8. THE SYSTEM OF MEASUREMENT USED IN TOWN PLANNING FROM THE NINTH TO THE THIRTEENTH CENTURIES

Philip Crummy

An avenue of research which has barely been entered into is the detailed analysis of the plans of planned towns in an attempt to detect the original scheme of land division as conceived by the town planner. Compared with medieval examples, many of the so-called late Saxon planned towns as first recognised by M. Biddle and D. Hill (1971) have superficially fairly irregular plans and the assertion that they exhibit planning is largely subjective. To demonstrate that their plans contain rhythmic patterns of measurement based on the standard units of the time would clearly be of much value since this would confirm that they had indeed been planned. Equally, the detection of similar patterns should be possible in later towns where planning is indisputable. The following is an attempt to do just this, but should be seen as a tentative forerunner of the much wider and more rigorous study that the subject merits.

In the medieval period the key unit of land measurement was equivalent in standard measure to 16^ feet and was called variously the pole, rod or perch. Forty of these units equalled one furlong and eight furlongs equalled one mile. Although thought to have been devised c. 1600 (Berriman 1953:174), the chain, 'Gunter's chain', would appear to have been based on a measurement which previously was commonly used in land-surveying, viz. four poles. In its new;form this was defined as being equal to a hundred new units, i.e. the link[1]. The formalisation of the four-pole unit in this manner underlines its importance in surveying at least in the 17th century and, as we shall see, its detection now in town plans can provide an insight into the strategies of the town planners concerned.

Dimensions based on multiples of four poles had the advantage of enabling areas of land to be calculated easily. The acre was equivalent to 160 square poles so that 10 or 20 times any multiple of four poles gives an area in acres or roods (quarter acres). This property of 160 is implicit in the Statutum de Admensuratione Terre, a statute believed to date to 1305, * which consists principally of a proportional table giving the lengths and breadths of an acre in a series of rectangular configurations where one side ranges at one-pole intervals from 10 to 80 poles. Thus in the Statutum the only calculations where the second side does not include a fraction of a pole are 10 x 16, 20 x 8, 32 x 5, 40 x 4, and 80 x 2 poles. The acre was usually defined as an area four poles wide and a furlong (40 poles) long,[2] hence underlining the significance of the four-pole unit in land measurement. Thus, every strip of land one pole wide and a furlong in length was one rood in area.

The five towns discussed below have been selected so that street patterns of differing foundation dates and historical contexts would be examined. These are Salisbury, Winchester, London, Bury St. Edmunds and Colchester. The plans which provided the basis for the figures and measurements below were the modern Ordnance Survey 1:2500 series except for Colchester where the 1:1250 series was used. After making allowances for the scale and precision of the maps consulted, the measurements cited can be regarded as accurate to the nearest half pole.[3]*4 The frontages of streets rather than their centre-lines were chosen as the points from which to take measurements because it seems that streets were laid out as a secondary process after the areas in question had been divided up on the basis of multiples of four poles.[5]

New Salisbury was founded by the Bishop of Salisbury in 1219 as a replacement for the hill-top site at Old Sarum. Figure 8.1 shows the northern part of the town; the cathedral precinct lies south of street fg. Irregularities in the layout of the street, notably street EK, may be caused by pre-existing features and established ways through the common marsh and common field in which the town is believed to have been laid out (Rogers 1969:1). The four roughly parallel north-south streets (AG, Na, PY and HL) were laid out on a 16-pole unit and subdivided by east-west streets spaced mainly on the basis of a 20-pole unit. Distance fg (60 poles) is equal to one and a half furlongs in length.

At Salisbury the bishop stipulated that the standard plot was to measure 7 x 3 poles (Benson and Hatcher 1843:728) and from an examination of the street plan the town planner's method of achieving this can be detected. The streets are approximately two poles wide, leaving, in our standard east-west 16-pole unit, 14-pole wide blocks which were divisible into two seven-pole wide strips. Similarly, the north-south module of 20 poles would, after allowing for a two-pole wide street, enable six three-pole wide plots to be laid out. (The central north-south row of blocks, each 16 poles wide, was subidived off-centre to make seven- and nine-pole wide plots.)[6] Thus, from the historical evidence, the intended dimensions emerge; but, from the physical evidence, the efficiency of the medieval surveyor can be gauged. The latter is clearly demonstrated by the four nearly parallel north-south streets which converge southwards by one and a half poles over their entire length.

Turning now to Winchester the street system here (Fig. 8.2) is seen as being of Alfredian date (Biddle 1975:27). The north-south streets have clearly been laid out on a 16-pole unit, the accuracy of which at the High Street frontage appears to vary by as much as one and three-quarter poles. Much of the street grid south of the High Street has been obscured by royal and ecclesiastical buildings.

At London, a small part of the complicated street system was laid out as a neat grid of closely-set parallel streets apparently at eight-pole intervals.[7] These lie west of Fish Street Hill and Gracechurch Street (Fig. 8.3, WS and SE respectively) and are now partly obscured by later streets. Part of the southern frontage of Upper Thames Street seems to have been divided up on the basis of a 24-pole unit (XY and YZ). This is probably of a different period to the eight-pole street grid, particularly since the two areas were separated by the Roman town wall which survived until at least the late Saxon period (Hobley and Schofield 1977:45-51 and 59).

