

A Pre-Norman Field-System at Hen Domen, Montgomery

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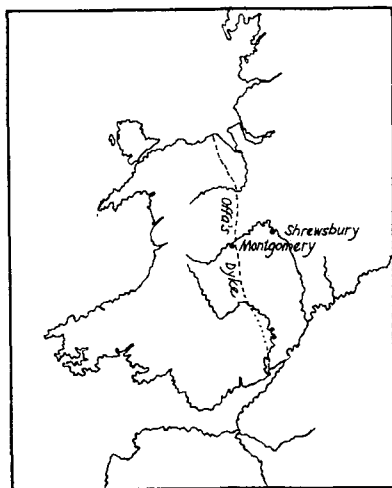
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SURVEY of a field immediately north of the early Norman motte-and-bailey castle of Hen Domen, Montgomery, revealed ridge-and-furrow, averaging 4 m. in width, cut by the outer ditch of the bailey. Excavation demonstrated that the ridge-and-furrow extended under the inner rampart of the bailey. Pollen analysis of the buried soil showed the former presence of cereals and the weeds of cultivation. A Carbon-14 date from charcoal in the buried soil reinforced the view that this field-system was in use before the Norman conquest.

THE ARCHAEOLOGICAL EVIDENCE

By Philip Barker



Scale 0 50 100 miles

FIG. 13

MAP SHOWING LOCATION OF HEN DOMEN, MONTGOMERY (p. 58)

EXCAVATION of the motte and bailey of Hen Domen, Montgomery, has been in progress since 1960.¹ The castle lies on a ridge of boulder clay a mile north-west of the town of Montgomery (PL. IV; FIGS. 13, 14) and overlooks the ancient ford of the Severn known as Rhydwhyman. The area was settled at least by neolithic times,² but being at the junction of the valleys of the Severn and the Rea-Camlad, and therefore on easily traversed north-south and east-west routes, it was inevitably and constantly fought over, so that settlement can rarely have been peaceful. Sir Cyril Fox showed, in his survey of Offa's Dyke, that alignments of the central sector of the Dyke suggested the presence of arable land at a date before the Dyke was constructed in the late 8th century.³ It cannot be shown whether this arable was then being

¹ Interim reports will be found in *Med. Archaeol.*, v (1961), 322; vi-vii (1962-3), 326; viii (1964), 262; ix (1965), 193; x (1966), 196; xi (1967), 290; xii (1968), 182; in *Current Archaeol.*, v (1967), 133-6; and in *Château Gaillard*, iii (1969), 15-27.

² B. St. J. O'Neil, 'Excavations at Ffridd Faldwyn camp, Montgomery, 1937-39', *Archaeol. Cambrensis*, xcvi (1942), 1-57, esp. p. 9.

³ Sir Cyril Fox, *Offa's Dyke* (London, 1955).

THE MONTGOMERY REGION

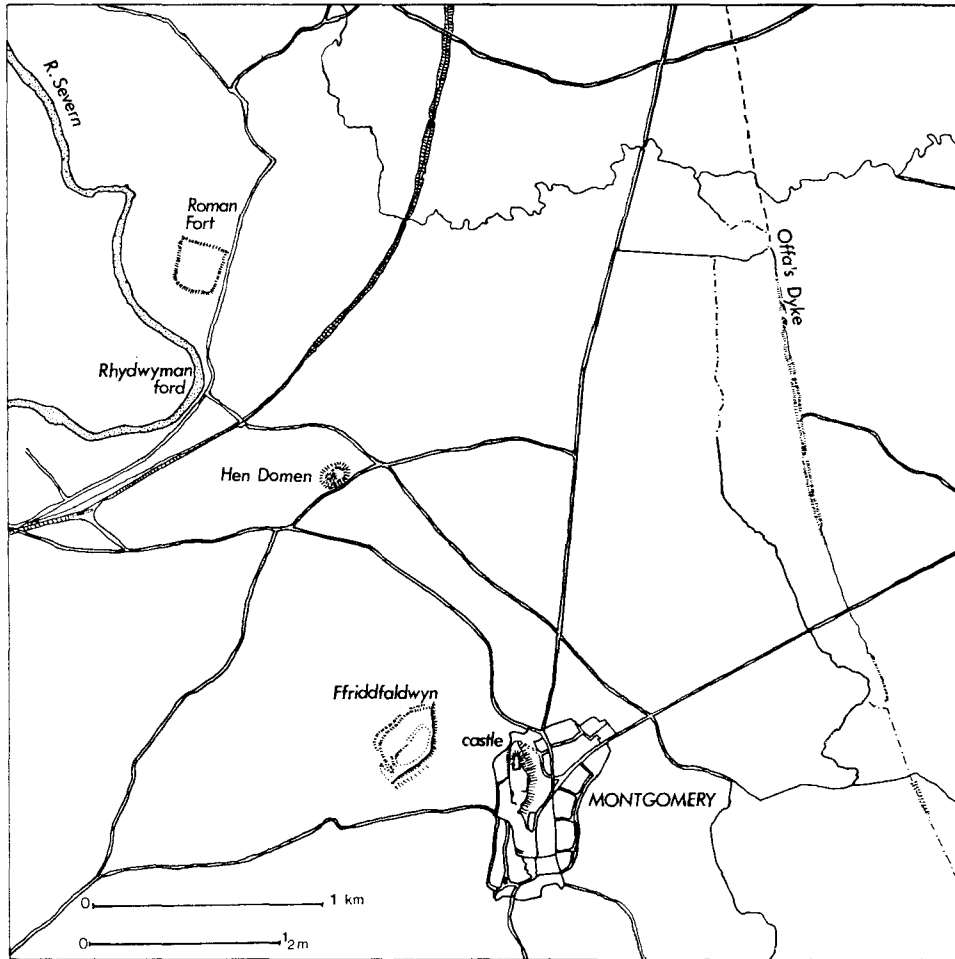


FIG. 14

MAP OF THE MONTGOMERY AREA

showing the situation of Hen Domen Castle, the line of Offa's Dyke, and other local features (p. 58f., 66)

farmed by Welsh or Saxons, or by a mixture of Saxon landholders and Welsh tenants (it is perhaps unlikely to have been the other way round), but within the next two centuries the area round what was to become Montgomery was settled in nucleated villages and hamlets with Saxon names, many of them, significantly, on the Welsh side of the Dyke (FIG. 14).⁴ The subsequent history of this edge of the kingdom of Powys, lying between the Dyke, the political boundary, and the Severn, here for a few miles the natural border, is difficult to follow, but the retrospective evidence of Domesday Book is unequivocal.

