yet others suggest lid-seating. Typically, no greyware lids have yet been recovered from St Albans, but wooden lids are known to have been used at that period (Moorhouse 1978, 14). There is a greyware vessel from Manor of the More (Hurst, in Biddle *et al.* 1959, Fig. 8 no.7) which might have been a lid.

Some statistics are given below relating to the 23 jars and pipkins represented by complete profiles, with the addition, where appropriate, of information from 12 further jars/pipkins represented by the rim and upper part only. This detail has not been included here for the other vessel forms because their numbers at present are too low to be meaningful. The thinness and evenness of the pot wall (Table 3) has already been commented on. There is a large range of rim diameters, (Table 4A Fig. 9) corresponding to the wide range of overall sizes of the vessels, but larger sizes, particularly around 200-230mm, are more common than smaller ones (Table 4B Fig. 9). The different rim types do not appear to be closely associated with any particular rim diameter (Table 5). Rim diameters are given to the nearest 5mm. Where, as is common, the rim is not a perfect circle, an average figure is given.

Fig. 2. Jug handles: St Albans

10-11:	Type 1A	Simple, plain
12-19:	Type 1B	Simple, with pierced decoration
20:	Type 2A	Raised edges, plain
21-22:	Type 2B	Raised edges, with pierced decoration
23:	Type 2C	Raised edges, with central spine
24-25:	Type 3A	Thumbed raised edges, plain
26-27:	Type 3B	Thumbed raised edges, with pierced decoration
28:	Type 3C	Thumbed raised edges, with central spine
29-34:	Type 4A	Thumbed, plain

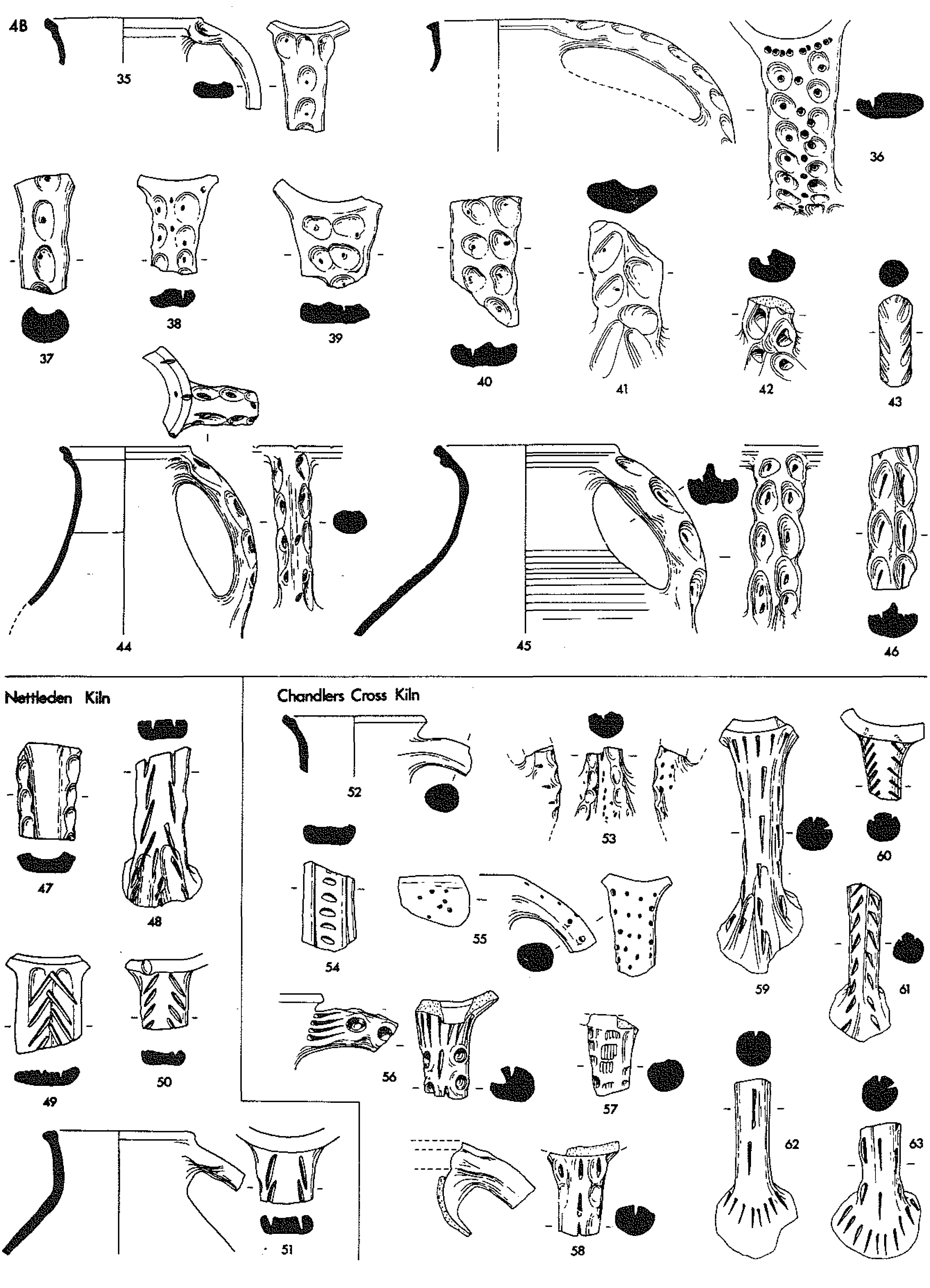


Fig. 3. Jug handles: St Albans, Nettleden, and Chandlers Cross
35-46: Type 4B thumbed handles with pierced decoration from St Albans
47-51: handles from Nettleden kiln
52-63: handles from Chandlers Cross kiln

Average (mm)	Frequency (3A)
3.5	1
4.0	1
4.5	3
5.0	5
5.5	5
6.0	7
6.5	1
Total	23

Variation (mm)	Frequency (3B)
1	5
2	9
3	3
4	4
5	2
Total	23

Table 3. Wall thickness: 23 jars and pipkins;
3A: Average thickness of pot wall
3B: Variation in thickness, i.e. unevenness of pot wall

Rim diam. (mm)	Frequency	Rim % (4A)
85	1	100
115	1	32
120	2	8 + 48.5
135	1	75
140	1	31.5
145	1	62.5
150	1	44
160	2	42.5 + 75
180	1	8
185	1	24
190	1	93
195	1	16
200	4	16 + 28 + 65 + 90
215	3	43 + 45 + 50
220	5	15 + 18 + 20 + 23 + 24.5
230	3	26 + 42.5 + 48
250	1	38
255	1	20
260	1	22.5
270	1	21
360	1	70
370	1	37.5
Total	35	

Mean rim diameter: 202mm (4B)
Standard deviation: 59.59

Table 4. Rim measurements of 23 complete profiles and 12 upper, partial profiles of jars/pipkins
4A: percentages for each diameter
4B: diameters: mean and standard deviation

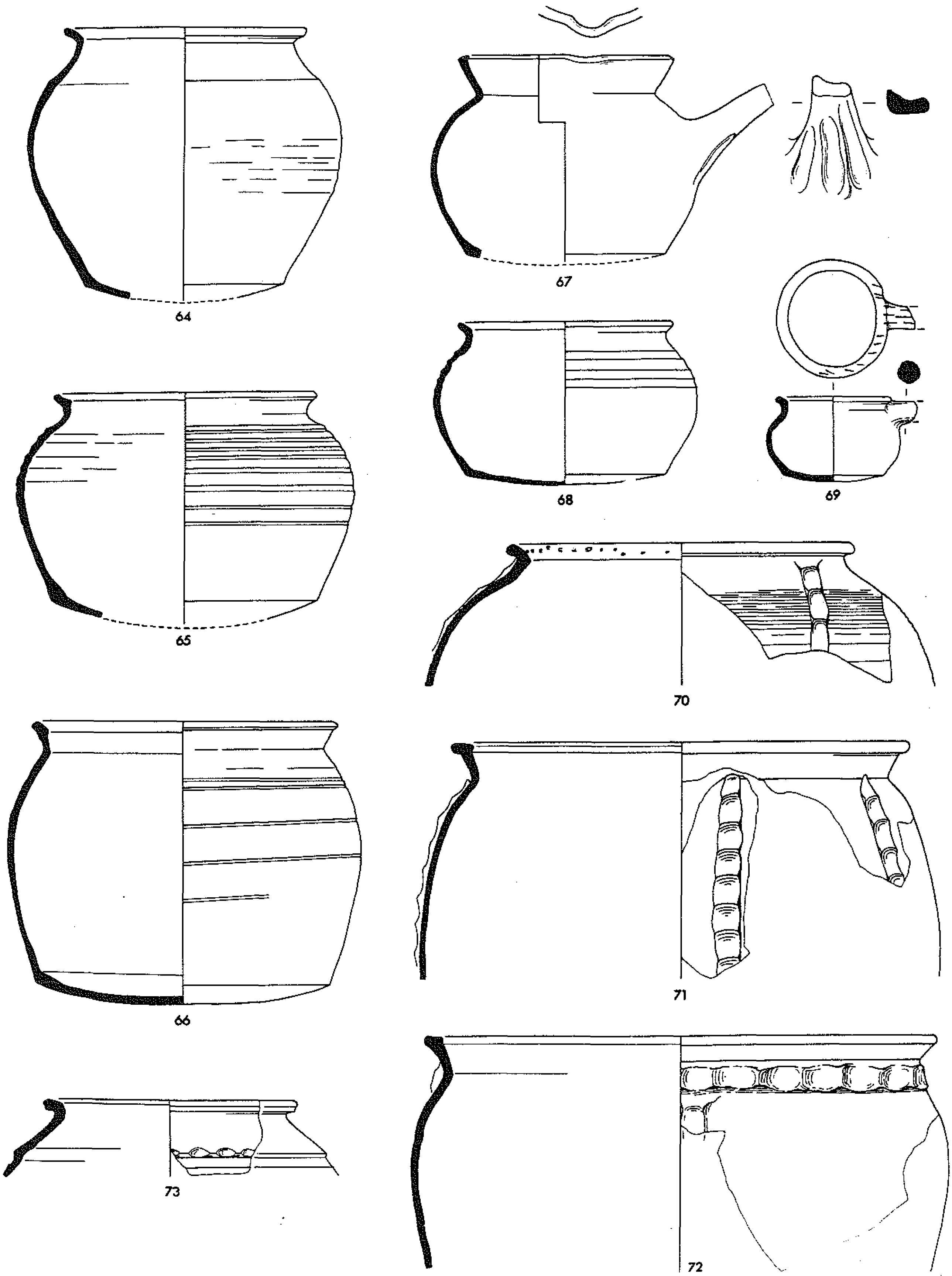


Fig. 4

Rim type	Mean diam. (mm)	Standard deviation	Total
1A	203	1.50	8
1B	194	3.20	4
1C	173	5.05	10
2A	241	1.14	4
2B	245	9.01	4
2M	202	9.07	5
Total			35

