The Stones of Stenness, Orkney

by J N Graham Ritchie
with an account of the Stone of Odin *by* Ernest W Marwick

INTRODUCTION

The central bowl of West Mainland Orkney, encircled by low rolling hills, encloses the adjoining Lochs of Harray and Stenness; separated by the promontories of Stenness to the SE and Brodgar to the NW, the lochs meet only at the Bridge of Brodgar which spans the narrows and links two of the most important assemblages of prehistoric monuments in Britain (fig 1). To the NW are the ditched cairn of the Ring of Bookan (ORK 45), the class II henge monument known as the Ring of Brodgar, a large number of mounds and several standing stones; to the SE are the class I henge monument of the Stones of Stenness, a series of standing stones and, 1·2 km to the E, the magnificent chambered tomb of Maes Howe (ORK 36).

The Standing Stones of Stenness (NGR HY 307125) dominate the W side of the SE promontory and are situated in a level arable field close to the shore at a height of about 4·0 m OD (pls 3a and 4a). Two existing outlying stones, the Watch Stone and the Barnhouse Stone, may be associated with the monument, the former 170 m to the NNW and the latter 700 m to the SE (pl 3b and d; RCAMS 1946, 304–5, nos 879 and 880). The stump of another standing stone, situated about 12·8 m SSW of the Watch Stone, was discovered in 1930 but is no longer visible; measuring 1·4 m by 0·13 m and at least 0·9 m in height, 'it had rested in a hole which had been cut in the shaly rock to receive it, and it was packed at the base with small stones' (RCAMS 1946, 320, no. 908). The Stone of Odin stood closer to the N tip of the peninsula 'about one hundred and fifty yards to the northward of the Ring of Stenness' (Thomas 1852, 101) but it was removed and at least partially broken up in December 1814. This stone caught Orcadian imagination, as a promise, plighted by lovers while holding hands through the hole by which it was pierced, was considered sacred and binding. Its destruction is linked to the devastation of the Stones of Stenness themselves, and the Stone and the traditions associated with it are discussed on pp 28–34. A catalogue of the more important illustrations of the circle and of the Stone of Odin forms Appendix 11. In the last century the name 'the Stones of Stenness' was used in an inclusive sense for the standing stones on both the Stenness and Brodgar promontories. In more recent archaeological literature, however, the name is used only for the smaller henge and the larger monument has been called the Ring of Brodgar or Brogar.

The henge monument known as the Stones of Stenness comprises an outer bank, an inner ditch with a single causeway in the N quadrant, a stone circle and a central rectangular box-like structure which contained cremated bones, charcoal and sherds of pottery. Cultivation has almost completely removed traces of the bank and ditch, although these could still be seen in the middle of the 19th century. At the time of the destruction of the Stone of Odin in 1814, one stone of the circle was felled and another broken up, leaving only two upright throughout the last century.

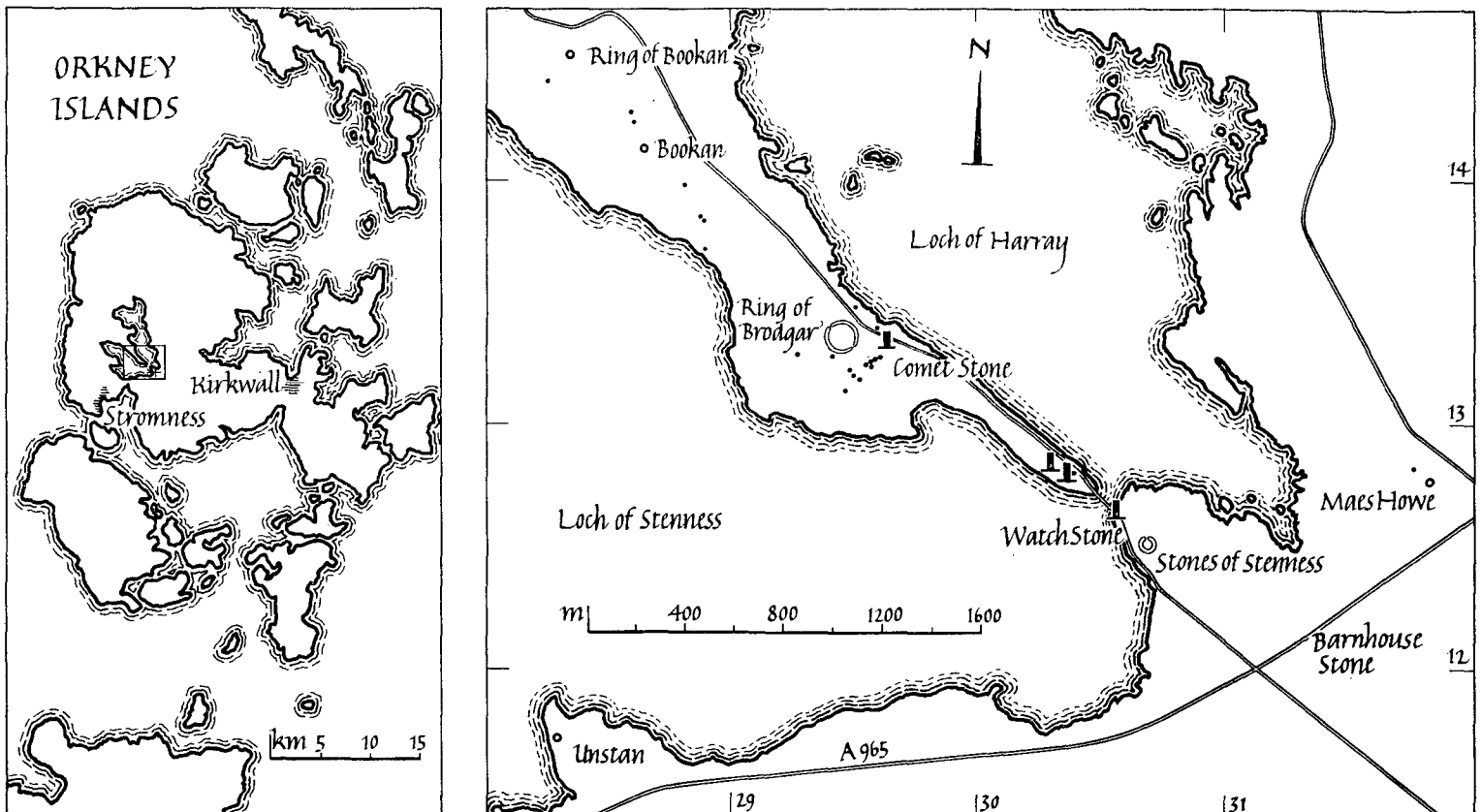

FIG. 1 The Stones of Stenness: location map

After the monument was taken into the guardianship of the Office of Works in 1906, the toppled stone was re-erected, another stone was discovered and put up, and a 'dolmen' was built, following the then accepted interpretation of a number of stones in the N of the interior of the circle. The capstone of this 'dolmen' was pushed over in October 1972. The excavation described in this paper occupied a period of seven weeks in 1973 and 1974, and was undertaken on behalf of the Department of the Environment in order to examine the structure of the 'dolmen', to advise on what should be done with the constituent stones and to discover more about the plan of the stone circle, bank and ditch. No detailed description of the site has hitherto been published apart from the account in the *Inventory* (RCAMS 1946, 302–4, no. 876). This report is divided into a historical section, a description of the excavation and a discussion of the site and finds.

HISTORICAL BACKGROUND

The historical background of the site has to be considered in some detail in order to build up a picture of it at three periods: the first is before December 1814, when the then tenant farmer tried to destroy at least some of the stones, before he was restrained by the threat of court action; the second is between December 1814 and 1906 during which time the idea that there ought to be a central 'dolmen' or 'cromlech' gained credence; in the third period, between 1906 and 1907, stone no. 5 was re-erected, stone no. 7 was discovered and erected, and the 'dolmen' was put up.

The main descriptions of the first period are those of Pococke, Low, Banks, Stanley, Barry and Lady Stafford, and, although the overall impressions of their accounts or drawings are similar, they are complementary rather than identical and they have, apart from Banks, left no measured plans. In the century or so following the partial destruction in 1814 the major accounts or plans are those of Thomas, Dryden and Petrie, and Pitt-Rivers. For the final period, 'the re-building', the information is sketchiest.

One of the earliest reliable descriptions is that by Richard Pococke, Bishop of Ossory, who visited Orkney in July 1760; his illustration of the site (pl 1a) is less successful than a number of others, but his written description is particularly clear, though his bearings for the Stone of Odin are hopelessly wrong: 'soon afterwards we came to another Circle of Stones which are 15 feet high, six feet broad, the Circle is about 30 yards in Diameter, and the stones are about eight yards apart. There are two standing to the South, one is wanting, and then there are two standing to the West, a third lying down, then two are wanting, there being a space of 27 yards so that there were eight in all: Eighteen yards South East from the Circle is a single stone, and 125 yards to the East of that is another with a hole in it on one side towards the bottom [the Stone of Odin], from which going towards the circle is another 73 yards from the fossee, the outer part of which fossee is 16 yards from the Circle' (Pococke 1887, 144). The important points for the present enquiry are that there were four stones standing, with a single space between the groups, and that there was another stone which, to judge by subsequent accounts, was the slab that became the capstone of the 'dolmen'.

An outline of Sir Joseph Banks's visit to Orkney in 1772 has recently been published along with the plan of the Stenness-Brodgar area and the view of the Stones of Stenness prepared by members of his party (Lysaght 1974, pls 6 and 8); the view (pl 1b) is perhaps one of the most evocative early illustrations of the site, showing as it does the four uprights of the circle (nos 2, 3, 5 and 6), the stones of the 'dolmen', the enclosing ditch and bank on the W side, the Odin Stone, the Watch Stone and the two stones to the NW of the bridge with the Ring of Brodgar in the distance. As an illustration of the stones of the 'dolmen' it is of considerable importance; one upright is shown standing above turf level, a fallen slab lies at an angle, partly leaning against

the former, and a third stone may be seen just protruding through the turf on the W side of the upright. In general terms this is a very similar arrangement to that illustrated by Thomas some eighty years later (1852, 99), but it means that the 'dolmen' stones cannot be explained away as the tumble resulting from the depredations of 1814.

George Low, minister of the parish of Birsay and Harray, writing in the 1770s, says that there were 'four entire, and one broken' stones (1879, xxi); the plan which he mentions may well have been based on the survey undertaken during Banks's visit (Lysaght 1974, pl 8), but this shows five uprights as well as the stones of the 'dolmen'; it seems possible that the surveyors have spirited the capstone of the 'dolmen' on to the stump of stone no. 8 (though from the position of the ditch terminal it is possible that no. 7 is intended). Lysaght has also published the account of the site in the 1789 edition of Camden's *Britannia* and has given a detailed background for the entry, which included material provided by Banks and Low (Lysaght 1974, 228–31). Alexander Gordon, Principal of the Scots College in Paris, describing the site following a visit in 1781, says 'the stones have been originally seven, four of which are still standing' (Gordon 1792, 263). The *Inventory* suggested that the three other stones mentioned by Gordon were three of the blocks that were later to be incorporated in the 'dolmen', and represented that described by Low as 'broken' (RCAMS 1946, 302–3); but Gordon does not say that the three stones still survived, and he may merely have been postulating a setting of seven stones by filling in the gaps between the four existing uprights.

In 1789, Thomas Stanley, afterwards First Lord Stanley of Alderly, visited Orkney on his way to the Faroes and Iceland; the Orkney section of the diary of one of Stanley's colleagues, James Wright, has been published (West 1970). Two illustrations of the monoliths, however, now in the National Library of Iceland, are of particular importance in showing the Stone of Odin both in its setting and also in detail (pl 8d), but the stones of the dolmen are not shown (Appendix 11, no. 5). It is possible that the drawing in the National Gallery of Scotland (Appendix 11, no. 6) signed JW. TSf, is a copy or a tracing of a drawing made during this visit. It depicts four upright stones (nos 2, 3, 5 and 6), with the intervening space clearly shown. Stone 6 has a rectangular section which, though apparently as thick as no. 5, is not as broad; stone 6, however, seems to be taller than its neighbour. These facts could well account for the deep stone-hole which was discovered during the excavation with a deep socket at its base which would accommodate a stone of the proportions illustrated. The stones in the foreground appear to be the embryo 'dolmen'.

Captain Columbine of the Royal Navy visited Orkney and Shetland in 1792 and among the drawings he made is an attractive view of the Stones of Stenness (Appendix 11, no. 7); it shows stones 2, 3, 5 and 6, with what may be the Stone of Odin in the distance. A fifth stone, however, may be interpreted as either the stump of no. 8, for which the angle seems wrong, or an upright which was later to be part of the 'dolmen', thus confirming Cleveley's drawing of twenty years earlier.

Two illustrations of the site date to the early years of the 19th century; the first is included in Barry's *History of the Orkney Islands* (1805, 209–10). 'The plain on the east border of the loch [of Stenness] exhibits a semicircle, sixteen fathoms in diameter, formed not, like the circle [of Brodgar], with a ditch, but by a mound of earth, and with stones in the inside, like the former in shape, though of much larger dimensions.' 'Towards the centre of the semicircle, too, is a very large broad stone now lying on the ground; but whether it stood formerly like those around it, or has been raised and supported on pillars to serve a particular purpose, we shall not take upon us to determine.' His illustration shows four upright stones (nos 2 and 3, and 5 and 6) and another small boulder or stump, possibly no. 8. The same stones with the space for no. 4

are shown in an etching by Lady Stafford, who visited and drew the site in 1805 (pl 8a; Appendix 11, no. 8).

From the evidence reviewed above it seems clear that at the beginning of the 19th century four stones were standing (nos 2, 3, 5 and 6), that the stump of a fifth was visible (no. 8) and that 'a very large broad stone' lay on the ground towards the centre of the semicircle (Barry 1805, 209). It was in this condition when Sir Walter Scott visited the site on 16 August 1814; his *Memoirs* state, 'About the centre of the semicircle is a broad flat stone, probably once the altar on which human victims were sacrificed.'

An attempt to reconstruct what remained of the monument at this time is essential to an understanding of the destruction that took place in December 1814 when the tenant farmer, Captain W MacKay, broke the Stone of Odin into pieces and began to destroy the Stones of Stenness; certainly stone 5 was toppled and stone 6 was broken up. Sheriff Peterkin describes the destruction of the three stones 'torn from the spot on which they had stood for ages, and . . . shivered to pieces' (1822, 20); the use of the term 'shivered' is a particularly apt description of the shattered remains discovered in stone hole no. 6. Local opinion was so incensed by the destruction that an action was threatened in the Sheriff Court to restrain MacKay from breaking up further stones. The Diet Book of the Sheriff Court of Orkney, in which Peterkin was Sheriff Substitute, records on 15 January 1815 as the first of the processes that were transmitted to the Sheriff Depute of Orkney for his consideration 'copy Proceedings and Correspondence in Summary Complaint, Procurator Fiscal against McKay', but no further account of the proceedings can at present be traced. MacKay had, however, clearly attempted to have them withdrawn by writing penitent letters to such local authorities as Captain Edmonston, Commander in Orkney, in terms that are still used to this day following some wanton destruction. He admitted to pulling down the stones of the circle 'for the purpose of strengthening the fields' and says that he had intended 'that two or three of them should stand, namely the one on the point of the Peninsula, and another on the Field as I thought that these would answer as a show without doing me any detriment. However as I cannot now recall what is done, I request the favour of you to make what use of this communication you deem best to prevent any further steps being taken that might operate to my prejudice' (Kirkwall, 30 December 1814). Edmonston showed the letter to Peterkin, to Malcolm Laing and to other objectors. Peterkin decided not to take the legal matter further, when MacKay promised 'to desist from his operations'; Peterkin continued 'The occurrence is to be regretted as it may tend to hamper Capt. MacKay's comfort in Orkney and as it may lead the vulgar to confound every improving farmer with the idea of a desolator' (Kirkwall, 4 January 1815). Laing in his reply to Edmonston took a broader view, in contrast to MacKay's feeling that the destruction of the stones was of concern only to himself and to the landowner; 'the offence', wrote Laing 'has not been given to Mr Riddoch or to me, who interposed merely as Justices of Peace, but to the community at large, which has an interest in the preservation of public monuments and to men of letters and curiosity throughout the kingdom (Pabdale, 26 January 1815). The three letters are in the Orkney Library, Kirkwall (D2/17/4); they illustrate attitudes to change and conservation that are as common a century and a half later as they were in 1815, showing perhaps the failure of 'the men of letters and curiosity' to present the case for preservation very clearly.

Thus by the time the Stones of Stenness was made the geographical location for the climax of Scott's novel *The Pirate* in 1821, it was no longer in the state in which the author had seen it seven years before.

'The Standing Stones of Stennis, as by a little pleonasm this remarkable monument is termed, furnishes an irresistible refutation of the opinion of such antiquaries as hold that the

circles usually called Druidical were peculiar to that race of priests. There is every reason to believe that the custom was as prevalent in Scandinavia as in Gaul or Britain, and as common to the mythology of Odin as to Druidical superstition. There is every reason to think that the Druids never occupied any part of the Orkneys, and tradition, as well as history, ascribes the Stones of Stennis to the Scandinavians.' So Scott introduces the site; his description is important because he gives wider currency to Barry's suggestion that the prostrate slab in the middle of the circle had perhaps been 'raised on pillars' (Barry 1805, 210); Barry's more sober proposal that this slab had originally been another standing stone is ignored. Minna, one of the heroines of the story, 'attained the centre of the circle, on which, in the midst of the tall erect pillars of rude stone that are raised around, lies one flat and prostrate, supported by short stone-pillars, of which some relics are still visible, that had once served, perhaps, the purpose of an altar' (chap xl). Although Scott was not the first to describe the stones, he was the most eminent antiquary to reconstruct the internal stones so explicitly, albeit in a novel; it is instructive, however, to compare Scott's note with Barry (1805, 209–10), and it seems clear that Barry was the foundation of the former's dogmatic attribution of the site to the Scandinavians. The construction of the 'dolmen' in 1907 may be attributed to academic and popular support for Barry's and Scott's romantic idea.

The plans of the mid 19th century show stones nos 2 and 3 upright, 5 fallen and the stump of no. 8, as well as the series of stones to the N of the interior which were to be constructed into the 'dolmen'; there is no mention of the remains of stone no. 6 nor of stone no. 7. Three of the stones of the 'dolmen' (the two supports of the E side and the capstone) are shown on both Thomas's and Dryden and Petrie's plans (pl 2; Appendix 11, nos 11e and 12a); the N support was upright, the S fallen outwards with the capstone on it, although Thomas's illustration (fig 11) suggests a more tumbled appearance (1852, 99). It is unfortunate that Dryden's pen-and-wash drawing of the Stones does not include the 'dolmen' in his view, though it shows nos 2 and 3, the fallen stone 5 and the stump of no. 8. Tudor, who visited the site between 1878 and 1880, describes 'the remains of a cromlech, one of the legs of which 2 ft high, remains *in situ*, and another has fallen outwards. The capstone, or covering stone, remains . . .' (1883, 308). The idea that these stones were the remains of a dolmen had become accepted by the 1880s and when Pitt-Rivers visited the site, in his capacity as Inspector of Ancient Monuments in August 1885, he described 'the remains of a dolmen consisting of 4 large stones one of which is upright and the other may have been a capstone' (Appendix 11, no. 14).

The circumstances surrounding the re-erection of stone no. 5 and the general conservation of the site are also of some interest; in November 1905 the proprietor of the estate, Colonel Balfour, found to his surprise that overtures were made to him from two unconnected bodies suggesting that work should be done on the Standing Stones of Stenness. The first approach was initiated by Mr Cathcart Wason, MP, who in proposing the toast to the Viking Club made an appeal that the Club should 'do some practical, living work' and suggested that the dilapidation of the Stones of Stenness and the Ring of Brodgar should not be allowed to continue (*Saga Book Viking Club*, 4 (1905), 279). The Society for the Protection of Ancient Monuments was approached; their architect reported in January 1906 that the fallen upright (no. 5) might be re-erected with careful cradling, but that the central 'cromlech' was 'too far broken for anything to be done'.

The second approach to Colonel Balfour was made by the Hon John Abercromby, who wrote to suggest that the area round the Stones of Stenness should be scientifically excavated and proposed that St George Gray, Keeper of the Museum at Taunton, should direct the work, with Abercromby himself bearing all the expense of the excavation. On hearing about the

proposal to re-erect the fallen stone, Abercromby stressed the need for prior scientific excavation, suggesting that a fortnight would probably be sufficient to complete the work (Orkney Library, DZ/17/4). Abercromby's attempt to interest the Society of Antiquaries of Scotland in the project was unsuccessful and no excavation was sponsored. The Society for the Protection of Ancient Monuments, however, discovered that the Office of Works was willing to take the monuments of the Stenness area (including the Ring of Brodgar and Maes Howe) into guardianship and, after this was done in April 1906, the assistant architect to the Office superintended the re-erection of stone no. 5. A contemporary photograph shows the completed re-erection on 31 August 1906; eight men seem to have been employed in building a timber framework under the stone and progressively lifting it up until it tipped by its own weight into the hole. Mr John Linklater, formerly of Tormiston Mill, Stenness, was in his teens at the time of the re-erection and he remembered that the first attempt to position the stone was not successful but that on the second attempt it dropped into the intended hole. A group of iron-age sherds, now in the Hunterian Museum, University of Glasgow, is said to have been found when the stone was re-erected; there is no mention of the sherds in Spence's account of the re-erection (1906), but a note accompanying them in the Museum provides this information. This pottery is listed and discussed on pp 25–7.

At this time, too, the stone that is now no. 7 was uncovered for the first time. 'Near this fine monolith (i.e. no. 5) and within the circle was unearthed a large, ill-shaped stone, lying in a position, with its end in proximity to the next socket, as if it were the next monolith of the circle. Its shape and uncomeliness make one doubt what the position suggests' (Spence 1906, 62). This stone was erected in its present position in 1907; Orkney antiquarians were not undivided about the propriety of this part of the work. 'The ill-shaped stone . . . with one end pointing to a socket, where no doubt an upright had at one time been, has been erected in the place indicated. Its end, we understand, suited the socket. We have doubts as to whether it is a genuine monolith. It looks such a dwarf amid these huge monoliths. . . . Mr Cursiter considers it is the broken part of the original stone, which is a likely explanation' (Spence 1906, 253). The stone is surrounded by a supporting raft of concrete and it is unlikely that further excavation would make its status clearer. The 'dolmen' was constructed out of the stones of the interior and was completed by the introduction of the W support; archaeological opinion is well expressed by the *Inventory*: 'the altar-like construction, which disfigures the interior, is a modern and wholly fanciful addition' (RCAMS 1946, 302).

Mr A Rutherford has kindly provided the following note on the origin of the place-name: Marwick comments on the Old Norse '*Stein-ness*, "stone-ness", so named from the famous Standing Stones near the Brig of Brogar: the medial "s" in the Saga form is probably a mistake (perhaps for a genitive plural "a")' (1952, 110). The form to which Marwick refers is 'Stæinsnese'; one might rather conjecture that the 's' is organic, and that the early form of the name contained the genitive singular, perhaps referring to the Watch Stone. Later spellings of the name, up to the 19th century, very often show a medial 'h' (as in Marwick's 'Stanehous'), but there can be no doubt that this is spurious, perhaps due to folk-etymologising.

EXCAVATION

In 1973, preparatory to the excavation, the site was surveyed by the Geophysics Section of the Ancient Monuments Laboratory of the Department of the Environment, using a fluxgate gradiometer; the results showed conclusively that the ditch surrounding the stone circle was broken by only one entrance-causeway, which was situated in the NW quadrant. The survey

also confirmed the existence of the ditch on the E side of the site where surface traces were slightest, presumably because of ploughing (Clark, A 1975, 311, fig 10). The plan of the ditch as revealed by the survey, and plotted to scale by the Ancient Monuments Laboratory, has been shown on fig 2. Excavation was conducted in two central areas following the plotting of anomalies in the gradiometer survey and this resulted in the discovery of the central stone-setting and a series of pits.

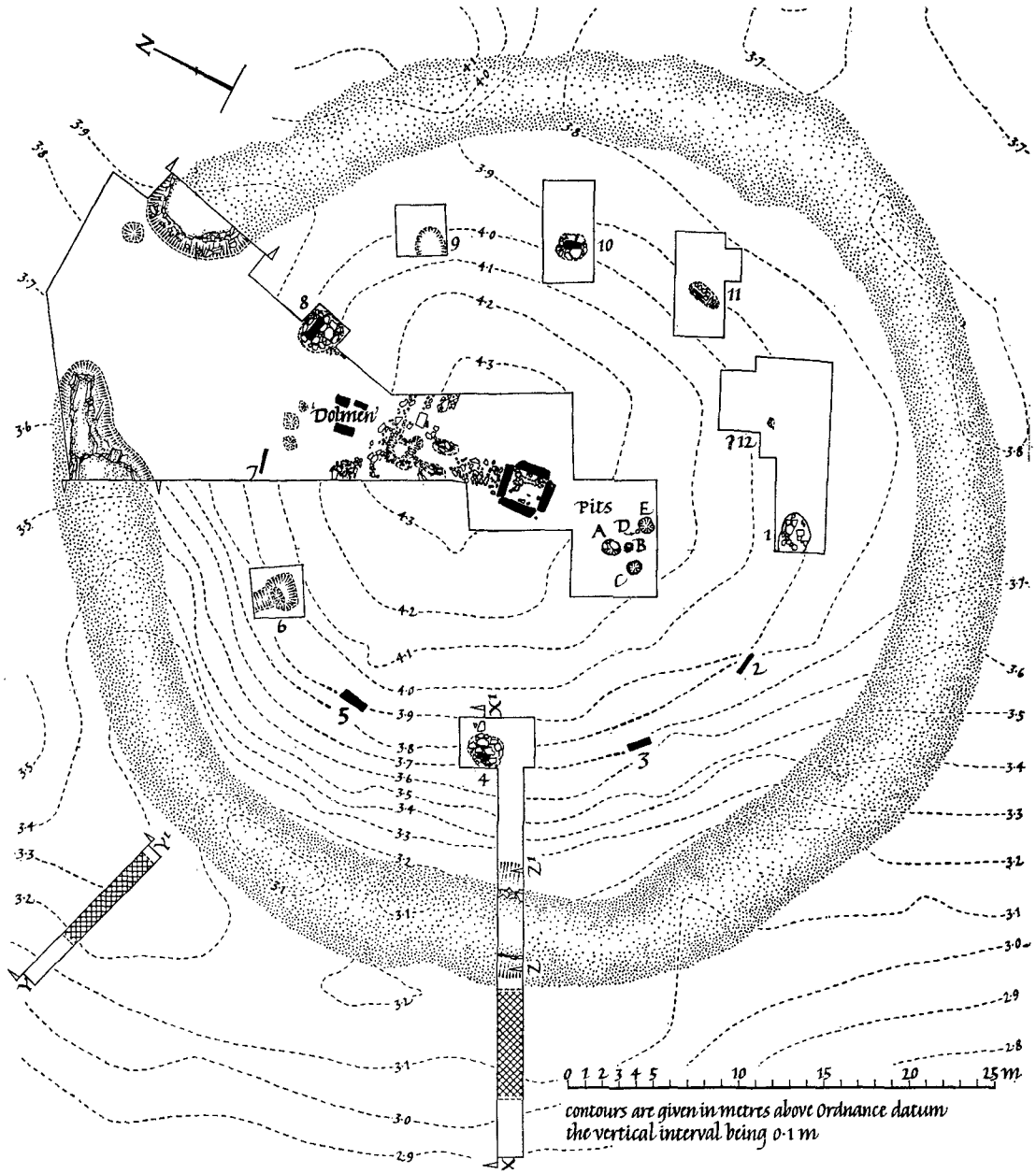

FIG 2 The Stones of Stenness: site plan

Stone Circle The stones of the circle are set within the surrounding ditch of the henge and stand on the perimeter of a circle with a diameter of some 30 m (fig 2); a more exact description of the shape of the circle is suggested in Appendix 8. No excavation was carried out in the vicinity of the existing standing stones (pls 3a and 4a; nos 2, 3 and 5) and those trenches that were laid out to examine the stone-hole of no. 7 revealed only that it was firmly set in a raft of concrete; this area was therefore abandoned. Stone 2, now leaning slightly inwards, is the tallest and perhaps the shapeliest of the surviving stones of the circle, measuring 5·7 m in height, 1·4 m in breadth and up to 0·25 m in thickness. Some of the packing stones at the base of the stone may be the result of consolidation by the Office of Works in 1906 or 1907. Stone 3 is 5·3 m in height, 1·35 m in breadth and up to 0·38 m in thickness; this monolith leans slightly outwards. Stone 4 survived as a substantial stump measuring 0·57 m in height, 0·8 m in breadth and 0·3 m in thickness and was erected in a deep stone-hole (fig 3). It was chocked around with several massive boulders, smaller stones and gravel.