⁴ Domesday Book, fol. 254, a, 1 (most conveniently found in *V.C.H., Shrop.*, 1, 316, 318). The documentary evidence will be discussed by James Lawson in the first report on the excavations (in preparation):

At the end of the reign of Edward the Confessor twenty-two of the surrounding vills with 52½ hides of arable were waste, and were being used by three Saxon thegns as a hunting ground.⁵ The context of these desertions is unknown; they may perhaps be connected with the rise to power of Gruffudd ap Llywelyn in 1039, though it is possible that Welsh raids had made the area untenable before this. Thirteen of these vills were still waste in 1086, though the other nine had recovered and were worth a hundred shillings.⁶

In this waste Roger de Montgomery, first earl of Shrewsbury, built a castle which he named Montgomery from the town in Normandy from which he came.⁷ The identification of the motte-and-bailey castle at Hen Domen as Roger's castle of Montgomery has recently been challenged,⁸ and it is hoped that work now being done on the documentary, place-name and field-name evidence will finally resolve the problem. However, this identification does not affect the validity of the conclusions drawn here that the adjacent and under-lying field-system at Hen Domen is earlier than the Norman conquest, since it is clear from the excavations of the last ten years that the castle must have been built in the years very soon after the conquest. The earliest periods of occupation are almost completely aceramic, producing only two or three sherds of Stamford ware. Elsewhere in Shropshire and the border pottery appears to be in widespread use by 1125-50, so that a date before 1100 seems certain for the foundation of Hen Domen.⁹

During the course of the work on the castle the surrounding fields have been closely examined, since there is some documentary evidence¹⁰ which suggests that there was a settlement attached to the castle. While this settlement has not yet been found, it was noticed, during the field-work in the area, that the fields immediately north and north-east of the castle (A and B on FIG. 15) show faint, though distinct, traces of ridge-and-furrow. In field A (PL. IV; FIG. 16), the field surveyed in 1969, the ridges appear to the eye to run up to the very low outermost bank of the castle earthworks and to be cut by the outermost ditch, leaving no room for a headland in which the plough-team could turn. This implies that the ditches and banks of the castle overlie and are thus later than the ridge-and-furrow. In field B, which has not yet been surveyed, the ridging is rather different and runs downhill from a curved, slightly hollow way that approaches the castle and swings away from it again. The relationship between this ridging and the castle cannot, therefore, be demonstrated.^{10a}

In 1968, during excavation of the rampart on the N. side of the bailey, a section was cut through the rampart and the buried soil beneath to the under-lying

⁵ *Locc. cit.* in note 4.

⁶ *Ibid.*

⁷ *Ibid.*

⁸ By Mr. Frank Noble, in a duplicated broadsheet.

⁹ P. Barker, *The Medieval Pottery of Shropshire* (Shrewsbury, 1970), p. 41.

¹⁰ To be published in detail by James Lawson (see note 4).

^{10a} In 1971 the owner of the farm sprayed the fields surrounding the castle with weed-killer. For the first time, therefore, the area lying between the castle and the present farm of Hen Domen could be closely examined and Mr. Michael Aston recognized four terraced platforms lying two on either side of the hollow way (a, FIG. 15), close to the present road. Their position can be seen on PL. IV. It is possible that these platforms are those of the pre-Norman settlement whose inhabitants were responsible for the ploughing described in the present article, though it is also possible that they are contemporary with the castle. This new problem can be solved only by excavation.