The Domesday Book records that between 1065 and 1086 Bury St. Edmunds had been extended over land previously ploughed and sown and had more than doubled its population (Beresford 1967:333-4). The gridded area of the town lies to the west of the monastery gate (Fig. 8.4). The main unit used in the grid here was 32 poles subdivided into lengths of 20 and 12 poles. The 32-pole unit is detectable not only north-south, i.e. BC/EF/NO and AB/LN, but also east-west, i.e. ac and ce. Although units based on four poles can be found along street SdX, the street curves considerably and may therefore relate to a boundary of the fields over which the town extension was built. The north-south streets converge northwards to such a degree that the modules detectable west of the monastery gate are lost. This distortion may be the result of constraints imposed on the new street grid by pre-existing boundaries.

Four phases of planning are now thought to be detectable in Colchester's medieval town plan (Fig. 8.6). The first of these represents the survival in small areas of the orientation of the buildings of the underlying Roman town and is apparently caused by the existence above ground of Roman structures in the post-Roman period. The second phase is concerned with most of the area within the town walls and was the major post-Roman organisation of the town's topography. The third involved the replanning of the southern frontage of the High Street so that a series of new properties extended up to a new back lane, subsequently known as Culver Street. This operation obliterated the underlying parts of the second phase of the street system. The fourth phase was caused by the construction of the castle which began c. 1075 and resulted in the High Street being diverted southwards around the new bailey defences (Crummy 1980).

The measurements shown in Figure 8.5 are to the nearest foot. The figures in brackets are the measurements expressed as poles correct to the nearest half pole.[8]

The phase of replanning at Colchester which concerns us here is phase two. To this period belong most of the measurements shown in Figure 8.5. A series of units based on 12 poles is detectable north of the High Street and east of North Hill. These are mostly accurate to within quarter of a pole of a multiple of the four-pole module although in some places (i.e. jk, lm) the discrepancy is as large as one pole. Along the northern frontage of the High Street a series of accurate multiples of the four-pole module is detectable, all within three feet or so of 40, 12 or 24 poles. West of North Hill-Head Street and south of Culver Street are areas laid out on a 40-pole unit. Like those along the northern frontage of the High Street, the two 40-pole units along Culver Street are within quarter of a pole of a furlong. These appear to have been further subdivided into units of 16 and 24 poles. The area between the High Street and Culver Street was replanned in phase three so that the phase two subdivisions have been lost. However, dimension EF is 108 poles and suggests that this area may have originally been subdivided on the basis of a 12-pole unit.

Some difficulties of interpretation

An imponderable difficulty is the local variations in land measurements. Local poles could vary from at least nine to twenty feet in length (O. E. D. sub pole) and it is possible that some of the street systems were not laid out with the standard 16^ ft long pole. However, that the latter was probably used for measurement in early English burhs is demonstrated by the marked correlation between the lengths of the defences of some of these <u>burhs</u> as indicated in the <u>Burghal Hidage</u> and as can be checked on the ground today (Hill 1971:91). This correlation is to within 1% at Winchester (Biddle 1970: 289), implying a pole within 2 in. of 16 i ft.

In the foregoing figures, a substantial degree of inaccuracy has been tacitly accepted in the measurements as they now appear on modern maps and there is therefore the danger of detecting measurements or 'modules' based on multiples of four poles where these do not exist. Moreover, where there is no consistency in the choice of the sides of the minor streets from which our measurements are taken, then spurious multiples of four poles are made even easier to find.

As an extreme example, if in any randomly arranged system as described above the margin of inaccuracy permissible is one pole and the streets are exactly two poles wide, then it is <u>always</u> possible to find a row of dimensions based on the four-pole module since the combined margins of inaccuracy at each side of each street provide a four-pole long distance within which multiples of four poles are bound to fall (Fig. 8.7). This example is important since the average width of the side streets examined here is about two poles. However, if the permissible margin of inaccuracy were reduced to half a pole, then the success rate at finding multiples of four poles would be reduced to 50% since the distances on the street frontage from which these dimensions can be measured are halved from four to two poles. This will hold true for all streets varying in width between one and three poles.

In general terms (Fig. 8.7), it can be stated that if the permissible margin of inaccuracy were x poles then a search for multiples of y poles will have a success rate of x 100% when y-2x> w >, 2x where w is the width of each Street. When w < 2x, this success rate equals 2x + w x 100%. If w >, y-2x, the calculation is more complex and not very Relevant to this present study.

The measurements here are reckoned correct to the nearest quarter of a pole. Thus, measurements taken as being to within half a pole either side of a multiple of four poles include those ranging up to within 5/8 of a pole. Therefore, on a theoretical basis, in a randomly arranged system, we would expect a success rate at finding false multiples of four poles to be 4 *4 8 x 100% = 62. 5%. This figure is high and underlines an in herent weakness of this kind of appraoch. Of the 118 measurements given here, 67% are to within half a pole of a multiple of four poles, a proportion not much higher (if at all) than that expected by chance.