Table 5. Rim type and diameter of 23 complete profiles and 12 upper partial profiles of jars/pipkins

(1d) Bowls

Bowls are large and relatively shallow, plain and undecorated, with rims of very variable form (Fig.6: 80-84). 'Spouted bowls' are represented by the 'spouts' only (Fig.6: 77, 78), and it is therefore impossible to make any definite statement about their shape. The 'spouts' could have been sockets for the insertion of wooden handles. The rim diameters and rim percentages present of the five complete bowl profiles are:

320mm (21%)
327mm (51.5%)
359mm (14%)
359mm (84.5%)
379mm (10%)

(1e) Basin

There is only one example of the form referred to here as a 'basin' and no published parallels have been found to date (Fig.6: 79). It is small and undecorated, with straight sides (rim diameter 130mm; 44%).

Fig. 4. Jars and pipkins: St Albans
Jar and pipkin shapes:
64-65: high-shouldered jars: 64, with angle on shoulder; 65, with 'corrugated' decoration on body
66: barrel-shaped, jar wih shallow grooves
67-68: globular, 67, pipkin; and 68, jar with' corrugated' decoration
69: low/concave shouldered, pipkin with slashes on rim and handle
70-73: incomplete jars with characteristic decoration: 70, thumbed applied bands and stabbed decoration on the rim;
71-72, thumbed applied bands;
73, thumb-pressed frill on shoulder

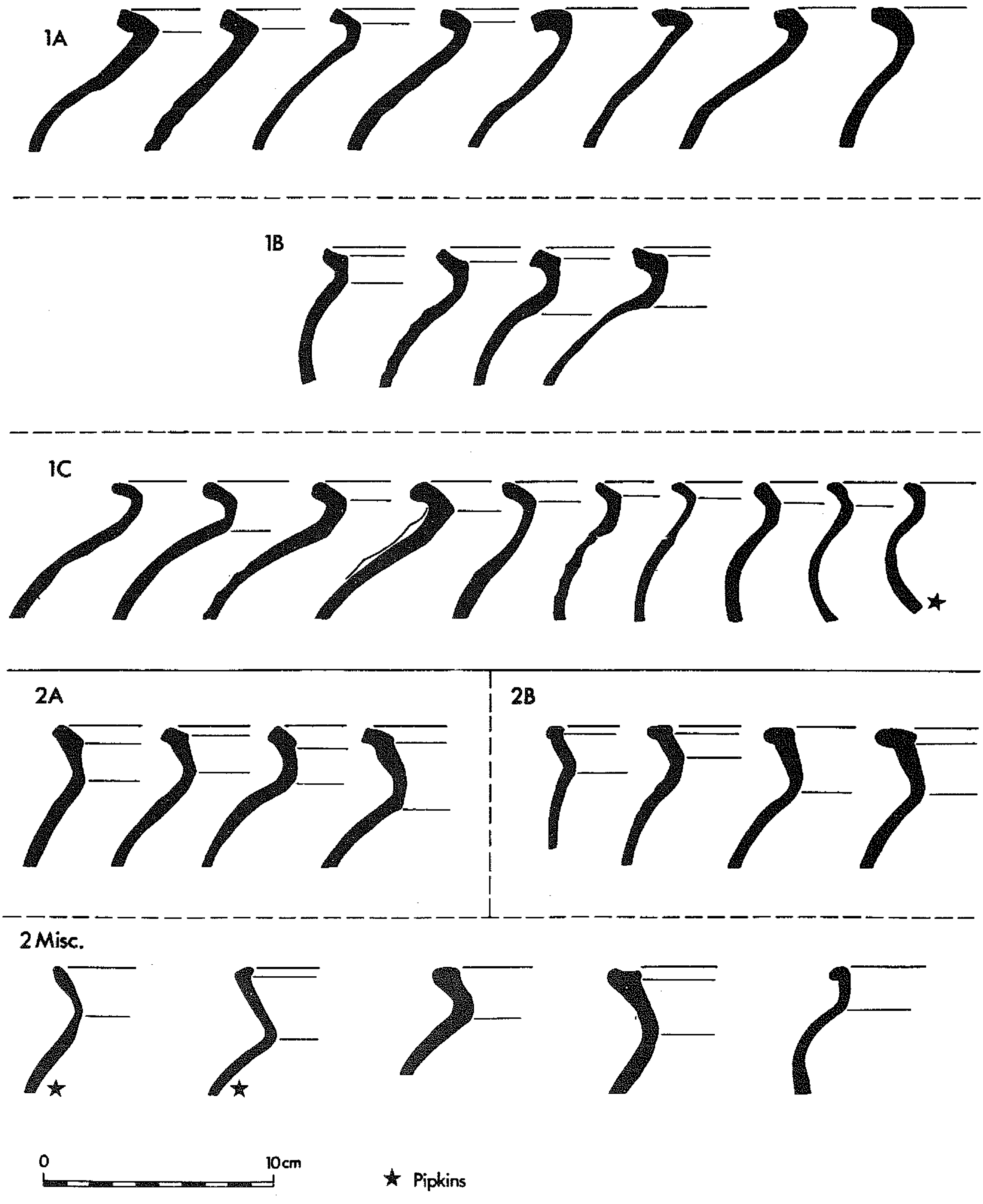


Fig. 5. Jar and pipkin rims: St Albans
Type 1A: shallow square
Type 1B: shallow 'lid-seated'
Type 1C: shallow round
Type 2A: deep/necked square
Type 2B: deep/necked round
Type 2Misc: deep/necked miscellaneous

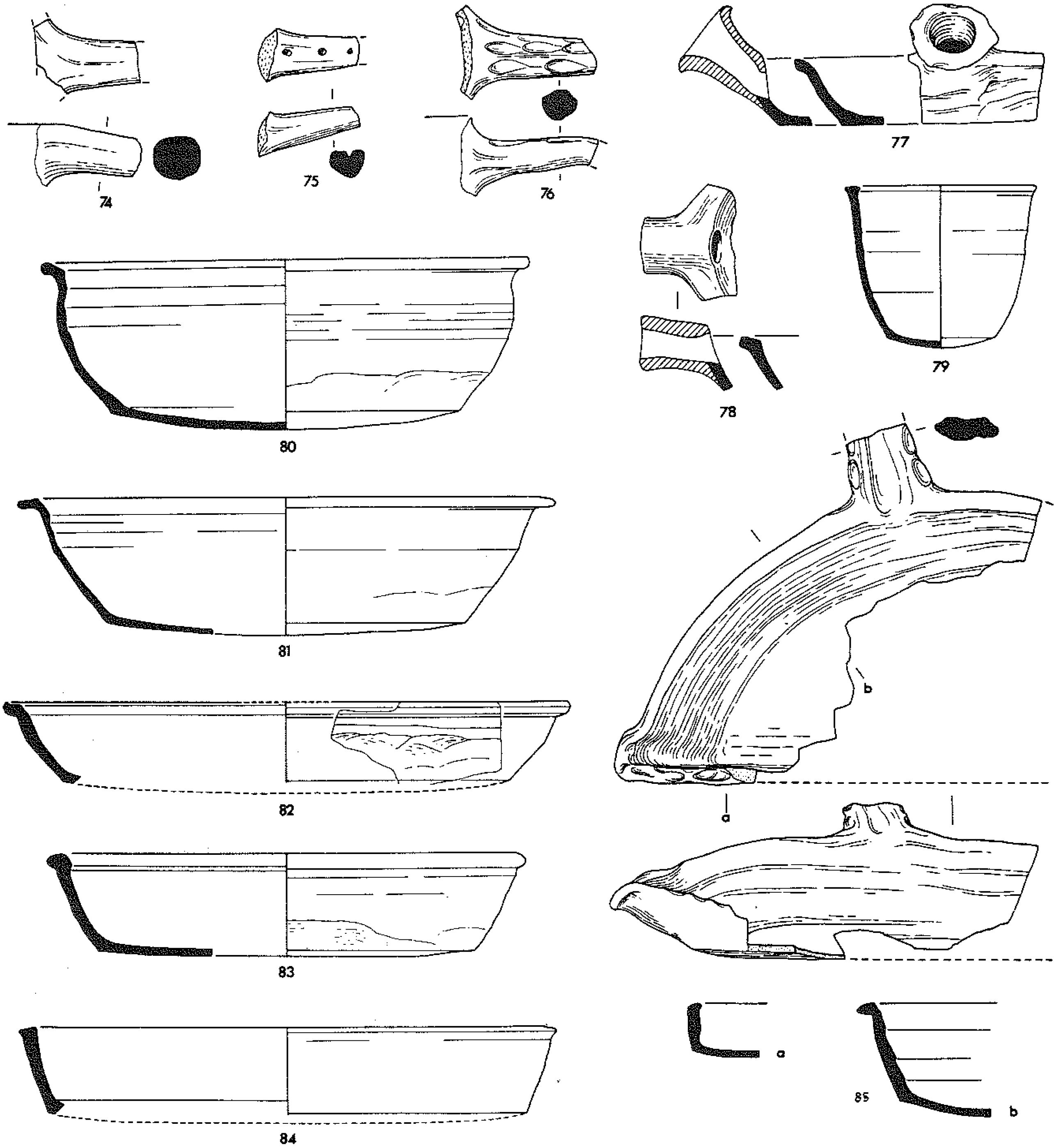


Fig. 6. Basin, bowls and dripping dish: St Albans
74-76: pipkin or dripping dish handles
77-78: spouts or sockets from 'spouted bowls'
79: 'basin'
80-84: bowls
85: dripping dish

(1f) Dripping dish

There are no complete examples of dripping dishes so far, but there are some large fragments, which suggest a shallow semi-circular form, with two handles on the round wall and a lip at each corner (Fig.6: 80). They tend to be heavily encrusted with soot.