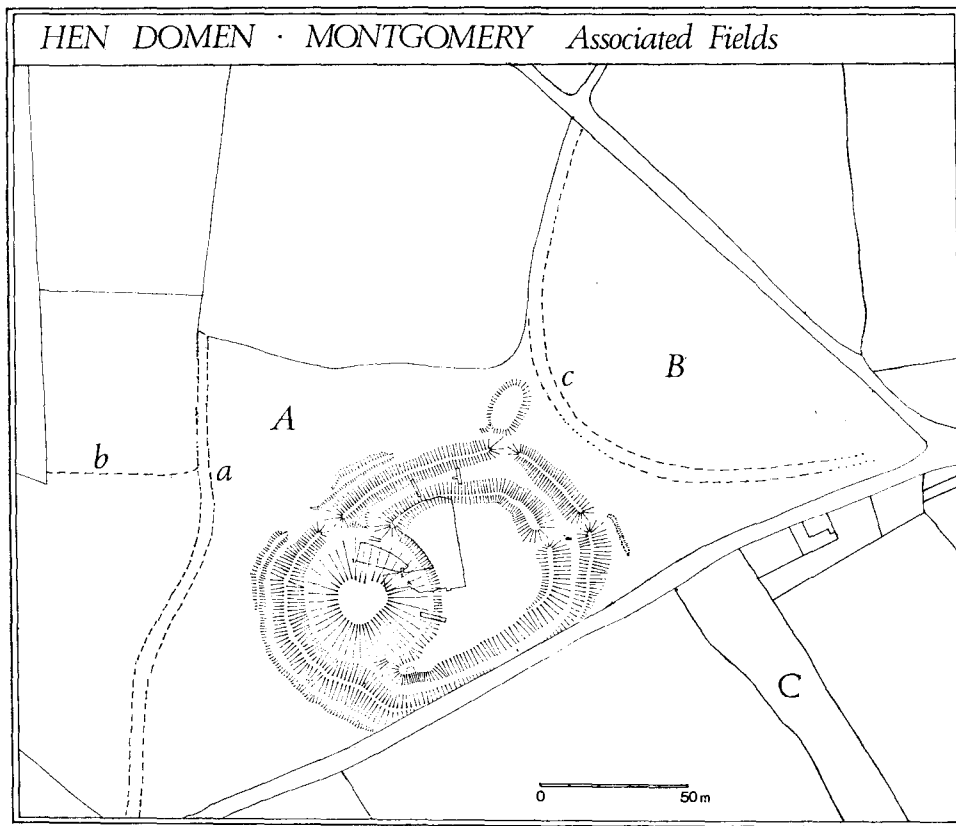


FIG. 15

The site of the castle, with surrounding fields (A, B), the hamlet of Hen Domen (C), hollow ways (a, c) and an old field-boundary (b) (pp. 60f., 63)

boulder clay. When the surface of the clay was cleaned plough-marks running approximately north-south were revealed (FIGS. 16, 18 and 19). This, coupled with careful measurement of the thickness of the buried soil (FIG. 18, sections a-b-c-d, b-e, c-f, d-g), suggested strongly that the rampart overlay former arable. Since the plough-marks lay more or less in line with what had been seen of the ridge-and-furrow in field A, the theory that they were all part of one field was strengthened.

In 1969 Mr. and Mrs. John Sellers offered their services as surveyors, and the opportunity to test the theory was gladly taken. Mr. and Mrs. Sellers took 3263 levels on a 1-metre grid over the area of field A shown in FIGS. 15 and 16. Contours at 20-cm. intervals were then interpolated and the ridge-and-furrow became immediately apparent as a ripple across the surface of the field (FIG. 16; see also FIG. 19). It will be seen that the ridging changes direction in the NE. corner of the field, where the slope falls off to the east, and that this area is cut across by a modern footpath. The ridges are fairly consistently 4 m. wide and, though sinuous, do

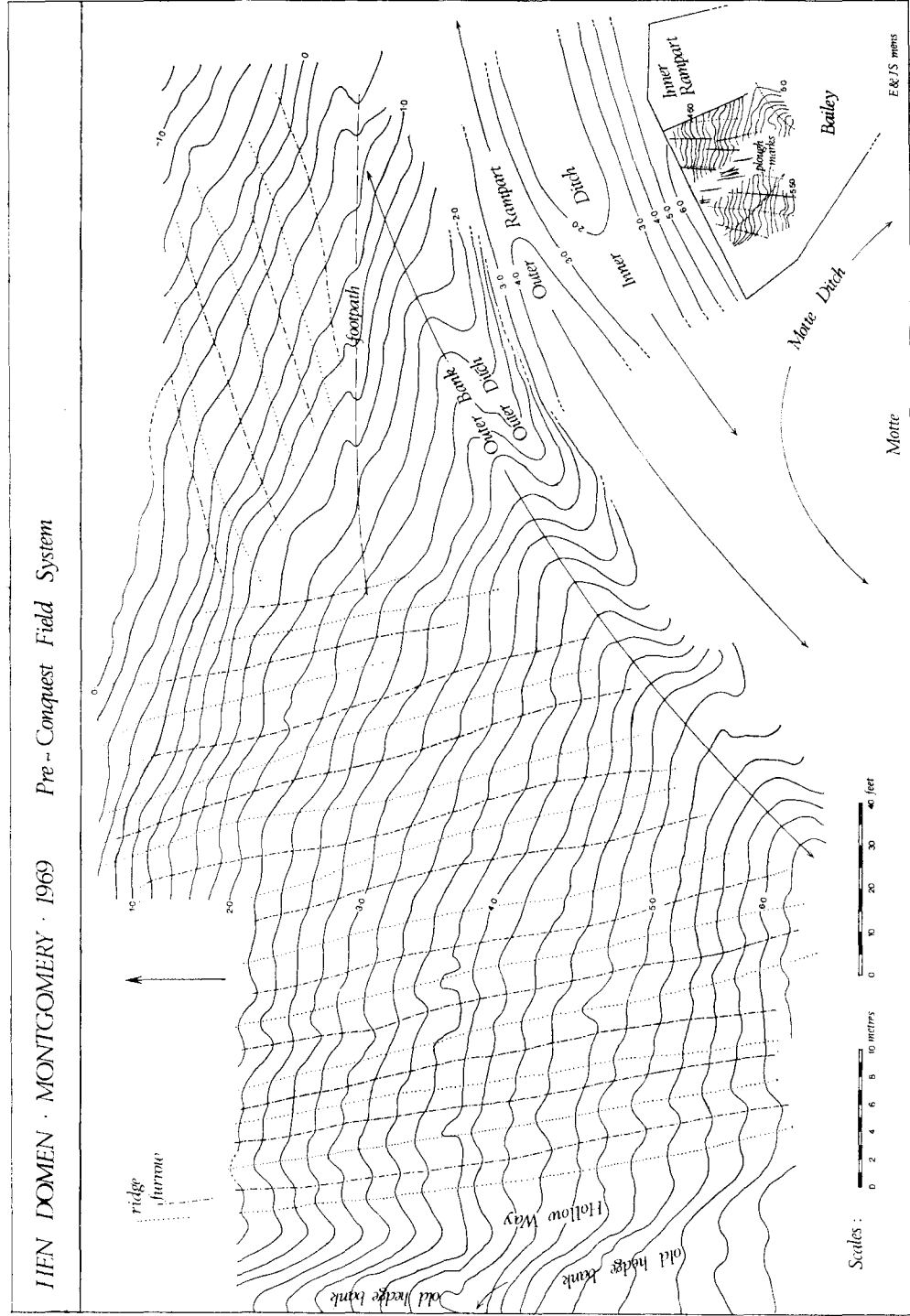


FIG. 16

Contoured survey of field A, illustrating the pre-conquest field-system (p. 6of.)