Information about the re-erection of stone no. 5 was recorded in a minute by the Office of Works foreman (Register House, Edinburgh, Office of Works papers, B 3196, 22 May 1907); this stone, toppled in December 1814, measured 5·5 m in length, and weighed between 9 and 10 tons. The original stone-hole was discovered and the exact position of the upright within it could be detected because of the survival *in situ* of the original packing-stones; only those of the inside edge had been crushed by the felling of the upright on top of them and these were fragmentary. The depth of the bottom of the stone within the hole could also be exactly determined, because a flat slab formed the bottom of the socket, lying at an angle corresponding to that of the bottom edge of the upright and thus helping to ensure that the stone stood vertically; one end of the socket was 0·75 m in depth and the other was 0·9 m in depth. From the sketches in this report there is no indication that the complete hole was excavated. As it stands at present, stone 5 measures 4·8 m in height, 1·55 m in breadth and 0·45 m in thickness. Stone 7, discovered and erected in 1906, is firmly embedded in a concrete raft; the stone now stands to a height of 2 m above it and measures on average about 0·1 m in thickness. Spence (1906, 63, fig 2) recorded that its original height was 9 feet (2·74 m).

The holes in which three stones (pl 4b–d; nos 8, 10 and 11) had been erected were delimited but were not emptied; no. 8 survived as a stump rising above ground level, but nos 10 and 11 were only visible once the turf and covering earth had been removed. The stump of stone 8 stands to a height of 0·4 m and is a feature of several early views of the circle. The stone-hole contained some very large and solidly packed chocking-stones. Stone 10 was a severely laminated slab measuring about 1·09 m in breadth by 0·4 m in thickness and at least 0·3 m in height (pl 4d); the stone-hole (about 1·8 m by 1·5 m) had been severely disturbed on the W side of the stone where few chocking-stones survived, but it had been supported by substantial slabs on the E. The stump of stone no. 11 remained in a narrow elongated hole (2·1 m by 0·9 m) and was carefully supported by medium-sized slabs (pl 4c); the stump itself measured only 0·81 m in length and 0·1 m in thickness and protruded for about 0·3 m.

Stones 1, 6 and 9 were represented only by the holes in which they had been erected. Stone-hole 1 measured at least 2·2 m by 1·7 m and 0·9 m in depth, though a part of the W end was in the trench section and was not excavated. The hole had been extensively disturbed, presumably during the removal of the standing stone, but some packing-stones at the edge of the hole seemed to be in their original positions, particularly on the inner side. The remaining fill of the hole comprised loose stones and earth. When this was removed, an earth-filled pocket at the bottom of the hole seemed to indicate the original position and approximate dimensions of the base of the upright (0·9 m in breadth and 0·4 m in thickness).

Stone-holes 6 and 9 had suffered even greater disturbance. The former measured about 2·2 m by 1·6 m and 0·7 m in average depth, with a deeper shaft dug into the till on the outer side of the hole, 0·75 m by 0·5 m and 1·2 m in total depth; this no doubt is the original socket for the standing stone. Only two stones which might be thought of as packing remained in the upper part of the hole, and the remainder of the fill comprised one large loose slab (0·91 m by 0·58 m and up to 0·18 m in thickness), a quantity of shattered stone fragments and loose earth. A trench at right angles to the long axis of the stone was found to merge with the stone-hole; measuring 1·2 m in breadth and 0·5 m in average depth it was filled with loose stones and earth. It seems more likely that this feature is connected with the toppling and destruction of the stone than with its erection as no packing-stones were found, even at that end which would have been adjacent to the upright.

Stone-hole 9 was about 1·6 m by 1·6 m (though the W side was not excavated as it was covered by a balk) and about 0·75 m in depth. The fill was re-deposited till with only a few small slabs and no sign of either stone stump or chocking stones. If there had been an upright, it and its supporting stones had been very systematically removed. There is likewise no good evidence for stone no. 12, for, although a sharp-sided hollow existed in the surface of the till, it is very slight compared with the other stone-holes and, had the pointed base of an upright been rammed into the natural at this point, the stone must have been carefully supported by surface stones. This sector of the site has been most severely denuded by ploughing (cf Thomas 1852, pl xiv), and, while this could not explain the greater destruction of stone-hole no. 12 compared to nos 1 or 9, it might help to explain the absence of any surface chocking stones at this point.

Ditch and Bank The major section across the ditch and bank was cut on the SW side of the site where the visible remains of these features were best preserved and were unencumbered by a field-drain which uses a depression on the W side. Much of the interest of this part of the excavation centres on the ditch section and the ditch terminals; the two cuts that were made through the remnants of the bank were less conclusive. Perhaps the most surprising feature of the ditch is that its base was cut into the solid rock to a depth of about 1·0 m over a width of some 4·0 m. The ditch sections were in all about 2·3 m in depth and indicated the following stratigraphy from bottom to top: the rock floor of the ditch had been cut virtually flat, presumably along the horizontal bedding planes of the bedrock; although flattish there is a definite slope down towards the inner side of the ditch. The irregularities of the sides of the rock-cut sections suggest that weaknesses in the rock were exploited and the degree of undercutting on the outer edge indicates that there was no attempt to keep the sides of the ditch vertical. Covering the rock floor was a thin layer of silty loam with some small sub-angular fragments of the natural flagstone as well as a few larger flags; colour changes in this layer (it was blue towards the centre of the ditch and browner or more yellow at the sides) has been caused by differential drainage rather than deposition. Above it in the centre of the ditch there was a layer of silty loam with quantities of organic material; the deposit measured 1·7 m in extent across the bottom of the ditch and up to 0·4 m in thickness and comprised a silty matrix with a number of sub-angular fragments of the natural flagstone, animal bones, twigs and pieces of wood. The animal bones (Appendix 1) comprised wolf or dog, domestic ox and sheep; most of the bones were from mandibles or the extremities of limbs and, as Dr Clutton-Brock has pointed out, 'could represent the unwanted refuse from food, sacrifice, clothing or artefact manufacture'. Perhaps the first two suggestions are more in keeping with the ritual nature assumed for such sites. Analysis of collagen from animal bones from this deposit gave a radiocarbon date of 2356 bc ± 65 (SRR-350). The complex interpretation of the pollen and macroscopic material from this deposit is discussed in Appendices 2 and 3. The plant remains were recovered from this deposit in the same way as

those that will be mentioned subsequently; flotation techniques were employed, but were only partially successful in recovering organic remains, and wet-sieving in wire-baskets of 4 mm and 2 mm mesh yielded considerable quantities of material, which were sorted on site to separate cereal and other plant remains from small stones and bones. A magnifying glass was used to increase the efficiency of this operation, but it was not undertaken with botanically-trained personnel.

Abutting against and also overlying this layer on the inside of the ditch there was a deposit of silty loam with considerable numbers of flagstones and boulders; the remains of what seemed to be at least two parallel long bones were noted in the gravel, but these were too crumbly to recover. These two main layers merged in the centre of the ditch and together they form the primary phase of silting; slighter changes in texture or colour were examined and were thought to be the result of differential drainage, with the grey silty clay-loam mottled with iron panning as the result of temporary waterlogging. Above this there was a comparatively even layer of brown-grey silty loam with some small stones and slight organic content; in the centre of the ditch on the S side of the section there was a scattered deposit of burnt animal bone which measured about 1·0 m in extent and about 20 mm in thickness at the centre. This deposit was overlaid by a definite red layer, about 20 mm in thickness, which appeared to be comparable to the filling of Pit E. It is likely that the brown-grey layer represents a cessation of activity and is the boundary between the fast initial silting and the slower filling up of the broad hollow which, with the action of ploughing, went on till the early decades of this century.

Above the brown-grey silty loam are layers of brown, grey and finally brown loam beneath the turf and topsoil; it is possible that the greyish layer represents the turf line of the middle of the last century, when the bank was described as being about a metre in height. A pollen sequence was obtained for the upper 0·78 m of the ditch filling and, in contrast to the pollen evidence for the organic layer, this must relate to the most recent phase of the history of the site (Appendix 2, fig 10).

In general terms the sequence of silting of the east terminal of the ditch is similar to that described for the main ditch section (fig 3 and pl 5a). The terminal had been dug to a depth of about 0·8 m into the solid bedrock and is at present about 2·05 m in depth below turf level. No organic layer was found at the bottom of the ditch (although this level is now permanently waterlogged), but tiny fragments of burnt bone and 'cramp' were found scattered in the filling at all levels. The constituents of the unusual substance known as 'cramp' are described in Appendix 7.

In contrast to the rounded profile of the east ditch-terminal, the straight edges being the result of the splitting of the rock along lines of weakness, the west terminal has a strange linear appearance. The tip of the rock-cut ditch has the appearance of a narrow trench (pl 5b) measuring 4·5 m in length, up to 1·4 m in depth and about half the width of those other sections of the ditch exposed in the course of excavation. The rock-cut sides of this section of the ditch are parallel with the end at right angles to them. At the end of the terminal, in the angle between the end wall and rock floor, a series of pot sherds (SF 16) was discovered. (The small finds are numbered, e.g. SF 16, to distinguish them from the numbering of the stones, and are listed thus on pp 22–7.) The sherds had apparently been dispersed slightly in antiquity but could be restored to form part of the wall of a small grooved-ware vessel. The pottery had been deposited above the two thin layers of primary fill of the ditch – a silty layer and a layer of loose stone slabs. The sherds may have been associated with bones, but only a number of fragments of the tooth of a juvenile ox and two or three minute fragments of burnt bone could be recovered. The upper part of the filling is identical to that recorded in the main section X–X^1 (fig 3); sherds SF 17

were found at the level where the top of bedrock angled into the balk. The width and depth of the ditch increase at a distance of 4·5 m from the tip to a width and depth of over 3·5 m and 1·2 m (pl 5c). Above the initial silting, at a time when about one-third of the filling was in position, a series of bones were thrown into the ditch and were associated with a layer of grey-yellow clayey silt with angular blocks of stone to form a comparatively loose and unconsolidated layer. Included are two bones from human hands, bones of a wolf or dog (all of which may have come from the same animal), cattle bones, including one from a large ox, and others from smaller domestic animals (Appendix 1). These bones are at a higher level in the ditch fill than are the animal bones in section X–X[1] and must represent a deposit after the initial silting had taken place.

The remains of the bank visible in the trench on the SW side and in another cutting on the N side (figs 2 and 3) showed how completely denuded it had become. In the main section the top of the flattened remains of bank is only 0·15 m below the turf, and the material forming the bank must have been broken down and scattered by years of ploughing; what survives is a band (6·5 m in width and about 0·15 m in thickness) on top of the natural till. This band is composed of till of a light red colour and clayey texture and is presumably some of the bottom material of the bank with the addition of the clayey silt that had washed down through the bank over the centuries. A section was also cut through the remains of the bank on the W side of the henge in order to discover whether the evidence obtained from the major section was typical. The bank was found to be a spread area of banded clay about 6·5 m in width, up to 0·4 m in height at the centre but tapering to an exceedingly thin smear at the ends. The bank was made up of an upper layer of reddish till, a thin discontinuous layer of light-coloured clay (15 mm in thickness) and a lower band of reddish material on the surface of a rocky natural or decayed rock. No old land surface deposit was found under the remains of either bank section. From the surviving bank material it seems likely that the basal material of the bank has come from the upper levels of the ditch.

Central Features In the centre of the site was discovered an almost square setting of four massive stones enclosing an area 2·1 m by 1·9 m (pl 6a). The blocks, measuring up to 0·5 m in breadth and 0·3 m in depth, seem to have been carefully set into bedding trenches. When first discovered, with the stones just protruding above the natural, several flat slabs, lying apparently at random, were found on the surface of the interior fill, particularly in the NE corner. Under the stones the fill was red, whereas the remaining fill was mottled greyish black in colour, a colour division that was visible in general terms between the NE third of the fill and the blacker mottled W and S two-thirds. In the NE third, at a depth of about 50 mm, were found tiny flecks of cremated bone with larger pieces at a slightly lower level, and another scatter was found in the SE quadrant; the cremated bone was too comminuted to be identified, but, in the absence of cremated human bones elsewhere on the site, it is possible that this bone too was of animal origin. Analysis of the charcoal found scattered throughout the red area produced a radiocarbon date of 2238 bc ± 70 (SRR-351); this date relates to the second of the two periods to be noted for this stone setting (the possible timber post being the earlier). The S and W two-thirds was covered with mottled black earth containing some seemingly pulverised pieces of charcoal and a few small fragments of bone. A few fragments of pottery (SF 4–12) and a small flint flake (SF 25) were also recovered. The macroscopic plant remains (Appendix 3) belonged to an assemblage comparable to that recovered from the ditch, suggesting perhaps a similar origin.

Quantities of 'cramp' were discovered within this feature, mainly in the upper levels of the fill and particularly in the SW quadrant; first in small particles and at a lower level extending in a discontinuous band in the centre and at a depth of 50 mm to 75 mm, this was more solidly

packed including fist-sized pieces. There were also patches of 'cramp' in the SE corner against the surrounding grey band. 'Cramp', the chemical analyses of which are discussed in Appendix 7, was of several colours, black, white, greenish and purple, the latter two being the least common.

Between the surrounding stones and the central area there was a distinct greyish band of between 80 and 100 mm in width (shown in white on fig 4); this band of silty material was of fairly uniform depth between the stones and the inner filling. Finds of charcoal, cremation and pottery were very limited in this marginal band but were not totally absent. Fragments of bone were discovered in the centre of the E side, and charcoal, cremation and pottery (SF 11) on the S side. The lower levels of the filling of this stone feature were puzzling and their elucidation owes much to the skill of excavation and recording of Mrs I A G Shepherd (Miss A Tuckwell). There is no doubt that the central area, shown on the sections of fig 4, is natural till; the side slabs have thus been carefully manoeuvred into position into trenches dug round a central upstanding area of natural subsoil and, as the outer edges of the trenches follow the shapes of the stones with some accuracy, the layout of the trenches and stones has been calculated with considerable precision. The stones had also been very carefully levelled to provide a horizontal upper surface and the W end of stone 1 had been neatly supported by two flat slabs; the packing of the trenches in which the stones had been set was mainly of earth though some stones were present. There was a looser packing between this natural hump and the grey slot next to the stones on the N and E sides (stones 1 and 2), but the grey material on the other two sides filled a slot between the natural and the adjacent stones (3 and 4). Against the natural hump there was a slot filled with loose stones and reddish brown soil, and containing some tiny fragments of calcined bone, 'cramp' and an unworked flint flake (SF 25). This slot, which was U-shaped in profile and ran parallel to stone 2, was 1·7 m in length and 0·25 m in breadth and was 0·25 m in depth. There was a circular expansion at the N end of the slot and there were packing stones on the E side of the slot below the looser packing. What this seems to represent are the remains of an upright post set at the circular N end with a supporting horizontal beam in the slot (presumably with a junction timber, rather in the manner of an inverted gibbet). The upright and its supporting beams were the reasons for the construction of the stone setting in the position in which it was; the existence of an upright timber provides the best interpretation for the way in which the central hump was not dug out when the main slabs were set into position. The post and slot feature was clearly earlier than the main filling of the stone setting as it was not visible until the surface layers (about 0·14 m in thickness) were removed. On the removal of these layers the presence of the slot could be detected as a linear stony patch 1·7 m in length, adjacent to the natural hump, with loose earth between the stones. As excavation of this feature progressed it could be seen as a distinct band of pink-red earth with the natural till to the W and a clayey loosely-packed material with some small stones (a deliberate fill) on the E. But although the reddened earth suggests burning, whatever stood or rested in the slot does not appear to have been burnt *in situ* and the stones associated with this feature were not fire-shattered.

An area of flat slabs was found lying on the top of the natural till to the N of the stone setting and running between it and the second of the central features; this comprised two stone-holes and the last remains of a timber structure (pl 7a; fig 4). No satisfactory solution can be offered for this slab 'path', but there is no reason to associate it with the destruction of uprights or with recent disturbance to the monument.

Just to the N of the twin stone-holes there were the slight remains of an almost square structure 2·0 m in overall measurement; circular depressions at each corner seemed to indicate the position of corner posts and these were linked by slots some 0·45 m in width and 0·12 m in depth. In the SW angle of this feature two minute deposits of decomposed wood may represent

the remains of upright posts; analysis of this material produced a radiocarbon date of 1730 bc ± 270 (SRR-592). The E and W sides of this little structure were approximately in line with the position of the upright stones in the two holes, and it seems likely that these two stones would have formed a porch or monumental entrance to the slighter timber setting. The shallow U-shaped slots and the corner expansions of the timber setting were severely denuded, possibly by ploughing, on the N side, but were still well preserved on the S and W. The slots or bedding trenches were filled with brown well-packed earth with a number of flat stones, some of them almost completely filling the space. From the SW angle of this small feature a similar shallow trench links it with the W stone-hole but there does not seem to have been a corresponding trench linking the E hole.

The W stone-hole measures 1·4 m long by 0·9 m broad and is at least 0·65 m in depth. The upper fill is of loose earth and stones, but a series of packing stones at the bottom presents a straight edge against which an upright had presumably been positioned (pl 6b). At the edge of the pit there were further possible chocking slabs; the dimensions of the upright must have been about 1·2 m by 0·37 m. At the bottom of the hole and in the original packing there was a chipped pebble (SF 28). It may also be significant that a tiny patch of ochre had been pushed into the side wall of the stone-hole. The E stone-hole was about 1·55 m in length, 0·85 m in breadth and 0·65 m in depth; again the lower level of the packing stones remained *in situ* leaving a space for an upright 1·1 m in length and 0·25 m in breadth. The upper filling, and that occupying the space where the upright had been, consisted of small stones and earth. It is likely that the upright stones had been deliberately removed (they had clearly not rotted *in situ*), and that the stone-holes had been filled with earth and stones in order to even out the resultant hollows (pl 6c). It may be permissible to link these stone-holes with the small square bedding trench; the deliberate extraction of the upright stones may thus mean that the timber structure too may have been dismantled and the trench backfilled with stones and earth.

'*Dolmen*' No completely satisfactory interpretation can be offered for the three original stones of the 'dolmen' – the pair on the E side of the setting and the former capstone. There is no reason to doubt that the W upright was introduced at the time of the reconstruction of 1907, and local tradition has it that the stone was brought from Yesnaby. The two uprights of the E side, however, appear in several early views of the site and were apparently firmly set – though in Thomas's drawings (fig 11) they are more tumbled than in Cleveley's of some seventy years earlier (pl 1b). Excavation in 1973 revealed that these two stones were set in large modern holes (up to 0·85 m below turf level) and were surrounded by concrete; any trace of their original stone-holes had been destroyed in 1907. The western (modern) support had merely been placed on a bed of concrete. The original stones are approximately in the positions indicated on Thomas's and Dryden's plans, and it seems likely that they were merely righted in 1907, rather than re-sited, and that their position on fig 2 is more or less that intended by the megalith builders. This continues the linear arrangement of features formed by the central setting, the stone-holes and the possible timber structure; in general terms the N and S axis of the causeway continues the line. It is not likely that all these features are contemporary (the radiocarbon date for the possible timber building is more recent than that for the central feature), but reconstruction and re-forming such internal arrangements should cause no surprise. Such an interpretation might even support the suggestion that the 'capstone' should be envisaged as the W side of a three-stone setting on the same axis as the W stone-hole. This would account well for the angle at which it had come to rest shown in several early illustrations. Any shallow stone-hole would have been completely destroyed during the construction of the concrete bed for the W stone of the dolmen in 1907. It has to be admitted that there are no parallels for such a feature in other excavated henges, but

the parallel pair of stone-holes already described make such a setting the most likely solution to the problem. The stones of the E side measure 1·92 m by 0·54 m and 0·36 m in thickness and 1·94 m by 0·73 m and up to 0·49 m in thickness, but the tops of both of them have been flattened (presumably in 1907 in order to keep the 'capstone' level) and the original heights cannot be determined, nor can the depths to which the stones were originally set into the ground. The stone of the W side of this hypothetical setting, the former 'capstone', measures up to 2·74 m by 1·99 m and 0·16 m in thickness.

To recapitulate the series of central features: near the centre of the circle a slot with a circular expansion at one end suggests the existence of an upright post with a lateral support; this was succeeded by an almost square stone setting, constructed round the 'post', and in the upper filling of which was cremated bone, charcoal, 'cramp' and pottery. To the N of this feature, and linked to it by a rough slab 'path', was a pair of stone holes from which the parallel uprights had been removed and which had then been deliberately backfilled; presumably associated with this were the slight remains of what appears to have been a small timber structure. The stones of what was to become the 'dolmen' may originally have formed a parallel upright setting on the other side of this timber structure, but excavation could not reveal the original stone-holes for this setting as these appear to have been destroyed during the construction of the 'dolmen' in 1907.

Pits There is a group of five pits, about 5 m to the S of the central feature, dug into the natural yellow glacial drift (pl 7b; fig 2). Pit A measures 1·05 m in diameter and 0·6 m in depth; it is possible that this pit may originally have been slab-lined and, although only two slabs remained upright, two others were found lying flat within the filling. Sherds of pottery (SF 1) were found beside these slabs on the W and S. The fill of the pit was not as homogeneous as in Pit C; the fill on the W side was earthier than that to the S of the upright slab which consisted of natural till. Above the two fallen slabs there was an earthy charcoal stain. Flotation of the earthy fill recovered a number of organic remains which are described in Appendices 3 and 4. Pit B is smaller, measuring 0·64 m by 0·5 m and 0·35 m in depth with straight sides and a round bottom. At a depth of about 0·2 m were found two flat slabs at a slight angle to the sides of the pit. Flotation of the earthy materials beneath these produced the carbonised cereal and other remains (Appendices 3 and 4). Pit C, comparable in dimensions to Pit A and measuring 0·95 m by 0·85 m and 0·58 m in depth, has straightish sides and a rounded bottom; it had a fill of black earth and stones with a comparatively stone-free top half and a much stonier bottom half; flotation of the earth filling recovered several carbonised cereal caryopses and other remains discussed in Appendices 3 and 4. A greasy organic smear at the bottom of the pit contained charcoal from which a radiocarbon determination of ad 519 ± 150 (SRR-352) has been obtained. Pit D was a smaller hollow in the natural (0·4 m by 0·37 m and 0·15 m in depth) and had a rounded section; upright in the centre of the pit there was the base of a pottery vessel (SF 3), the upper part of which had presumably been destroyed by ploughing. The pit and the pot had been filled with yellow gravel. Adjoining this, Pit E was an area of reddish burnt material (0·9 m by 0·85 m and 0·15 m in depth) forming a shallow scoop into the natural. Sieving and flotation failed to reveal any organic material.

A group of features which could not be explained was found between stone no. 7 and the 'dolmen'; they were squarish hollows with rounded corners, dug into the glacial till, the largest measuring about 1·15 m by 1·0 m and about 0·3 m in depth. This hollow was filled with loose slabs and broken stones, the slabs piled against the SW side where it was cut more definitely into the natural and where a single long slab seemed to form the edge. The filling of the hole of stone 6, which may have been partly broken up *in situ*, was very similar; but the size of the

largest hollow is not like any of the other stone holes, and it might be suggested very tentatively that the feature represents a destroyed shallow cist, but this is clearly not a very satisfactory solution. The two other hollows of this group were more clearly of recent origin (one containing fragments of a modern field-drain); that beside the E ditch terminal is apparently a natural hollow (1·3 m by 1·2 m and up to 0·5 m in depth) and may be the result of the removal of a boulder from the till.

DISCUSSION

Several neolithic monuments in Orkney have been excavated recently by a number of research teams with differing, but allied, objectives; the settlement sites of Knap of Howar and Skara Brae will clearly provide a more rounded picture of day-to-day life of the period than will ritual monuments such as the Stones of Stenness or the Ring of Brodgar. The writer of the final report of this series of excavations, or a subsequent reviewer of the evidence, will have a great deal of interlocking material to deal with. It seems likely that the various excavation reports will concentrate on different aspects of the period and, as this is one of the first to be published in full, the environmental evidence of Appendices 1–4 is presented with little comment (*see also* Davidson *et al* 1976). However, the adjacent promontory at the time of construction seems to have been covered by open grassland, probably with some cereal cultivation present.

Although the sequence of construction cannot be demonstrated, economy of effort and the creation of a larger area of manoeuvre during the erection of the monoliths suggest that the standing stones were raised into position before the total digging-out of the ditch; this can clearly be no more than hypothetical. Whether the postulated timber post near the centre of the circle had a part to play in the layout cannot now be determined, for, although there is little doubt that the builders of the circle originally planned a ring of twelve stones, the fact that only six stones or stumps now survive *in situ* (nos 2, 3, 4, 8, 10 and 11) makes the geometrical elucidation of the plan unclear. The evidence suggests, however, that an ellipse was intended (Appendix 8).

It is impossible to be certain whether the complete plan was ever carried out, for, although there is no doubt where there are existing stones or stumps or clear historical evidence of the existence of a stone (no. 6), in the case of two holes there is no clear evidence that the hole or space was ever filled (nos 9 and 12). The interpretation of the stone no. 7 is also a problem; in the case of no. 9 it is perhaps unlikely that the removal of an upright would be accompanied by the total withdrawal of the packing stones. There is of course even less evidence for the presence of stone no. 12. Rather similar problems have faced MacKie in the interpretation of the circle at Cultoon on Islay (1976a). Here some fallen stones were without adjacent sockets, and a number of stone holes had no adjacent stone; MacKie suggests that, because of a change of plan, the site had been abandoned in the course of construction, one socket having been deliberately filled up (comparable perhaps to stone hole no. 9 at Stenness). If it is reasonable to suggest, however, that at Stenness the circle is earlier than the ditch, the fact that the ditch has been completed round the site may point to the subsequent removal of stones rather than to an uncompleted plan – despite the negative evidence of stones 9 and 12; but as has already been stressed the constructional sequence cannot be finally demonstrated. Equally it cannot be shown that the ditch was excavated as a single operation – the narrow tip of the west ditch terminal giving every appearance of being an afterthought or later cutting, comparable perhaps to the deliberate backfilling of one of the ditch terminals at Stonehenge. The grooved ware at the terminal and its similarity to that within the central feature, and the comparable dates of

the central feature and main ditch section (SRR-350 and 351) suggest to the excavator, however, that these components of the monument are at least broadly contemporary and belong to a single concept of construction and use.