However, the probability of finding n <u>consecutive</u> spurious dimensions which are to within half a pole, correct to the nearest quarter pole, of four poles, or a multiple thereof, is much less and is 0.625^n. Reverting to the general case, this can be stated as(y^)^n where y-2x> w > 2x. Furthermore, if the measurements are all taken from the same relative side of their respective streets, then the probability of finding n consecutive dimensions as described above is reduced to 0.3125^n. Again, in general terms, this can be stated as(£^)^n regardless of the value of wl Two good examples of this are provided by Winchester and the eight-pole grid at London, although in both cases the accuracy of the dimensions is not good, being to within if poles of a multiple of four poles. Despite these inaccuracies, the possibility of these arrangements being the result of chance is very small. In the case of the northern main street frontage of Winchester, laid out on a 16-pole unit, the possibility of finding seven spurious dimensions of this size, or multiples thereof, measured from the same side of each street and accurate to within If poles is$(- \wedge j \wedge)^7 = 0.2188^7 = 0.00002$.

In general, some of our measurements could relate to areas of land left over after the town planner had designed for an irregular site a town based on four-pole modules, a situation which must have been the norm rather than the exception. Good examples of these 'remnant' and therefore spurious measurements are probably IJ and FG at Salisbury.

Another difficulty when examining street systems is that some of the planning in a town could be confused with the piecemeal use of four-pole multiples in subsequent redevelopments of small areas. This problem is especially relevant in towns such as Colchester where there is no distinctive repetition of the same measurements such as the 16-pole unit at Winchester or the 16- and 20-pole units at Salisbury. The widespread use of four-pole multiples in land surveying could tend to obscure the original layout of planned towns, although whether in extreme cases this could give a false impression of town planning where this does not exist is problematic.

Conclusions

The analysis of town plans in the manner above has only just begun. Despite the superficially analytical approach of this study, the assessment of the validity of our four-pole module and therefore the act of planning itself is here largely subjective. In essence, the difficulty is how to recognise multiple units as such when their variations in length can be large by comparison with the basic module, whether or not this be four poles. A more rigorous approach, whatever its form, would entail tabulating for each town plan all possible dimensions consistent with predetermined criteria (e.g. those only along street frontages) and examining these figures statistically for non-random components rather than as here prejudging the issue and looking for dimensions little better than intuitively guessed at beforehand. There is furthermore the question of burgage plot sizes. As at Salisbury, these may form an integral part of the overall plan and therefore where possible these also need to be studied in detail.

Nevertheless, it does seem that the planning of classic early medieval towns such as Salisbury and New Winchelsea,[9] and late Saxon towns of which Winchester is the key example, can be placed more firmly in the same tradition. Their common roots are explicit in their common systems of land division and measurement. Further study of town planning may reveal significant regional and temporal differences. For example, subject to appropriate detailed study of their street layouts, a distinctive 'Wessex-style' plan based on 16-pole units can be postulated at the southern towns of Chichester. Wareham and Wallingford as well as Winchester. That this type seems confined to towns listed in the Burghal Hidage supports a pre-lOth-century date but its absence at places such as Exeter and Colchester suggests that different circumstances may lie behind the origins of these town plans.

Finally, by way of a postscript, there remains to be considered the circumstances whereby pre-existing towns could be replanned. Towns were built or expanded over vacant fields, as at Salisbury and Bury St Edmunds repectively, but to replace an occupied town centre, with its buildings and properties, must have been quite a different matter. Conditions were perhaps only right in the latter case if the built-up areas had been destroyed by a catastrophe. Fire damage, whether accidental or the result of a Danish attack, for example, could provide contexts for the replanning of large parts of towns such as period 3 at Colchester or the eight-pole planning in London. Could Winchester perhaps have been entirely replanned after the Danish attack on the city c. 860, a date consistent with the archaeological evidence but before Alfred?

Acknowledgements

I am grateful to Bob Moyes who drew for publication the plans of Colchester and to Stephen Crummy for the other street plans. I am also indebted to Mr. J. Doran and Mr. M. Biddle for their helpful comments about the text. Finally, thanks are due to Ian Jenkins who saved me a trip or two to the British Library.

Notes

1. Statutes of the Realm, 1811, sub measurement.

2. E.g. c. 1450 (O.E.D. sub rod), 1523 (O.E.D. sub perch) and, of uncertain date, Compositio Ulna rum et Perticarum (Statutes of the Realm, 1811, sub measurement.

3. It would be useful to check some of these measurements on the ground. The margin of error assumed here may well be too low. There is too the problem of encroachments and other changes in the positions of street frontages caused by rebuilding. Where these are obvious, allowances in the measurements taken have been made e.g. H at Winchester (Fig. 8.2) and E, M and R at Salisbury (Fig. 8.1).

4. Streets laid out on sloping land will appear shorter on plan than they really are, but the errors introduced by this effect are slight. As a very extreme example, an error of 2% will be introduced on plan by a slope of one in five. In the case of a one in ten slope, the error is less than \%.

5. A good illustration of this is to be found at Salisbury where the north-south streets NRUXa and PSVY (Fig. 8.1) were formed out of the east and west 16-pole wide blocks respectively, leaving the central one intact (see below),

6. See map in Rogers 1969. The north-south boundary is shown here in Figure 8.1.

7. Figure 8.3 is based on the plan of the medieval city as shown in Biddle and Hudson 1973 with the later streets omitted.

8. Although the plan is based on the modern 1:1250 Ordnance Survey maps, it has been altered to incorporate information lost by redevelopment but surviving at the time of the 1875-6 series of Ordnance Survey maps. The

latter series could not be used as the basis of the figure since, according to the recent large-scale Ordnance Survey maps, many of the dimensions are slightly inaccurate.