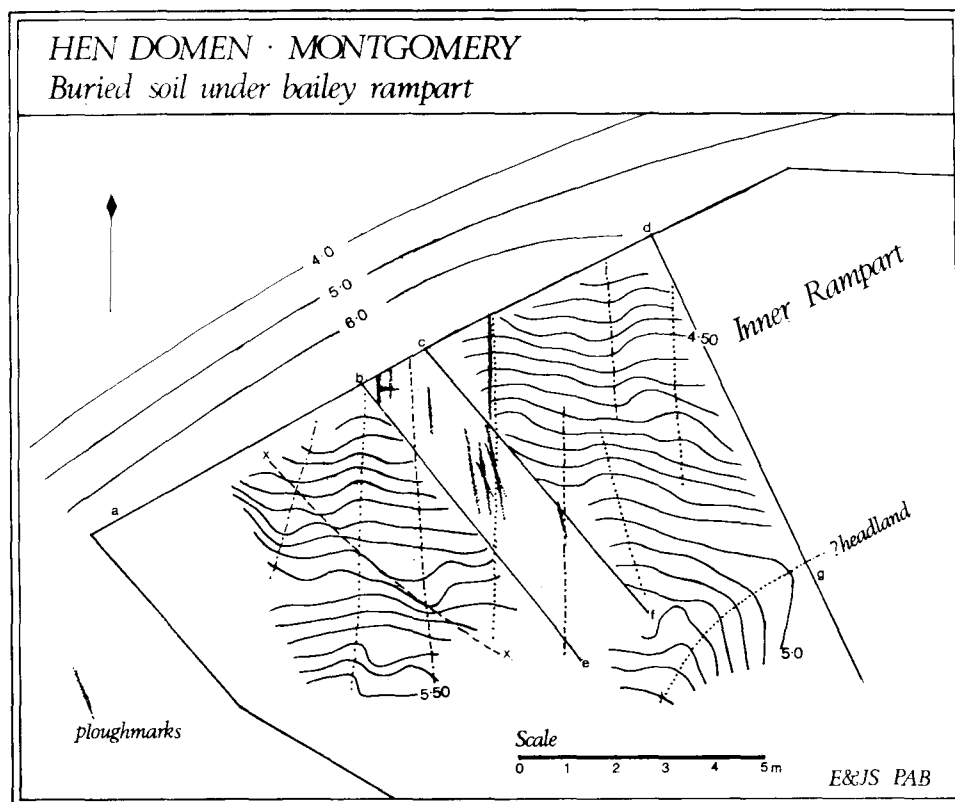


FIG. 17

Contoured survey of the area of soil revealed under the rampart of the bailey (p. 63)

not have the familiar long reversed-S shape of the massive ridges of the midlands.¹¹

Field A is bounded on the west by a hollow way (PL. IV; and a, FIG. 15) which passes the castle and is cut by the modern road. Since the pre-conquest ridge-and-furrow lies parallel to this hollow way, it is possible that the hollow way itself existed before the conquest. Most of the other field-boundaries near the castle appear to be modern.

Following up the discovery of the plough-marks under the bailey rampart, a larger area of the rampart was stripped down to the surface of the buried soil. This surface was cleaned with meticulous care and levelled, the contours being drawn at 5-cm. intervals. As will be seen from FIG. 17, the buried soil lay in ridges parallel to the under-lying plough-marks, though there had been some disturbance, perhaps when the castle was being built. The ridge lying from north-east to south-west under the tail of the rampart may be the remains of the headland, which would have been likely to have been here along the crest of the ridge. When the

¹¹ However, some field-boundaries running downhill south of the present hamlet of Hen Domen (C on FIG. 15) are reversed-S in shape and these will be investigated as part of the documentary and topographical background to the site. It seems likely that they belong to some date after the time when the castle was founded.

HEN DOMEN · MONTGOMERY
 Axonometric diagram of sections of buried soil under bailey rampart