Unlike jug handles (see above), dripping dish and pipkin handle fragments are both as scarce as the complete or nearly complete vessels and the form was probably relatively uncommon.

2. Decoration

(2a) General

Decoration in St Albans was found on jugs, jars, pipkins, cisterns, and dripping dishes, while the bowls and the basin were plain. Figures 1-4 and 6 show examples of various forms of decoration of the rim, body and handles, typical of greyware and often considered to be at least partly functional. Similar motifs are found on the upper body of both jars and jugs, for example Fig.1: 4 and Fig.4: 73; Fig.1: 7 and Fig.4: 65 and 68; Fig.1: 9 and Fig.4: 64. The thumbed applied strips, however, which are among the most common decoration found on greyware jars, have not so far been observed on jugs. Except on jug handles, decoration is, on the whole, not common.

(2b) Jug handles: decoration

The decoration of greyware jug handles has long been considered as one of the most significant attributes of the ware for source and/or chronology. 148 jug handles were recovered from the excavations listed above, and these have been considered under nine headings, depending on their type of decoration, and a representative sample from each is illustrated. The relative numbers of each of these types are given in Table 6 below. 'Pierced' decoration refers to slashed, stabbed or pricked patterns, which have not yet been further differentiated because of the small numbers in each class.

	Decoration	Frequency	Figure No.
1A.	Simple, plain	12	2: 10-11
1B.	Simple, with pierced decoration	23	2: 12-19
2A.	Raised edges, plain	3	2: 20
2B.	Raised edges, with pierced decoration	2	2: 21-22
2C.	Raised edges, with central spine	4	2: 23
3A.	Thumbed raised edges, plain	4	2: 24-25
3B.	Thumbed raised edges, with pierced decoration	2	2: 26-27
3C.	Thumbed raised edges, with central spine	1	2: 28
4A.	Thumbed, plain	25	2: 29-34
4B.	Thumbed, with pierced decoration	71	3: 35-46
5.	Miscellaneous	1	not illustrated
TOTAL		148	

Table 6. Greyware jug handles from St Albans

Thumbed or thumbed and pierced types are in the majority in St Albans, constituting 64.9% of the total number. Jugs with deeply thumb-pressed handles are reported from many sites in Hertfordshire and are considered to be particularly characteristic of the county (see Dunning 1944; Biddle 1961a and b; Renn 1968). They are traditionally associated with the Elstree area.

For comparative purposes, Figure 3 includes some examples from the small amount of Nettleden (Fig.3: 47-51) and Chandlers Cross (Fig.3: 52-63) kiln material, which is currently held by the Verulamium Museum. The Chandlers Cross pottery comes from D. S. Neal's excavation at the site. It is at present awaiting publication and we are very grateful for his permission to publish some of the handles here. In these two samples, there is an absence of both sites of 'Thumbed decoration' (4A and 4B), and a predominance of 'Simple' forms (1B), occasionally with two or three thumbings at the top or the base.

(2c) Jug handles: manufacture

The cross-sections of these handles are based on both rod and strap shapes, modified to varying extents by the degree of decoration. In St Albans, strap types form 54.7% of the total, and rod types 41.9% (with 3.4% unclassified). All examples from Nettleden are strap handles. From Chandlers Cross the opposite is the case, with 78.9% rod types.

Only on a small number of pieces is it possible to be certain of the method of attaching the handle. Some handles from St Albans are simply luted onto the body, others appear to have a round tang pushed through a hole in the pot wall to secure them. The latter applies to both rod and strap varieties, and to both upper and lower ends; in one case the top and bottom ends of the same handle were attached by different means. At Chandlers Cross and Nettleden, both luting and tanging methods appear to have been used. Sometimes the upper end (but never the lower), had stabs or slits into it from the inner wall.

Greyware from St Albans: comparisons of size and shape

The sample of jugs and bowls is small, but when all of the jars had been reassembled, many of them appeared to have been made to standard sizes, as well as to certain distinct shapes. It is difficult to judge size by eye when vessels are incomplete, and impossible to measure directly in the normal way by filling the vessel with water or beans. However, a method for calculating the capacity of incomplete vessels using a mainframe computer, was the subject of an unpublished undergraduate thesis by D. Gardner at Sheffield University. He was kind enough to allow us access to his thesis, and this method has now been adapted to run on micros. An extension of the program, which draws an outline of the pot on the computer screen using the measurements from the capacity calculation, has proved to be ideal for allowing comparisons of the shape of vessels. These two programs, 'POTCAP' and 'POTDRAW', have been published in outline (Havercroft, Rugg and Turner-Rugg 1986). A more detailed description of the method is given in Appendix 1, and its application to the greyware vessels from St Albans follows.

1. Capacity of greyware vessels

Greyware vessels, like many others at that period, could well have been made to standard sizes (Appendix 2), and appeared to have been so made in St Albans. Their capacity was calculated using POTCAP. Exact figures could not be expected, only a statistical tendency which will be stronger the larger the sample of vessels. This is because of the various sources of error mentioned in Appendix 1, where the inaccuracy that may result from the asymmetry of the pots, and from problems in reconstructing profiles from partial vessels, has already been mentioned. The capacities for each vessel given here are, therefore, displayed as a range: the extreme ends of this range are arrived at by adding and by subtracting 10mm to the measurements taken from the drawing, which is represented by the small vertical mark (see Fig. 8). This figure of 10mm was based on comparisons of diameter measurements taken experimentally by different people on the same set of rims. A further problem is whereabouts on the pot to take the first measurement - along the line at the top of the rim, or lower down to exclude the rim area. It is unlikely that pots would have been filled to the very brim, and pots of otherwise identical sizes may have rims and necks of different shapes and depths which may add a significant amount to the capacity. The capacity measurements given below have therefore been taken to the narrowest point of the neck in the case of jars and pipkins.

Figure 7A-D shows the different vessel forms, A jugs, B bowls and basin, C jars and D pipkins, superimposed at their true relative sizes (POTDRAW unscaled). The jars fall into two clear groups, with only one very large example outside them.

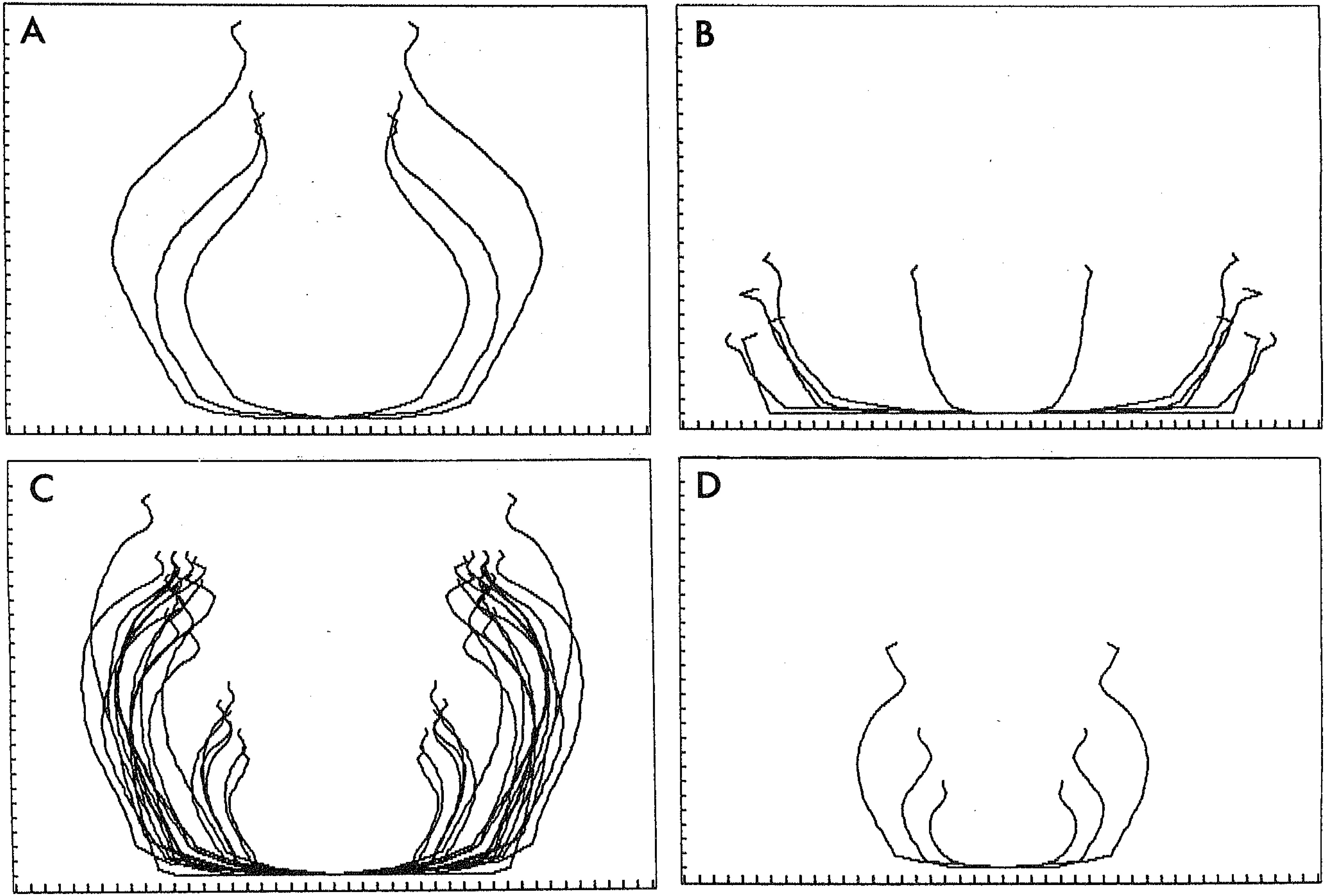
Figure 8 shows the capacities of jars and pipkins calculated by POTCAP. Two major and two minor groups of different-sized vessels are demonstrated by this method.