The visible architectural feat of the raising and positioning of the monoliths is fully matched by the excavation of the rock-cut ditch. The physical effort required for the entire operation of the construction of the henge has been evaluated as being some 50,000 man-hours (Appendix 10). The original depth and width of the Stenness ditch must have given the stones an impression of greater height and aloofness. The ditch of the adjacent henge monument of the Ring of Brodgar, as revealed by excavation, is an even greater engineering feat; it measures no less than 10 m in width and 3·4 m in depth from the outside surface, and was, like that at Stenness, cut into solid bed-rock. Renfrew, using data on traditional quarrying methods in Orkney, suggests that the effort required might indicate a figure of 80,000 man-hours. Clearly such estimates can give no more than a tantalising impression of the complex organisation of neolithic society in Orkney.

The ditch must have started to silt very quickly after it was cut, but there is no means of telling how often, nor indeed if the ditch bottom was cleared out after the initial cutting. The organic deposit in the main ditch section (fig 3, X–X^1, Z–Z^1) must, however, relate to a period early in the history of the site, given the radiocarbon determination of 2356 bc ± 65 (SRR-350). The straight interface between this organic layer and the silty clay loam with sub-angular fragments of stone, which gave the impression of gravelly washes of material from the ditch sides, and possibly the bank, is difficult to interpret. It suggests the prior existence of this body of material forming a central spine in the ditch bottom against which the silt gradually butted. The processes of build-up of this part of the section are, however, complicated by the fact that the ditch was waterlogged, probably soon after cutting; some of the plants shown to be present in this layer were certainly growing in the water – the numerous fruit stones of pond weed for example indicate a plant that grows with all its leaves submerged (Appendix 3). The organic evidence may thus be the result both of man's deposits into the muddy bottom of the ditch and also of the plants that were growing there naturally. As has been shown in Appendix 3, the twigs, seeds and nutlets are evidence both of the plant life of the ditch sides and surrounding ground and of that of the wet ditch bottom. The fragments of wood (alder, birch, spruce and pine) must, like the animal bones, have been thrown by man into the open waterlogged ditch; the most likely source for the wood is drift timber (*see also* Clarke 1976a, 24–5). The animal remains in this layer – wolf/dog, domestic ox and sheep – are fully described in Appendix 1, but it is worth stressing that they represent mandibles and extremities of limbs, the debris of more usable sections of bones or more succulent joints. Of particular interest is the presence of bones of wolf/dog. An accumulation of animal bones has also been recorded in and on top of the earliest ditch silts at Marden (Wiltshire; Wainwright *et al* 1971, 187–8, 234–5) and the Devil's Quoits, Stanton Harcourt (Oxon.; Gray, M 1974). At Stenness such deposits continued even after the initial silting of the ditch had taken place and at a time when the profiles of the ditch (and bank) had lost much of their original sharpness; the bones in the west ditch-terminal (Appendix 1) and the deposit of cremated bone, shown on section fig 3, demonstrate a continuing interest in the site. The fact that none of the cremated bone can be shown to be human – some at least is animal – sounds a caution against interpreting mention of cremated bone in excavation reports as indicating a human burial deposit, unless the bones have been properly analysed or were associated with a presumptively funerary vessel; in the latter case it is usually impossible to connect the deposition of the vessel with the construction of the circle (Burl 1976, 40, 47).

The part of the ditch that was rock cut must have produced a considerable quantity of

stone and this must have been used in the body of the bank; slabs were certainly present in the early slip into the ditch, but these were on the inside half of the ditch-fill rather than on the outer (bank) side. At the Ring of Brodgar, the evidence of an outer bank was inconclusive; in Trench C, on the S side of the site, a thin layer of clayey soil (0·8 m in width and only 0·04 m in thickness) was all that survived, while on the NE side of the henge the slight indication of a rise was found to be the result of a rock hump. At other henge monuments where the ditch has been cut into the rock, such as Arbor Low and the Bull Ring, the bank appears in general to be of limestone quarried from the ditch (Gray, H St G 1903, 477–8; Alcock 1950, 85).

In no case can the central features of a henge monument be fully interpreted; Stenness is clearly no exception and only a small part of the interior has in fact been excavated. Central stones have been found for example at Arbor Low, Derbyshire, and the Stripple Stones, Cornwall, but in neither case was a large enough area opened to give more than a slight indication of the focal importance of the centre of the henge monument (Gray, H St G 1903, 479–80; 1908, 11–13). The two stones at Arbor Low lie approximately on the axis of the entrances of the class II henge – a state of affairs clearly comparable to the structures at Stenness. A similar axial arrangement of two four-post settings has been recorded at the Mayburgh, Westmorland, but as only one stone now survives the precise arrangement depends on the interpretation of 18th-century information (Dymond 1891, 193–5; Clark, J G D 1936, 44, fig 24). A central feature may also have been present at Bryn Celli Ddu, Anglesey, but this may have been replaced by the builders of the subsequent passage-grave (Lynch 1970, 59). Stone circles are features of only 17% of known henges (Burl 1969, 8–9; 1976, 24–30), but without excavation it cannot be taken as certain that they were not more common and even with excavation it is impossible to prove in most cases that they are contemporary. At Cairnpapple the stones were removed in a subsequent phase and their positions could be detected only by the stone-holes; the stones at Bryn Celli Ddu were incorporated in the body of the later mound. Knowledge of the internal arrangements of henges and stone circles, with the exception of the allied late-neolithic enclosures recently excavated by Wainwright (Durrington Walls, Marden, Mount Pleasant), is uneven and unsatifsactory.

The central stone setting at Stenness may be compared to the central arrangement of stones within the stone circle at Balbirnie, Fife (fig 5), but here, apart from the remains of the trench in which the rectangular blocks of stone had been set, there were no constructional details, although it was tentatively suggested that the decorated slabs, which were re-used in subsequent phases of the site, might originally have been associated with this structure (Ritchie 1974, 6, 11). The radiocarbon date associated with this feature, 890 bc ± 80 (GaK-3426), is not considered to be a helpful indication of the period of construction of the setting; the assay was made on a collection of small pieces of charcoal found in the land surface within the stones and beneath the cairn material; quite apart from the unsatisfactory nature of the original sample, the charcoal could be the result of later destruction and disturbance wrought to the site. In the report on the excavation of Balbirnie attention was drawn to a series of 'cult houses' or 'mortuary houses' in Denmark, which have on occasion been interpreted as temples (Ritchie 1974, 13); it seems possible that the central setting at Stenness may be the foundation of such an enclosure, designed to receive offerings, sacrifices or bones, and the timber setting, with what must have been impressive stone portals, may also belong to a similar tradition.

The rectangular settings at Stenness and Balbirnie are clearly distinct from the three-stone features known as 'coves', which are represented by mpressive uprights at Avebury, Wiltshire, Stanton Drew, Somerset (pl 9) and less probably at Arbor Low, Derbyshire. Piggott has discussed these fully in the report on the 'three-hole' setting at Cairnpapple, West Lothian,

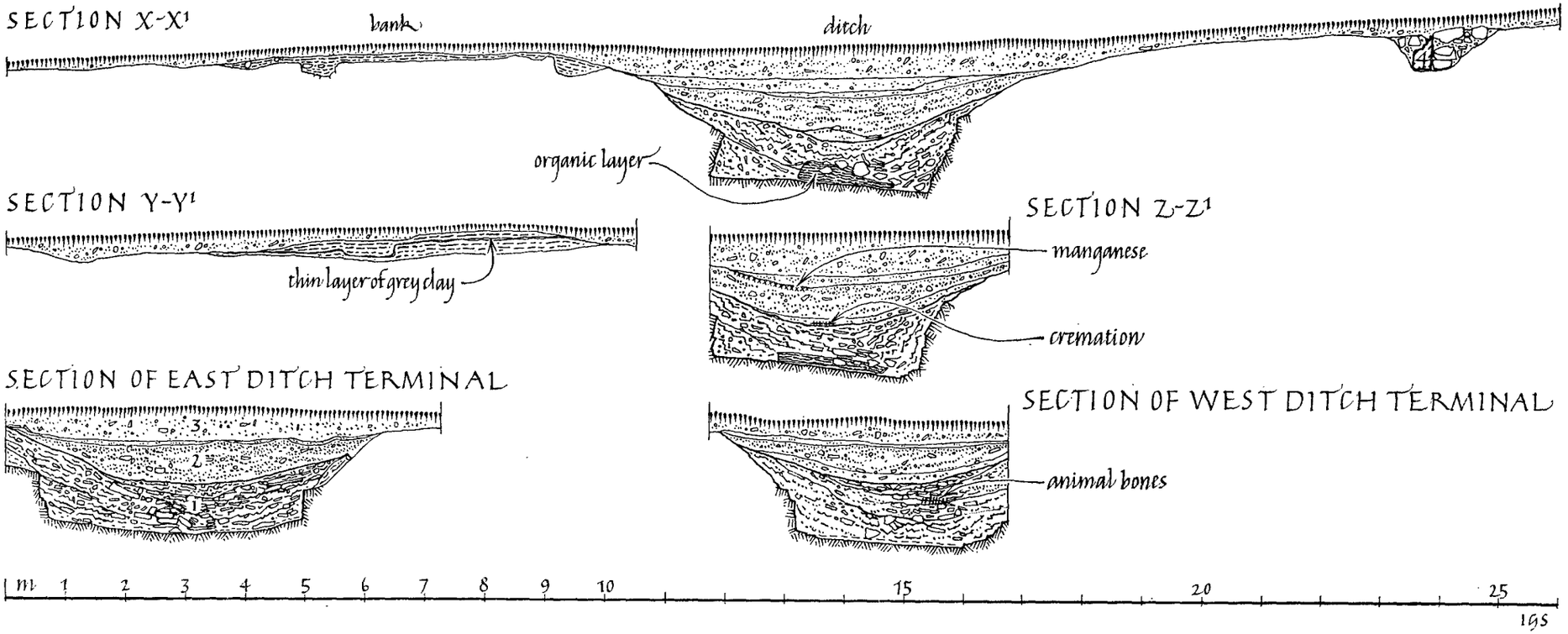

FIG 3 The Stones of Stenness: sections

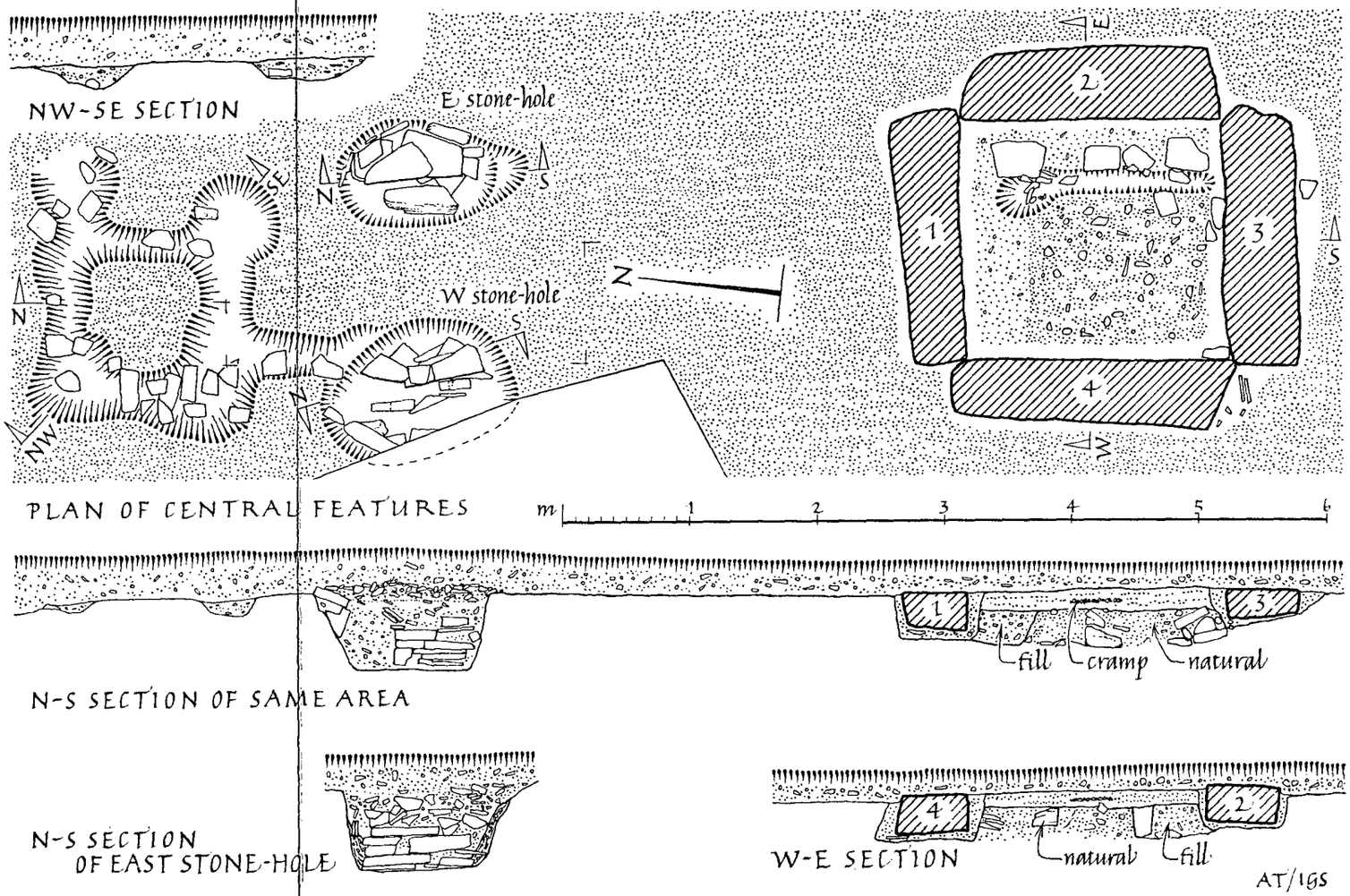

FIG 4 The Stones of Stenness: central features

and no exactly similar structures have since been found, although the stone setting at Mount Pleasant, Dorset (Wainwright 1970), is comparable in some respects. In the absence of firm evidence Burl seems to overstress the 'funereal associations' of such monuments (1976, 105–6, 170). One feature of the Avebury and Stanton Drew 'coves', not shared by the stones of the Stenness 'dolmen', is the great size of the uprights (Stukeley 1743, 23–4, tab xiv and xv). The stones of the 'dolmen' may either be envisaged as a setting of three uprights, two on one side and only the 'capstone' on the other side of the setting; alternatively this large flat stone might have been set leaning against the pair of uprights to form a more 'cove-like' feature. The best illustration of such an arrangement, likened by Burl to 'the sides of an unroofed sentry-box' (1976, 105), is the Cove at Stanton Drew (pl 9). This is now difficult to photograph, but Stukeley's drawing of 1723 gives a good impression of this free-standing three-stone setting which may be

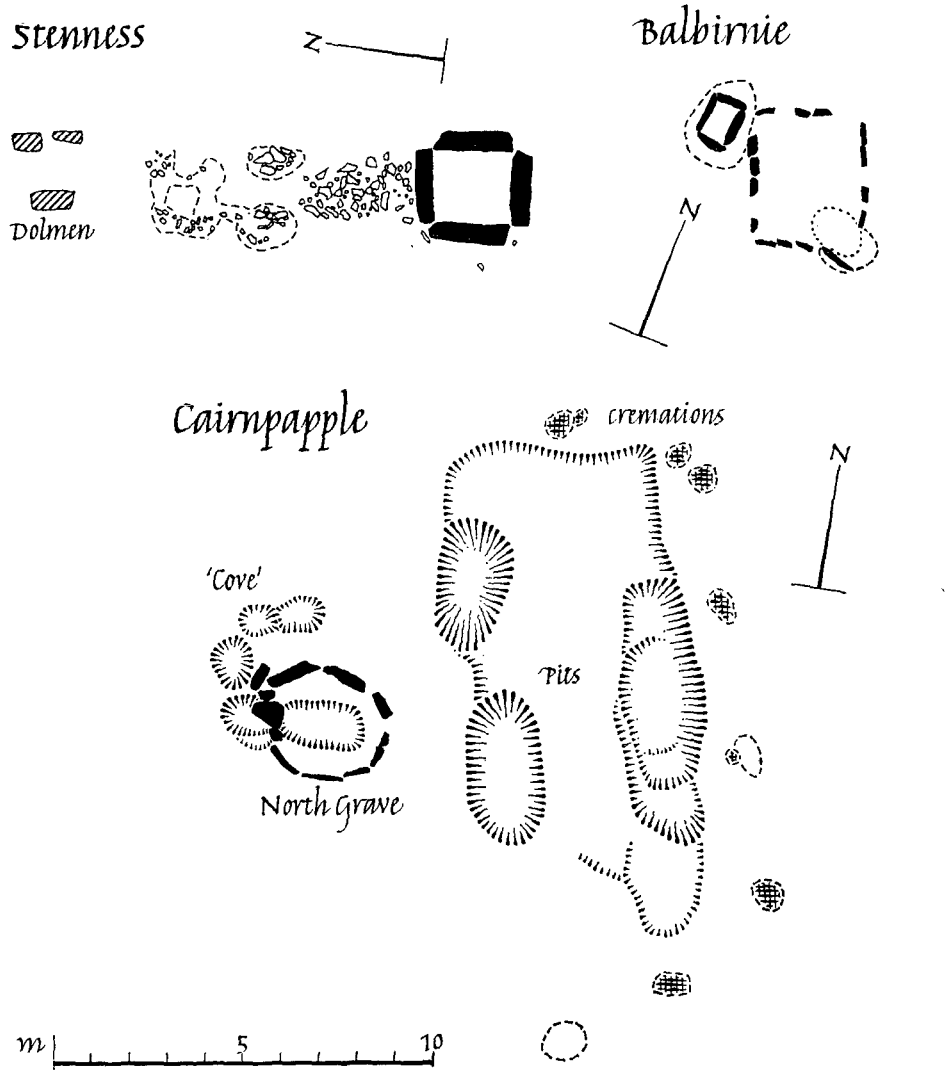

FIG 5 Central settings at Stenness, Balbirnie and Cairnpapple

comparable to that at Stenness. The juxtaposition of such a setting with the rectangular feature at the centre of the henge monument is comparable perhaps to the position of the 'Cove' and central pits at Cairnpapple. Piggott leaves open the status of these vanished features assigning 'Cove' and cremation pits to a period before the construction of the henge, and the Pits, North Grave, stone circle and henge to the second period of activity (1948, 86–8). While it is clear that the North Grave is later than the 'Cove' it might be permissible to associate the henge and circle with the central feature represented by the Pits (either a dismantled three-stone setting with very large stone holes or perhaps a dismantled rectilinear feature) with the 'Cove' and (as their holes respect the pits) the arc of cremation deposits.

The only finds from the Pits were scattered fragments of cremated bone in the southern area and two sherds of undecorated beaker from near the bottom of the NW pit (Piggott 1948, 86; *see also* Burl 1976, 281). Whatever these pits represent was certainly dismantled before the construction of the Period III cairn, as this involved the deliberate filling of the SW pit with blue clay in order to act as a foundation for the kerb-stones. Such an interpretation might mean that the henge was built at a rather earlier period than the beakers of the North Grave suggest.

The individual features of the central setting at Stenness are difficult to compare: the primary 'post' might be allied to those circles with central monoliths, but it might have been involved in the laying out of the stones or the ditch (though see pp 48–9); the large blocks of the setting were laid in position around this point without disturbing this area of subsoil, but for no discernible reason; the band between the surrounding stones and the central area had the appearance of a replacement soil (finds were virtually, but not totally, absent) and it is possible that this represents the line of a timber surround, within which the various deposits or scatters of earth, bones, pottery and 'cramp' were made (the decay of this surround producing the grey band of replacement soil).

While it is easy to envisage the east and west stone-holes, the post structure and the 'dolmen' as 'ribbon development' between the centre of the circle and the entrance to the henge, there is only one chronological pointer to the sequence – the radiocarbon date from the decayed timber of the post structure; the tiny quantity of surviving wood has meant that the date 1730 bc $\pm$ 270 (SRR-592), has an unusually large standard deviation (Appendix 9), but it may suggest that this structure and the two stone-holes associated with it are a later development than the construction of the henge and the use of the central setting. The chronological position of the stones of the 'dolmen' is not of course known.

The pottery found during the excavation falls into three groups both on archaeological and petrological grounds (Appendix 6); the first includes the grooved-ware sherds (for example SF 4, 5, 12 and 16), the second comprises the undecorated sherds from the E ditch terminal (SF 13–15), and the third is represented by the sherds from Pits A and D (SF 1 and 3) – the radiocarbon date from the adjacent Pit C providing the only indication as to their period. The sherds of a grooved-ware vessel (SF 16; fig 6) belong to a straight-sided flat-bottomed pot which has been decorated with incised lines to produce elongated lozenges; in fabric it is very similar to a vessel from the chambered tomb at Quanterness, though the latter has a rather more crumbly texture. Sherds with comparable decoration have been found at Dingieshowe in Orkney (Stevenson 1946, 142–3) and from Rinyo (Childe and Grant 1939, 25, pl xxii, 4) but are not represented at Skara Brae. Childe links the decoration of the Rinyo pot (found 'close to virgin soil under the floors of chambers C and D') to one from Lion Point, Clacton (Warren *et al* 1936, pl xxxix, 12; Wilson, K E *et al* 1971, 112, no. 135), but whether such wide-ranging comparisons are valid, in view of the chronological difference between the Orcadian and the eastern and southern grooved-ware groups, is still a matter for discussion (Clarke 1976b, 238). The Stenness material would

fall into the *Clacton Style* of grooved ware, and comparable intermediary vessels could be quoted from Yorkshire and Northumberland (e.g. Manby 1974, 78–9; Miket 1976, 118–19). A corrected date within the earlier third millennium for the henge and grooved ware at Stenness may be confirmed by the not dissimilar dates from Quanterness (Renfrew *et al* 1976, 202–3) and Skara Brae (Clarke 1976a, 27; b, 238–9). One of the most interesting features about the pottery style represented by SF 16 is the range of sites from which comparable vessels have been recovered; it provides a link between the henge monument at the Stones of Stenness, the settlement at Rinyo, the use at least of such chambered tombs as Quanterness, Quoyness and by implication Maes Howe (Henshall 1972, 285–6; Renfrew *et al* 1976). Two sites in west-central Scotland have produced similar pottery – Knappers, Dunbartonshire, and Townhead, Bute (Mackay 1950). A radiocarbon sample from the latter site (not, however, from charcoal associated with grooved ware) has provided a date of 2120 bc ± 100 (GaK-1714) (Scott 1968). A comparable sherd comes from Tentsmuir, Fife (Longworth *et al* 1967, 75, 90–1).

As far as Scotland is concerned, only in Orkney does grooved ware give any impression of cultural cohesion; but this point should not be overstressed as the pottery from Skara Brae is very different in character to the grooved ware from Stenness and Quanterness. The apparent dichotomy between the makers of grooved ware and the makers of Unstan ware may suggest the presence of two distinct social groups in Orkney by the third millennium BC. This suggested model for the prehistory of Orkney in the third millennium BC is at variance with Renfrew's vision of Orkney at this period; he infers a linear relationship between Unstan ware and grooved wares, and between stalled cairns and the Maes Howe class of tomb (Renfrew *et al* 1976, 200). While there is every indication of the chronological overlap of the two styles of pottery, study of the pottery itself does nothing to confirm a process of evolution culminating in the grooved ware style within Orkney itself. There are as yet no dates for the period of construction of any of the Orkney tombs. The present writer is not convinced by a model that has no place for the introduction of the cruciform passage-grave to Orkney and would rather see the makers of grooved ware as 'one strand of a complex society' (Wainwright and Longworth 1971, 268). The work undertaken by Williams on the fabric of both Unstan and grooved wares may provide one important key to our understanding of that society in Orkney; the pottery sequence recovered from the excavations at Skara Brae will be another (Clarke 1976a, 20).

The association of grooved ware with monuments of considerable architectural expertise such as Stenness and Quanterness, whether with the builders or with the users, is, however, important and is in line with the evidence, admittedly of rather later date, from recent excavations in the south of England. But this is a tradition, whether unified or not, that includes not only impressive architectural feats such as stone circles and late neolithic enclosures (e.g. Durrington Walls; Wainwright and Longworth 1971), but also many deposits with no architectural associations, such as those described by Manby (1974).

If the radiocarbon dates from the central feature and from the organic layer in the ditch are accepted as providing a reasonable *terminus ante quem* for the construction and use of the henge monument and stone circle (2356 bc ± 65 and 2238 bc ± 70), they suggest a period, in terms of corrected dates, early in the third millennium BC. This is considerably earlier than the dates obtained from the excavations of the large late neolithic enclosures at Durrington Walls, Marden and Mount Pleasant (Burleigh *et al* 1972), but even earlier dates have been obtained from henge monuments at Arminghall (2490 bc ± 150; BM-129), Barford (2416 bc ± 64; Birm-7) and Llandegai (2790 bc ± 150; NPL-220). If the suggested contemporaneity of the Stenness henge and the use of some of the Maes Howe class tombs is relevant, and the dates from the Maes Howe ditch and the earlier of the dates obtained from Quanterness certainly suggest that this is so, then the

dates from Newgrange may also be mentioned. Whatever the connection between this cruciform passage-grave and the Maes Howe group is, and the evidence has been discussed most fully by Henshall (1972, 268), the three dates obtained suggest that the construction of this tomb was undertaken about 3300 BC in terms of corrected dates (O'Kelly, M J 1969; 2475 bc ± 45 and 2465 bc ± 40, GrN-5462-C and 5463; 2585 bc ± 105, UB-361). Thus if the 'Great Circle' at Newgrange is in fact contemporary with the mound (O'Kelly, C 1967, 69; Burl 1976, 240–2), it must be one of the earliest stone circles. On the available evidence, if the main architectural components are indeed broadly contemporary, the circle at Stenness would also seem to be earlier than the main period of circle-building. It seems likely that, because it is a Class II henge, the Ring of Brodgar is rather later in date than the Stones of Stenness. Some writers have seen a ceremonial way between Stenness and Brodgar marked out by a line of standing stones (pl 3b and c), but there is no firm evidence for the architectural sequence of these impressive ritual or ceremonial centres.

The partial excavation of the henge monument of the Stones of Stenness has provided information about the stone circle, the ditch and the unusual series of central features. It has been at least partly successful in providing an interpretation of the stones of the 'dolmen'. The pottery recovered and the radiocarbon dates obtained may be used to build up a series of links with the approximately contemporary monuments of the Maes Howe class of tomb and the settlement-sites of Skara Brae and Rinyo.

A further interesting aspect of the excavation has been to show the continuing interest in the henge and stone circle some 3000 years after it was put up, at a date when the silting of the ditch would already have been well advanced. Although only the radiocarbon date from Pit C provides a clear indication of the late date of the pits, and it seems likely that they are approximately contemporary, the pottery from Pits A and D (SF 1 and 3) also belongs to different groups from those represented by the other sherds (Appendix 9; Groups III and IIc); the stone object from Pit C (SF 26) is perhaps comparable to a worked stone from Jarlshof from a later prehistoric context (Curle 1934, 303, fig 64, 2). The iron-age pottery said to have been found during the re-erection of stone no. 5 (SF 29–36) is further confirmation of an interest in such sites as henges and cairns (Daniel 1972); this may be paralleled by the Period V graves at Cairnpapple (Piggott 1948, 100, 117–18) and by the dates for the enlarging of the bank encircling Maes Howe (Renfrew *et al* 1976, 198).

CATALOGUE OF SMALL FINDS

Small Finds from the 1973–4 Excavations

by A S Henshall and L Savory

Pottery

Note that, although the angles of the rims can be estimated, no rims are sufficiently large for the angle to be known exactly (figs 6 and 7).