9. Although not studied in detail, New Winchelsea appears to have been laid out on the basis of 20 poles (east-west) and 24 poles (north-south).

References

Barley, M. W. (ed.), 1975. The Plans and Topography of Medieval Towns in England and Wales, CBA Research Report no. 14.

Benson, Robert and Hatcher, Henry, 1843. 'Old and New Sarum' part 2, a volume from The History of Modern Wiltshire by Sir Richard Colt Hoare.

Beresford, Maurice, 1967. New Towns of the Middle Ages.

Berriman, A. E., 1953. Historical Metrology.

Biddle, Martin, 1970. 'Excavations at Winchester, 1969: eighth interim report' in Antiquaries Journal, 50 (1970):277-326.

Biddle, Martin, 1975. 'The evolution of towns: planned towns before 1066' in Barley 1975:19-32.

Biddie, Martin, 1976. 'Towns' in Wilson 1976:99-150.

Biddle, Martin and Hill, David, 1971. 'Late Saxon planned towns' in Antiquaries Journal, 51 (1971):70-85.

Biddle, Martin and Hudson, Daphne, 1973. The Future of London's Past.

Crummy, Philip, 1980. Aspects of Anglo-Saxon and Norman Colchester, forthcoming.

Hill, David, 1071. 'The Burghal Hidage: the establishment of a text' in Medieval Archaeology, 13 (1969):84-92.

Hobley, Brian and Schofield, John, 1977. 'Excavations in the City of London: first interim report, 1974-5' in Antiquaries Journal, 57 (1977):31-66.

Lobel, M. D, (ed.), 1969. Historic Towns.

O.E.D. Oxford English Dictionary.

Rogers, K. H., 1969. 'Salisbury' in Lobel 1969.

Wilson, David M. (ed.), 1976. The Archaeology of Anglo-Saxon England.

Fig. 8.1 Salisbury

Measurements (in poles and grouped by areas as appropriate)

AB	24+|
BC/HI	20-1/20-1
CD	20
DE/JK	20/20+f
EF/KL	40+^/40+i
FG	20+11
MN/CR/TU/WX/Za	16-1/16+^/16+1/16/16
NP/RS/UV/XY	16+i/16+|/16+|/16-i
PQ/SI/VJ/KY	16+l|/16+|/16+ii/16-!
MQ/CI/T J/WK/Z L	4 8+f/4 8+|/4 8+|/4 8-|/4 8-f
be	20+i
de	24
fg	60
IJ	36-1

Differences between each measurement and the nearest multiple of four poles:

differences (in poles)	no.	
0	6	
1	9	20
i	5	
2 3	5	
4	-	
1 or more	6	
Total		31

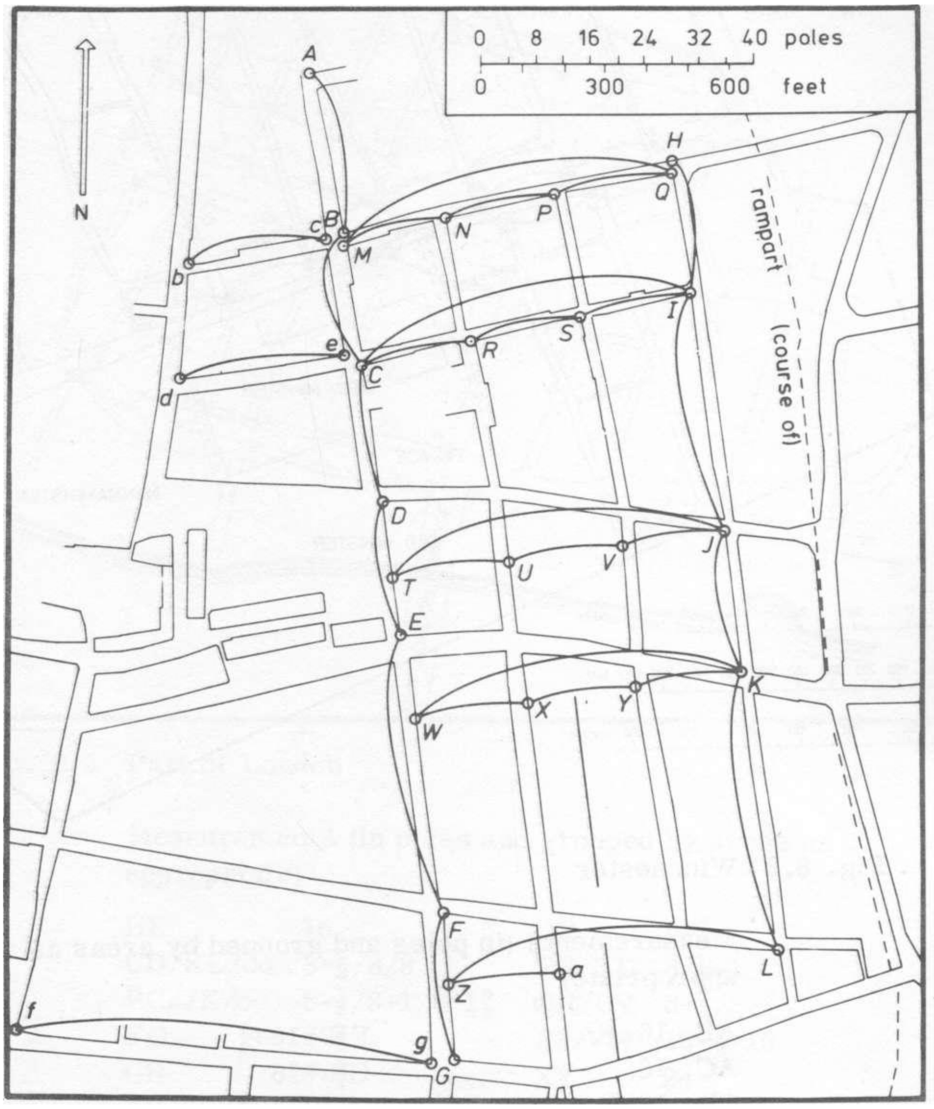

Fig. 8.1 Part of Salisbury (extended caption opposite)

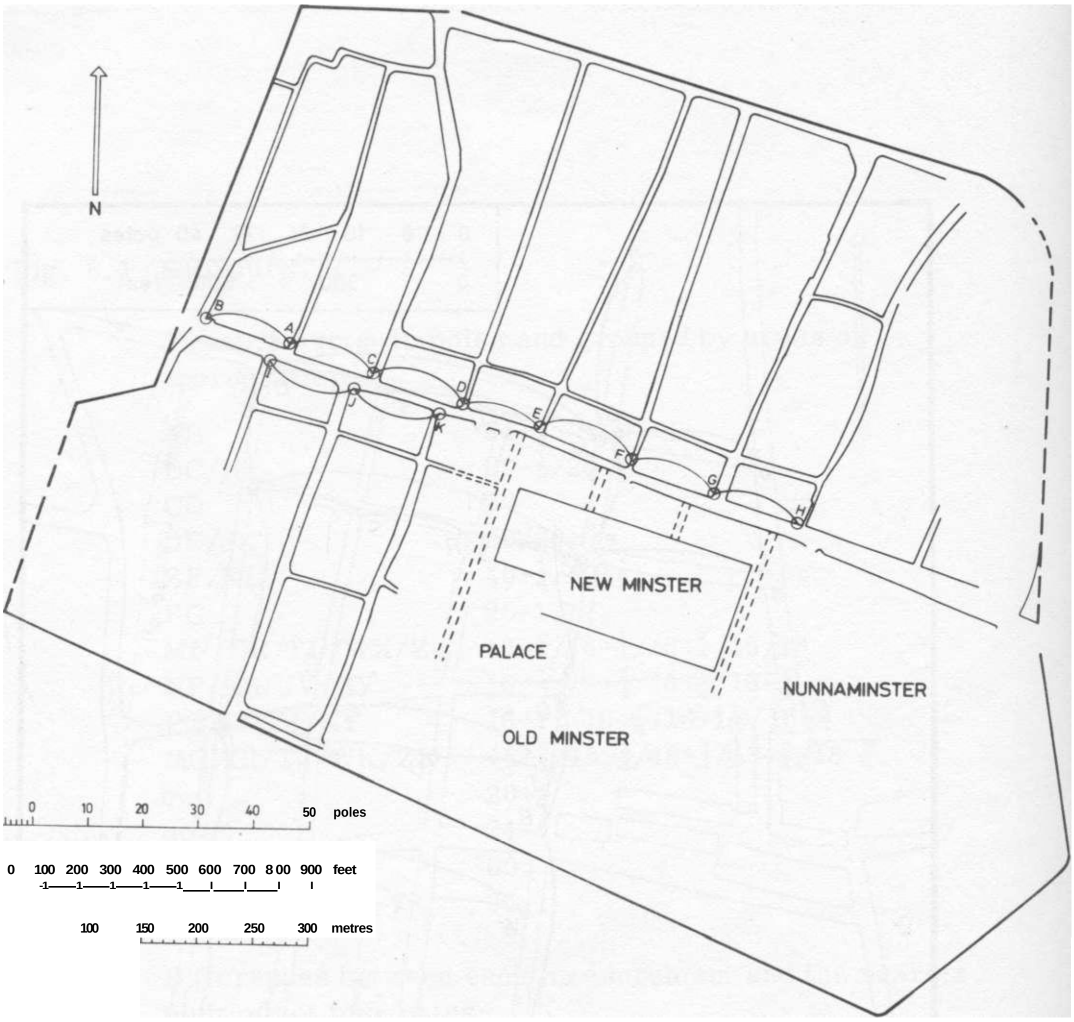

Fig. 8.2 Winchester

Measurements (in poles and grouped by areas as appropriate)