It therefore seems likely that two sizes of cooking vessel of a fairly standard size were in use in St Albans at that time. As the sample comes from several different sites in the town, probably differing in date and quite possibly obtained from different potters, this is a very interesting result.

Fig. 7. Greyware vessels shown superimposed by POTDRAW, unscaled and on the same base line, to show size differences. Scale divisions shown are at 10mm intervals

A 3 jugs
B 5 bowls and 1 basin
C 20 jars
D 3 pipkins

Fig. 7



There are not at present a sufficiently large number of bowls and jugs to be worth plotting. The actual figures, taken 'to the brim', are given below:

capacity in litres	-10mm	+10mm
jugs:		
2.90	2.14	3.79
5.03	3.98	6.23
9.72	8.07	11.55
bowls:		
3.41	2.92	3.94
4.01	3.54	4.52
4.23	3.72	4.78
5.37	4.64	6.15
6.12	5.25	7.05

2. Comparison of vessel shapes

A program is currently in preparation which will allow automatic comparisons between vessels, based on a mathematical expression of their similarity, together with a further program which will group them automatically as well. For the present, the external profiles of the 23 greyware jars and pipkins have been compared by eye, using the POTDRAW program to try out different combinations, with the following results.

Experiments with circles of different diameters (Fig. 10A), have shown that to eliminate the size difference without distorting the shape, and thus to allow vessels of the same body shape to be identified, either the 'scaling to the same height' or the 'scaling to the same maximum girth' options are most useful (Fig. 10C and D). However, since pots of otherwise similar body shape may have rims of varying depths and bases with a varying degree of concavity, both of which are counted by the program as part of the height for the calculation, the 'scaling to height' option is of less use in practice than the 'scaling to maximum girth'. The program also allows pots to be displayed with their maximum girth aligned, which is also useful when both the necks and the bases of the group are of very different depths.

Fig. 8. Capacity of 23 jars and pipkins calculated by POTCAP
The capacity of these vessels is calculated up to the narrowest point of the neck, using a vertical interval of 10mm. A range is given for each vessel, based on a variation of +/- 10mm on the diameter of the illustrator's drawing