1 Sherds from the rim and wall of a large heavy vessel, apparently a deepish bowl, with burnt accretions from use on both the inner and outer surfaces. The rim has a rounded edge and deep inner bevel; its angle is uncertain but the wall was probably vertical or slightly inturned. The ware varies from dark grey to pinkish-buff, and is heavily tempered with large angular grits. A slip over the outer surface does not cover the protruding grits entirely, leaving a rough and uneven surface. In places the pot has broken along the building rings. Pit A.

2 Part of the flat base of a vessel, estimated diameter 120 mm, the lower surface slightly concave. The grey ware is heavily gritted, the outer surface covered by a pink/brown slip, the inner surface missing. Topsoil.

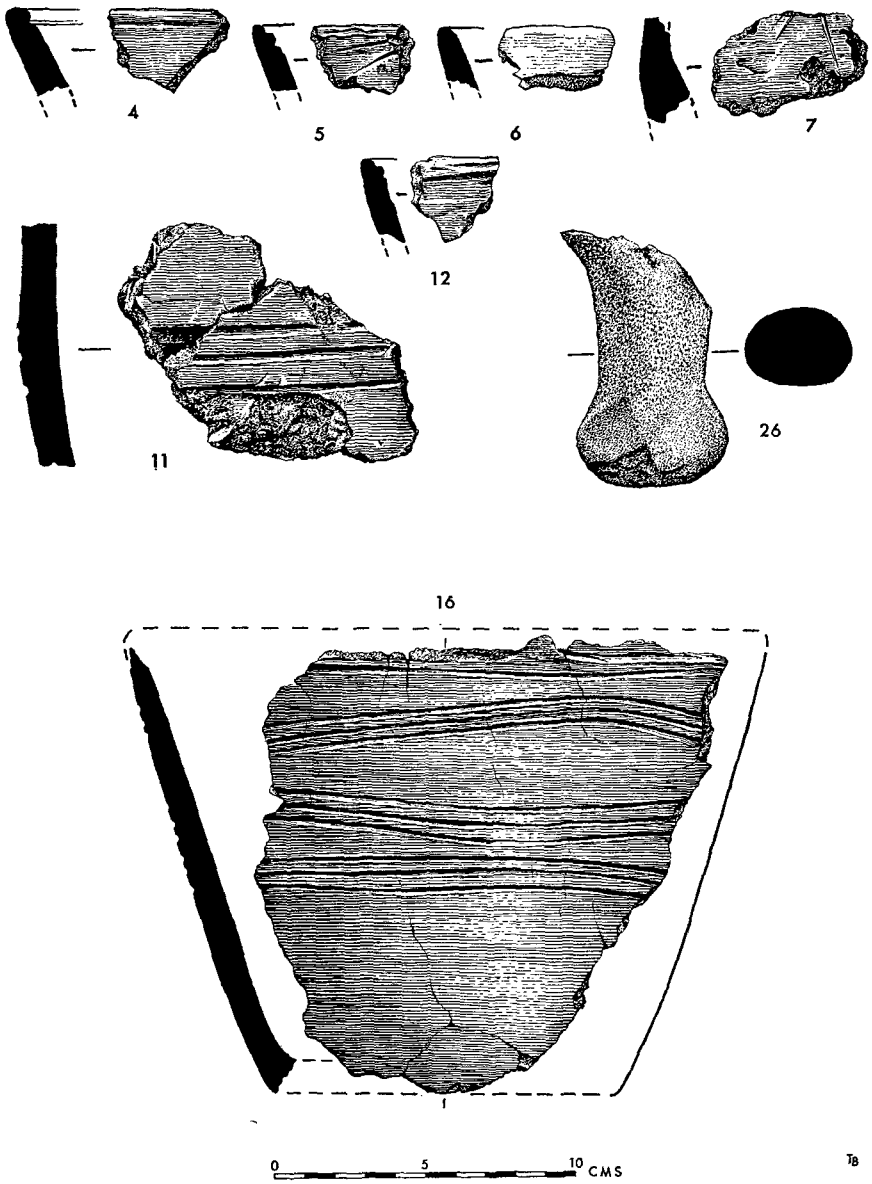

FIG 6 The Stones of Stenness: pottery (4–7, 11–12, 16) and stone (26)

3 Complete base with the lower walls, and other wall sherds, from a flat-bottomed vessel, the lower surface slightly concave. The ware is dark brown, heavily tempered with large grits, covered inside and outside by a fine buff slip, becoming pink to one side where there has been secondary burning. Pit D.
4 Rim sherd from a vessel probably from a vertical-sided or open bowl. The rim has an internal bevel, below which is an incised line of varying depth and below this is a faint groove apparently made with a finger tip. The ware is dull brown, fine and hard with relatively small grits. The outer surface retains a fine burnished slip including tiny specks of mica, and this extended over the rim bevel. The ware is of the earlier neolithic (Western or A) tradition, but the internal line below the rim is an alien feature and would seem to relate it to the grooved-ware sherds 5. Central Feature.

5 Rim sherd from a thin-walled straight-sided vessel, with little curve on the rim edge suggesting an unexpectedly large diameter. The rim has an internal bevel with two horizontal incised lines, the upper forming a step in the profile. The lines are drawn with varying firmness in long stab-and-drag technique. Below them, a slanting line suggests the decoration continues with a chevron-like pattern. The fine ware is chalky with few grits, and pink in colour, probably due to secondary burning. Central Feature.
6 Rim sherd with a rounded edge and internal bevel, broken along a building ring; fairly hard ware with a few medium-sized angular grits, the ware now orange-pink due to secondary burning. In form and size the vessel is likely to have been similar to SF 4. Central Feature.

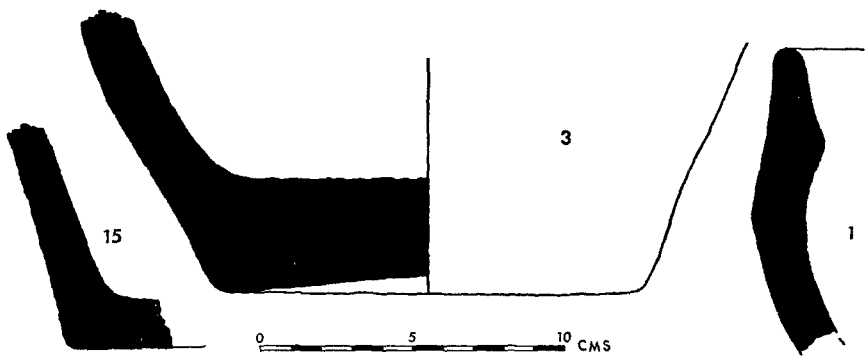

FIG 7 The Stones of Stenness: pottery

7 Wall sherd bearing converging incised lines on its outer surface; probably part of a horizontal chevron pattern. The ware, now pink from secondary burning, is very heavily tempered with medium-sized grits, some of which have fallen out of the surface. The surfaces are uneven, but with no appreciable curve on the presumed circumference, and are angled inside on the presumed vertical section becoming thinner at the part bearing decoration. Central Feature.
8 Tiny fragment from the edge of a rounded rim with an internal horizontal incised line. The ware is very similar to SF 5, and if this pot were slightly irregular in rim section, this sherd could well belong to it. Central Feature.
9 A group of seventeen wall-sherds, perhaps not all from the same pot, one with an incised horizontal line. Mostly they are heavily gritted with a fine slip, either dull brown or reburnt orange/pink; some are possibly from pot 7. Central Feature.
10 Wall sherd, 7 mm thick, fairly hard ware with some medium-sized grits, the uneven surface bearing marks from wiping the surface before firing. There is no detectable curvature. Central Feature.
11 Wall sherd from a straight-sided vessel similar to 16, the outer surface decorated with three wide incised lines. The ware is heavily tempered with fair-sized angular grits, but has a thick slip outside, which has covered the grits though the surface is rather uneven; the inner surface mainly worn off. It is now bright orange-pink from secondary burning. Central Feature.
12 Rim sherd and wall sherd; the rim is so similar to 5 as to suggest that it is part of the same vessel though there is no sign of the lower chevron pattern and instead there is the suggestion of a third horizontal line which is probably no more than a mark made in wiping the pot before firing. Dull brown in colour. Central Feature.
13 Eleven wall-sherds, 6–9 mm thick, of dull buff-grey ware, the outside mainly black, with sooty accretions from use, rather sparse grit temper. East Ditch Terminal.
14 Eleven wall-sherds, 12–14 mm thick, heavily gritted brown ware, thick chalky slip inside and outside. East Ditch Terminal.
15 Sherd from the flat base and lower wall of a vessel, heavily gritted but fairly hard ware, dull grey in colour with a rough inner surface, the outside slip burnt pinky-buff near the base, darker above with sooty accretion from use. East Ditch Terminal.
16 Sherd comprising nearly a quarter of the side of a vessel (and a second small wall-sherd), the angle of the junction with the flat base being just preserved inside, the actual rim edge missing but two irregular lines inside the rim remaining. The outside is decorated with wide incised lines, two (possibly originally

three) just below the rim, and three groups of three, each group forming very wide chevrons, the groups related to produce horizontally attenuated diamonds. The ware is dull brown, partly burnt pink inside, heavily tempered with large grits, a thick slip outside almost black in colour. West Ditch Terminal.
17 Three sherds from a flat base, 15 mm thick, soft dark grey ware, buff lower surface, black accretions inside, rather light sandy ware with almost no grits but many cavities of varying size due to the loss of organic tempering material. West Ditch Terminal.

Flint and Stone (fig 8: 18, 19, 21: fig 6: 26)

18 Worked flint, possibly part of a plano-convex knife, burnt, pieces of the surface having broken away. The long sides have both been trimmed fairly steeply, the surviving end having a sharp point. Slight chipping visible on the lower part of the upper surface along one edge indicates use. Topsoil.
19 Small flake of speckled honey-coloured flint, retaining at one end a fragment of the crust of the flint pebble. There is shallow re-touch along both edges. Damage through use at proximal end. East Ditch Terminal, at a depth of 1·4 m from turf.

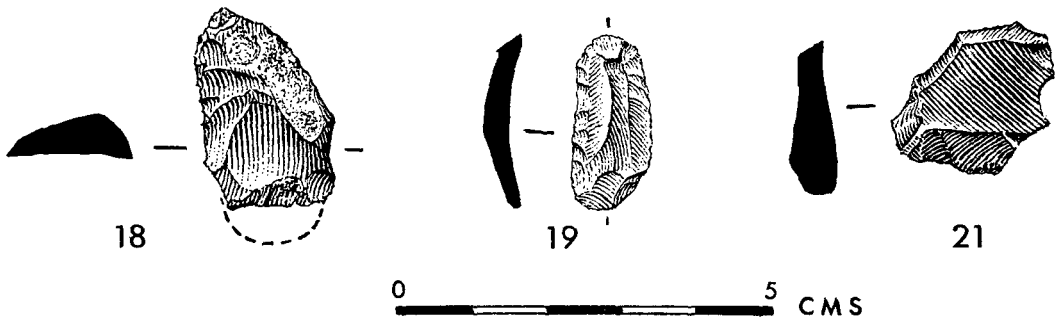

FIG 8 The Stones of Stenness: flint

20 Fragment from the top of a large flake of speckled grey flint with cherty streaks, retaining the bulb of percussion. Topsoil.
21 Part of a thin scraper on an irregular flake of dark grey flint, showing considerable edge damage, possibly caused by use, around much of the perimeter. Topsoil.
22 Fragment of pale grey flint with a worked edge much chipped from use, the maximum thickness 11 mm. Topsoil.
23 Two flint chips and one possible scraper fragment. Topsoil.
24 Chert flake. On natural surface to S of stone no. 8.
25 Flake of pale grey translucent flint with edge damaged through use. Fill of 'slot' within Central Feature.
26 Handle-like object broken from a larger implement. The surviving portion, 80 mm maximum in length, consists of a flattened oval-sectioned shaft 32 mm by 23 mm curving out into a spatulate terminal 50 mm by 18 mm, ellipse-shaped in section. The shaft is broken off at the other end at the point where it begins to curve out again. Both sides and one broad surface are finely pecked. The spatulate end on this same surface is chipped and pitted along its edge as if by wear. The other broad surface is smoothed and scratched, again as if by wear. Pit C.
27 Disc of slate, 5 mm thick, about 84 mm in diameter, the edges roughly chipped to shape. East Ditch Terminal.
28 Pebble chipped by wear at both ends 86 mm by 75 mm; lower fill of West Stone-Hole.

Iron-Age Pottery from the Stones of Stenness, 1906

by E W MacKie

Introduction and general context

Among the extensive collections of Scottish archaeological material presented to the Hunterian Museum of the University of Glasgow by A Henderson Bishop in 1914 (and again in 1951) are two groups

of iron-age potsherds from Stenness, Orkney. One of these (B.1914.716) was in a box with a pencilled label which reads 'taken from below the tallest stone in Stenness semicircle when re-erecting in 1906. by B of W (sic)'. The second group (B.1914.724) of similar sherds is simply catalogued 'Stenness, Orkney' but must be part of the first group, although boxed separately, presumably by Bishop. Joining parts of two separate vessels are in each of the groups and the entire collection is a homogeneous one. It is fortunate that there is no doubt about this, as the second, less well-labelled group includes one fine rim sherd of a characteristic iron-age fluted-rimmed jar (fig 9, no. 29).

Description

29 Fluted rim sherd of an everted rim, globular jar of very hard-fired, smooth-surfaced, light buff-grey sand-tempered ware; outer surface orange, inner grey-buff; interior surface of rim decorated with three broad, horizontal shallow flutings; 180 mm in diameter (B. 1914.724).

30 Rim sherd of plain, barrel-shaped jar of very hard-fired, smooth-surfaced, grey sand-tempered ware with a dark grey outer surface and light buff-brown inner; temper includes some larger grits a few of which

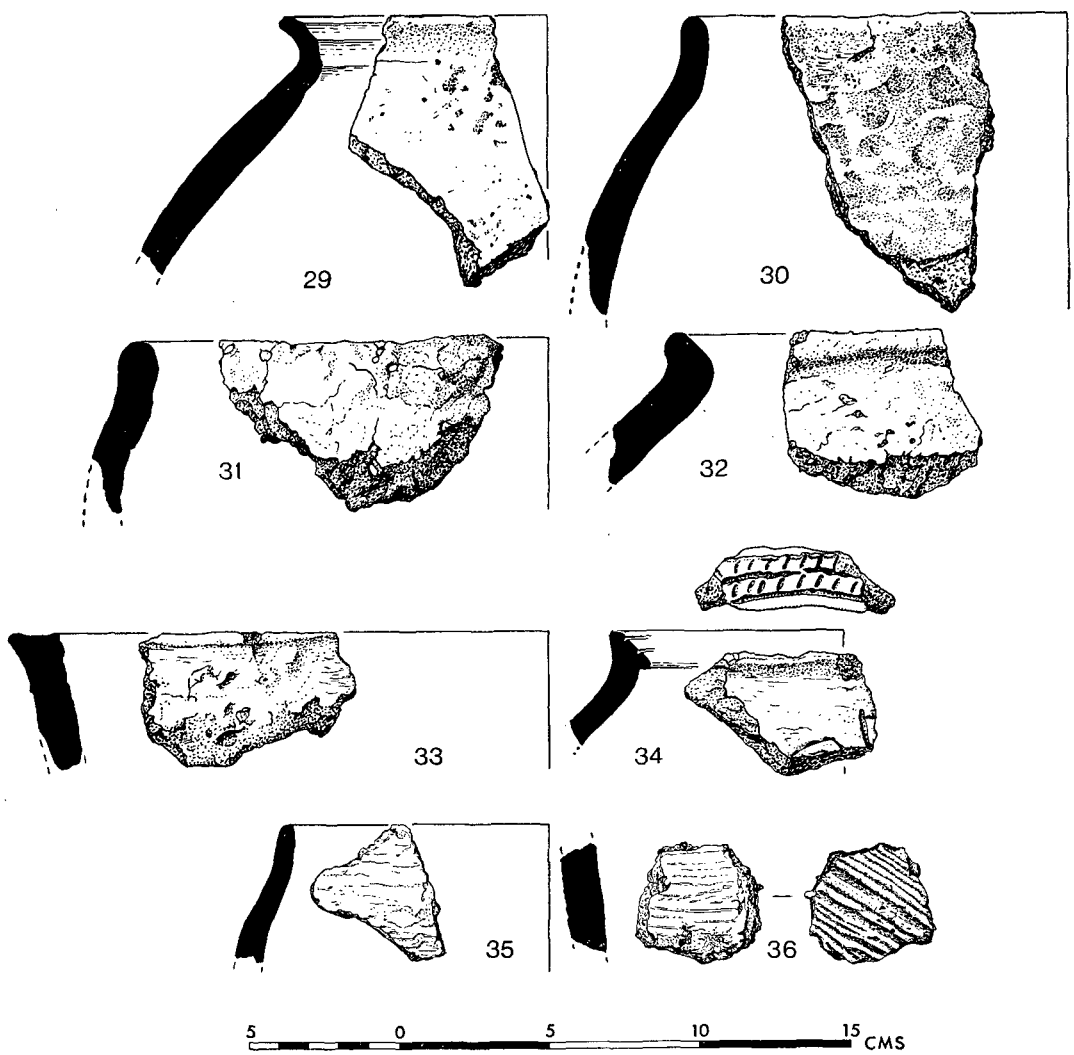

FIG 9 The Stones of Stenness: iron-age pottery found in 1906

just break the outer surface; 255 mm in diameter (B.1914.716). A joining piece of the same vessel is in the second group of sherds mentioned above (with no. 29).

31 Rim sherd of a large, plain, coarse barrel-shaped jar of hard-fired, grey ware tempered with pieces of angular gravel up to 11 mm long, some of which break through the surfaces; outer surface dark grey, inner dark grey and orange brown; 280 mm in diameter (B.1914.716). A joining piece of the same vessel is in the other sherd group, but that one has a pattern of roughly grooved, shallow parallel lines on part of its outer surface, like the interior of no. 36 below.

32 Rim sherd of a plain jar with a slightly everted lip, made of very hard-fired, light grey ware, tempered with sand and small pieces of gravel some of which just break the surfaces; surfaces both orange brown; diameter approximate but at least 255 mm (B.1914.716).

33 Rim sherd of bucket-shaped vessel with a flat and slightly expanded lip; of very hard-fired grey ware tempered with sand and with small angular stones some of which break through the surfaces; outer surface dark grey and dark grey-brown, inner buff-brown and orange; diameter at least 355 mm (B.1914. 716).

34 Rim sherd of decorated, black-burnished, everted rim, globular or situlate jar of very hard-fired, sand-tempered dark grey ware containing occasional angular pieces of gravel showing through the inner surface; outer surface dark grey and burnished, inner dark-grey; rim has an unusual lower extension. Decoration of incised lines—outer surface showing part of an angular geometric pattern and the inner face of the rim having a 'compressed double-ladder pattern' (three horizontal parallel lines with parallel diagonal dashes joining each pair); 150 mm in diameter (B.1914.716). A fragment of the rim of a very similar vessel is in the other sherd group, but there the rim decoration consists of a raised horizontal central cordon with three rows of short, diagonal parallel strokes, incised on it and on either side of it.

35 Rim sherd of a plain, barrel-shaped jar with a slightly out-turned lip, of hard-fired, light grey-buff ware, tempered with sand and a few small angular stones; outer surface grey and buff, inner light orange-brown; about 180 mm in diameter (B.1914.716).

36 Wall sherd of very hard-fired grey ware, tempered with sand and many pieces of small, angular gravel which often break through the surfaces; outer surface light brown, inner dark grey; internal decoration of many close-set, approximately parallel grooved lines (B.1914.716).

Discussion

The two groups of pottery from the Stones of Stenness – 51 sherds in all – form a typical selection of Orkney iron-age wares of the broch-wheelhouse period and should be datable to between about 50 BC and AD 300 or later (though individual styles could have had longer lives than this). The pottery from the Midhowe and Gurness brochs includes many similar pieces (all the pottery mentioned below is in the National Museum of Antiquities in Edinburgh and the numbers are those of its collections). For example the fluted everted rim sherd (no. 29) has an exact parallel in the Midhowe broch (GAM 148), in the Ayre broch (L.1948.83) and also in the broch of Mousa in Shetland (GA 1121). This kind of pottery was found in quantity at Clickhimin, Shetland, where it occurred in the pre-broch, broch and post-broch levels (Hamilton 1968). However, there is no independent evidence for the date of *c* 400 BC suggested for the earliest examples of fluted rim ware from that site and it may not be older than the 1st century BC (MacKie 1974, 108).

The vessels represented by nos 30 and 35 seems to be examples of the standard, plain native broch pottery of Shetland, Orkney and Caithness. It is seen in quantity in the brochs of Jarlshof (Shetland; Hamilton 1956) and Midhowe, Gurness, Ayre and Lingro in Orkney. The vessels with a coarse surface resulting from the inclusion of angular gravels in the clay (nos 31 and 33) seem to be outlying examples of the plain, gravelly late bronze- and iron-age pottery of the central and NE Scottish mainland – Dunagoil ware – which is commonly found in vitrified forts and other contemporary sites (MacKie 1976b). Pottery decorated with incised lines in geometric patterns is really a Hebridean iron-age phenomenon but it extends to a few sites in Orkney, notably the brochs of Lingro and Ayre. Lingro in particular has examples of rims with incised patterns on their inner surfaces (very rare in the Hebrides) – such as GE 56, 79, 102, 104 and 106 while Ayre also has a few (L.1948.61).

The Stone of Odin

by Ernest W Marwick

Introduction

The Stone of Odin, though broken into pieces in December 1814, had such a hold on local imagination that an outline of its story is still familiar to Orcadians. The Stone was pierced by a hole and this was associated with two distinct traditions – one curative and the other contractual. Through the hole, it is recorded, were passed the bodies of infants, to prevent them from taking specific diseases, and the palsied limbs and pain-racked heads of older men and women seeking a cure. It was also used by all kinds of people in making vows, particularly by lovers, who stood on either side, clasped hands inside the hole and swore an oath known as the Oath of Odin. Several visitors to Orkney in the 18th and early 19th centuries described and illustrated the Stone and these accounts provide an impression of it and of its situation. The circumstances surrounding its felling in 1814 are those already discussed for the desecration of the Stones of Stenness, but the Stone was not completely destroyed and it may here be put on record for the first time that a part of the Stone of Odin survived till 1940. Finally some of the traditions associated with the Stone may be presented in order to complete the story from prehistoric to modern times.

Description

The earliest mention of the Stone – briefly and without being specifically named – was by the Rev James Wallace in *A Description of the Isles of Orkney* in 1693 (Wallace 1883, 26). Rev John Brand, 'one of a Commission appointed by the General Assembly of his Church to inquire into the state of religion and morals in these parts' visited Stenness in 1700, perhaps because of the traditions associated with the Stone of Odin, and his account is given in the first person (Brand 1883, 66). Bishop Pococke visited Orkney in 1760 and described the situation of the stone (1887, 144; Appendix 11, no. 1). Sir Joseph Banks visited Orkney in 1772 and the view of the Stones of Stenness completed by his draughtsman is shown on pl 1b; it gives a good impression of the openness of the promontories and shows the Stone approximately to the N of the circle, standing on a slight rise in the ground, and with the perforation clearly marked about one third of the way up the stone on the W side. The survey of the area done by another of Banks's draughtsmen, F H Walden, a naval architect and surveyor, is perhaps even more important in pinpointing its position about 92 m N of the circle and 76 m SE of the Watch Stone; it also contains an illustration of the Stone to one side of the ornamental title (pl 8b; Appendix 11, nos 2a and b).

Five other ministers of religion make mention of the stone: G Low (1879, xxii); A Gordon (1792, 263); R Henry, minister of Greyfriars Church, Edinburgh, who presented a drawing of the Stones of Stenness to the Society of Antiquaries of Scotland in 1784 (Low 1879, xxiii–xxvi); J Malcolm, minister of Firth and Stenness between 1785 and 1807, who wrote the parish entry for the Statistical Account (*Stat Acct*, 14 (1795), 125–38); finally G Barry, minister of Kirkwall between 1782 and 1793, who makes a brief allusion to the Stone of Odin (1805, 209). But perhaps more useful are those accounts by visitors to Orkney who were taken to Stenness as part of the northern tour and who recorded what they saw in their day-books or journals. The immediacy of Ker's Naval Log of 1780 makes it an important source about the contractual associations of the Stone of Odin (National Library of Scotland, Ms 1083). Ker visited the stones with a

shooting party in the company of a Kirkwall doctor, Dr Groat; he describes the outlying stones to the N of the Stones of Stenness:

> near this are two large Stones standing singly, the shortest perforated with a hole near the Edge large enough to admitt a Man's Head, thought to have been used to bind the Victims to and called therefore the Stone of Sacrifice, the other which has nothing remarkable about it is named the Stone of Power. Dr Groat says that about 20 years ago he remembers it customary with Lovers, when Circumstances did not admitt of their marrying immediately in a publick manner: to put their Hands thro' on opposite Sides and joining them Swear Fidelity to each other, likewise that whenever Circumstances would admitt their marriage should be publicky solemnised. He adds, that after this they proceeded to Consummation without further Ceremony & that no Instance was ever known of their refusing to keep their agreement afterwards. The Situation of these Remains of Antiquity would be highly picturesque had it the addition of Trees but alas not so much as a Shrub is to be seen!

Other distinguished visitors to the area before the fateful day in December in 1814 when the stone was broken to pieces were Thomas Stanley in 1789, Dr Patrick Neill the eminent botanist (1806, 18), and Sir Walter Scott, as recorded in his *Memoirs* for 16 August 1814. Some of the more traditional names (the 'Temples of the Sun and Moon'), first recorded by Martin Martin (1716, 365), were apparently still current when the area was visited by Edward Fitzgerald in 1841(Ross 1933).

What can be learned of the likely position, size and appearance of the Stone as presented to us from the pre-1814 evidence? Wallace in comparing it with the Stones of Stenness describes the Stone as of the 'same largeness with the rest' (1883, 26); Brand also considered it to be of a 'like bigness' (1883, 66), but he appears in this matter to echo Wallace, and what he says need not be accepted as confirmatory evidence. Neill speaks of 'a solitary stone of great size' (1806, 18). Unfortunately, not all the observers are in agreement: Low refers to it in 1774 as 'pretty broad stone, probably broke from its original height' (1879, xxii), and both Gordon (1792, 263) and Stanley estimated its height at 8 feet, an estimate accepted by Thomas, whose informant was a local man named Leisk. Peterkin, with the adjacent circle in mind, calls it 'a similar detached pillar' (1822, 20–1).

A number of illustrations of the Stone are known, but those of Pococke and Aberdeen cannot help us to visualise the Stone of Odin. The drawing by Cleveley (pl 1b) seems to give a good impression of the general appearance of the Stone and of the position of the perforation, and that by Stanley (pl 8d) in 1789 also seems to give a reliable and deliberate representation of the Stone. The notes to the drawing confirm parts of Low's observations, Gordon's measurements and Thomas's informant; it is 8 feet in height, 3 feet 6 inches in breadth and the perforation is 3 feet from the ground. One of Stanley's companions, James Wright, records that the perforated stone 'would admit a hand'. Malcolm, who as the local incumbent should be a reliable source, says that the oval hole was large enough to admit a man's head, and that the part between the hole and the edge of the Stone had the appearance of being worn (*Stat Acct*, 14 (1795), 134–5); a worn area between the hole and the edge is clearly indicated by the picture of what must be the Stone of Odin in the ornamental title to Banks's map (pl 8b).