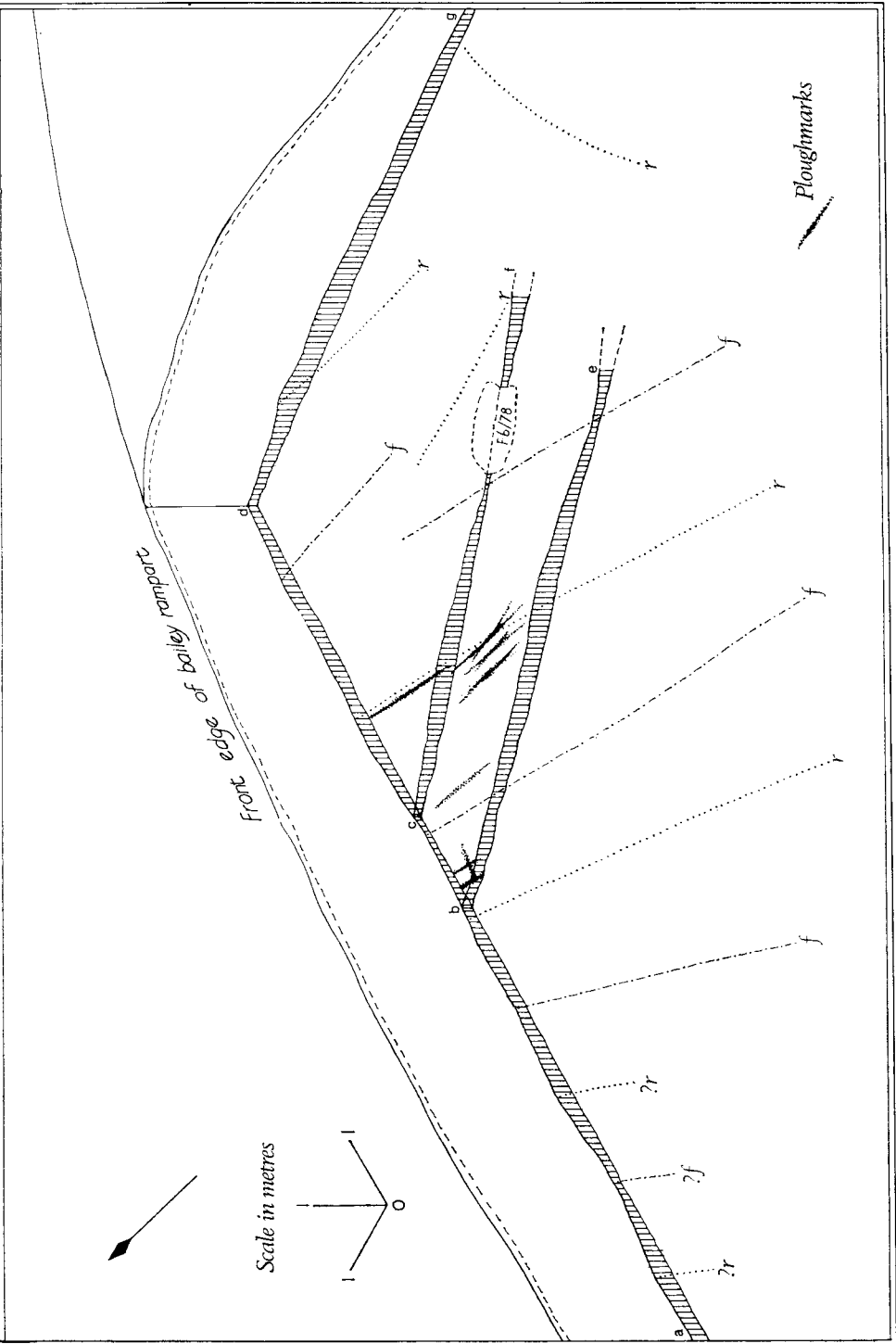


FIG. 18 (pp. 61, 65). The vertically shaded layer is the plough-soil buried under the rampart. f = furrow; r = ridge; F6/78 is a later pit.

buried soil was removed from half the excavated area, further plough-marks aligned in the same direction became apparent. Measurement of the varying thicknesses of soil buried beneath the rampart reinforces the evidence for the early field-system. As will be seen from the sections (FIG. 18), the surface of the buried soil undulates while its base remains more or less level. The ridges are approximately 30 cm. high at their maximum and fall to approximately 10 cm. in the furrows, though it will be appreciated that here the soil has been compressed for 900 years under a massive boulder-clay rampart, and a compression-factor of at least 20 per cent can be assumed.¹²

Finds from the buried soil were very few indeed, consisting of a few small abraded Roman sherds, one of them apparently carved into a crude amulet, with a knife-cut groove made for it to be hung, presumably round the neck. A large rectangular post-hole building, found below the buried soil under the rampart, also produced no finds of any kind. Not only, therefore, are the earliest periods of the castle aceramic, but it appears that the inhabitants of the area used no pottery for many centuries before the building of the castle.

Samples taken from the buried soil were submitted to Dr. Peter Moore, of the Botany Department, King's College, University of London, who contributes a report on the pollen in Appendix I (p. 69f.). His analysis suggests the presence of an abandoned arable area which had possibly been used for growing cereals, situated in a landscape which had been largely cleared of forest, particularly in the valleys.

The raw level figures from field A were given to Miss Susan Laffin of the Computer Centre, University of Birmingham. One of the resultant three-dimensional plots is reproduced in FIG. 19. It provides independent and objective confirmation of the contour plot.

DISCUSSION

The existence at Hen Domen of a field-system involving ridge-and-furrow that is earlier than the castle, and therefore presumably earlier than the conquest, is attested by the following evidence:

- a* A contoured survey of field A north of the castle demonstrated the presence of ridge-and-furrow averaging 4 m. in width running approximately north-south, with a smaller number of strips running east-west. The N.-S. ridge-and-furrow is cut by the outermost bank and ditch of the bailey defences of the castle.
- b* Survey of the soil buried beneath the bailey rampart revealed ridge-and-furrow of about the same width, running north-south.
- c* Sections of the buried soil showed that the ridge-and-furrow does not reflect undulations of the subsoil, but that the buried soil varies in thickness along the lines of the ridge-and-furrow. The height of the ridges above the furrows is now of the order of 20 cm., though a compression-factor of some 20 per cent must be assumed.

¹² I am grateful to Mr. Peter Barker for discussion of this point.

- d The undisturbed boulder clay beneath the buried soil was scored with plough-marks approximately in alignment with the ridge-and-furrow above.
- e Pollen analysis of samples from the buried soil implies the existence of former arable.
- f The archaeological evidence is supported to a remarkable degree by the documentary evidence.

Whilst a number of examples of early ploughing with or without ridging are known both in Britain and the continent, it is easier to give a *terminus ante quem* than a *terminus post quem* for these systems. Only two post-Roman, pre-Norman examples in Britain have been published, at Gwithian, in Cornwall,¹³ and in the Isle of Man.¹⁴ There is also a less closely-dated example from Ireland.¹⁵ The system at Gwithian is dated by sherds of the 9th to the 11th centuries, presumably derived from manuring, in the plough-soil. There were no sherds of later date. In the Isle of Man, Bersu, excavating under a Viking barrow, found plough-marks and an apparently associated field-boundary ditch. These were both parallel to visible field-boundaries near by, regarded as being of Viking date.

Evidence for early medieval field-systems and ploughing on the continent has come notably from Lindholm Høje,¹⁶ Walcheren,¹⁷ Wijster¹⁸ and Borup,¹⁹ where ridging, as distinct from flat stone-edged strips, is ascribed to the period of increased wetness after *c.* 1200.