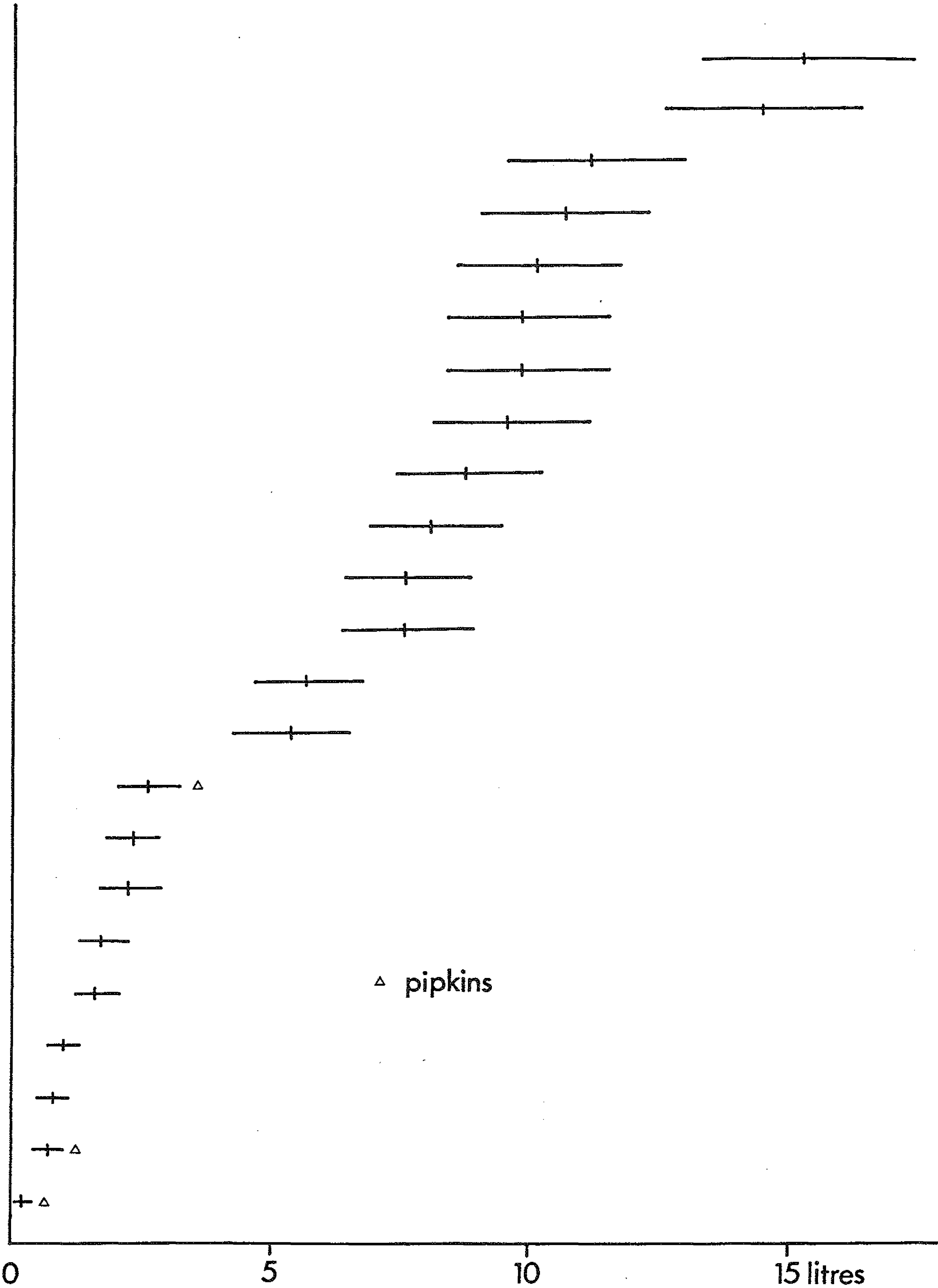


Fig. 8

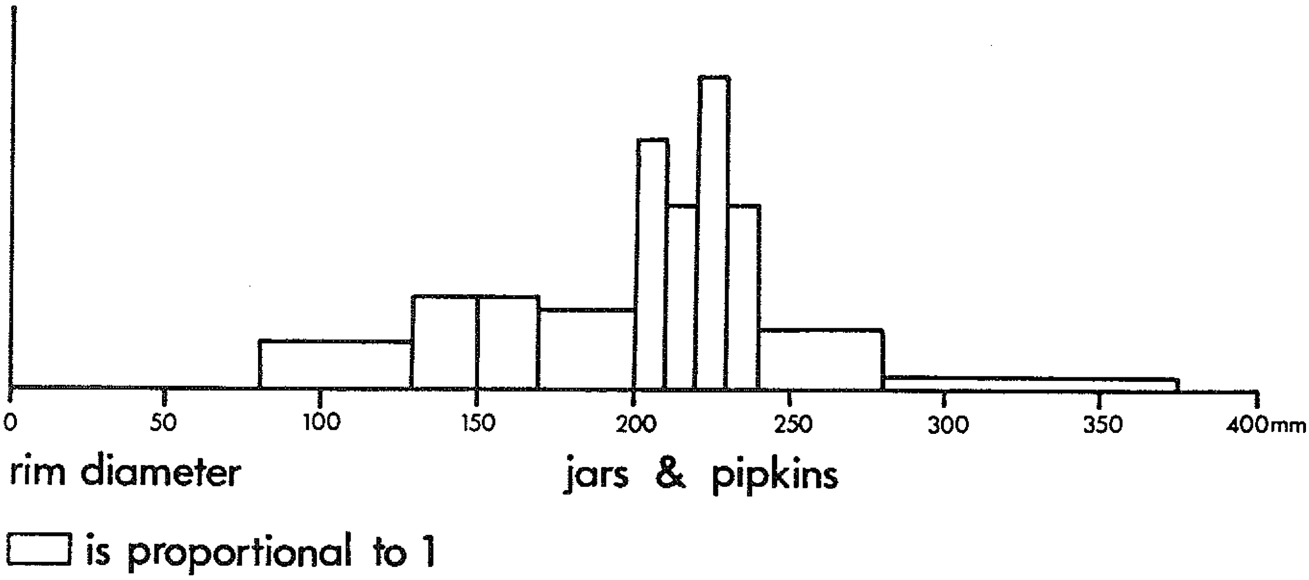


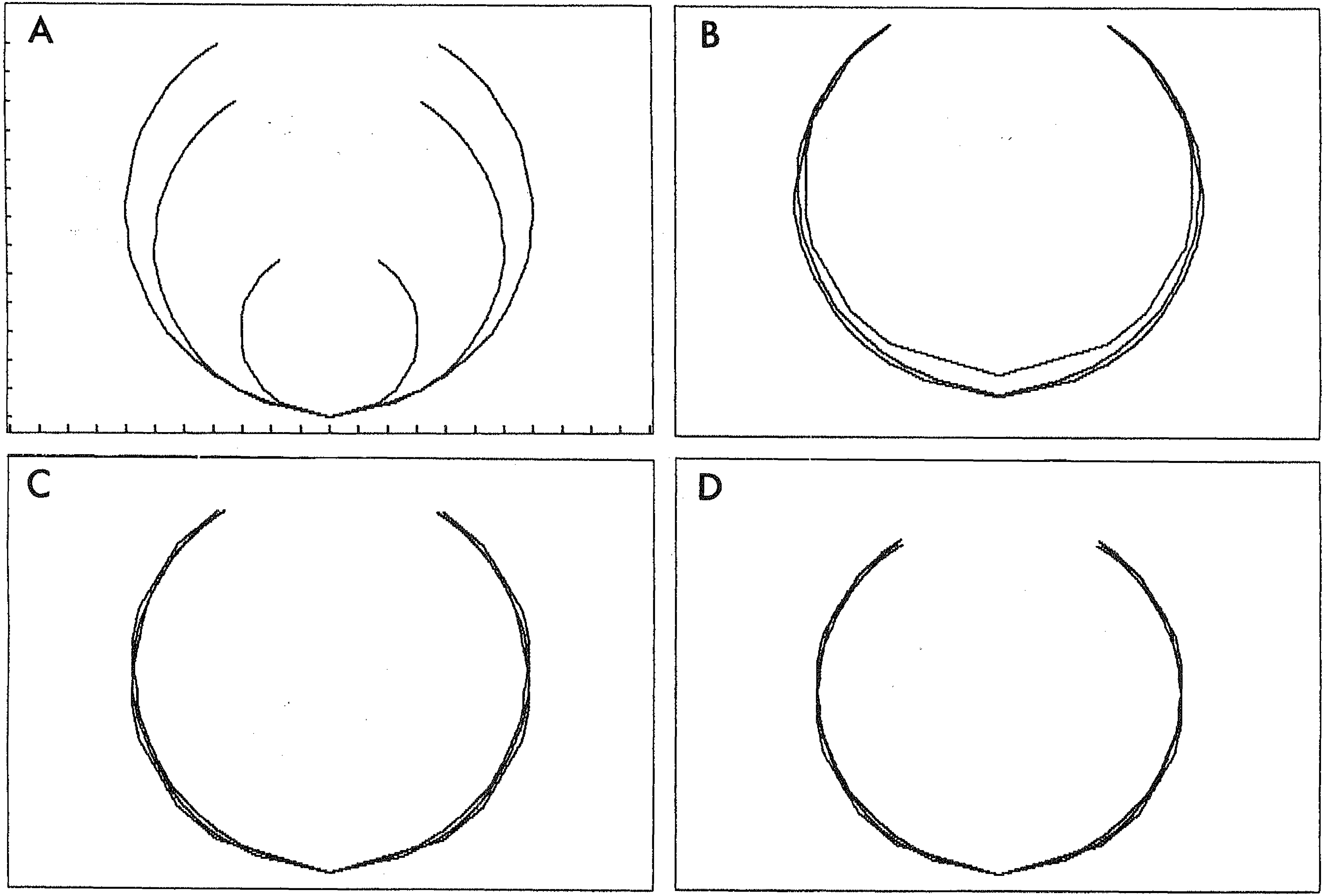
Fig. 9. Rim diameters of 35 jars and pipkins
The diameters are shown in mm in the form of a grouped frequency diagram with unequal class boundaries

(2a) Jugs

As there are only three complete examples of this form, there is little that can be said, other than that these three jugs are all of a similar shape when the size differences have been eliminated (Fig. 11A). The existence of other shapes, however, is suggested by some of the incomplete examples (Fig.3: 36, 44).

Fig. 10. Test circles of different diameters (30mm, 60mm, 70mm) showing some of the POTDRAW options
A unscaled, on same base line
B scaled to same rim diameter and on same rim line
C scaled to same height
D scaled to same maximum girth

Fig. 10



(2b) Jars and pipkins

The 23 jars and pipkins have been divided empirically into four body shape groups. The most obvious difference appears to be the position of the shoulder or point of maximum girth, and whether the wall above and below this point was concave or convex in outline. Other important differences were whether a form of this basic shape was tall or squat, the relative diameter of the mouth, and whether there was an angle at the shoulder. Shape, size, rim diameter and rim form do appear to be related to some extent, but the small size of the sample of pots available does limit the confidence with which this relationship can be stated.

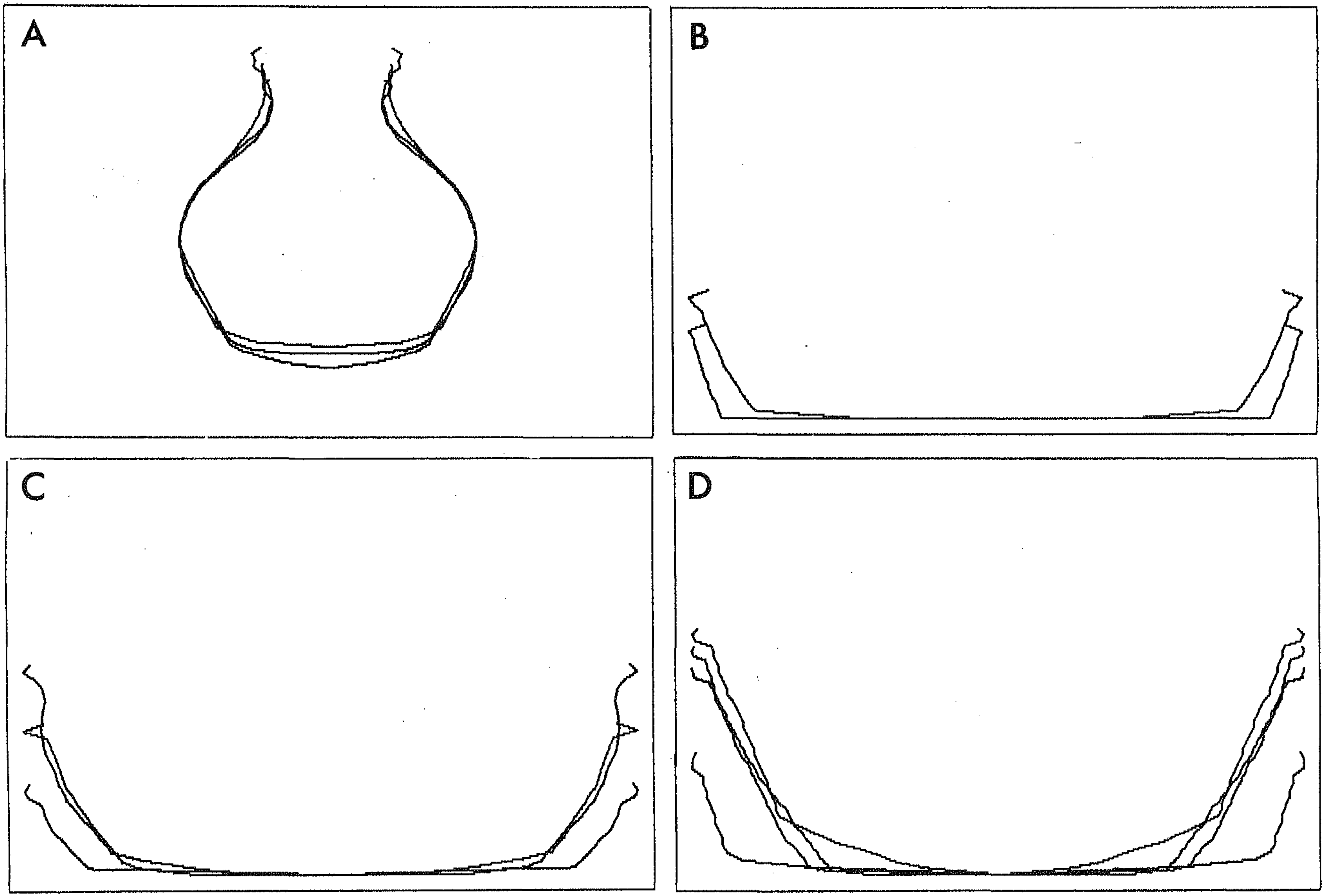
Four groups of body shapes are listed below. Figure 12 shows a typical example of each shape compared to a standard circle, and Figure 13 shows all examples of each group (excluding one miscellaneous example), superimposed and scaled to maximum girth; Figure 14 shows them unscaled.

Shape Group	Frequency
A High shouldered	8
B Barrel shaped	3
C Low/concave shouldered	3
D Globular	8
E Miscellaneous	1
TOTAL	23

Table 7. Body shapes of jars and pipkins

Fig. 11. Shapes of jugs and bowls shown using POTDRAW
They are all scaled to the same maximum girth.
A jugs aligned to the position of maximum girth
B straight-sided bowls, aligned to the base position
C convex-sided bowls, aligned to the base position
D deep and shallow straight-sided bowls from various sites (see text), taken from published drawings; aligned to the base position

Fig. 11



The individual pots making up groups A, B, and C, appear to be more consistently similar to one another than those making up group D. They are also more consistent as regards rim shape and rim diameter. Table 8 shows rim diameters of the four main groups, Table 9 shows rim shapes as illustrated in Fig. 5.