The exact position of the Stone would be uncertain if we had to rely on the contradictory and confusing evidence of most of the observers, but Banks's map, a plan in Register House, Edinburgh (RHP 4002), and the information collected by Thomas (1852, 101), whose local informant 'had looked through it in his youth', seem to confirm the approximate site indicated above (p 28). The Register House plan is of the common land in the parish of Stenness as it

was divided proportionately between the heritors in 1812 and was surveyed by James Chapman and Alexander Gibbs of Inverness. The four stones of the circle at Stenness and the Stone of Odin are indicated rather schematically but the measurements and compass bearing of this map tend to confirm the position suggested by Banks's map. This is practically the same situation as that shown on a sketch map of Orkney in 1774 by George Low, a skilled and painstaking observer. The site of the Stone of Odin, as shown by Low, Banks and Thomas (very near to the modern bungalow named 'Odin') is also the traditional one, and, within close limits, may be accepted. (In 1976, in the course of deep-ploughing close to the suspected site of the Stone, several surface boulders were thought to suggest the packing of the stone-hole. The site was investigated by Mr and Mrs J Hedges but it was clear on excavation that the boulders were of natural origin. JNGR.)

Destruction

On Christmas Day 1814, the historian Malcolm Laing was entertaining friends to dinner in Papdale House, near Kirkwall, when he was informed that Captain MacKay, the tenant of lands in Stenness, had begun to demolish some of the Stones of Stenness. Laing was much perturbed and entreated a guest, Alexander Peterkin, who had been appointed Sheriff Substitute of Orkney a couple of months before, to intervene. On Peterkin's advice Provost Riddoch of Kirkwall and Laing, as Justices of the Peace, made application to the Procurator Fiscal, who executed a Sist and Suspension against MacKay in order that the matter be discussed by the Sheriff and the Trustees of the Estate. The felling of the Stones, however, is, as Hossack clearly relates, just one strand of a series of disagreements between Rae, the factor to the estates on which Stenness lay, and the Town of Kirkwall and its chief citizens (1900, 396–400). Archaeologically the damage was quickly wrought – the Stone of Odin was felled and broken to pieces; of the stones of the circle no. 5 was toppled and no. 6 completely destroyed. As has been related earlier, no further stones were felled, but local feeling against MacKay was greatly increased by the destruction of the stones and for other reasons too, as Peterkin commented a few years later that the offending farmer 'has indeed suffered a mean persecution ever since. The peasantry who were removed by his landlord when he entered to this farm, availing themselves of the prejudice which had risen against him, partly at least as a *Ferry Louper* (the name by which all persons not natives of Orkney are designated by the vulgar), were loud in their complaints against him. Various conspiracies were basely formed to injure him, and two different attempts were made to set fire to his dwellings and his property, happily with little effect' (1822, 21).

Later History

The explanation made on MacKay's behalf was that his pasture was being spoiled by people who walked over it to the Stones; this is hardly credible for most of this area was still undivided into fields in 1849 (Thomas 1852, pl 2), and could only have been rough pasture in 1814. Another explanation of MacKay's action is that he wanted stones for building byres or a pig-sty, and it has been assumed that large pieces of the broken-up stones were incorporated in the farm buildings in Barnhouse. The writer has explored the walls of that steading without finding any large stones of this type. Contrary to the accepted account, the fragments of the Stone of Odin were not used for building purposes; it appears that the Stone of Odin was completely broken up in 1814, but that a piece roughly five feet long, which contained the actual hole, remained in the neighbourhood of Barnhouse for a considerable time.

Later in the century – the exact date is uncertain – a horse-mill was installed at the farm, and the very heavy piece of stone with the hole in it was sunk into the ground to anchor the

outside gear wheels. The end of the 'crown-wheel' shaft seems to have rotated in a bush fixed into the hole by running molten lead into the space between the outside of the bush and the interior edge of the hole. This short vertical shaft was a substantial one, for the mill had four wooden levers to which horses were harnessed. The horse-mill at Barnhouse was replaced a number of years later by a water-mill. This mill, on the testimony of a Stenness man who once lived at Barnhouse, was certainly in operation by 1895, and perhaps a good deal earlier. The redundant horse-mill was bought by a neighbour and taken to the farm of Overbigging. With the mill went the piece of stone, which continued to be used for the purpose to which it had been adapted. The whole of the gear, including the stone, was moved once again when the farmer of Overbigging bought a nearby farm and settled there.

At this farm the ancient horse-mill was in use until the early 1940s, when it was replaced by a threshing mill powered by an oil engine. The gear was pulled up from the 'mill-course'. Together with the massive stone it lay around the farmyard. One day when the owner of the farm was away from home, his son decided to tidy away the scrapped machinery. He found the stone impossible to move. Knowing nothing of its history, he took a large hammer and broke the stone into tiny pieces. Only when his father returned and exclaimed angrily, 'You had no damned business to break that stone: that was the Stone of Odin that came from Barnhouse', did he realise what the discarded stone had actually been.

This farmer, who is still alive, has given the writer the most complete co-operation in his efforts to gain a clear impression of the appearance of the stone. It is due to his excellent memory and powers of observation that it has been possible to form an idea of what the main part of the stone looked like. He is sad that an accident deprived us of the remaining part of what was, without much doubt, the Stone of Odin, when it had existed for a century and a quarter unknown to the general public and the antiquaries alike. The farmer, who was the last person to look upon what we may regard as the main portion of the stone, said that the hole was a fairly large one, but he could not remember if it was near to one side. The block of stone which he broke up was roughly 5 feet long and tapered in width from at least 2 feet 6 inches to something over 2 feet. The thickness at one end could have been 'a good bit more than a foot' but the stone got thinner towards the hole, which was considerably bevelled around the edge, but whether this resulted from its original 'work' condition, as described by several authors, or was the result of later trimming it is impossible to say. I handed the farmer a copy of Lady Stafford's drawing (pl 8c) and he thought that the stone he had seen could well have been part of the monolith she illustrated. It was, he said, a hard blue rock very different from that quarried in the neighbourhood. Mr G H Collins of the Geological Survey has kindly commented on the blue colour of the flagstone; the 'blue' nature of the flagstone indicates that it is rich in calcite and Mr Collins considers that it would be possible to derive slabs which were grey with a bluish tinge from beds of the Stromness Flags.

Folklore and Tradition

The Stone of Odin is connected in the earlier accounts with ceremonies carried out at the group of standing stones nearby. The following is Henry's account as given in Anderson's introduction to Low's Tour (Low 1879, xxvi) and accompanied the illustration that is described in Appendix 11, no. 4.

> There was a custom among the lower class of people in this country which has entirely subsided within these 20 or 30 years. Upon the first day of every new year the common people, from all parts of the country, met at the Kirk of Stainhouse, each person having

provision for four or five days; they continued there for that time dancing and feasting in the kirk. This meeting gave the young people an opportunity of seeing each other, which seldom failed in making four or five marriages every year; and to secure each other's love, till an opportunity of celebrating their nuptials, they had recourse to the following solemn engagements: – The parties agreed stole from the rest of their companions, and went to the Temple of the Moon, where the woman, in presence of the man, fell down on her knees and prayed the god Wodden (for such was the name of the god they addressed upon this occasion) that he would enable her to perform all the promises and obligations she had and was to make to the young man present, after which they both went to the Temple of the Sun, where the man prayed in like manner before the woman, then they repaired from this to the stone marked D [the stone of Odin], and the man being on the one side and the woman on the other, they took hold of each other's right hand through the hole (mentioned above), and there swore to be constant and faithful to each other. This ceremony was held so very sacred in those times that the person who dared to break the engagements made here was counted infamous, and excluded all society.

It was likewise usual, when husband and wife could not agree, that they both came to the Kirk of Stainhouse, and after entering into the kirk the one went out at the south and the other at the north door, by which they were holden legally divorced, and free to make another choice.

Thomas believed that this account was extremely exaggerated, but gave no good grounds for thinking so. Gordon (1792, 263) was the first to put the term 'Promise of Odin' on record He asserted that the original design of the hole was unknown (he must have meant to people who were not native Orcadians) 'till about twenty years ago, it was discovered by the following circumstance: A young man had seduced a girl under promise of marriage, and she proving with child, was deserted by him. The young man was called before the session; the elders were particularly severe. Being asked by the minister the cause of so much rigour, they answered, "You do not know what a bad man this is, he has broke the promise of Odin". Being further asked what they meant by the promise of Odin, they put him in mind of the Stone at Stenhouse with a round hole in it, and added that it was customary when promises were made for the contracting parties to join hands through the hole, and the promises so made were called the promises of Odin'. Baine wrote in his diary during the Stanley expedition of 1789: 'We were told that the young Country Lovers meet here and join hands thro this hole, and having agreed to go together, for Life they consider the ceremony equally binding as that by the Priest himself, no instances being found of infidelity on either side after this' (West 1965).

Neill (1806, 18–19) made only two comments worth noting in this context: the first was that the hole 'it has been supposed, was intended for tying the sacrifices offered at this rude, but magnificent temple . . .', and the second was that 'The more superstitious of the natives also are of opinion, that if, when they are young, they pass their head through this hole, they will never shake with palsy in their old age'. 'Up to the time of its destruction', wrote Thomas, 'it was customary to leave some offering on visiting the stone, such as a piece of bread, or cheese, or a rag, or even a stone' (1852, 101). Magnus Spence found, as late as the 1880s, traditions connecting the stone with the well at Bigswell, about two miles to the SE (1974).

Tudor gives an instance of how binding the Oath of Odin was considered to be. In telling some of the adventures of the pirate John Gow, he writes, 'Whilst lying off Stromness he fell in love with a Miss Gordon, who, according to tradition, pledged her troth to him at the stone of Odin. . . . So binding did she consider this engagement, that, in order to be released from it,

she considered it necessary to journey all the way to London to shake his hand after his execution in 1729' (1883, 295).

We have seen that the Stone of Odin had two distinct traditional aspects – one curative and the other contractual. It shared a curative function with a number of similar stones which have been discussed by Grinsell (1976 15–16, 89, 91–2, 142–3), one of the best known examples being Men-an-tol in Cornwall (Burl 1976, 332). The contractual function of the holed stone has also been recorded (Grinsell 1976, 15), but no other instance of a stone in which both curative and contractual functions were combined has been traced. A tradition of handfasting through a perforated stone, in this case of runaway couples, was recorded by Cuthbert Bede at the church of Kilchousland in Kintyre (1861, 206–7), but White, while recounting the tradition, also suggests that the stone was no more than 'a common grinding stone' (1873, 112–13). Grant seems to imply, however, that 'handfasting' at a perforated stone was not altogether a rare occurrence (1975, 362; *see also* Vernon 1911). The close association of such stones with betrothals, and the binding character of the promise, has made one wonder if consummation of the token marriage took place immediately after the ritual at the Stone of Odin; and in Ker's Naval Log one finds the assertion that 'after this they proceeded to Consummation without further Ceremony'.

There is a tendency to suppose that the name Odin Stone and the term Oath of Odin may not be of ancient provenance, but fairly modern, and perhaps fanciful inventions. Important among the considerations that have given rise to this assumption is the fact that the Odin attributions appear at a very late stage in written or printed records. There is also a belief that there is little sign of an awareness of the god Odin in Orkney history or folklore, far less any suggestion of an Odinic cult. To those who have confined their investigation of Orkney folk-belief to the *Orkneyinga Saga* it has seemed significant that there is only one reference to Odin in that work (Taylor 1938, 142). While there is obviously no way of proving that Odin's Stone was the name given to the stone by the first Norse settlers, the argument against this being so because of the late appearance of the name has no validity whatsoever. Written accounts of Orkney in the 17th, 18th and even 19th centuries were produced almost entirely by strangers, who had little idea what Orcadians believed and talked about among themselves. The other assumption – that Odin hardly appears in local folklore – is based on lack of knowledge, due to the strange reluctance of historians to collect and evaluate their own island traditions.

Odin in a place-name would hardly excite comment (even though there are no more than twelve with this name element in the whole of Norway; Turville Petre 1964, 66, 295), and there are certain place-names in Orkney's North Isles which may well be compounded with the name of the god: Odisngarth and Odinswick (the old name of Otterswick) in Sanday, Odin in Shapinsay, Odin's Ness and possibly Guuden in Stronsay, and a mound known as God-Odina – this is just below the house of Odness.

Memories of old myths relating to Odin were to be found last century in the two North Isles of Sanday and Stronsay and in the West Mainland of Orkney. There remains a remarkable tale, whose full significance has not been recognised. It was written down in the latter part of the 19th century by a Sandwick man named George Marwick, whose collected folklore, containing a wealth of local traditions, but requiring extensive and critical editing, the writer has been allowed to read. The story (related very diffusely and with extensive corruption of place and personal names) tells how Odin (Oddie), with a servant named Hermoð (Har Mowat), went to Hel (Huli) to look for Baldur (Ballie). They had a number of adventures, but brought Baldur back to life by means of the charm of the old Æsir, Mistletoe. From internal evidence, this would seem to be an authentic myth, remembered for centuries in Orkney, and owing nothing to literary sources.

Another Orkney folk-tale, related at some length by Walter Traill Dennison (1961, 55–61), tells how the man Thorodale, who freed the island of Eynhallow (Hilda-land) from the Fin Folk, acquired the power to see the still invisible island: 'For nine moons, at midnight, when the moon was full, he went nine times on his bare knees around the Odin Stone of Stainness. And for nine moons, at full moon, he looked through the hole in the Odin Stone, and wished he might get the power of seeing Hilda-land.'

This tale, which must be very old, and which was remembered in large part by an old man, born in Evie, who had not seen Dennison's printed version, has one of the unmistakable marks of Odin: the association with the number nine. Odin hung on the tree for nine nights. As the Shetland folk-rhyme has it:

> Nine lang nichts I' da nippin rime,
> Hange he dare wi' his naked limb.

He learned nine mighty songs from the son of the giant Bolthor; he could perform eighteen spells (twice nine); when sacrifice was made to him the number nine was important. 'According to Adam of Bremen, the notorious festival at Uppsala was held every nine years, and continued for nine days. Nine head of every living thing was sacrificed; and the bodies were hung on trees surrounding the temple. . . . We could believe that the hanged victims were dedicated to Odinn . . .' (Turville Petre 1964, 49–50). What was extremely important was that Odin was the master of magic; and very strong magic was needed by the man who had sworn to free Eynhallow. When he finally set foot on the island, he cut nine crosses in its turf, and caused it to be encircled with nine rings of salt. As for the Oath of Odin, it comes quite clearly into a curious Orkney ballad, 'The Play o' de Lathie Odivere' reconstructed from fragments in oral tradition by Dennison (1894, 53–8; *but see also* Bruford 1974, 71–2). A man named Odivere courted a Norwegian lady, 'An swore bae him dat hang on tree' to marry her. When he was successful, 'he bragged near and far He wan his wife bae Odin's Aith'. The story ends in misfortune and Odivere 'rues de day/He ever tuk de Odin Aith'. In discussing the ballad, Dennison describes as its 'moral' the belief that to swear the Oath of Odin was sure to bring success to the swearer in the first place, but was most certain to bring him bitter disappointment in the end.

Acknowledgments

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APPENDIX 1

Animal Remains from the Stones of Stenness, Orkney

by Juliet Clutton-Brock, Department of Zoology, British Museum, Natural History BM (NH) Record No. ARC 1974 R 5039

Ditch Section (X–X^1; Z–Z^1; figs 2 and 3)

The following mammalian species are represented by the animal remains from the organic layer in the ditch; wolf and/or domestic dog; domestic ox, domestic sheep.

Wolf or Dog

The proximal and distal ends of a left tibia and the distal end of the associated fibula with parts of its shaft. The large size of this bone suggests that it is from a wolf rather than a domestic dog. The areas

for tendon attachment on the bone are well developed and imply that the animal was fully adult at the time of its death. It is not possible to distinguish between dog and wolf on this tibia except by size and although it would be unusual for a domestic dog to be as large as this in the neolithic or bronze age, there are few records of definite dog for these periods from the north of Britain. Table 1 (*see also* Clutton-Brock forthcoming) shows the measurements of tibiae of dogs from various British neolithic sites, including those recently excavated from Grimes Graves, Norfolk (Burleigh *et al* 1977) and from Quanterness and Skara Brae on Orkney and it can be seen that the tibia 1 from Stenness is the largest of this admittedly small sample.

TABLE 1

DIMENSIONS OF THE TIBIAE OF SOME COMPARABLE BRITISH NEOLITHIC DOGS

Site	Length	Proximal width	Distal width	Width shaft	Proximal A-P depth	Distal A-P depth	Shaft A-P depth
Stenness 1	—	44·5	—	17·7	—	—	—
Stenness 2	—	—	—	13·1	—	—	—
Quanterness	184·0	38·3	24·6	15·6	41·3	17·6	13·8
Skara Brae	—	—	24·5	13·6	—	17·0	12·7
Grimes Graves	173·1	35·7	23·5	12·9	37·6	16·1	12·0
*Easton Down	148	—	—	—	—	—	—
*Windmill Hill	146	—	—	12	—	—	—
*Maiden Castle	149	—	—	12	—	—	—
*Maiden Castle	159	—	—	10	—	—	—

* Quoted from Harcourt 1974

A second tibia shaft of a canid was also identified. This bone is from a right hind leg of a smaller animal and it is more likely that this is the tibia of a domestic dog rather than a wolf. The proximal articular end of the bone appears to have been smashed and has a battered appearance.

Domestic Ox

Remains of adult, juvenile, and post-natal cattle have been identified in small numbers from the ditch. The bones have been placed in the following associated groups:

Adult

Part of a mandibular ramus with cheek teeth.
Foot bones that probably came from one fore-foot. Distal end of a left radius, width, 68·7 mm. The bone has been chopped diagonally through the shaft, just above the distal epiphysis. The complete left carpus (scaphoid, lunate, cuneiform, accessory, trapezoid and magnum, unciform) with sesamoid bones; one distal condyle of a metapodial bone, medio-lateral width, 28·2 mm; two 1st phalanges; two 2nd phalanges; two navicular bones; and two hoof cores. The foot bones are from a fully adult small ox. There are some exostoses around the articular surfaces of the hoof cores and these bones are strangely elongated. Measurements of the foot bones are:
1st phalanx, proximal width, 29·4 mm; minimum width shaft, 23·9 mm.
2nd phalanx, proximal width, 27·7 mm.
3rd phalanx (hoofcore), maximum length along base, 80·6 mm: maximum height, 36·0 mm.
Fragment of a rib and sternal rib.

Juvenile

One lower cheek tooth, unworn but older than a new born calf. No cement on the tooth.
One right lunate bone from the carpus of a smaller or younger ox than the complete carpus.

Neonatal

A very young calf, perhaps a few weeks old, is represented by the shaft of a radius, the proximal and distal epiphyses of a humerus, and the proximal epiphysis of a femur. There is also a number of unworn cheek teeth that could possibly have come from the same calf.

Domestic Sheep

One proximal end and shaft of a right radius, proximal width, 26·7 mm, minimum width of shaft, 13·5 mm.
One atlas vertebra.
One right calcaneum, length, 55·3 mm.
2 fragments of hoof cores.
One carpal bone.
There is no evidence that these sheep bones were associated with each other or that they do not come from separate individuals.

The identification of these small ruminant bones as sheep is not certain. It is possible that they could be from either roe deer or goat, although the latter is less likely. Careful comparison of the bones with comparative material and with the criteria for differentiation described by Boessneck (1969) could not establish their identity beyond doubt but when all characters are considered the bones do appear to resemble those of a very small fine-limbed sheep. This identification is consistent with the appearance of the cremated animal bone, some of which also seemed most to resemble small sheep.

West Ditch-Terminal (figs 2 and 3)

Human Bone

One distal end of a femur, human?
One second phalanx from a human hand.

Wolf or Dog

One fragment of a right anterior mandibular ramus with alveoli for the incisors, canine, P1, P2, and the anterior cusp of P3.
One fragment of a right vertical ramus and one right mandibular condyle.
One fragment of an unerupted lower right M1 and one fragment of an unerupted lower right M2. These unerupted teeth are likely to be from a different individual that was less than five months old at its death.
One distal end of a right scapula, medio-lateral width of glenoid cavity, 22·0 mm.
One distal end of a right humerus, width, 36·5 mm.
One proximal and one distal end of a right radius, distal width, 30·3 mm.
One fragment of a right pelvic bone including the acetabulum.
One proximal part of a shaft of a left tibia. This bone is from a smaller and possibly a younger canid than the rest of the bones. It is similar in size to the smaller right tibia that was identified from the ditch section.

It is possible that the small left and right tibiae and the unerupted lower molars are from domestic dogs and that all the rest of the canid remains are from one individual wolf, for the bones are the same size as those of a modern adult European wolf.

Domestic Ox

There is one fragment of a cervical vertebra that appears to have been from a rather large ox, the rest of the cattle bones and teeth are from small domestic animals and they are comparable in size to the specimens described from the main ditch section. At least three individuals are represented, these being an adult, and more than one juvenile of different ages. One of the best preserved specimens comprises part of the left maxilla of a calf with the three milk premolars erupted but little worn. This calf was probably less than six months old at the time of its death. The ox remains are very fragmentary, the only nearly complete bones being a pair of hoof cores and these are probably from a juvenile animal. The length along the sole of one hoof core is approximately 53 mm and the height of the bone is 34·5 mm. The length of one lower third molar that was fully in wear is 39 mm and the height of the crown, 53 mm. Fragments of the tooth of a juvenile ox were found associated with pottery sherds (SF 16) at the tip of the W ditch-terminal.

Conclusions

It is difficult to make any inferences about the sporadic collection of mammal bones from the ditches. Most of the bones are from mandibles or the extremities of limbs, and therefore could represent the unwanted refuse from food, sacrifice, clothing, or artefact manufacture. It is rather surprising that only one condyle of a metapodial has been recovered when all the rest of the tiny bones of an ox carpus are present as well as the phalanges, that is, assuming that the metapodial condyle is from the same limb as the carpus. Perhaps the metacarpal bone was chopped through just above the distal condyles and the shaft

retained for the marrow, or some other purpose, whilst the unusable parts of the foot were thrown into the ditch.

Cremated Bone

The cremated bone recovered during the excavation was very comminuted, and none of the fragments from the central feature or from the deposit in the ditch section (shown on fig 3) could be positively identified, although a few fragments appeared to be of animal rather than human origin; the fragments of small bones from the central feature that have a circular cross-section could be from metapodial bones of very small sheep/goat, and one bone from the latter deposit may be a fragment of the proximal epiphysis of a humerus of a small ungulate. Those deposits or scatters containing bone fragments that allowed an attempt at identification may be listed as follows. *West Ditch-Terminal*: fragment of the pelvic bone (acetabulum) of a small sheep. *East Ditch-Terminal*: a fragment of the distal end of a tibia or radius of an ox or a small horse; distal articular condyle of the humerus of a small sheep/goat or roe deer; carpal bone of a small ungulate; a tiny fragment of horn core; tiny fragment of the distal end of a tibia of a small ungulate; part of the enamel plate at the base of the crown of an ox cheek tooth. Bones around sherds SF 14, East Ditch-Terminal: part of the proximal epiphysis of a tibia of a juvenile sheep/goat or roe deer; fragment of a metapodial bone – the turned-over edge might suggest a deer, but the bone is very thin and it is probably from a very young animal (this bone is also distorted from the burning and is thus difficult to identify); distal epiphysis of a long bone of a juvenile animal, probably too big for sheep/goat; tiny fragment that might be the proximal tip of a metatarsal bone of a sheep/goat or roe deer.

APPENDIX 2

Pollen analysis of material from the Stones of Stenness, Orkney

by C J Caseldine and G Whittington, Department of Geography, University of Exeter, and Department of Geography, University of St Andrews

Introduction

Excavations at the Stones of Stenness provided several opportunities for obtaining material for pollen analysis, and two of the analyses made are reported here. The ditch section on the SW side of the henge revealed at its base a layer of material of high organic content (X–X^1, Z–Z^1; fig 3); this occurred at a depth of 2·0 m and lay immediately on the primary silt. The pollen obtained from this layer was of variable condition but was relatively well preserved. Samples were also taken at various levels from the section at the W ditch-terminal (fig 3); the organic layer was not present in this part of the ditch. The material from the W ditch-terminal varied in texture from coarse, angular fragments at the base to a fine grained soil at the surface. Below a depth of 0·8 m pollen was sparse and so degraded as to make recognition difficult and identification unreliable. In general the pollen in the ditch terminal was considerably inferior in its quality of preservation to that of the organic layer of the main ditch section.

Before Erdtman's acetolysis, which removes organic material, all samples for analysis were subjected to treatment in hydrofluoric and hydrochloric acids in order to remove the siliceous content. The pollen from the organic layer was mounted in glycerine jelly and stained with safranin. From this pollen 1,000 land plant grains were counted and details of these are shown in Table 1. The pollen from the W ditch-terminal was mounted in silicon oil (12,500 cs) and 400 land plant grains were counted at each level. The details of these may be found in fig 10.

Arboreal Pollen

The arboreal pollen component (7·6%) for the organic layer (Table 1) is in line with results from other Scottish island sites (Blackburn 1946; Flenley and Pearson 1967; Moar 1969) where there was also little tree growth. The domination of the arboreal pollen by *Betula* agrees with the findings of Moar at Yesnaby and could indicate the presence of small, local stands of birch scrub (Spencer 1975) as at present on Hoy (Prentice and Prentice 1975). There is evidence from the last century (Traill 1868) of birch remains in blanket peat on the island which are representative of local tree growth. But it is also possible that the frequencies of *Betula* and *Alnus* pollen in the sample from the W ditch section could be due to the influx of wind-transported pollen from Caithness which is probably also the source of the *Pinus* and *Quercus* pollens (Durno 1958). It is also noticeable how the arboreal curves from the sample decline and become discontinuous.

TABLE 1

POLLEN SPECTRUM FROM THE ORGANIC LAYER (X–X^1, Z–Z^1; fig 3)

ARBOREAL 7·6%		HERBACEOUS 86·9%	
Betula	44·4	Gramineae	46·3
Pinus	28·4	Cyperaceae	11·7
Quercus	2·5	Ericoids	3·1
Alnus	24·7	Compositae	4·7
		Plantago	23·7
		Rumex	8·3
SHRUBS 5·5%			
Corylus/Myrica	96·6		
Salix	3·5		
AQUATIC			
Lemna	28·3	Armeria, Artemisia	
Potamogeton	37·7	Cruciferae, Urtica	
Triglochin	33·0	Labiatae, Myriophyllum	
		Potentilla, Rosaceae,	
		Ranunculaceae: all less than 1% each	

The total land pollen (TLP) count was of 1,000 grains and the arboreal, shrub and herbaceous totals are given as a percentage of this. The species within each of those classes are given as a percentage of the class. The total aquatic pollen was 106 grains and each species is shown as a percentage of this.

Shrub Pollen

Moar suggests from his site at Loons that after the late-Weichselian there was an expansion of shrubs which were replaced by grasses and sedges, either just before or contemporaneously with the first human settlement in the area. *Corylus* was the only shrub of which Traill found macroscopic remains in the Orkneys. The low shrub value of 5·5% TLP for the material from the organic layer would seem to suggest therefore that it was deposited after the shrub expansion. The percentage of *Corylus* found may have been due to the growth of local hazel thickets, or, as hazel is a copious pollen producer, the source could again be the mainland. The sample from the W ditch-terminal shows how the *Corylus* curve follows the same trend as the *Betula* and *Alnus* curves, probably indicating the same mainland source. The present pollen rain as measured at Garth Farm (Moar 1969) and at Stenness (Table 2) shows only a trace of *Corylus*, which also accords with its rare occurrence on Hoy (Prentice and Prentice 1975).

Herbaceous Pollen

As is apparent from the low arboreal and shrub pollen totals (Table 1 and fig 10), the environment being considered throughout the period of study was of an open nature. Environments of this kind are usually either grass or heath dominated. This is obviously an example of the former. The main feature of interest is whether the pollen record indicates a natural or a man-induced flora.