THE HISTORICAL EVIDENCE

By James Lawson

The discovery of ridge-and-furrow underlying the bailey at Hen Domen in 1968 and the survey of its extent in the field north of the castle in 1969 must raise the question, to which settlement earlier than the Norman conquest did the field-system belong? The analysis of pollen from beneath the rampart of the bailey also calls for comment.

In the area of the Overgorther to the north and south of Montgomery and in Chirbury hundred to the east the evidence of shrunken hamlets and deserted sites indicates that settlements were closely packed in the lowlands on either side of Offa's Dyke (FIG. 14). In the mid 11th century the area probably underwent

¹³ S. Fowler and A. C. Thomas, 'Arable fields of the pre-Norman period at Gwithian', *Cornish Archaeol.*, 1 (1962), 61-84.

¹⁴ G. Bersu and D. M. Wilson, *Three Viking Graves in the Isle of Man* (Soc. Med. Archaeol., monograph series, no. 1, London, 1966).

¹⁵ J. Fowler, 'Ridge-and-furrow cultivation at Cush, co. Limerick', *North Munster Antiquarian J.*, x, no. 1 (1966), 69-71.

¹⁶ T. Ramskou, 'Lindholm Høje. Third preliminary report for the year 1957.', *Acta Archaeologica*, xxviii (1957), 193-201.

¹⁷ J. A. Trimpe Burger, 'Beknopt overzicht van het oudheidkundig bodemonderzoek in het Deltagebied', *Ber. Rijksdienst v. h. Oudheidkundig Bodemonderzoek*, x-xi (1961), 205, pl. 8; here, however, the size and form of the ridges perhaps suggest lazy beds rather than ploughed ridging (cf. E. Estyn Evans, *Irish Folk Ways* (London, 1957), chap. xi, fig. 48).

¹⁸ W. A. Van Es, *Wijster, a Native Village beyond the Imperial Frontier 150-425 A.D.* (Groningen, 1967).

¹⁹ A. Steensberg, *Atlas over Borups Agre* (Copenhagen, 1968).

constant ravaging by the Welsh under Gruffydd ap Llywelyn, king of Gwynedd and Powys (J. E. Lloyd, *History of Wales*, II, 357-71). It occurred certainly in 1039, and on the evidence of the Anglo-Saxon Chronicle again in the 1050s, when there was extensive border activity. The evidence of Domesday Book for manors within the area before 1066 confirms the picture; low manorial values are recorded (*V.C.H., Shrop.*, VIII, 303), for Alretone (Trewerne), and Alberbury in the Breiddin gap, with large areas of waste in Alretone (*V.C.H., Shrop.*, I, 316). Nearer Montgomery the manor of Chirbury (*loc. cit.*) and 52½ hides of the Overgorther comprising at least thirteen manors were waste in 1066 (*ibid.*, p. 318). The 52½ hides appear to have been so badly devastated that Edward the Confessor had granted them to three thegns, Sewar, Oslac and Azor, as a hunting reserve. In the same area these thegns held a further nine manors which were waste in 1066, but had clearly been in recent cultivation; these included Horseforde and Staurecote (*loc. cit.*), immediately adjacent to Hen Domen, which are discussed below; they had both returned to cultivation by 1086. The pollen analysis at Hen Domen is entirely consistent with this historical evidence, that is, if one postulates devastation in the 1050s extending through the 1060s, and terminating in the late 11th century with the building of the castle, when the cultivation of the surrounding area was resumed.

The identification of the hamlet to which the ridge-and-furrow belonged is uncertain, although it clearly belonged to the thegns, Sewar, Oslac and Azor, in 1066. It seems likely that in the 11th century the hamlets of the central Welsh lowland region were cultivated on an 'infield-outfield' system (see below) and that therefore the ridge-and-furrow relates to a hamlet close to the castle. The name of this hamlet was not recorded in Domesday because by 1086 'Montgomery' had superseded it, and its lands had been swallowed up by the castle demesne, which comprised four ploughs belonging to Earl Roger and two belonging to one of his chief lieutenants, Roger Corbet (*ibid.*, p. 316). The fields of Montgomery at this date, taking into account the earliest evidence available, dating from the mid 13th century, probably lay to the south-west of the castle in the vicinity of Court Calmore, Sutton and Jamesford.

The nearest settlement-sites to Hen Domen mentioned in Domesday are too far away for the ridge-and-furrow to belong to them. Horseforde (½ hide) and Staurecote (1 hide), which are briefly mentioned in 1086, were then in the tenure of Roger Corbet (*ibid.*, p. 318). The former may be identified with a site 300 yd. north-west of Hen Domen in the immediate vicinity of Rhydwyman farm (SO 209984) where seven fields bore the name Horsewall in the 1840s (Montgomery parish tithe map). This name occurs as early as 1648 (National Library of Wales, Powis Castle deeds no. 12930) and is probably a corruption of *Horsefordes hul* mentioned in the late 13th century (*ibid.*, no. 16264). Staurecote lay 440 yd. north-east of the castle and north-west of Mill Pool cottage at Stalloe. The present evidence suggests that it was deserted during the middle ages, for when the site occurs in 1556 as 'Starcottes Field' it was clearly field land (*ibid.*, no. 16274). The site of the hamlet is easily identifiable on the tithe map in two fields named Starcote (National Library of Wales, Montgomery parish tithe map). The history of

the two hamlets subsequent to Domesday is obscure. The tenure was not continued in the heirs of Roger Corbet but returned to the honour of Montgomery, and the land was probably absorbed into demesne, as the hamlets do not appear to occur again as settlements.