Body Shape	**Mean (mm)**	**Standard Deviation**
A High shouldered	204	1.60
B Barrel shaped	233	1.25
C Low/concave shouldered	107	1.55
D Globular	174	3.46
E Miscellaneous	145	not applicable

Table 8. Rim diameters of jars and pipkins by shape groups

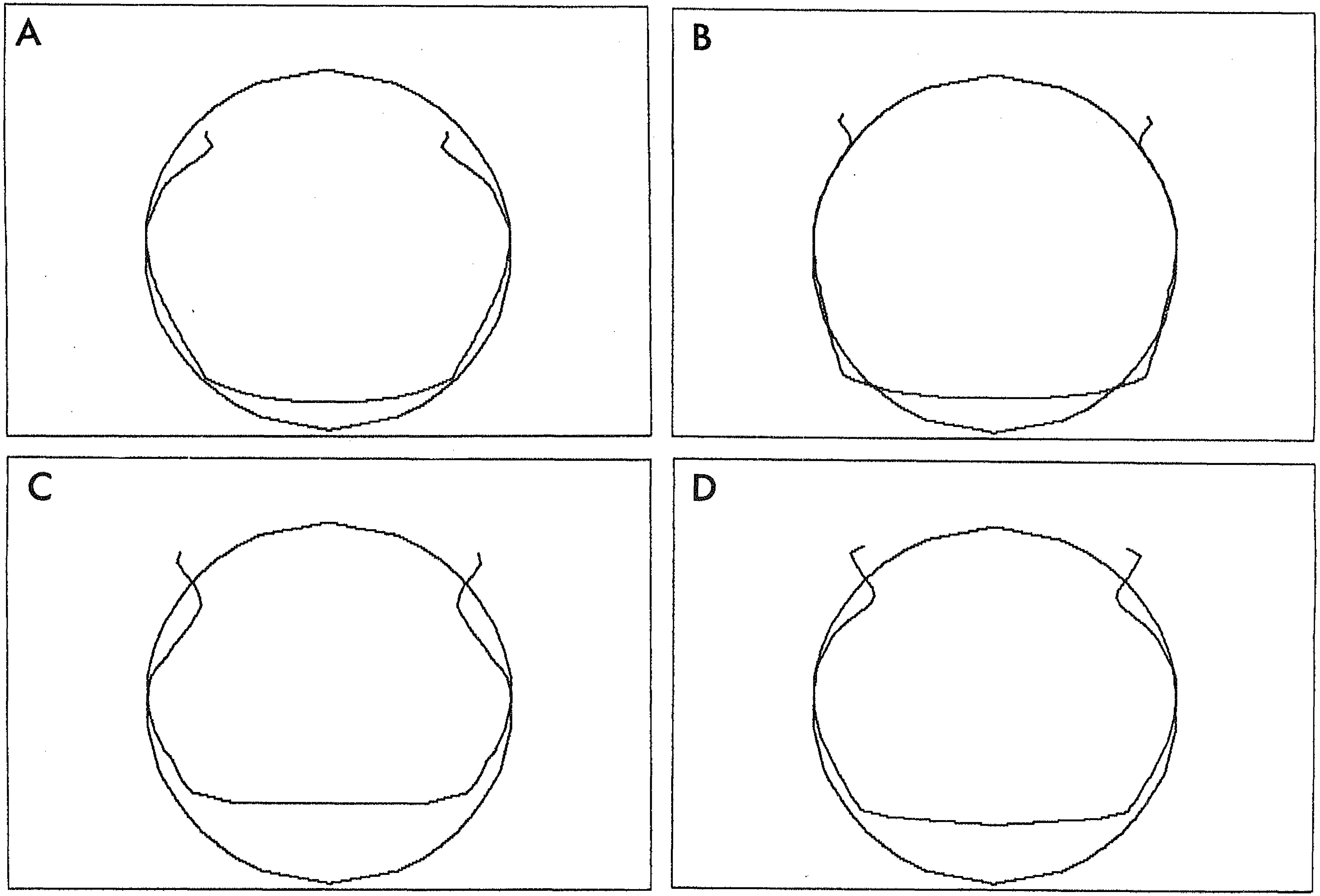
Body Shape	**R1A**	**R1B**	**R1C**	**R2A**	**R2M**	**TOTAL**
A High shouldered	4	1	3	0	0	8
B Barrel shaped	0	0	0	2	1	3
C Low/concave shouldered	0	0	2	0	1	3
D Globular	1	1	4	1	1	8
E Miscellaneous	0	0	0	0	1	1
TOTAL	5	2	9	3	4	23

Table 9. Rim shapes (R) of jars and pipkins by shape groups

Fig. 12. Four different shapes of greyware jars and pipkins shown using POTDRAW
The profile of a typical example of each shape is superimposed on a circle; the two shapes are scaled to the same maximum girth; each pair is aligned so that the position of the point of maximum girth coincides.

A high shouldered
B barrel shaped
C low/concave shouldered
D globular

Fig. 12



(2c) Bowls

The bowls from St Albans are of two shapes, a straight-sided, shallow type, and a convex-sided type of varying depth (Fig. 11B and D).

It is possible to use the POTDRAW program on measurements taken from drawings published in journals. A piece of transparent graph paper may be laid over the drawing, and measurements taken at 1mm intervals. On a drawing published at the usual scale of 1/4, the 1mm interval is equivalent to a 4mm interval at true size, and the radius measurements must be multiplied by four. The resulting outline is slightly more sinuous than usual, because the multiplication compounds any irregularities, but it still provides an adequate outline.

When the bowls from St Albans are compared to bowls illustrated from Northolt (Hurst 1961), Manor of the More (Biddle *et al.* 1959), Otterspool (Biddle 1961a), and Pinner (Sheppard 1977), the Northolt example is straight-sided and shallow, similar to the shallow examples from St Albans, but the other three are straight-sided and deep, and a very similar shape to one another, constituting a third shape group (Fig. 11B).

Conclusion

These notes describe a series of 'Greyware' vessels from recent excavations in St Albans, with particular reference to all of the pots complete enough to constitute a type series for this, the commonest type of pottery found in the medieval town centre. These are shown to be typical of a ware well-known throughout Hertfordshire and adjoining counties. In St Albans, over 800kg of sherds produced not one single complete greyware vessel. However, comparisons of size and shape,

Fig. 13. Four different shapes of greyware jars and pipkins shown using POTDRAW
The profiles of all examples of each shape are superimposed; the profiles are scaled to the same maximum girth and aligned so that the position of the point of maximum girth coincides.
A high shouldered
B barrel shaped
C low/concave shouldered
D globular

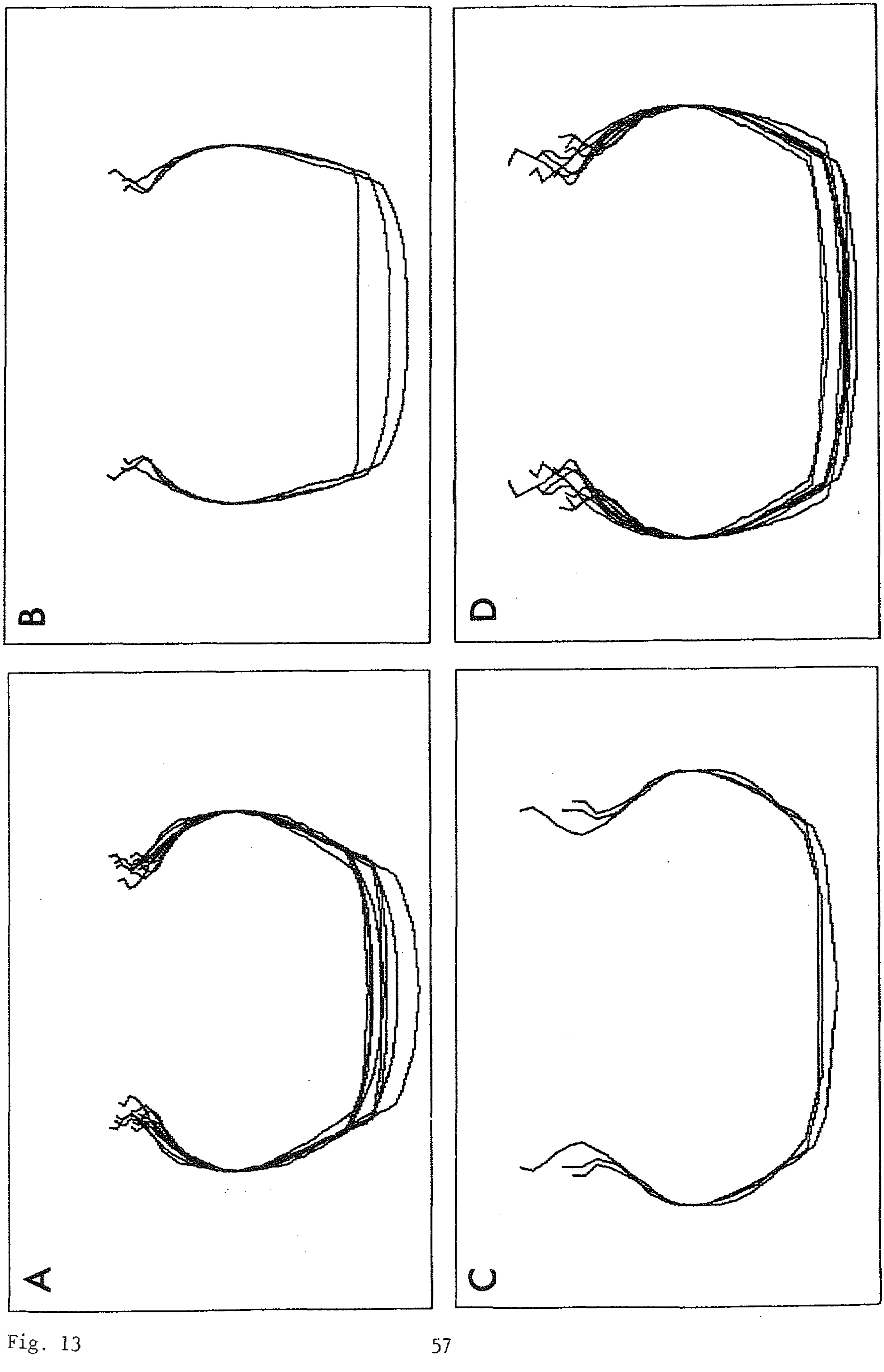


Fig. 13

resulting in the provisional recognition among jar forms of two size groups and four body shape groups, have been made possible by the use of two simple computer programs. It is next hoped to relate these features of size and shape to kiln and to date, and, as slight variations in shape may relate less to function or fashion than to the potter's personal motor patterns, eventually perhaps even to individual potters.