AB	16-i	FE	**164**
AC	16	GH	16
CD	16+1	IJ	16-^
DE	16-lf	JK	16+^
EF	16+1		

Difference between each measurement and the nearest multiple of four poles:

differences (in poles)	no.
	2
I 4	3
JL 2	1
3 4	0
1 or more	3

Total

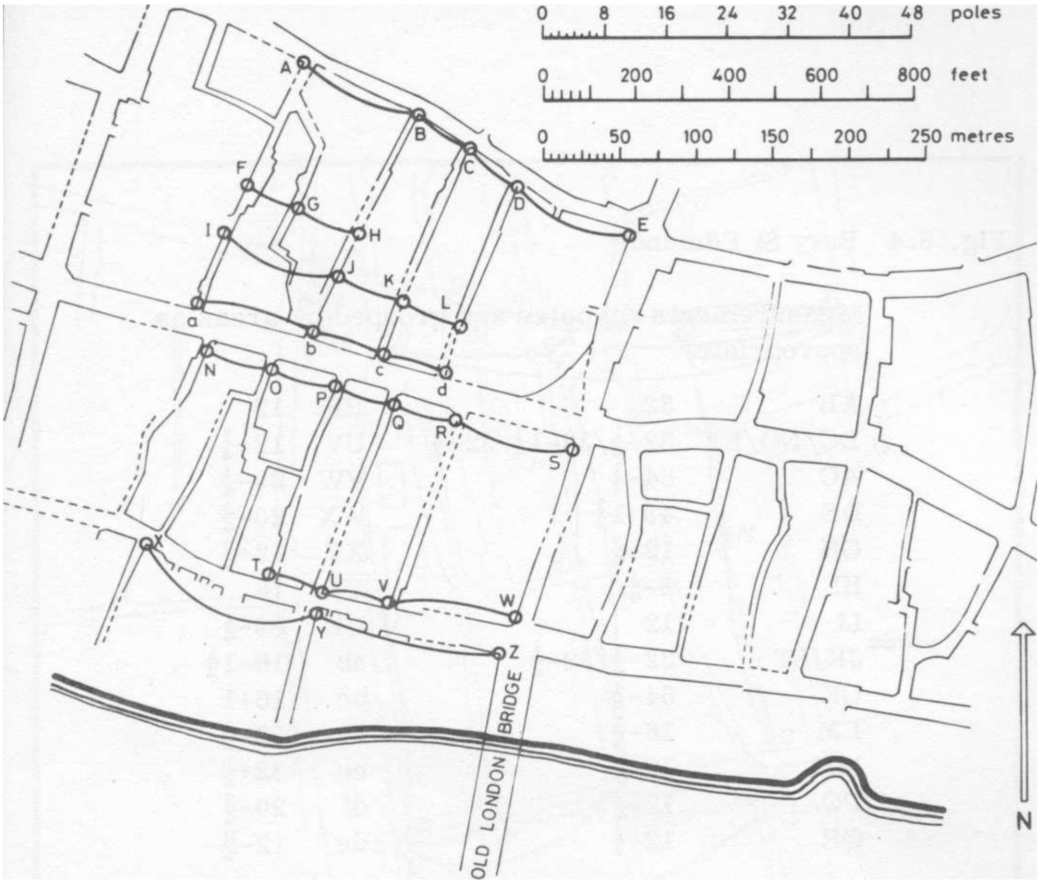

Fig. 8.3 Part of London

Measurements (in poles and grouped by areas as appropriate)

DE	16	OP	8+£
CD/KL/cd	8-i/8/8	PQ/TU	8/8-1
BC/JK/fcc	8-|/8+l/8+l|	QR/UV	8+£/8+£
FG	8-|	RS/VW	16-1/16
GH	*8+h*	XY	244
AB/IJ/ab	16/16/16-1	YZ	24
NO	8+|		

Differences between each measurement and the nearest multiple of four poles:

difference (in poles)	no.	
0	8	
1/4	3	15
1/2	4	
3/4		
1 or more		
Total		22

Fig. 8.4 Bury St Edmunds

Measurements (in poles and grouped by areas as appropriate)

AB	32	RS	12
BC/NO/EF	32-|/32-l|/32-i	UV	12+|
AC	64-^	VW	20-i
DE	48+l£	WX	20-f
GH	12+|	XY	12+|
HI	8-4	YZ	16
IJ	12	uz	80-i
JK/ST	32-4/32-1	ab	16-l|
GK	64-i	be	16+1
LM	16-£	ac	32-|
MN	16	ce	32+i
PQ	12+i	df	20-f
QR	12+|	de	12-|

Differences between each measurement and the nearest multiple of four poles:

differences (in poles)	no.	
0	5	
\	8	20
\	7	
4	5	
1 or more	4	
Total		29

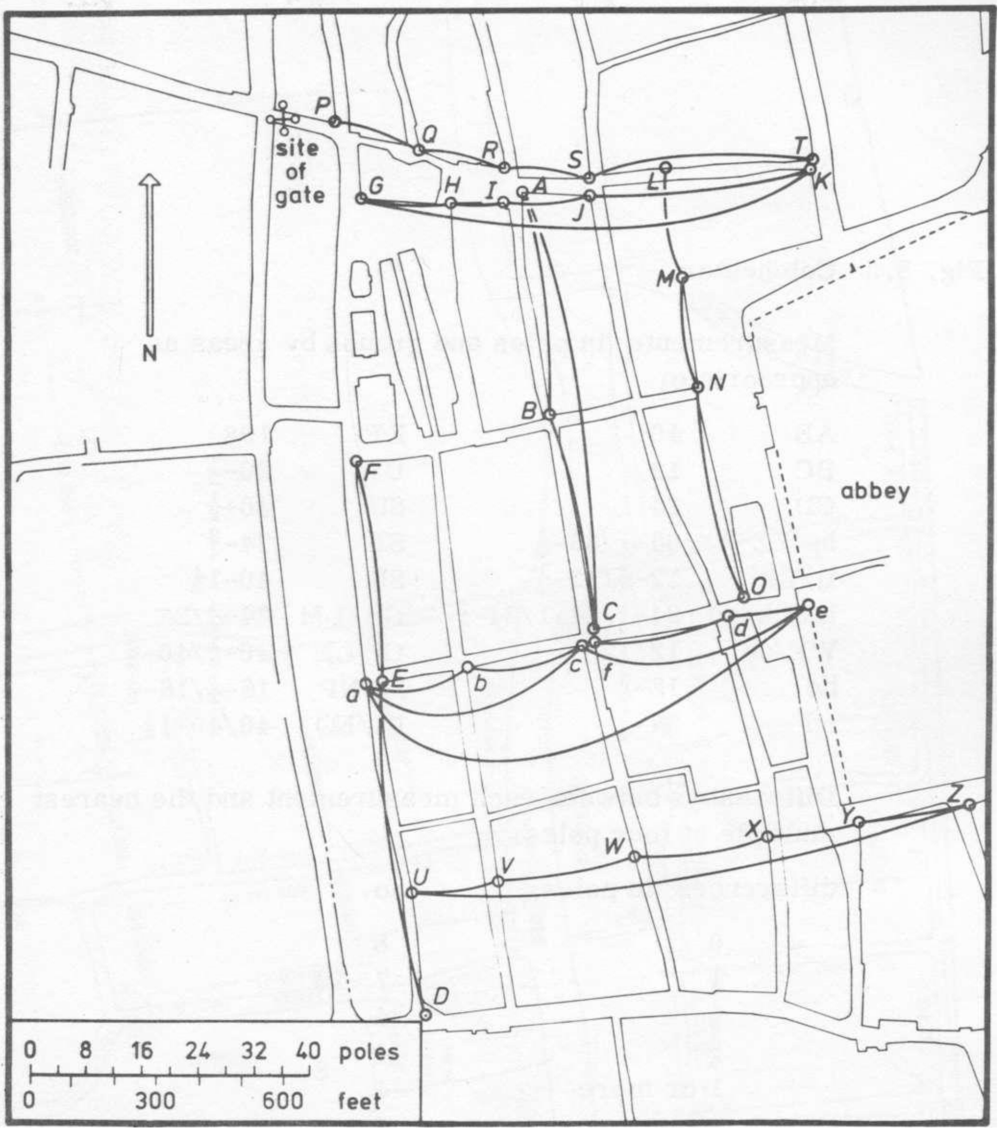

Fig. 8.4 Bury St. Edmunds (extended caption opposite)

Fig. 8.5 Colchester

Measurements (in poles and groups by areas as appropriate)

AB	40	EF	108
BC	12	UV	20-£
CD	24	SU	40+£
hi/YZ	36+4/36-"I 4	ST	24-|
ij/Za	12-4/12-"1 4	SR	40-lJ
lm/jk/ac	24-1/24--1/24-f	GH/LM	24+^/24
WX/ab	12/12	GI/LN	40-4/40-f
be	12-|	IJ/NP	ie-i/i6-i
cd	36-4	IK/NQ	40/40+14

Differences between each measurement and the nearest multiple of four poles:

differences (in poles)	no.	
0	8	
i 4	7	19
1 2	4	
3 4	4	8
1 or more	4	
Total		27

co

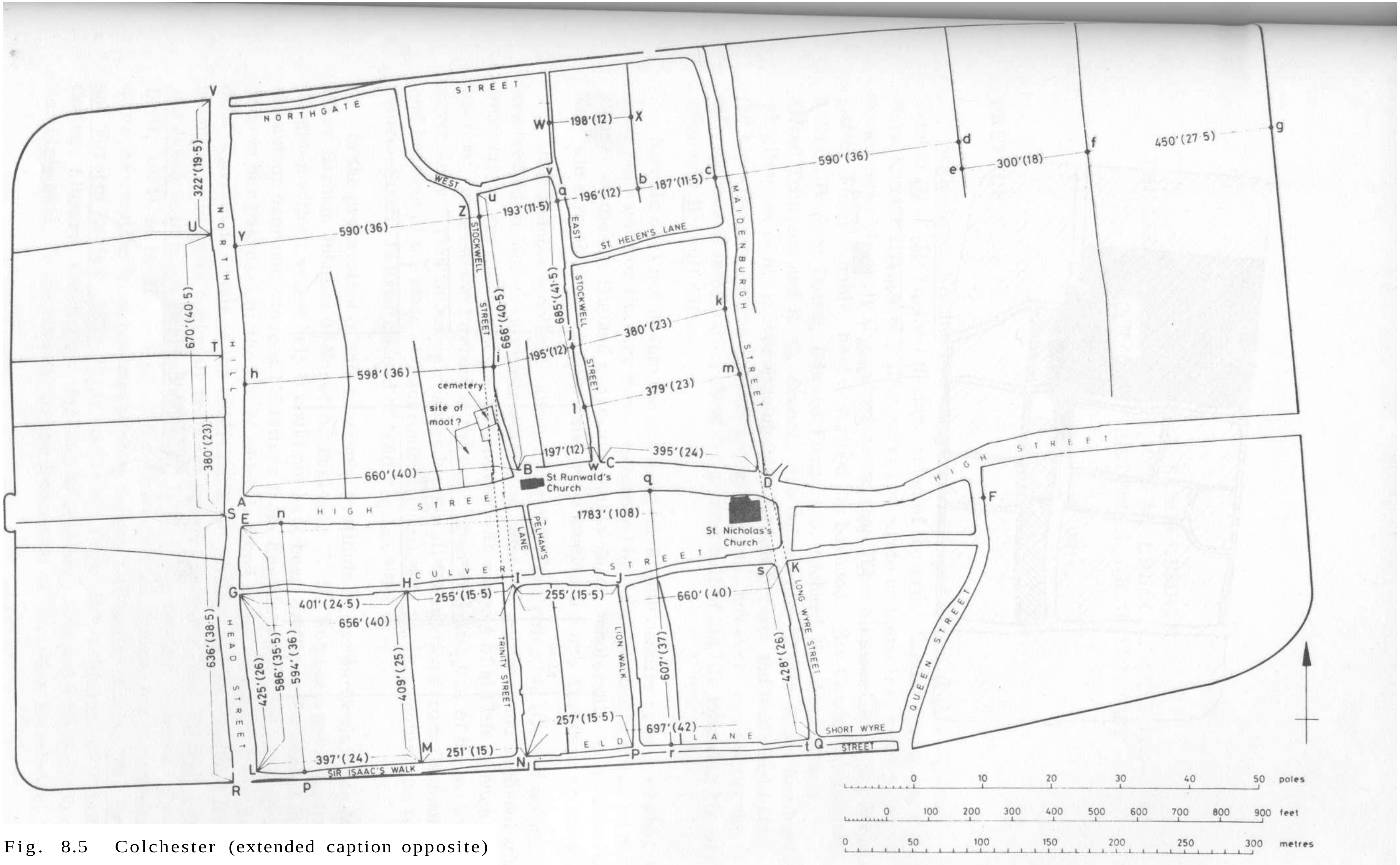

Fig. 8.5 Colchester (extended caption opposite)

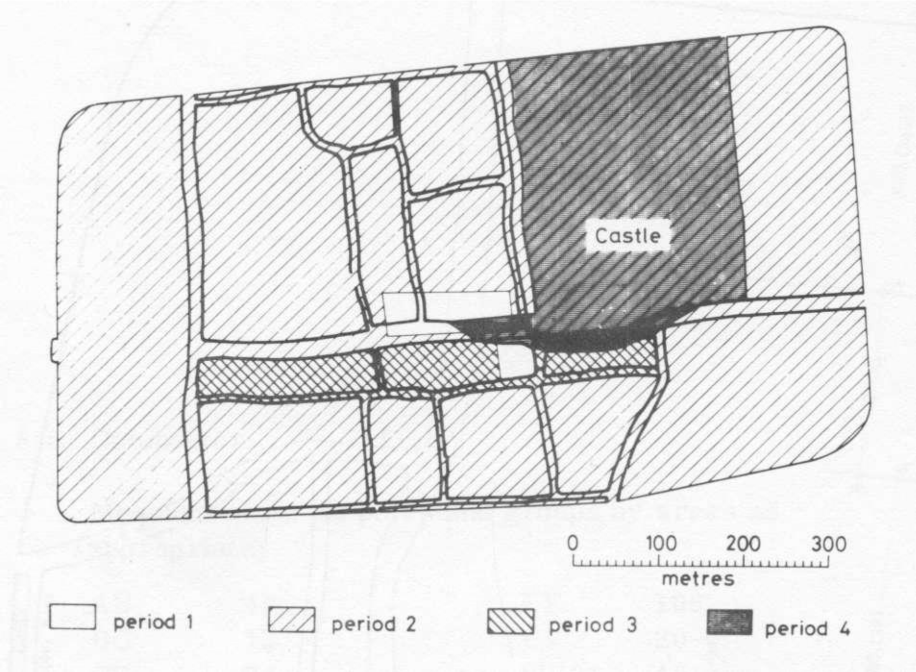

Fig. 8.6 Colchester

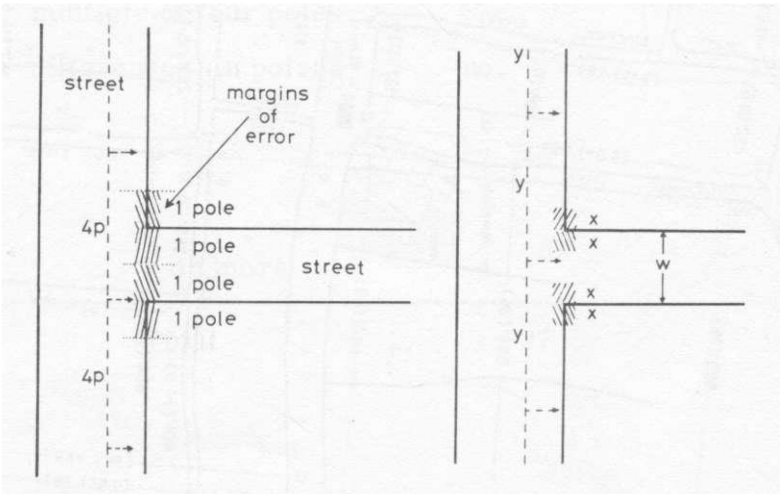

Fig. 8.7 Margins of Error