In the light of present evidence, therefore, the ridge-and-furrow at Hen Domen probably belongs to a hamlet existing before the conquest which was wasted by the Welsh in the 1050s and not reoccupied when Hen Domen was constructed in the 1070s and certainly not occupied in 1086. That the field north of the castle was an infield is suggested by the occurrence of 'Le Aldefyld' in a mid 13th-century Montgomery deed (P.R.O. E315/53/50) and by the use of the words *veteri campo* in reference to Montgomery in 1248 (P.R.O. E315/39/113), although in both instances the land referred to probably lay near Sutton (SO 204968). Further research now in progress could reveal the identity of the hamlet, though the present indications are not promising. Field-work might reveal its site, but again this settlement may have been superseded by the borough of Old Montgomery, and may lie under Hen Domen farm.

THE RIDGE-AND-FURROW

There is nothing remarkable about the occurrence of ridge-and-furrow around and under the site of the castle, dated though the castle is to the period of the conquest. The researches of Glanville Jones and others have made it plain that some form of open-field agriculture was widespread through the lowland regions of central Wales during the middle ages. Normally the infield-outfield system was followed, under which there was only one common field, permanently in cultivation, which was supplemented by outfields—temporary cultivations of the waste, which were allowed to lapse after a few years. It is becoming clear that this system was almost as common in neighbouring Shropshire until the early 13th century. Mention may be made of two mid Shropshire sites which seem to parallel Hen Domen. At Hawcock's Mount (SJ 349077), a ring-work to the north of the Rea valley and $\frac{3}{4}$ mile east of the more famous castle of Caus, very pronounced ridge-and-furrow runs up to the edge of the site on all sides. The first element of the modern name is a corruption of 'Old Caus', and this with other scraps of evidence (*V.C.H., Shrop.*, VIII, 303; Hereford City Library MS. 23628 f.12 verso) suggests that it preceded Caus as the border castle of the Corbets of Caus, descendants of one of the principal lieutenants of Roger, earl of Shrewsbury, lord of 'Hen Domen'. The motte-and-bailey castle of Smethcott (SO 449994) occupied a situation superficially similar to that of Hen Domen on a low ridge overlooking a major road to the south. No physical evidence of ridge-and-furrow has yet been found there, but the site of the castle is known to have been bounded on three sides by one of the open fields; there was an ancient road to the west. In the mid 13th century, when the memory of the conversion of the infield-outfield system to a three-field system was still fresh in the minds of the Smethcott peasantry, this field was called 'The Old Field' (*V.C.H., Shrop.*, VIII, 148)—sufficiently clear evidence in a Shropshire context to identify this as the original infield.

APPENDIX I

POLLEN ANALYSIS OF A BURIED SOIL AT HEN DOMEN

By P. D. Moore

For many years now the technique of pollen analysis has been applied to the problems of reconstructing past vegetation and hence past climates. However, the potentialities of the technique as a tool in archaeological research have yet to be fully exploited. Increasing amounts of data on pollen morphology have allowed palynologists to improve methods of pollen identification, which means that past habitats can be reconstructed with greater precision. With these tools the archaeologist can not only describe more accurately the habitat in which contemporary man found himself, but also the extent to which man's activities were modifying his environment.

Recent work in mid Wales by Turner and Moore and Chater²⁰ has demonstrated how pollen analysis of peat deposits can be used to document the progressive removal of forest from the area as the density of man's population increased and the exploitation of natural resources intensified. Destruction of forest began in neolithic times, when deteriorating climate had caused the upland woods to become unstable and therefore sensitive to the grazing of domestic stock and unable to recover from local clearance. Pressures increased during the bronze age, particularly over the uplands, where high level woodland was giving way to blanket bog. Iron age and Roman times saw heightened agricultural activity, particularly in the foot-hills of mid Wales, where many of the low-lying areas were cleared of forest. During post-Roman times many of these lowlands and foot-hill areas were abandoned and lay fallow, as a result of which first scrub and then woodland was able to regenerate. This fact can be deduced from the falling frequency of weed pollen and the increasing quantities of tree and shrub pollen found in peaty deposits in the region. It was not until the foundation of the Cistercian monasteries that this trend was reversed and agriculture received new impetus. Clearance of forest then proceeded at an ever-increasing rate, being interrupted only by periods of social unrest (which were not infrequent in medieval mid Wales) and by epidemics such as the Black Death. Enclosure of the foot-hills and uplands encouraged the clearance of woodland, which was greatest during the Napoleonic wars, when much of the uplands were put under the plough. Subsequently depression and depopulation, coupled with recent programmes of afforestation, have reversed the situation and woodland is again on the increase.

It is into this background of vegetational history that one must attempt to fit the analysis of the buried soil at Hen Domen.

Disturbance of soil, e.g. by ploughing, increases aeration of the soil and this in turn results in an increased activity on the part of the soil microbes—the decomposers. As a result of this pollen rarely survives in ploughed soils, but becomes decomposed. However, some has survived at Hen Domen, possibly because the construction of the rampart produced an anaerobic environment in which recently-deposited pollen was preserved. This pollen represents the vegetation growing at or near the site immediately before the construction of the rampart.

Despite the paucity of pollen, a crude count was possible and the results are given in the accompanying table. A number of interesting points emerge from the data which permit certain tentative conclusions to be drawn.

1. There is very little tree pollen; some oak and hazel and a single grain of holly represent the sum total. These values are far too low for a woodland soil and one must therefore conclude that the region in which the rampart was built was open land, more

²⁰ J. Turner, 'The anthropogenic factor in vegetational history. 1. Tregaron and Whixall mosses', *New Phytol.*, LXIII (1964), 73-90; P. D. Moore and E. H. Chater, 'The changing vegetation of west-central Wales in the light of human history', *J. Ecol.*, LVII (1969), 361-79.

or less devoid of tree cover. Tree pollen attains similar proportions in present times on the moorlands of upland mid Wales, where the trees are very scarce. Since most types of tree pollen are light and easily transported by the wind, these grains can be carried for some distance before they are deposited on the ground.