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Sites until 1980 were excavated by C. Saunders and A. B. Havercroft; Orchard House 1982 by C. Saunders; all other sites by A. B. Havercroft.

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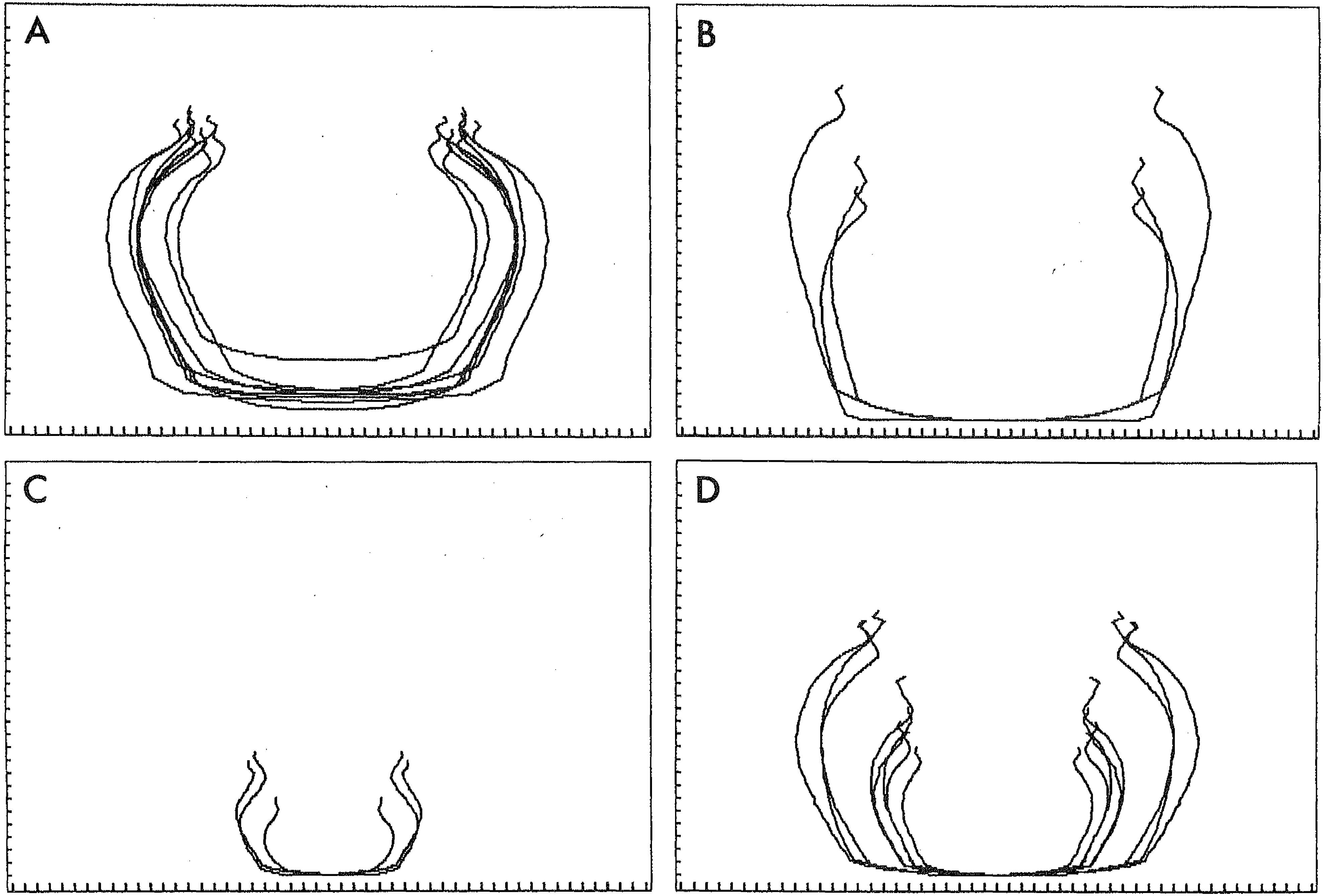
APPENDIX 1: THE 'POTCAP' AND 'POTDRAW' PROGRAMS

'POTCAP'

When the capacity of a vessel cannot be measured directly, but a complete profile of the vessel is present, it is possible to calculate the volume of the vessel mathematically instead. The formula involved is simple, but involves a large number of calculations, and the use of a computer or programmable calculator is indispensable to reduce both the time required and the risk of calculation errors to manageable levels.

Fig. 14. Four different shapes of greyware jars and pipkins shown using POTDRAW
The profiles of all examples of each shape are superimposed unscaled, to show the variation in size.
A high shouldered
B barrel shaped
C low/concave shouldered
D globular

Fig. 14



The method used for calculating the capacity is as follows. The pot is treated as if it were a series of thin, horizontal, cylindrical slices (Fig. 15A); the capacity of each cylinder is then calculated, using $\pi r^2 h$, and the capacities of all the cylinders are then added together to give an estimated capacity for the vessel. The radius of each cylinder is calculated by averaging the bottom and the top radius measurements for each 'slice', and the vertical interval between each pair of measurements gives the height. The method has the disadvantage that the averaging process treats each slice as if its walls were straight, whereas they are likely to be curved; this means that the average measurement is likely to be a slight under-estimate of the true radius measurement. This error can be reduced by decreasing the interval between measurements, and a smaller interval will be needed when measuring small vessels than when measuring large ones.

Tests using geometric shapes whose exact volume could be worked out by direct calculation, as well as by using the program with a series of radius measurements, showed a greatest error of 4% in 'program-calculated' volumes compared to directly-calculated volumes. This was in the case of a small sphere, using a 10mm vertical interval. For two cones, two cylinders, and a larger sphere used in this test, the error was less than 1%; reducing the interval between measurements to 5mm considerably reduced the error.

Further sources of possible error are (a) variation in the estimation of the diameter measurement on which the reconstruction drawing of an incomplete pot is based; (b) systematic error in measurements taken by different people; (c) irregularities in the profile of the pot which is being measured.

Figure 15 shows some actual examples of the effect of these sources of error: in Figure 15B, the same pot has been measured with three different intervals between the measurements; in Figure 15C, the same pot has been measured by three different people using the same interval of measurement: the variation is small in both cases. Figure 15D shows the same pot measured by the same person using the same interval, but at different places around the circumference: here the variation is quite large. The pot shown in Figure 15D is a particularly asymmetrical one, but is a useful reminder that the formula used in the program assumes a symmetrical pot; attempts to use the program on asymmetrical pots will lead to less accurate results. Any inaccuracy is

Fig. 15. POTCAP and POTDRAW: method and tests

A measurements used for POTCAP and POTDRAW: r = radius, h = height/interval between measurements

B three profiles of the same jug shown by POTDRAW using intervals of 2mm, 4mm, 8mm

C three profiles of the same pipkin shown by POTDRAW using measurements taken by three different people

D a jar shown by POTDRAW: five profiles drawn at different points around the circumference