Organic Layer (X–X^1, Z–Z^1; fig 3)

The earliest evidence of the flora comes from the pollen contained in this layer. The presence of high frequencies of *Rumex*, *Plantago* and *Compositae* could represent man's interference with the vegetation but the treeless condition of the area could have allowed the natural occurrence of these species.

A counter argument to the pollen assemblage being representative of a natural environment can be promoted from the existence of four cereal pollens. These were identified as such by their grain and pore size (Beug 1963, 36–7) and by their surface sculpturing revealed under phase contrast (× 1500). From the studies made by Beug, one grain could be classed as of *Avena* type and the others of *Triticum* type. Later work by Andersen and Bertelsen (1972) suggests that, on the basis of scanning electron microscopy, *Avena* and most varieties of Triticum cannot be separated by surface sculpturing, both being areolate, but only on a difference in the size of annulus. On this basis the conclusion arrived at from Beug's description still holds. The small number of cereal pollens is not surprising in that such cultigens are self-pollinating.

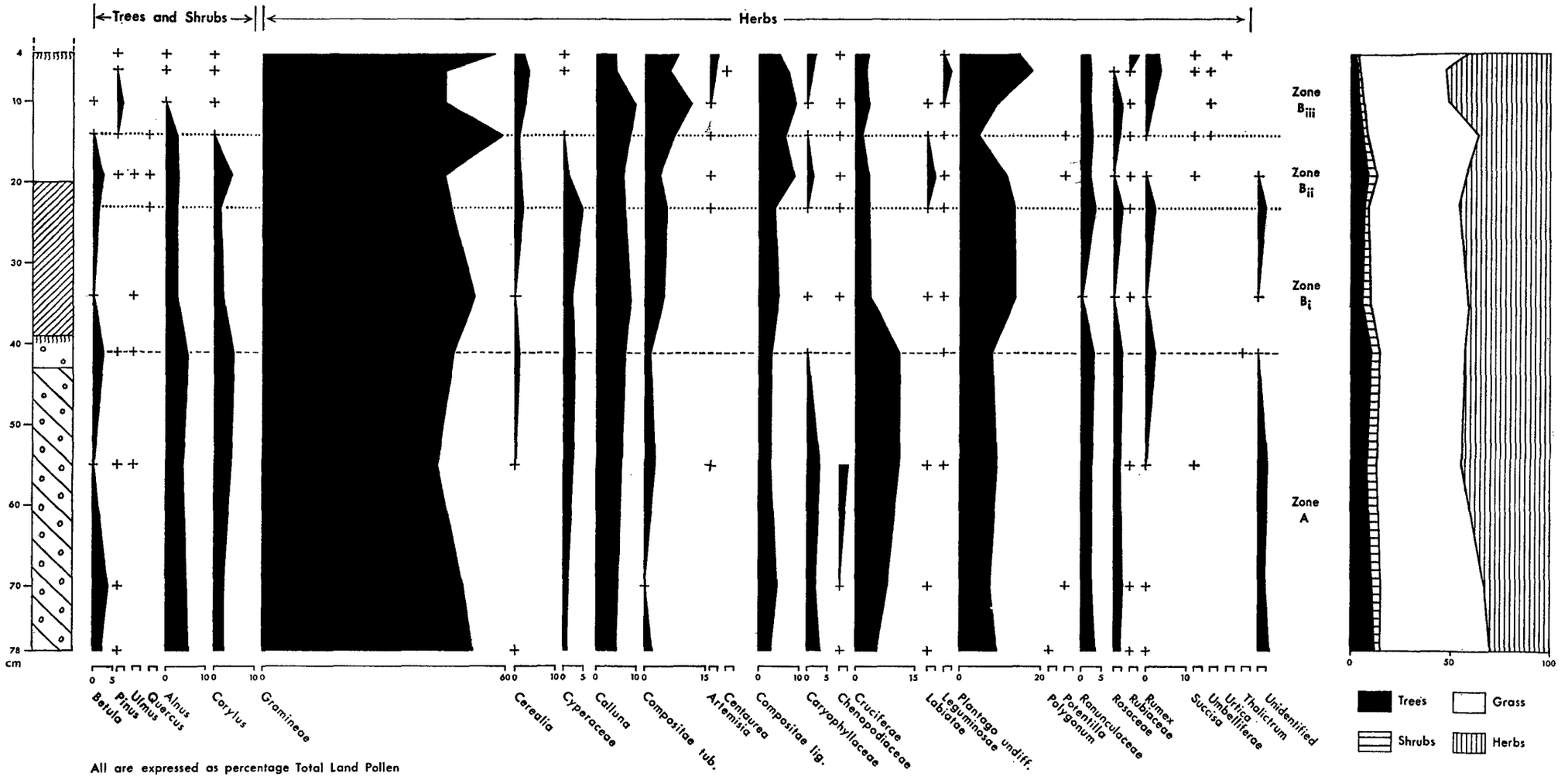
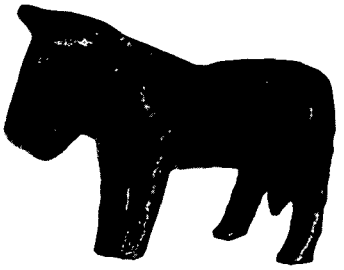


FIG 10 The Stones of Stenness: pollen diagram, W ditch-terminal

LANARKSHIRE

An Inventory of the Prehistoric and Roman Monuments



Bronze bull, Bank Farm,
National Museum of Antiquities of Scotland

This volume is based on original fieldwork and contains detailed descriptions of all the known prehistoric and Roman monuments in the former county of Lanarkshire, an area which has now been absorbed in Strathclyde Region.

Of particular interest in the prehistoric period are the numerous Bronze Age burial-cairns and cists, the extensive groups of small cairns in the Carnwath–Dunsyre area, a vast and puzzling enclosure at Blackshouse Burn, and a rich variety of Iron Age forts and settlements. The Roman monuments include a short stretch of the Antonine Wall, six forts of widely differing sizes, four fortlets, a watch-tower, and as many as seventeen temporary camps.

Many monuments, known only from the reports of early antiquaries, were destroyed during the course of the Industrial Revolution, the full force of which was felt in northern and western Lanarkshire; all these reports are gathered together here for the first time. A large number of previously unrecorded earthworks, long since levelled by cultivation, have also been detected on air photographs, some of which were taken by the Commission during the preparation of this volume. In all, more than 350 monuments are described in the text, which is illustrated by over 100 original survey drawings and 63 photographs. A concise account of the topography of the area is included in an introduction in which the various classes of monument are discussed and set in their wider context.

Demy 4to; pages i–xxxiv + 1–172 and 26 plates, map, glossary and index.

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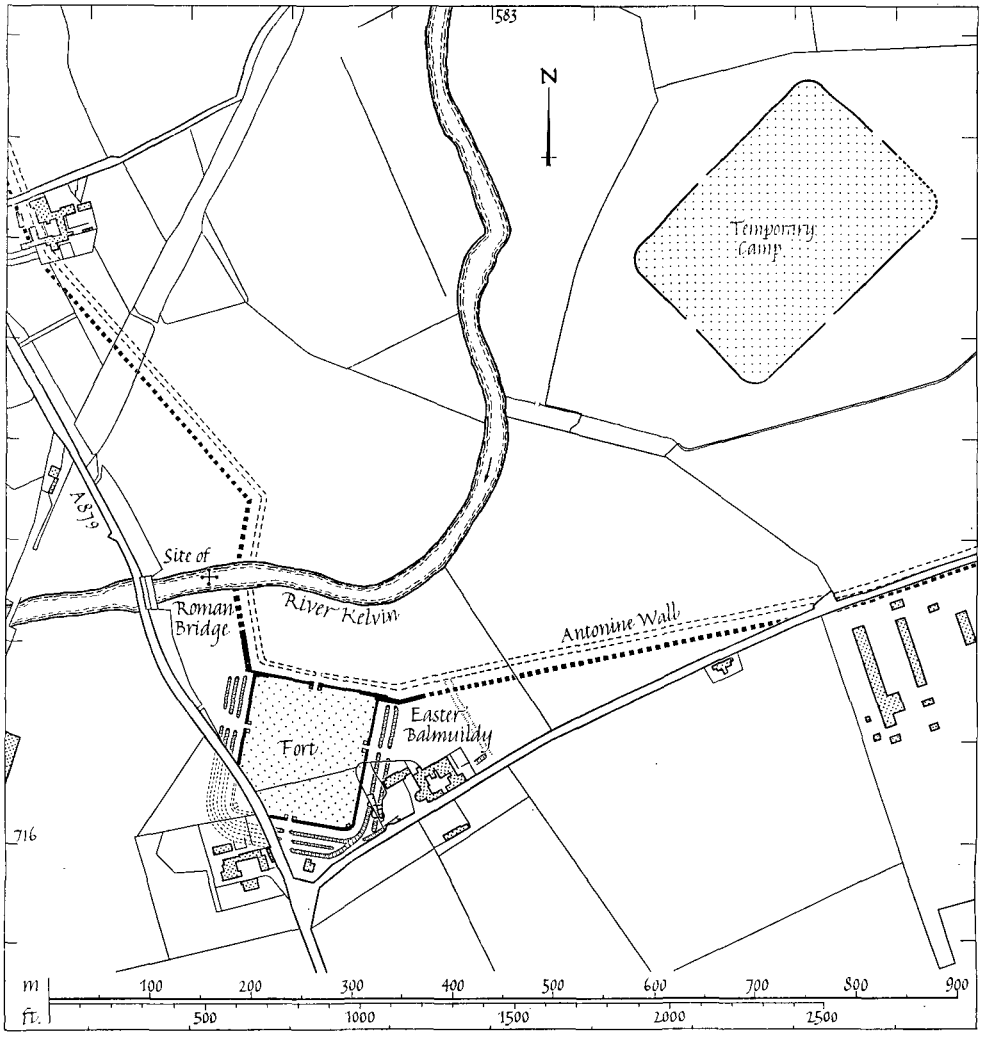


Fig. 70. General plan showing the Roman fort, bridge and temporary camp, Balmuildy (No. 248)

Ruines of the Wall' in the vicinity of 'Caddir Mannor', and Macdonald suggested that it had stood some way to the E of Cadder fort,[1] but the exact find spot may never be known. Flanked by simple ansate decoration, the inscription reads IMP(ERATORI) CAES(ARI) TITO AELIO / HADRIANO ANTONINO / AUG(USTO) PIO P(ATRI) P(ATRIAE) LEG(IO) II AUG(USTA) / PER M(ILIA) P(ASSUUM) III DCLXVI S(EMIS). 'For the Emperor Titus Aelius Hadrianus Antoninus Augustus Pius, father of his country, the Second Legion Augusta (built this) for a distance of 3666½ paces.' If Macdonald's interpretation of the evidence relating to the Distance Slabs is correct, the stone will have marked the E end of the sector referred to; it is now in the Hunterian Museum, University of Glasgow.

NS 57 SE, NS 67 SW November 1975

248 Roman Fort, Bridge and Temporary Camp, Balmuildy (Sites). No trace of the Roman works at Balmuildy (Fig. 70) can now be seen above ground. The fort, which is situated on the S bank of the River Kelvin immediately to the NW of Easter Balmuildy farmhouse, is the third largest of the known stations on the Antonine Wall, and in 1762 Gordon likened its surviving remains to 'the Ruins of an old City';[2] these, however, were severely denuded in the course of agricultural improvements during the early 19th century, and our present knowledge of the site is largely the result of excavations carried out on behalf of the Glasgow Archaeological Society by S N Miller in 1912–14.[3] The

[1] *RWS*, 369–80.
[2] *Itin. Septent.*, 53.
[3] Miller, S N, *The Roman Fort at Balmuildy* (1922).

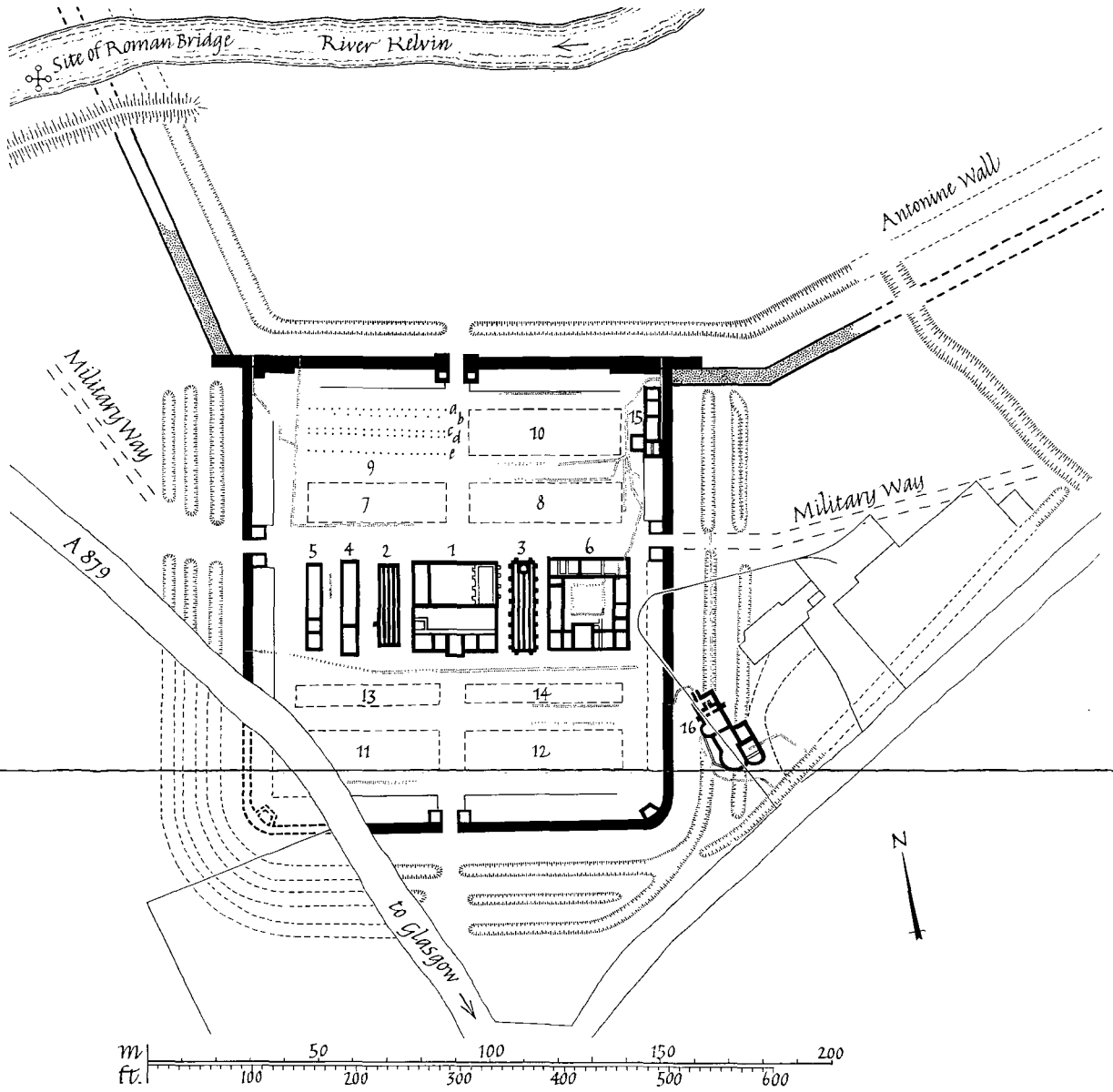
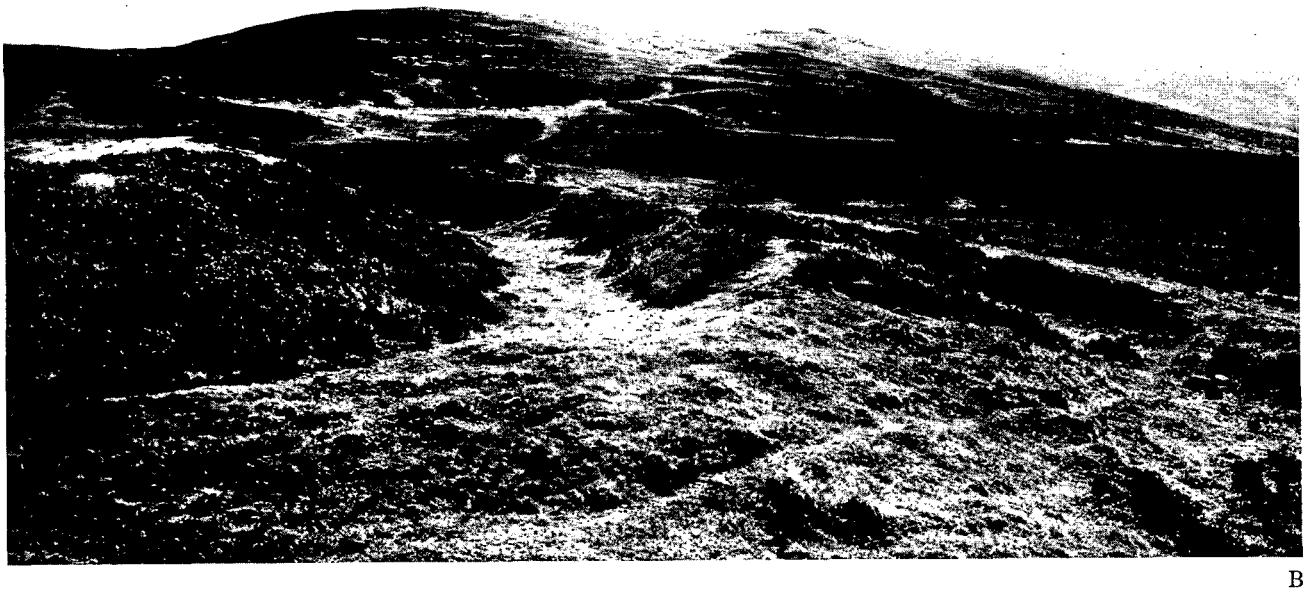


Fig. 71. Roman fort, Balmuildy (No. 248); after S N Miller

existence of a bridge by which the Military Way, and possibly also the Roman road from Clydesdale (No. 264), crossed the River Kelvin was accidentally revealed during the Second World War, when blocks of masonry and fragments of timber were dredged from the bed of the river to the NNW of the fort. More recently, crop-markings on air photographs (CUCAP nos. GN 73, 76 and 80; WC 13 and ADY 96) have disclosed the presence of a temporary camp on a shoulder of rising ground to the N of the Wall and approximately 470 m NE of the fort.

THE FORT (Fig. 71), which occupied the N slope of a gently inclined gravel plateau, was protected in Roman times on the N by the river, on the E by a steep-sided gully, and on the W by an extensive area of low-lying marshy ground. Facing N, it had been defended on all sides by a stone wall and measured externally 140 m by 126 m, an area of 1·8 ha (4·4 acres). The wall, which rested on a heavy cobble foundation, had been almost entirely removed, but it could be calculated that it was about 2·3 m thick on the E side and probably somewhat

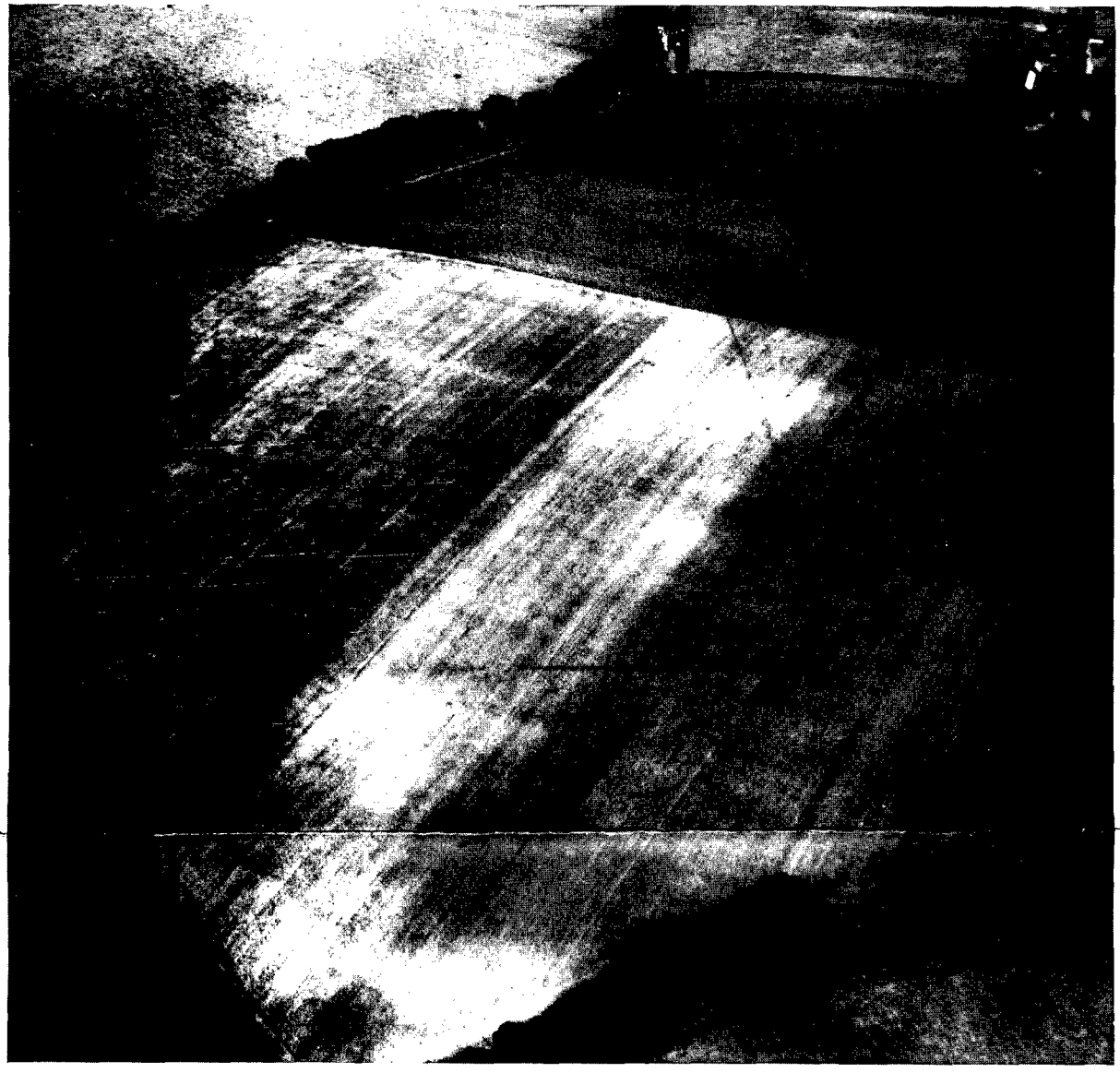
A



B

FORT, FALLBURN (231);
A aerial view
B view of ramparts on W from N

SPECIMEN FULL-PAGE PLATE



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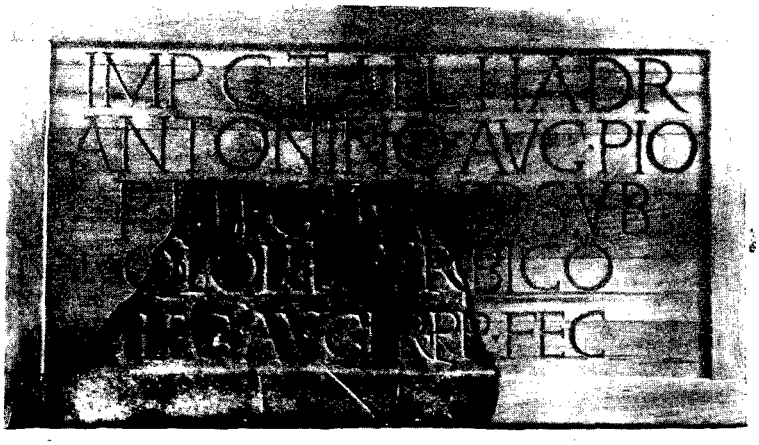

B

BALMUILDY (248);
A Roman temporary camp
B inscribed stone (*scale* 1 : 8)

PLATE 12

SPECIMEN FULL-PAGE PLATE

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As such pollens are only found in proximity to their cultivation area the conclusion must be that arable cultivation was at least a partial contributor to the open nature of the vegetation complex at a period before or when the ditch was open.

West Ditch-Terminal

The floristic composition which post-dates that of the organic layer is revealed in the analysis of the material in this section. Unfortunately the condition and sparseness of the pollen below 0·8 m precluded any conclusions being drawn about the vegetation in existence while the earliest infilling of the ditch was taking place. Above 0·8 m, however, the same openness of vegetation as shown in the earlier sample occurs, but with certain constituent differences. Throughout the profile and especially at its base, the totals for *Plantago* and *Rumex* rarely reach the levels encountered in the organic layer. The section at the W ditch-terminal appears to embrace two different zones of pollen assemblages (fig 10) separated by an old turf line. Zone A, from 0·8 m to 0·41 m is characterised by high values of Cruciferae, Caryophyllaceae and *Plantago* with Rosaceae and Ranunculaceae as continuous curves. *Alnus* and *Corylus* are also continuous and relatively high. At a depth of 0·41 m, at the start of Zone B, there is a change as Cruciferae decreases noticeably from 11% to 3%, Caryophyllaceae disappears while *Plantago* and Compositae increase.

TABLE 2

SURFACE POLLEN SPECTRUM: STONES OF STENNESS, 1974

ARBOREAL	HERBACEOUS	
Betula, Ulmus, Alnus	Gramineae	48·8
All less than 1%	Cerealia	5·8
	Calluna	8·3
SHRUBS	Compositae (tub)	7·9
Corylus and Salix	Cruciferae	7·4
Less than 1%	Plantago lanc	2·3
	Plantago maj/med	2·1
SPORES	Plantago marit	1·0
Pteridium, Sphagnum, Filicales	Rosaceae	1·0
All less than 1%	Rumex acetosa	6·3
	Cyperaceae, Artemisia, Caryophyllaceae, Leguminosae, Polygonum avic, Ranunculaceae, Rubiaceae, Rumex crispus, Umbelliferae, Urtica, Trifolium repens All less than 1%	

The total land pollen (TLP) was 500 grains and all species are given as a percentage of this total, except the spores which are percentages of the total land pollen plus total spores.
An area (B_{II}), in which *Plantago, Rumex* and Cruciferae all decline and the Compositae increase along with the Gramineae, divides Zone B into three components of which the upper (B_{III}) and the lower (B_I) are similar.

The organic layer of the main ditch section on the SW of the site revealed evidence of cereal growing and this is further evinced in the section at the W ditch-terminal. Using the identification methods for cereals outlined above, all the grains which were well enough preserved for detailed examination, those above 0·34 m, were of *Avena* or *Hordeum*. There was no clear observation of any specialisation or localisation of either species. It is in the identification of the *Cerealia* that one of the problems of soil pollen analysis, such as is being dealt with here, becomes acute. The majority of pollen from this section was degraded to a certain extent and a probable manifestation of this was the swelling of the pores on many grains, especially those of *Plantago* and *Cerealia*. Thus exact measurement of pore and annulus size are of questionable value for identification purposes; this is of considerable importance for the *Cerealia* because the only reliable method of differentiating *Avena* from most *Triticum* species is on the basis of the size of their annulus (Andersen and Bertelsen 1972, 85).

Present Pollen Rain

The figures from the present pollen rain for *Cerealia* of 5·8% TLP represents the effect of cultivation on three sides of the site (as close as 10 m from the surface sampling site) suggesting that figures such as 4% TLP in B_{III} at 0·06 m and up to 2% TLP in B_I must represent cultivation near the site although not

necessarily as extensively. Overall, the surface sample reflects the herbaceous-dominant vegetation around the Stones of Stenness very well. The low *Plantago* value reflects the lack of pasture, limiting the *Plantago* sp. to the roadside and occasional occurrences by the Stones, whereas the high *Rumex* value is indicative of the high productivity of the scattered plants on the site. There is however a noticeable lack of pollen of such species as *Trifolium repens, Vicia* and *Taraxacum officinalis* which are well represented on the site.