2. There is an abundance of 'weed' pollen. The term 'weed' is used here to denote those plants which are intolerant of heavy shading and competition from other plants. They are therefore typically found in disturbed habitats such as agricultural fields. Their presence in this soil in such large quantities suggests quite strongly that this site has been used for arable agriculture. The fairly low level for grass pollen precludes a pastoral interpretation. The single cereal pollen grain tempts one to suggest that this is the crop which was grown there; however, this cannot be certain.

3. The large quantity of bracken spores suggests that, to allow this spread of bracken, the abandonment of this arable field is of several years' duration. If the area had been used for rough grazing this would have encouraged such a growth.

Although it is fairly certain that this soil has been cultivated, little can be said of its date except what is indicated by its stratigraphical position, i.e. that it is earlier than the Norman conquest. It is likely, however, that it was abandoned not more than a decade or so before its burial beneath the rampart, otherwise a greater development of scrub and woodland is likely to have occurred.

TABLE I. POLLEN AND SPORE COUNT FROM BURIED SOIL, HEN DOMEN

	NO. OF GRAINS	% OF TOTAL
Trees and shrubs:		
<i>Quercus</i> (oak)	6	10
<i>Corylus</i> (hazel)	4	7
<i>Ilex</i> (holly)	1	1.5
Grasses and sedges:		
<i>Gramineae</i> (grasses)	6	10
<i>Cyperaceae</i> (sedges)	3	5
Weeds:		
<i>Plantago major</i> (plantain)	1	1.5
<i>Liguliflorae</i> (dandelion type)	13	21
<i>Cirsium</i> (thistles)	3	5
<i>Artemisia</i> (mugwort)	4	7
<i>Matricaria</i> (mayweed)	4	7
<i>Ericaceae</i> (heathers)	1	1.5
<i>Aster</i> (daisies, etc.)	2	3
Crop plants:		
<i>Cereals</i>	1	1.5
Fern spores:		
<i>Pteridium</i> (bracken)	10	17
Other ferns	2	3
Total	61	101

APPENDIX II

A THREE-DIMENSIONAL COMPUTER PLOT
OF THE RIDGE-AND-FURROW (FIG. 19)*By Susan Laffin*

The values used for the contour plot were also fed into the computer program to draw a 3-dimensional picture of the surface. This used a routine written by J. Newbury of the Computer Centre, University of Birmingham, to produce an isometric projection drawing of a square mesh laid over the surface of the field. The slope of the ground is indicated by a distortion of the square mesh. By using the routine several times, it was possible to produce several pictures of the surface, viewed from different directions, and the one which showed the ridge-and-furrow most clearly was chosen for publication.

The action of program PLOT 3D is best explained by comparing it with a model. Suppose we had a cube of plasticine or some similar material and the top face of this cube is moulded to provide a scale model of the surface in which we are interested. When the original readings were taken, they were made at equal intervals along lines on the ground so that the whole set of data formed a mesh of squares on the surface of the ground. Let us assume that these lines have been painted on our model. Now if our model is placed on the table and photographed from each corner in turn we get a picture in which the humps and hollows in the ground are shown up by bends or distortions of this square mesh. This is exactly the picture produced by the program.

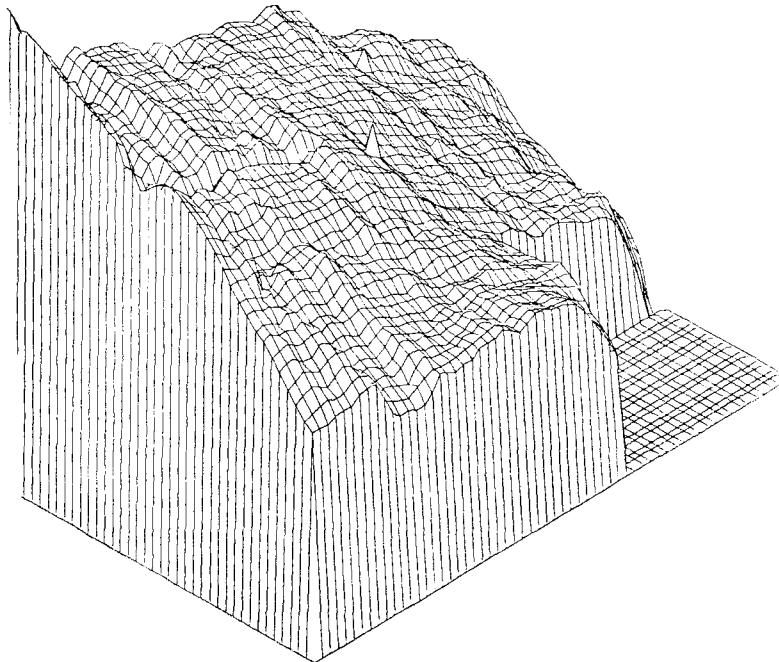


FIG. 19

HEN DOMEN, MONTGOMERY

Three-dimensional computer-plot of field A. The N.-S. slope has been removed (pp. 61, 65, 71f.).

There are two parameters in the program which we can vary to emphasize different qualities in our model. The first is a scale factor for heights, called `SCALE`. If `SCALE=1`, we get a scale model of the actual surface. If `SCALE=2`, all the heights are doubled relative to the distances along the surface. This is equivalent to making another model which emphasizes the changes in height. On the other hand, if `SCALE=1/2`, we have a model which reduces the size of changes in height. In the case of the plot for Hen Domen, we were interested in the small height changes caused by ridge-and-furrow and so we chose `SCALE=3` to make these show up clearly.

Unfortunately this increase in vertical scale meant that the view which showed the ridge-and-furrow most clearly was hidden, because we were unable to see over the bank along the near side of the picture. So we had to introduce the second variable `ANGLE`. This has the same effect as holding our plasticine model by one edge of its base and tilting the rest of the model through some angle, in order to look at the top surface from each of our four fixed viewing points. This means we have to cut a wedge off the bottom before standing it back on the table. By considering our model, it will be obvious that, although the height of all the points on the surface above the table has been altered, the shape of the surface is unchanged. By this means, we obtain our final picture of the surface.

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