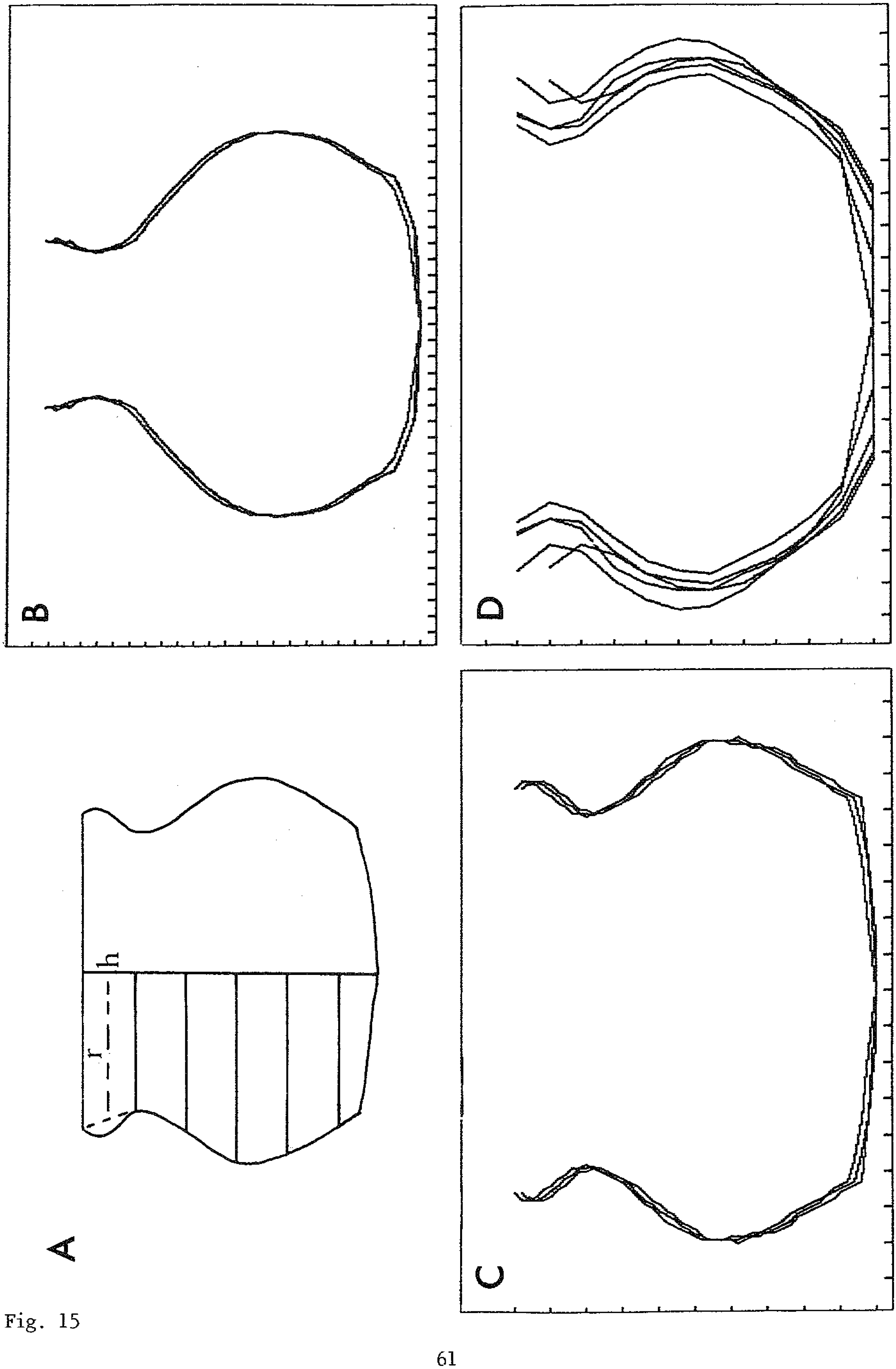


Fig. 15

compounded by the squaring of all the radius measurements, so a 10mm error on all measurements can produce dramatically different estimates of capacity. It is therefore essential to have a reasonably large sample of pots to allow recognition of tendencies statistically, as isolated calculations will produce meaningless results.

To help to allow for these sources of potential error, the program automatically calculates a second and third reconstructed capacity, one with all the measurements 10mm smaller, and one with all the measurements 10mm larger than the originals. This provides a pair of bracket values within which the true volume is likely to fall. The program can also automatically print out the results on paper, together with the code for the pot, providing simultaneous hard copy.

An 8mm or 10mm interval used was found to give satisfactory results for pots of the size in question here.

'POTDRAW'

Traditionally, a researcher wanting to compare the profiles of two or more pots would need to trace drawings of them onto the same sheet of paper, or superimpose drawings of them on separate transparent sheets. If the researcher also wanted to compare them scaled, so that shape alone was being compared without the confounding variable of size, it was necessary to adjust the size of the image manually.

Drawing profiles of pots on the computer screen is much faster, and much more flexible. The pot drawing program, 'POTDRAW', uses the same set of measurements as 'POTCAP', and the measurements can be stored on tape or disk for re-use. 'POTDRAW' works by using the radius measurements and the interval between them to calculate the position at which each measurement was taken; it then 'joins the dots' to give a profile drawing of the original pot. Like 'POTCAP', it assumes straight lines between the measurement points; however, with a sufficiently large number of measurements, the distortion involved becomes negligible, except for a slight loss of detail with rims and bases. An interval of 4mm between measurements gave satisfactory results for the pots described here. Clearly, the time taken to draw the pots on screen from memory depends both on the number of pots and on the number of measurements for each pot: for the pots described here it is in the order of minutes for each illustration.

With the program, the user can display pots either at their actual proportional sizes to each other, or using any of several other scaling criteria (e.g. scaled to the same height, widest point, rim diameter, neck diameter, base diameter, etc.). Another option allows the user to display up to four pots with one in each corner of the screen, rather than superimposed.

The position of the pots relative to each other on screen can also be changed, so that the pots can be shown with their bases at the same level, their necks at the same level, their rims at the same level (useful for comparing the upper parts of vessels with incomplete profiles), and so forth.

The on-screen size of the pots can be increased or decreased by the user, and there is also an option on one version of the program for displaying a three-dimensional drawing of the pot or pots being displayed.

It is possible to produce print-outs of the on-screen image at the press of a key. The paper print-out of the on-screen image takes about thirty seconds to complete.

TECHNICAL DETAILS

The program was originally written for a Dragon 64 microcomputer, but should be easily adaptable to other micros. A version for the Amstrad 8256 word processor is also in use, which has some advantages over the Dragon program. Measurements can be taken from the illustrator's drawing by overlaying it on graph paper, (laborious but simple and cheap), or from the illustrator's drawing with a graphics tablet (simple but more expensive). The measurements used so far have been taken by museum volunteers, most of whom had no previous experience with computers, and their results when checked were of a perfectly acceptable standard. The authors hope soon to investigate the possibility of constructing a machine to take the necessary measurements directly from the pot, rather than from a drawing which has to be laboriously constructed by an illustrator first.

The program works by treating the profile as a series of X and Y co-ordinates. The radius measurements provide the X co-ordinates, and the vertical interval between them provides the intervals for the Y co-ordinates. Both sets of measurements are multiplied by a size factor and a scaling factor before being plotted; since the original measurements are used each time, there is no cumulative error as the pots are scaled up or down. The intervals between the points are then filled in by straight lines. This method is less sophisticated mathematically than using mathematical constructions such as fitted curves (Laflin 1985) or centroids (Tyldesley, Johnson and Snape 1985), but has the advantage of being much easier for non-mathematicians to understand and use. There is no theoretical reason for the measurements to be taken at even intervals; this was done for the practical reason that it halved the amount of data needed to draw a vessel. Similarly, the program draws the left-hand side of a vessel as a mirror image of the right; again, this halves the amount of data required. There is, however, no reason why the program should not be adapted to draw asymmetric items such as flints etc.

The scaling and drawing method

The scaling process is accomplished as follows: as well as the information about radius measurements and the interval between them, two things need to be known about each pot before it can be drawn. The first is how big it is relative to the other pots: the second is how big it is in absolute terms on the computer screen.

The relative size of the pot, if a scaling option is being used, is determined as follows: a specified measurement of the pot (e.g. its rim diameter) is compared to a standard, essentially arbitrary, measure (e.g. 100 millimetres), and expressed as a proportion of that standard. Thus if the rim diameter of the pot were 200 millimetres and the standard measure was 100 millimeters, then the proportion would be 2. In order to bring the pot down to a size where its rim diameter was 200 millimetres, its rim size would therefore need to be halved. Another pot with a rim diameter of 50 millimetres, however, would need to have its measurements doubled. This process is applied to all the pots being scaled, so that they are all standardised to a chosen common denominator.

The absolute size of the pots on screen is determined by the ratio of millimetres (in the pot measurements) to picture elements, 'pixels', on the computer screen. Since different pots are different shapes, it is not practical to stick to one rigid ratio: for example, a wide bowl scaled to a height of 200 pixels will overflow off the edges of the screen, whereas a baluster jug scaled to a height which would allow the whole of the bowl to fit on screen would appear tiny in comparison. To handle this, the user is able to increase or decrease the on-screen size of the pots to fit their needs.

Each pot, then, has its measurements multiplied by two components before being drawn: an individual scaling factor, and a general size factor. If the pots are being shown unscaled (i.e. at their proportional sizes relative to each other) then the individual scaling factor is not applied.

One last thing needs to be known before the pot can be drawn, namely, where the pot is to be drawn on screen. If bases are being compared it makes sense to draw the pots with all their bases at the same level; similarly, if rims are being compared, it is useful to have all the rims at the same level. These 'common drawing lines' are useful, but by no means the only useful ones. Other possibilities include the neck angles, the widest point, and the half-way height of the vessel, all of which have their uses with different scaling criteria.

'POTDRAW' can handle the following scaling and common drawing line options:

1 unscaled: pots at their proportional sizes relative to each other

2 scaled to height: all pots the same height

3 scaled to rim: all pots scaled to the same rim diameter

4 scaled to neck angle: all pots scaled to the same neck angle diameter

5 scaled to widest point: all points scaled to the same maximum diameter

6 scaled to base: all pots scaled to the same base diameter, if not round-bottomed

a rims on same common drawing line

b neck angles on same common drawing line c widest points on same common drawing line

d mid-height point of each pot on same common drawing line

e bases on same common drawing line

Each of the above scaling criteria can be used with each of the above common drawing line conventions, giving thirty possible permutations, not all of which are equally useful in practice. In addition, it is possible to display pots separately in each corner of the screen simultaneously, though with a more restricted set of scaling and common drawing line options. It is hoped to add an option for scaling to the same base angle diameter, and one for having the angle of the base as the common drawing line, as well as a scaling option which would produce hard copy of the pots at standard publication scale.

It is also possible for the user to alter the thickness of the drawing line so that the hard copy comes out at the best thickness of line for reproduction for publication etc.

APPENDIX 2: VESSEL CAPACITY

In England in the 12th to 14th centuries, official weights and measures, including capacity, were far from standardised, in spite of official concern that they should be. Attempts at standardisation were principally to promote fair trading, and how far they would have affected ordinary domestic vessels, especially those of the lowest socio-economic groups, is unknown. Moorhouse (1981) states that there are frequent documentary references to specific capacities of earthenware pots: pint, quart, pottle, gallon and bushel, the quart, pottle (2 quarts) and gallon being the commonest. Customers are known from these references to have ordered specific sizes and shapes of vessels from the potter, sometimes even supplying a template.

If standard sizes of pot were identified, relating the capacity of the greyware vessels to a particular unit of measurement would not be straightforward. The gallon in medieval times was a different size, or rather several different sizes, from the modern gallon. For example, Moody (1960) gives the size of the medieval wine gallon until 1527 as 172.8 cu.in. or 216.1 cu.in., depending on whether it was calculated using the 'Tower pound' or the 'Merchants pound' as the basis. There was also a 'corn gallon' which was of yet another size. The modern Imperial gallon he gives as 277.42 cu.in. Thus the gallon in medieval times was only approximately 62% or 78% of the modern gallon, and pots standardised to multiples or sub-divisions of the gallon would be significantly smaller than their modern equivalents.

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