Conclusions

One factor which is crucial to the interpretation of the pollen record is the provenance of the material of the organic layer in the ditch section (X–X^1, Z–Z^1); part was clearly deposited by man at an early period in the existence of the ditch and part is of natural formation. The pollen record therefore is obtained from a partially derived material from an unknown source potentially containing the vegetation history of a very long period. The lack of shrub pollen may perhaps be taken to indicate that the soil does not pre-date the shrub maximum discussed by Moar. The pollen contained in the soil embraces that produced by plants which grow where standing water occurs (Lemna, Potamogeton and Triglochin) and also that derived from open grassland. The low total of ericaceous pollen, from species so prolific in pollen production, tends to rule out local heathland as being in existence at the time of the construction of the stone circle and the ditch (cf Maes Howe; Godwin 1956) and the lack of sphagnum spores points to an absence of bogland. None of the pollen in the organic layer conflicts with a suggestion that the material was obtained in close proximity to the ditch. The herbaceous pollen could already have been in the soil when it was deposited while the aquatic pollen could have come from plants growing in the ditch at a time when it contained standing water. The presence of cereal pollen in the organic layer makes it likely that grains were being grown on this site before the ditch was cut as it is improbable that the pollens could have been incorporated into the soil after its deposition and submergence.

Although no pollen of any real worth was recovered from the coarse infill of the ditch (below 0·8 m), the high level of the Cruciferae immediately above this and the presence of a cereal grain at a depth of 0·8 m suggests that the vegetation complex represented at the base of Zone A was partly man induced. Cultivation during Zone A seems to have been very slight, but it increased in intensity with the expansion of herbaceous species at the beginning of Zone B. Agriculture at this time appears to have had pastoral and arable components, the latter involving the growing of barley and oats. Cultivation then apparently declined with the extension of grassland in Zone B_{ii} before expanding again in Zone B_i leading up to the situation of the present day. However, it was recorded in the last century that the ditch was still visible in places to a depth of about one metre so it is quite possible that Zone B represents a very short period of time. If this is so then the apparent move away from mixed agriculture in Zone B_{ii} may represent a localised event rather than an important shift in the overall agricultural activity of the area.

There are however two main difficulties in interpreting the herbaceous pollen assemblages in terms of human influence. Firstly, there is the degradation of the pollens, e.g. *Plantago*, which makes the separation of littoral types from those associated with cultivation difficult; and secondly, there is the still relatively restricted knowledge of pollen assemblages relating to the natural herbaceous cover of the Orkney Islands in the pre-human period. At this time it is therefore very difficult to contrast natural and anthropogenically induced pollen records. Because of such problems the precise interpretation of different vegetation groupings is difficult, resulting in perhaps an unhealthy over reliance on *Cerealia* and certain other plants, such as *Plantago* and *Rumex*, for evidence of human activity.

APPENDIX 3

Macroscopic Plant Remains from the Stones of Stenness, Orkney

by C A Dickson and J H Dickson, Department of Botany, University of Glasgow

The most rewarding samples we examined were those from the organic layer at the bottom of the ditch on the SW side of the henge (Section X–X^1, Z–Z^1; figs 2 and 3); the material had been sieved and dried prior to our investigation. The sediment is a silty coarse detritus with wood, stem and root fragments, fruits, seeds and mosses. There are numerous caddis larval cases, some encrusted with the achenes of *Ranunculus* subgenus *Batrachium*. The taxa we have determined are listed in Table 3.

TABLE 3

MACROSCOPIC PLANT REMAINS FROM ORGANIC LAYER

Taxa	Common Name	Remains	Number
Alnus sp	Alder	wood fragment	1
Betula sp	Birch	wood fragment	1
Calluna vulgaris (L.) Hull	Heather	leafy twig	1
Cerastium holosteoides Fr.	Common Mouse-ear Chickweed	seed	1
Cirsium spp	Thistles	achenes	7
cf Glyceria sp	Flote-grass	caryopses	3
Hippuris vulgaris L.	Mare's-tail	fruit	1
Montia fontana L.	Blinks	seeds	2
Picea sp	Spruce	wood fragments	2
Pinus sp	Pine	wood fragment	1
Potamogeton berchtoldii Fieb.	Pondweed	fruit stones	numerous
Prunella vulgaris L.	Self-heal	nutlet	1
Ranunculus subgenus Batrachium	Water-crowfoot	achenes	numerous
R. acris L.	Meadow Buttercup	achene	1
R. flammula L.	Lesser Spearwort	achene	1
R repens L.	Creeping Buttercup	achenes	13
Rorippa cf islandica (Oeder) Borbas	Marsh Yellow-Cress	seeds	2
Rumex spp	Docks	nutlets	numerous
R. crispus L.	Curled Dock	nutlets with perianths	numerous
Sonchus asper (L.) Hill	Spiny Sow-Thistle	achenes	2
Urtica dioica L.	Nettle	nutlets	10
Mosses (all as leafy stems)	—	—	
Bryum sp	—	—	2
Calliergon giganteum (Schimp.) Kindb.	—	—	1
Calliergonella cuspidata (Hedw.) Loeske	—	—	3
Campylium stellatum (Hedw.) J. Lange & C. Jens.	—	—	1
Ceratodon purpureus (Hedw.) Brid.	—	—	1
Cratoneuron filicinum (Hedw.) Spruce	—	—	1
Eurhynchium praelongum (Hedw.) Hobk.	—	—	1
Fissidens adiantoides Hedw.	—	—	1
Hylocomium splendens B., S. & G.	—	—	3
Hypnum cupressiforme Hedw.	—	—	14
Polytrichum section Juniperina	—	—	3
Pseudoscleropodium purum (Limpr.) Fleisch.	—	—	2
Rhytidiadelphus squarrosus (Hedw.) Warnst.	—	—	5

Excluding the wood fragments, the plants can be placed in two categories according to the habitats they may have occupied (Table 4).

TABLE 4

A. Species from the wet ditch bottom

cf Glyceria sp	Rorippa cf islandica
Hippuris vulgaris	Ranunculus flammula
Montia fontana	Ranunculus subg. Batrachium
Potamogeton berchtoldii	

B. Species from the ditch sides or near by

Calluna vulgaris	Ranunculus repens
Cerastium holosteoides	Sonchus asper
Prunella vulgaris	Rumex crispus
Ranunculus acris	Urtica dioica

Cirsium spp and *Rumex* spp cannot be assigned with certainty but are likely to fall in category B. *Potamogeton berchtoldii* is the most aquatic of category A in that it grows with all its leaves submerged. The same might apply to *Ranunculus* subg. *Batrachium* according to which species is represented. Both these taxa were very common in the sediment. *Calluna* excepted, the species in category B are commonly regarded as weeds. They could have grown on the ditch sides or near by. Some of the mosses could have grown in the wet ditch, perhaps especially *Calliergon*, *Calliergonella*, *Campylium* and *Cratoneuron*. The majority, however, grew more likely on the ditch sides or near by. If one envisages that the non-aquatic plant debris originated from areas away from the ditch, one might infer a mossy and weedy grassland or a heathland if stress is given to the single heather fragment. None of the plants need have derived from an acidic peatland and indeed the absence of *Sphagnum* (bog moss) is striking.

Work by C A Dickson (*in* Godwin 1956) on plant remains from the ditch surrounding the Maes Howe tomb (Table 5) is comparable with the Stenness material. Although only *Hippuris* is shared, the plants clearly and solely indicate a wet community in the overgrown ditch just as they do in part for Stenness.

TABLE 5

MACROSCOPIC PLANT REMAINS FROM MAES HOWE

Carex spp	Sedges
Hippuris vulgaris L.	Mare's-tail
Hydrocotyle vulgaris L.	Pennywort
Juncus effusus L.	Soft rush
Menyanthes trifoliata L.	Bogbean
Potamogeton polygonifolius Fourr.	Pondweed
Potentilla anserina L.	Silverweed
P. palustris (L.) Scop.	Marsh Cinquefoil

The remaining macroscopic fossils we studied came from the central feature (Table 6) and pits A and C (Table 7).

TABLE 6

MACROSCOPIC PLANT REMAINS FROM CENTRAL FEATURE

Calluna vulgaris	leafy twig	1
Eleocharis sp spike-rush	nutlets	3
Gramineae	base of spikelet	1
Potamogeton berchtoldii	fruits	15
Prunella vulgaris	nutlet	1
Ranunculus subg. Batrachium	achenes	20
Rumex spp	nutlets	12

TABLE 7

PIT A		
*Carex spp	nutlets	4
*Caryophyllaceae	seed	1
Gramineae	caryopsis	1
Potamogeton berchtoldii	fruit stone	1
Rumex sp	nutlet	1
PIT C		
Potamogeton berchtoldii	fruit stone	1
*Ranunculus repens	achenes	2
Rumex cf crispus	nutlet with perianth	1
Rumex sp	nutlets	3
*cf Veronica sp speedwell	seeds	2
Caddis larval case		1

The asterisk indicates carbonisation. These remains were extracted from material after flotation before our investigation. Although *Eleocharis*, *Carex* and cf *Veronica* were not found in the ditch material (Table 1), the similarity in the macroscopic assemblages from the central feature and the ditch is very obvious and perhaps points to a shared provenance.

All the vascular plant taxa recovered from Stenness are well known from British Quaternary deposits. This remark applies also to the mosses, many of which are frequently found in archaeological contexts. *Hylocomium splendens*, for instance, now has ten archaeological records (Dickson 1973).

All the taxa recovered as leafy twigs, fruits or seeds are common on Orkney at present with the minor exception of *Rorippa islandica* which is known only from the northern islands of the archipelago (Bullard 1972). However, this statement cannot be applied to the four trees recovered as wood fragments. Birch is a native Orcadian tree, though only on the island of Hoy is it thriving at present. Alder is not an Orcadian native, though it is indigenous in Caithness. Pine is not native, nor is spruce which, indeed, has not grown wild anywhere in the British Isles for 60,000 years. The two conifers certainly came from outside Orkney, probably the alder did too and perhaps even the same applies to the birch. The most likely explanation is driftwood, used in some way by man before arrival in the ditch. The dimensions of the two pieces of spruce wood are about 70 mm by 20 mm by 10 mm and 40 mm by 10 mm by 5 mm. The larger is eroded in such a way as to appear grooved. The identification as spruce was made on the observation of horizontal resin ducts with eight or nine thick-walled epithelial cells. The piece of pine wood, measuring 70 mm by 20 mm by 10 mm was identified by its thin-walled and easily torn epithelial cells and by its dentate rays. It is not possible to say if any of the wood fragments derive from artefacts. These are not the first occurrences of exotic wood in archaeological sites in the northern and western islands of Scotland. Pine charcoal has been found both at Rinyo in Orkney and Jarlshof in Shetland. Both pine and spruce have been recovered from the bronze-age site at Stanydale in Shetland and spruce charcoal has been found in an iron-age site on Barra. Graham (1952) gives an extended discussion of the identification and possible provenances of these discoveries. Pilcher has identified spruce charcoal from the broch of Dun Mor Vaul on Tiree (1974, 204). Finally, it can be mentioned that as part of our current investigations of Skara Brae, C A Dickson has recognised spruce wood from the midden material (Clarke 1976a, 24).

Acknowledgment

A preliminary investigation of the wood fragments was made by Mrs H Thompson of the Royal Botanic Garden, Edinburgh. We are grateful for this assistance.

APPENDIX 4

Cereals from Pits A–C, Stones of Stenness, Orkney

by Coinneach MacLean, Christ's College, Cambridge

The cereals from Pits A–C (fig 2) were identified on the basis of the morphological evidence of the caryopses; the other macroscopic remains are listed in Appendix 3. Because of the poor nature of the preservation of the surfaces of the caryopses, a more precise identification was not attempted; in certain cases it was possible to observe the striations caused by the differing cell structure of the palea and lemna present in the hulled form.

TABLE 8

Context	Hordeum sp	Unidentifiable fragments of cereal
Pit A	8	1
Pit B	69	23
Pit C	177	34

All identifiable caryopses were of barley; one intact caryopsis from Pit B was unidentifiable. This exclusive cereal population may perhaps be due to a bias in sampling, particularly since pollen spectra indicate the presence in this area of other forms of cereal. However, in this context a sample of carbonised

grain recovered from the house-site of Ness of Gruting, Shetland, is of interest. Identification by Helbaek indicated that the 28 lb of grain were exclusively of hulled and naked barley (Calder 1956, 353). The question of crop purity in material derived from various contexts has been discussed elsewhere (Dennell 1974); however, the presumptively ritual nature of the site of Stenness would make the attempted attribution of this sample to a processing technique of dubious value. The radiocarbon date from Pit C (ad 519±150) indicates that the activities represented by the pits is of much later date than the main period of use of the henge.

Acknowledgments

The writer acknowledges the assistance of H N Jarman and G R Chadwick.

APPENDIX 5

Geology of the Stones of Stenness, Orkney

by G H Collins, Institute of Geological Sciences, Edinburgh

Introduction

The standing stones of Stenness are most probably derived from the Stromness Flags, a division of the Middle Old Red Sandstone strata which, with the exception of small outcrops of basement rocks in the Stromness and Yesnaby districts, form the whole of the western part of the Mainland of Orkney. Recent work on the area (Fannin 1970; Mykura 1976), has modified the geological sequence given in the Geological Survey Memoir (Wilson G V *et al* 1935). The sequence is as follows (after Fannin 1970):

Upper Stromness Flags	290 m
Sandwick Fish Bed	0·5 m
Lower Stromness Flags	350 m

The division into an upper and a lower series is made on palaeontological grounds, the Sandwick Fish Bed being the dividing factor. This is a 0·5 m thick formation of thinly bedded dolomitic flagstones rich in fossil fish. There is no difference in the lithology of the upper and lower series. Both are composed dominantly of blue-grey calcareous flagstones and thin beds of fine grained sandstone. The flags are often micaceous, generally dolomitic, and may be thinly laminated. With an increase in silica they become more resistant to weathering.

The Stones of Stenness

Of the standing stones remaining at Stenness, nos 2 and 3 are typical blue-grey calcareous flagstones of fine to medium grain size. Carious weathering is present and is best developed on the north-facing edges. Ripple laminations, stained with limonite are visible on the smoother surfaces and indicate that the rocks were deposited in shallow water conditions. Subordinate partings parallel to the bedding planes are present but not conspicuous. The most likely explanation for these is that they represent time intervals (laminations) in deposition. Stones 5, 7 and the stones that formed the uprights of the 'dolmen' (including that introduced in 1906) are of slightly coarser grain and are more siliceous and less micaceous than those just described. Very thin laminations are absent and the stones are more resistant to weathering. With the exception of 7, all the stones in this group are of similar thickness and exhibit load castings on the bottom surfaces of the bedding planes. Stone 8 is carbonate-rich siltstone and appear to be more micaceous than any previously described. Thin laminations parallel to the bedding planes are very pronounced, occurring from between 6 mm and 75 mm apart, making these stones very much weaker than the others. The former capstone exhibits carious weathering towards one end only, suggesting that one end was embedded in the ground at some time. The stumps are of two types; no. 11 is a grey flagstone, probably siliceous and with no visible lamination. This stone was probably destroyed by force. The stumps of nos 4 and 10 and the remaining fragments of stone 6 are different in that they exhibit strongly developed laminations and are richer in iron oxide – probably limonite. The closeness of the lamination would make these stones very much weaker than any of the others, and nos 4 and 10 may well have fallen by natural causes.

Source of the Standing Stones

Two previously suggested sources (Wilson, G V *et al* 1935) were visited and exposures examined at Arion and Vestra Fiold. The former, on the western edge of the Loch of Stenness, shows flagstones

dipping gently to the south-west. Much of the exposure was covered by the high water-level of the loch and no large slabs were seen. However, they may well be obtained after very little quarrying. An ancient quarry at Vestra Fiold where large monoliths of the country rock have been wedged outwards and upwards has been described on several occasions (Wilson, G V *et al* 1935, 56; RCAMS 1946, 269, no. 727). Geologically it is quite possible that some of the monoliths of the Mainland originated in this locality. A third possible source may be the circular ditch surrounding the henge, for the excavation shows that the bed-rock around the henge had been quarried and it may well have yielded blocks large enough for erection as monoliths.

APPENDIX 6

Petrological analysis of pottery from the Stones of Stenness, Orkney

by D F Williams, Department of Archaeology, University of Southampton

Fifteen of the seventeen pottery small finds were submitted for petrological analysis. From an initial macroscopic examination, followed in each case by thin sectioning and study under petrological microscope, three divisions could be made on the basis of temper inclusions.

Group I (Sandstone)
SF 4, 5, 7, 8, 9, 10, 11, 12 and 16 (fig 6)

The prominent inclusions consist of medium-grained sandstone grains, up to 2·6 mm across, set in an optically anisotropic matrix of fired clay. The main constituent of the sandstone is subangular quartz, together with a little plagioclase felspar and plentiful mica. Also present are numerous discrete grains of well-sorted subangular quartz, average size 0·15 mm to 0·3 mm. Large grains of mudstone were noted in SF 4 and 7.

The sandstone is similar in all the samples and represents the Middle Old Red Sandstone of the Orkneys (Wilson, G V *et al* 1935). Due to the broad distribution of these beds it is not possible to point to a likely area of origin, though it should be noted that, as the Stones of Stenness stand on Upper Stromness Flags, the tempering material could have been obtained locally. Comparison with the large group of sandstone tempered pottery from the chambered cairn at Quanterness (Williams forthcoming) shows that the sandstone in the latter sherds is much coarser than that in the Stenness pottery. This may possibly be a reflection of the different sandstone beds on which the two sites lie, Upper Stromness Flags at Stenness and Rousay Flags in the case of Quanterness (see Mykura 1976, 72–80).

Group II (Camptonite)
SF 3, 6, 13, 14 and 15 (figs 6 and 7)

In thin section the major inclusions are made up of grains of deep brown hornblende, green augite, olivine and lath-shaped felspar, set in an optically anisotropic matrix of fired clay. Scattered thoughout are frequent grains of subangular quartz.

This group can perhaps be further divided on the basis of the condition of the felspar, frequency of hornblende and size of accompanying quartz grains:

A. SF 13, 14 and 15. Relatively fresh felspar, with only a moderate amount of hornblende. The quartz grains appear well-sorted and are rarely above 0·1 mm in size. Heavily packed with mica.

B. SF 6. The camptonite inclusions are not dissimilar to those in SF 13, 14 and 15; however, there is only a very small amount of mica present and the quartz grains are of an average size 0·1 mm to 0·3 mm.

C. SF 3. The felspar is not as fresh as in the previous samples and there are plentiful phenocrysts of hornblende. The quartz grains are ill-sorted, average size 0·1 mm to 0·5 mm.

The mineralogy suggests that the main inclusions of Group II are characteristic of the lamprophyric rocks, in this case the camptonites, which are to be found in the majority of the basic dykes which occur in the Orkneys (Flett 1935, 174–7; Mykura 1976, 94–9). It is possible, of course, that because of glacial action the camptonite inclusions may have been present in the local Boulder Clay Deposits. However, this seems unlikely given the amount of wear they display and the fact that they appear to be unassociated with other inclusions which might also be expected to be present in the event of glacial action (see Group III).

None of the samples from Stenness appear sufficiently similar to the camptonite group at Quanterness (Williams forthcoming) to suggest a common origin. There are a number of camptonite dykes

situated within 2·5 km to 3 km radius of Stenness, though without further detailed work it is not possible to say whether or not it is likely that the camptonite in the Stenness pottery originated from any of these.

Group III (Boulder Clay)
SF 1 (fig 7)

Thin sectioning shows an optically anistotropic matrix of fired clay containing crisp grains of olivine and small crystals of augite, together with large coarse-grained sandstone grains up to 1·6 mm across and also finer-grained sandstone up to 2·4 mm across. Scattered throughout are ill-sorted subangular quartz grains ranging in size from 0·1 mm to 0·5 mm.

The igneous inclusions are characteristic of the lamprophyric rocks, more specifically the monchiquites (Flett 1935, 180–2; Mykura 1976, 94–9). However, the crispness of the monchiquites and the presence of two varieties of sandstone suggest that these inclusions are due to glacial action and that they are likely to represent Boulder Clay Deposits, possibly those which cover the Stenness area.

Discussion

Due to the nature of the inclusions in the above groups, it has not proved possible to suggest precise origins for them. It should be pointed out, however, that the raw materials involved could have been obtained from the near vicinity of Stenness. All the recognisable grooved ware sherds (SF 4, 5, 11, 12 and 16) fall into Group I, and, together with the other samples which make up this group, show every appearance of being made at the same location. This situation differs from that at Quanterness, where the grooved ware samples (totalling 27) were seen to originate from at least six different sources, and where half the sherds contained inclusions unlikely to be found in the Quanterness area. Admittedly the number of sherds analysed from Quanterness was considerably more than that at Stenness, and this may account for the apparent difference in homogeneity between the grooved ware assemblages at each site. Alternatively, the grooved ware from Stenness may reflect deposits of pottery from a purely local context, while the chambered cairn at Quanterness may have attracted burials from a wide area of the Orkney Mainland. However, this view does not take into account any exchange system in pottery that may have operated at Quanterness, and until grooved ware vessels from other sites in Orkney have been analysed, no firm conclusions can be reached.

Attention has already been drawn to the similar schemes of decoration on SF 16 (fig 6) and a vessel from Quanterness; although the Quanterness vessel contains a different tempering agency (olivine-basalt), one of the two known areas of olivine-basalt dykes in Orkney is situated around Bockan, by Loch Harray (Flett 1935, 180), some 3 km N of Stenness. It is possible, therefore, that both vessels may have originated from roughly the same areas.

The three undecorated sherds from the East Ditch Terminal (SF 13, 14 and 15) also form a homogeneous group, though they may be related in some way to SF 6, the only non-sandstone tempered sherd from the Central Feature. The two samples from Pits A and D (SF 1 and 3 respectively) appear to be unconnected with the other sherds examined and this is confirmed by the differences between the radiocarbon dates (Appendix 9).

APPENDIX 7

'Cramp' from the Stones of Stenness, Orkney

compiled by A J Fleet, Department of Earth Sciences, The Open University

Introduction

The unusual vitreous material, known as 'cramp', that occurs on a number of sites in Orkney and Shetland of broadly neolithic and bronze-age date was found in several deposits during the excavations at the Stones of Stenness, notably in the central setting (fig 4) and in the west ditch terminal. Samples of 'cramp' were submitted to several laboratories and individuals in the hope that analyses by different methods might further elucidate the origin of this strange substance and suggest a reason for its presence in both settlement sites and in burial or ritual deposits. In 1936 a series of analyses and a discussion of the results were published in these *Proceedings* (Callander 1936, 448–52); the present studies add further analyses and point tentatively to similar conclusions.

Petrological analysis was carried out by Miss Stephanie Sofranoff, Department of Archaeology, University of Southampton: 'Hand Specimen: 'cramp' appears friable and amorphous in hand specimen, with rounded holes with an average diameter of 5 mm; the density is low; the substance does not seem to contain calcium carbonate. Thin section: the matrix is isotropic and ranges from a greyish brown to a dark, opaque brown-black; the holes visible in hand specimen are rounded with an orange (probably some sort of iron) stained rim. There are reddish stains randomly throughout the slide. Fine and medium-grained sandstone inclusions are present as well as rounded, monocrystalline quartz sand grains. The indistinct greyish portions of the section consist of very tiny, close-packed laths in a sub-radiating pattern of probably a secondary growth mineral which could not be identified [this is probably impregnating resin: A J F]. In conclusion the substance appears to be soil or fine silt and mud with quartz sand grains included, and the whole has undergone a heating process at a low temperature, causing fusion of some of the grains. The tiny laths of unknown identity may be the result of groundwater deposition or just from rainwater containing ions in solution which precipitated out on the 'cramp'.'

Chemical analysis. Two samples were examined by X-ray fluorescence analysis by Dr Livingstone of the Department of Geology, Royal Scottish Museum, Edinburgh: one showed high traces of strontium with minor traces of zirconium, rubidium and manganese; the other indicated that minor traces of strontium, barium, rubidium and manganese were present.

Mr J C McCawley, formerly of the Research Laboratory of the National Museum of Antiquities of Scotland, examined a sample of 'cramp' from the central setting. Mr McCawley was asked to consider the likelihood, suggested in an earlier account, that the substance be the result of burning seaweed. 'Larger fragments were brushed free of loosely adhering soil then washed. The cleaned material was hard and brittle, grey in colour, and with a glass-like surface in places. At several points on the surface and in the interior holes or cavities, up to 5 mm in diameter, were visible. These are thought to be the shells of small crustaceans which one would expect to find attached to the seaweed surface. Dilute acid applied to these 'shells' resulted in the evolution of carbon dioxide – this would be a typical reaction of the calcium carbonate of shells. When the 'cramp' was heated very strongly a distinct smell of halogens was observed – iodides being present in appreciable concentrations in seaweeds.'

Perhaps the most productive of the new analyses was undertaken by Mr P M Brotherton, Alginate Industries Ltd, Girvan. Two milled fractions of the sample were analysed and the results, given as a percentage of net weight of 'cramp', are given below:

	Sample 1	Sample 2
Ash	97·65	99·92
Insoluble Ash	88·76	87·50
Cl	Nil	Nil
P	2·36	3·20
Na	0·12	0·16
K	0·07	0·06
Ca	0·9	1·28
S	Nil	Nil
CO_2	Nil	Nil

Both samples had very high ash contents which were mainly insoluble even when digested in hot hydrochloric acid, the inference being that the ash was mainly siliceous; indeed, sand granules were visible in the samples. Analysis of the soluble portion of the ash showed the presence of sodium and potassium, and more particularly, a very high phosphate and calcium content. The phosphorous level was considerably higher than that found by Davidson (Callander 1936, 450). Perhaps variations in the proportions of sand, seaweed residue and bone residue might explain these differences – certainly the sodium and potassium figures appear to be lower than might be expected from the 1936 analysis, possibly indicating a low seaweed content. The analyses do not specifically suggest the presence of burnt seaweed, but the high calcium/phosphate level may, however, indicate the presence of bone residue.

Discussion

These analyses may be examined both from the point of view of mineralogy and chemistry. Mineralogically, all forms and examples of analysis show that 'cramp' is composed of grains of quartz with some feldspar or small quartzo-feldspathic sandstone clasts in an amorphous matrix; Davidson suggested

that the mineral content was derived from an argillaceous quartzo-feldspathic sandstone (Callander 1936, 449) and Sofranoff's thin section is in full agreement with this. Examination by X-ray diffraction in the British Museum (Natural History) by A J Fleet indicated the presence only of quartz, and a minor amount of feldspar. Calcite may be present in minor quantities as a biogenous component, as noted by McCawley, but it is not invariably present (it was not recognisable in Sofranoff's section nor on the X-ray diffractogram). Heating at temperatures necessary to cause quartzo-feldspathic sandstone fusion (eg very approximately 850° C – based on figures in Tuttle and Bowen 1958) is unlikely to lead to the survival of shell material intact as carbonate, therefore the shells seen by McCawley are probably post-formational contamination. (It should be noted that the presence of fluids may lower the fusion temperature.) This explanation would also explain the carbon dioxide recognised by McCawley but not detected by Callander or Brotherton (see also below). Chemically the analyses of Davidson (Callander 1936, 450) and Brotherton suggest that the major element chemistry of 'cramp' is dictated by its lithogenous content (i.e. the rock detritus incorporated in it). The high sodium and potassium contents found by Davidson are not confirmed by either of Brotherton's analyses. The presence of any biogenous carbonate would govern the calcium content, but the absence of carbon dioxide from either Davidson's or Brotherton's chemical analyses indicates that it was absent in the samples analysed. Davidson noted the high phosphorus content of his sample, which is far exceeded by Brotherton's values, and proposed bone as a source of this element whilst noting the contradictory low calcium value (*in* Callander 1936, 451); this paradox is underlined by Brotherton's analyses. The absence of chlorine in the latter's samples and iodine in Davidson's analysis should be noted, but is by no means conclusive. The remarks in McCawley's report about smelling halogens do not seem to be confirmed by other workers. The relatively high ferrous-ferric iron ratio of Davidson's analysis is interesting and implies that 'cramp' formed under relatively reducing conditions.

In the discussion of 'cramp' from the burnt mound of Beaquoy in Orkney, Sofranoff concluded that the evidence indicated a fine soil or silt with a small percentage of quartz sand which had been heated to such a temperature that the silt had fused, trapping volatiles similar to volcanic pumice, and releasing them only after the substance had solidified, thereby retaining the shape (*in* Hedges 1975, 91).

Conclusion

The results of this work are hardly conclusive; they are not inconsistent with a source involving the burning of seaweed, but, as Brotherton has shown, there is no result that specifically suggests the presence of burnt seaweed. This is probably because the halogens, the presence of which might be taken as proof, would be volatilised during burning. At present, therefore, the situation must rest, but it is unlikely that a conclusive test will be found. It is hoped that future work will include microprobe analyses to determine the nature of the 'cramp' matrix. This is unlikely to resolve the problem but may, along with consideration of data such as the ferrous/ferric iron ratio, help to define the physio-chemical conditions under which 'cramp' formed. In conclusion, then, it must be said that the main line of evidence linking 'cramp' with seaweed burning is one of deductive reasoning.

APPENDIX 8

Geometry and astronomy of the Stones of Stenness, Orkney

by G R Curtis

The excavation indicated that at least ten stones were erected, and there are spaces for two more which would have completed a ring comprising twelve stones, almost equally spaced around the perimeter. To be equally distributed, twelve points would have to be regularly spaced at 30° intervals. Ignoring stones nos 5 and 7, the positions of which are unreliable, and nos 9 and 12, the positions of which are unknown, it is found that the remaining stones are all within 4·5° of this regular 30° pattern.

The positions of the four corners of the stones in terms of polar co-ordinates were offered to Dr G I Crawford, Department of Natural Philosophy, University of Glasgow, who kindly agreed to use this data in a computer programme designed to find the best fits of the stones as a circle or as an ellipse. It had already been ascertained from the plan of the site that neither an 'egg-shape' nor a 'flattened circle' suited. Three categories of accuracy were suggested by the results of the excavation: the first included those stones the positions of which were certain (nos 2, 3, 4, 8, 10, 11); the second included the re-erected

stone (no. 5), the reasonably precise hole of no. 6, and the likely position of stone no. 1; the third included no. 7 (uncertainly re-erected), nos 9 and 12 (uncertain positions).

Results are given in Table 9 for the best fits for the centres of the stones (taken as the arithmetic means of the radii and angles of the four corners of each stone) or the centre of the stone-hole where appropriate. In addition the best fits for the inner faces of the stones are given (taken from the co-ordinates of the two inner corners). In one case the position of stone no. 1 was added to the stones of the first category of accuracy in the hope that it would help to define the southern end of the major axis. The ellipses provide significantly better fits than the circles.

TABLE 9

			CIRCLE		ELLIPSE				
	Analysis using centre or	Categories of	Radius	SD	Major semi-axis a	Minor semi-axis b	Semi-focal distance c	Perimeter P	Orientation*
Line	face of stone	stones used	m		m	m	m	m	Degrees
1	Centre	1+2+3	15·637	0·341					
2		1+2	15·679	0·299					
3		1	15·671	0·372					
4	Centre	1+2+3		0·093	15·853	15·351	3·96	98·04	−19
5		1+2		0·033	16·003	15·404	4·34	98·68	+16
6		1		0·015	16·431	15·325	5·93	99·79	+24
7	Inner face	1+stone no. 1		0·049	15·932	15·272	4·54	97·96	+22
8		1		0·021	16·420	15·150	6·33	99·36	+27·5
					Major axis 2a MY	Minor axis 2b MY	Focal distance 2c MY	Perimeter P Rods	
9	Centre	1			39·64	36·97	14·31	48·15	
10	Inner face	1+stone no. 1			38·44	36·84	10·95	47·27	
11	Inner face	1			39·61	36·55	15·28	47·94	
12	Pythagorean triangle:				39	36	15	47·14	

* + equals West of true North. − equals East of true North.

It is clear that using the centres or using the inner faces, the stones of the first category provide the most satisfactory best fits, or in other words the standard deviations are least. For the circles the standard deviations are between 300 mm and 370 mm, while for the ellipses they fall from 93 mm using stones of all categories to between 15 mm and 20 mm using only those of the first category. As this may appear to be exceptionally precise it is suggested that the excellent quality of the parallel-sided slabs of stone lends itself to accurate positioning. Nevertheless, with only six reliable stones out of a possible twelve, such precision cannot be confirmed. For the same reason the orientation of the major axis can only be indicated as about $20° \pm 10$ West of true North.

Taking lines 6–8 in the table, changing semi-diameters to full diameters and converting these to Megalithic Yards lines 9–11 are obtained. It may be noted that these ellipses are not far from the ellipse in line 12, which is based on the Pythagorean triangle having sides in the proportions 13 : 12 : 5 or 39 : 36 : 15 MY. This ellipse is of the same size and proportions as the northern ellipse at Stanton Drew, Somerset (Thom 1967, 72).

The ring and the horizon were surveyed by theodolite from a station which was located within the central setting, but towards its eastern side. The data and detailed drawings have been deposited in the National Monuments Record of Scotland. It has not yet been possible to suggest that any of the possible foresight horizons were used for solar or lunar observations by an observer within the henge monument. The Watch Stone, the Barnhouse Stone, the two stones at Brodgar Farm, as well as the Odin Stone and the stone which stood near the Watch Stone, would all have been clearly visible from within the ring. It is perhaps likely that the various outlying stones are themselves oriented to indicate horizon foresights for particular astronomical observations in a somewhat similar manner to that indicated by Thom and Thom for the monuments round the Ring of Brodgar (1973; 1975), but further work would have to be undertaken to test this hypothesis.

APPENDIX 9

Radiocarbon dates from the Stones of Stenness, Orkney

by D D Harkness, Scottish Universities Research and Reactor Centre, East Kilbride, Glasgow

Four radiocarbon determinations were undertaken from samples from the excavation at the Stones of Stenness.

SRR-350 2356 bc$\pm$65 Collagen from animal bones from the basal ditch deposit in the main ditch section – organic layer (fig 3; Section X–X^1, Z–Z^1).

SRR-351 2238 bc$\pm$70 Wood charcoal from central feature, associated with calcined bone and grooved-ware sherds (fig 4).

SRR-592 1730 bc$\pm$270 Fragments of decomposed wood from the bedding trench of the putative rectangular timber structure (fig 4). The small sample of decomposed wood, which after decontamination and subsequent preparation for C 14 assay, yielded just under 1 gm of datable carbon, has limited the precision obtainable ($\pm 1\sigma$ error term); despite this there is no analytical reason that the date is otherwise than it should be.

SRR-352 ad 519$\pm$150 Wood charcoal from Pit C (fig 2).

An attempt was also made to provide a confirmatory sample by analysis of the charred barley, from Pit A alone and, when this proved insufficient, by amalgamation of the material from Pits A–C, but this too did not make a sample of adequate size.

APPENDIX 10

Estimate of the effort involved in the construction of the Stones of Stenness, Orkney

by I B M Ralston, Department of Geography, University of Aberdeen

Estimates of the effort involved in the construction of the several varieties of neolithic and early bronze age monuments are, by their nature, notoriously difficult to substantiate (Coles 1973). Nevertheless, given the extremely fragmentary vision of the occupation of Britain presented by the settlement evidence, in addition to the equivocal value of demographic estimates made from burial data (Atkinson 1968), hypothetical estimates of the kind delineated below (ideally supported by field experiment) are of some worth in outlining the range of possible societal forms with which we may be dealing. As Atkinson (1961, 292) has indicated, the monuments alone testify to the concerted operations of 'social aggregates larger than the individual family': the same author has warned of the dangers of utilising such figures as may be obtained, by extension, in the field of demography (1972). In sum, though such calculations may enable us to say something of manpower requirements, the more pressing question of manpower availability cannot be derived from the data obtained. Although many of our 'ritual' interpretations may hide monuments initially destined to bond the fabric of small scale societies as much as other more otherworldly factors (Renfrew 1973), we must bear in mind Piggott's caveat (1973, 10) about 'capricious and irrational social conventions' at work in determining the use of human resources on such projects. Such factors lurk, unquantifiably but prominently, behind all such estimates.

At Stenness, as a result of the particular character of the ditch and of the tenuous nature of the surviving evidence for the bank recovered by the excavation, an additional factor of uncertainty is built into the calculations. The rock-cut ditch must have represented a much more exacting quarrying task to its original excavators than the southern British chalk series on which most work has been effected to date. The laminations characteristic of the Orkney sandstone, which permit the rock to split along a straight plane in each dimension, provided the basis for the precocious development of architecture in the Orcadian chamber tombs: this feature must also have facilitated the quarrymen's task. Indications from all the ditch cuttings, and more particularly from the east terminal, are that the workforce was able to detach substantial blocks of bedrock along an even plane, which suggests both a high level of technical competence and considerable geological comprehension in dealing with this material, as Clark and Piggott demonstrated to be the case with flint mining (1933). Ward-Perkins has mentioned the laborious nature of much early quarrying (1971); in the calculations below we have subjectively scaled up the estimates produced by Atkinson's formula, using as a rather unsatisfactory check an estimate based on output expressed in

terms of cwts/man-hour, though Cornwall (*in* Evans and Limbrey 1974), documenting the Wareham experiment, has recently shown the extreme variability in output that can be obtained.

In terms of the techniques and equipment used, there is little to add to Atkinson's several discussions of the subject (1956; 1974). It could perhaps be argued that the character of the rock would alter the method of working – the digging of an initial pit and then proceeding on a vertical face – suggested by Atkinson (1956, 97) for undertakings in the chalklands. An argument on the grounds of efficiency might allow for the prior extraction of the overburden round the entire circuit, or a segment of it, before any of the underlying rock was quarried, as this would allow surface irregularities and cracks to be best exploited. The nearness of the water table may have been more of a help than a hindrance; Callander and Grant (1934, 444) record that wedges of wood, driven in dry and allowed to swell by the absorption of sea-water, were used in recent times to prise off sandstone slabs on the shores of Rousay. The suitability of antler picks for levering stones as hard as sarsen is noted by Ashbee and Cornwall (1961, 130).

Atkinson has argued (1961) that, in such undertakings, vertical lift demands a far greater input of effort than horizontal displacement, and so we may imagine that a secondary task carried out in the ditch would be the breaking up of the detached blocks into manageable sizes for ease of extraction. This suggests that it is unlikely that the stones employed in the construction of the circle were derived from the ditch. Although a twelve-stone circle, with each slab as voluminous as the largest surviving orthostat, would only have required about 10% of the sandstone excavated from the ditch, the time and effort involved in quarrying and lifting them would increase the estimates enormously. The slighter dimensions of the west ditch-terminal raise another possibility, given the small fraction of the total ditch excavated: that the ditch may be of uneven width or depth elsewhere on the circuit. Such a feature is recorded elsewhere (e.g. Stonehenge), but remains hypothetical at Stenness: and the dimensions we have used are taken from the other ditch cuttings, with no attempt being made to reconstruct the original profile of the upper part of the ditch.

The bank, sadly ill-defined, presents further problems. The portion of it derived from the till would be liable to slumping in extreme weather conditions, though a capping of broken sandstone might have served both to compact and to stabilise it. We have selected the figure of 6 m, given by the soil discoloration, as the original bank width: this is almost certainly an overgenerous figure, but any allowance for slippage would be completely notional. The same adjective could be applied to any estimate of the original profile of the bank, and a cross-section of a simple geometric shape has been used for ease of calculation. The figures produced below are thus to be regarded with much circumspection, but we feel that they represent a reasonable estimate of the order of magnitude of the work involved. To carry out the calculations, we have used the empirical formula devised by Atkinson (1961, 295) for use in chalk areas. The volume of superficial deposits removed was approximately 1010 m^3 and approximately 620 m^3 of sandstone was quarried. The vertical displacement involved must have been of the order of 2·0 m (the bank is estimated originally to have been between 1·5 m and 2·5 m high). The horizontal displacement was approximately 7 m. These figures suggest an estimate of 12,500 man-hours for the work, and should perhaps be increased by a factor of 4 to account for the different rock type.

Stromness flagstone weighs approximately 130 lb per cubic foot (2082·5 kg/m^3) (Watson 1911, 268), and so some 1,250 tons (1,270 tonnes) was quarried. The Overton Down Report (Jewell 1963) suggests a workrate of approximately 3 cwt (152 kg) per man-hour, and thus this part of the work (again on chalk rates) would have taken approximately 8,500 man-hours to accomplish. Clifford (1950, 35) allowed 10 cwt (508 kg) per man-day as the quarrying rate for the oolite used at Rodmarton: this estimate would suggest a figure of about 20,000 man-hours for the Stenness ditch, for given the character of the rock involved it is perhaps not unreasonable to double this figure. If the workrate involved in moving the superficial deposits at Stenness is reckoned to have proceeded at the same rate as the Overton Down experiment, some 12,000 man-hours would have been required for this part of the undertaking. Overall, we can perhaps conjecture that some 50,000 man-hours were devoted to the construction of the bank and ditch; this might be expressed as 50 men, working a forty-hour week, for half a year. The detailed figures have been deposited in the National Monuments Record of Scotland.

Both Atkinson (1974), in comparing Silbury to the United States' space programme as a fraction of the gross national product of the societies concerned, and Herity (1974) in estimating the size of the neolithic community directly involved in the construction of the Newgrange cairn, have recently drawn attention to the magnitude of these respective tasks. The suggested figures for Stenness fall well below those for the large Southern English late neolithic enclosures – 900,000 man-hours at Durrington Walls and 1,560,000 man-hours at Avebury (Wainwright and Longworth 1971, 197) – and closer to the estimate

of 40,000 man-hours postulated for Maumbury Rings (Startin *in* Bradley 1975, 22–4) and the figure of 100,000 man-hours suggested for causewayed camps (Renfrew 1973, 230). A figure of 80,000 man-hours has been put forward (using a rather different basis than that outlined above) for the henge monument of the Ring of Brodgar. Whether estimates in the order of 40,000 to 50,000 man-hours allow us to think in terms of a complex chiefdom society focused on the Maes Howe/Brodgar/Stenness grouping, rather than 'a straightforward and fairly egalitarian tribal society' (Renfrew 1973, 137), may perhaps remain in the balance.

APPENDIX 11

Catalogue of early illustrations of the Stones of Stenness and the Stone of Odin

by J N Graham Ritchie and Ernest W Marwick

Because of the importance of early illustrations of the Stones of Stenness and the Stone of Odin in any discussion of these sites, the authors have compiled a catalogue of the most important drawings and engravings; this catalogue lists title, artist, present location and size, as well as a short comment on the interest of each illustration. They are presented in approximately chronological order ranging from 1760 to 1885.

1. *View of a small Druid Temple* by Richard Pococke
British Library, London. Add Ms 14257, f 79v (245 mm by 205 mm).
This pen and ink wash (pl 1a) provides an unusual view of the Stenness promontory from the N side of the causeway between the lochs; it shows the four stones of the circle, the Watch Stone, the Stone of Odin and an irregular, but apparently holed, boulder closer to the shore of the Loch of Harray. The drawing formed the basis for the less successful lithograph, which is published in Kemp's edition of Pococke's *Tours* (Pococke 1887, xxix, 143). Drawn in 1760, it is the earliest known illustration of the site.

2a. *A Plan of the Circle of Loda in the Parish of Stenhouse in the Island of Pomona with the country adjacent taken from an actual Survey by Fred. Herm. Walden*

2b. *View of a semicircle of Stones on the Banks of Stenhouse Lake in the Island of Pomona* by John Cleveley
British Library, London. Add Ms 15511, f 3 and f 10 (670 mm by 470 mm and 495 mm by 310 mm respectively); a pencil sketch of the view is folio 9.
The map and watercolour were done by members of Sir Joseph Banks's party during his visit to Orkney in 1772 (Lysaght 1974, pls 8 and 6). The map seems to be the clearest indication of the position of the Stone of Odin (Stone of Sacrifice), and of its relationship to the Stones of Stenness (Crescent) and to the Watch Stone. The decorated title to the map has a picture of a stone that can only be interpreted as the Stone of Odin – the perforation is to one side and there is a worn area between it and the edge of the stone. The highest point on the stone is on the edge with the perforation (pl 8b). The plan of the 'dolmen' shows two stones upright and that on the W side fallen. The watercolour too gives a good impression of the twin promontories and of the relationship of the Stone of Odin to the Stones of Stenness (pl 1b); this is the first reliable illustration of the stones of the 'dolmen'.

3. *A view of the Kirk, and Standing Stones of Stenhouse from the East*
Detail from 'A Chart of the Orkney Islands in which are printed out the Lands of the Earldom belonging to the Right Honourable Sr Laurence Dundass Baronet One of His Majesties most Honourable Privy Council'.
Orkney Library, Kirkwall (photostat in Register House, Edinburgh: RHP 6096).
Probably by William Aberdeen.
This is almost certainly the source for no. 4, though the view is not so complete, nor is it inhabited; the two stone circles, Odin Stone and Watch Stone are shown. Aberdeen followed his profession as a surveyor in Orkney in the 1770s on Dundas's behalf.

4. *A Perspective View of the Standing Stones in the Parish of Stenhouse in Orkney*
This drawing, now lost, was presented to the Society of Antiquaries of Scotland in 1784 by Dr Robert Henry, minister of Greyfriars Church, Edinburgh; it is published in Anderson's edition of Low's

Tour, along with Henry's notes which accompanied the presentation (Low 1879, xxiii–xxvi). The whole archaeological vista between Stenness Kirk and Maes Howe across to the Ring of Brodgar is illustrated in foreshortened perspective. The drawing (unlike no. 3) is peopled and may be the earliest illustration of the Oath of Odin, but is not very helpful archaeologically. The accompanying notes for C (the Stones of Stenness) and D (the Stone of Odin) read (Low 1879, xxv):

> 'C. – Standing Stones, called by the inhabitants of Orkney the Temple of the Moon; they are formed into a semicircle, the curve whereof is to the south; they are from 12 to 14 feet high, 3½ feet broad, and 18 inches thick.
> D. – A stone which is supposed to have been used for tying the sacrifice to, it is distant N.E. from the Temple of the Moon about 100 yards, and has a round hole cut artificially through it, six inches in diameter 3 feet from the ground'.

A rather different copy of the drawing presented by Henry is published by Hibbert in his paper on the 'Tings of Orkney and Shetland' (1831, 122); only the central part of the view appears on the wood-cut. See also Thomas 1852.

5a. *View of the Circle of Loda, the Stones of Power and the small Circle or Crescent at Stenhous in Pomona from the West or S. West* signed JTS. 1789 [John Thomas Stanley]
5b. *Stone of Power between the two Temples at Stenhous* signed JTS. 1789
National Library of Iceland, Reykjavik. Lbs. 3886, 4to – 307 and 299.

These two views were drawn during Stanley's visit to Stenness in 1789; the former is a unique panoramic view from the W with the Ring of Brodgar as the focus, rather hillfort-like, the stones to the SE are less successfully shown. The illustration of the Stone of Odin, 5b, is particularly interesting, giving the dimensions: height 8 feet, breadth 3 feet 6 inches, the hole 3 feet from the ground. The proportions of the stone are very close to those shown in Lady Stafford's etching, but Stanley's more slab-like stone gives perhaps a better impression of Orkney geology (pl 8d).

6. *Stones of Stennis*
National Gallery of Scotland, Edinburgh. D.168.

This pen and wash drawing (248 mm by 445 mm) is signed JW.TSf.; it shows the four uprights of the circle (nos 2, 3, 5 and 6) with the hills of Hoy in the background. The particular interest of this drawing is as an illustration of the stones of the 'dolmen'. The artist is not known, but, given the initials, it seems possible that he was James Wright, copying an original by Thomas Stanley; clearly this can be no more than a guess as the styles are very different and Wright's journal makes no mention of his own artistry – only that of Stanley and Bayne (West 1970, 17).

Catalogue of Scottish Drawings, National Gallery of Scotland. Edinburgh. 1960.

7. *Four flat stones standing on an arc of a circle, near the Lake of Stenhouse in Pomona, one of the Orkney Islands. From a drawing made on the spot by Capt Columbine*
National Library of Scotland, Edinburgh, Hutton Collection. Ms. Adv. 30.5.23, no. 184a (200 mm by 148 mm).

Captain Columbine, Royal Navy, visited Orkney and Shetland in 1792. The illustration shows the four stones of the circle (nos 2, 3, 5 and 6), what may either be interpreted as the stump of no. 8 (for which the angle seems wrong) or the single upright of what was later to become the 'dolmen'. An outlying stone to the N is more likely to be the Stone of Odin than the Watch Stone, but is too distant to be a helpful view. A uniformed man holds a stave against stone 2 as a scale. The heights of stones 2, 4 and 3 are given in a marginal note as 18 ft 6 in, 16 and 17 feet respectively.

8a. *Eastern Circle of the Stones of Stennis*
8b. *Western Circle of the Stones of Stennis*
by Elizabeth, Marchioness of Stafford (Duchess – Countess of Sutherland)

A pair of etchings, executed in 1805, and published privately in 1807 (218 mm by 107 mm and 216 mm by 110 mm) as *Views in Orkney and on the North-Eastern Coast of Scotland.* The first illustrates the Stones of Stenness, and the second the Watch Stone and the Stone of Odin with the Ring of Brodgar in the distance. Four stones of the Stenness circle (and the stump of no. 8) are shown, with the hills of Hoy forming an impressive background (pl 8a). The second is important as a close-up view of the Stone of

Odin, with a clear view of the perforation and the vein or line of weakness (shown also on Stanley's sketch, no. 5b), which may have made it easier for MacKay's men to break the stone to pieces (pl 8c).

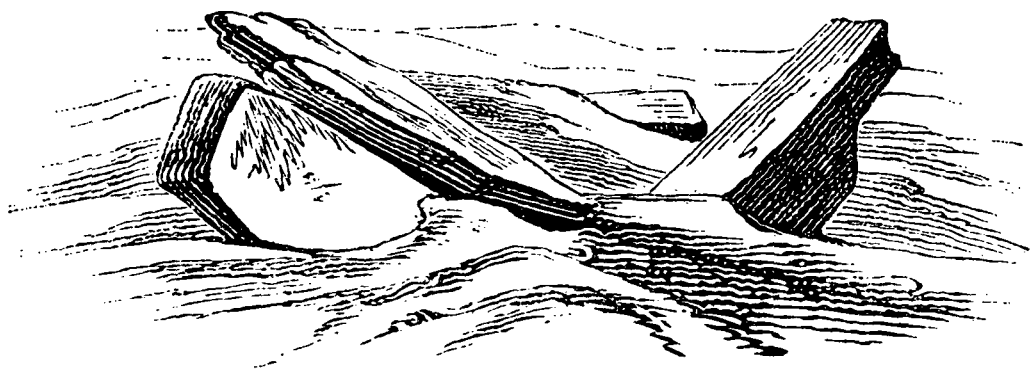
9. *The Stones of Stenness*
by John Spottiswoode

A water colour, from a sketch made in 1802 by John Spottiswoode, formed the basis of several subsequent illustrations of the site (including Barry 1805, opp p. 209; *Old lore Miscellany of Orkney, Shetland, Caithness and Sutherland*, vol iii, part iii, July 1910, frontispiece); the watercolour itself has not been located. The Watch Stone is shown in the foreground as an impressive monolith with the Stones of Stenness as the central group in the middle distance; the Stone of Odin is not helpfully illustrated.

10. *The Standing Stones of Stenness. From an original drawing which belonged to the late James Fergusson DCL* by P Skelton

The frontispiece to *The Orkneys in Early Celtic Times* by James M MacBeath (1892), this is a romantic view. The original has not been located.

Cromlech, from the Southward.



From the Northward.

FIG 11 The Stones of Stenness: 'dolmen' after Thomas 1852

11a. *Ring of Stenness and Cromlech from the Northward*
11b. *Ring of Stenness from the Westward*
11c. *Cromlech, from the Southward*
11d. *From the Northward*
11e. *Plan*

These four illustrations and plan accompany F W L Thomas's paper of 1852, grouped in pairs on pages 98 and 99 and pl xiv. The first two give one of the clearest, if slightly exaggerated impressions of the henge ditch on the W side of the site, and the plan indicates clearly the result of continuous ploughing in obliterating the S and SE portions. As a record of the state of the 'dolmen' in the mid-19th century 11c and 11d are particularly important (fig 11; the compass bearings should read from the W and E respectively).

12a. *Small circle, Stennis, Orkney* planned by H Dryden and G Petrie, 1851, copied by W Galloway, 1868
12b. *Stenness* signed by H. D.
National Monuments Record of Scotland, Edinburgh (560 mm by 385 mm and 340 mm by 240 mm respectively).

The plan (pl 2) gives the best indication, before the recent gradiometer survey, of the site as a class I henge, with a single entrance to the NNW; stones 2, 3 are shown upright, no. 5 fallen and the stump of no. 8. The stones of the 'dolmen' are shown *in situ* and also as a detailed plan at the foot of the page. The bank and ditch are shown as a brown wash, upright stones in pink and the fallen stones and the three stones of the 'dolmen' in purple. The plan formed the basis for RCAMS 1946, 302, fig 377. The view, from the interior of the circle looking NW, gives a good impression of the relationship of the Stones to the lochs and to the distant Ring of Brodgar.

13a. *The Stones of Stenness*
13b. *Menhir at causeway – Loch of Stenness*
13c. *Standing Stone opposite entrance to Maeshowe*
by W St G Burke
National Monuments Record of Scotland, Edinburgh.

Among the drawings done by Captain W St G Burke, Royal Engineers, who was employed on the Ordnance Survey of Orkney in 1875, there are attractive pen sketches of the sites on the Stenness and Brodgar promontories. The view of the Stones of Stenness (288 mm by 180 mm) shows the upright stones (nos 2 and 3) and the fallen stone (no. 5), with their respective measurements given; the stump of another is referred to in his description, as well as a passing mention of the 'dolmen'. Burke added that the surrounding ditch was 'rapidly disappearing under the plough'. The other two sketches are of the Watch Stone (300 mm by 200 mm) and the Barnhouse Stone (approx 100 mm by 120 mm).

14. *The two standing stones of Stennis* by W S Tomkin, 1885
Sketch in Public Record Office, London. Works 39, 16 (i.e. notebook 14).

Tomkin accompanied Pitt-Rivers as illustrator on his visit to Orkney in 1885, and the drawing (158 mm by 98 mm) is one of a series, that includes elevations of fifteen of the uprights of the Ring of Brodgar, one page to each, the Watch Stone and the Barnhouse Stone; the 'dolmen' is not shown. A general view of the situation of the two circles and an attractive view of Brodgar are in Tomkin's sketchbook numbered Works 39, 6 (i.e. sketchbook 4) (Thompson 1960, 106–7). Pitt-Rivers' accompanying notes are Works 39, 15, f. 156–61 (i.e. notebook 13).

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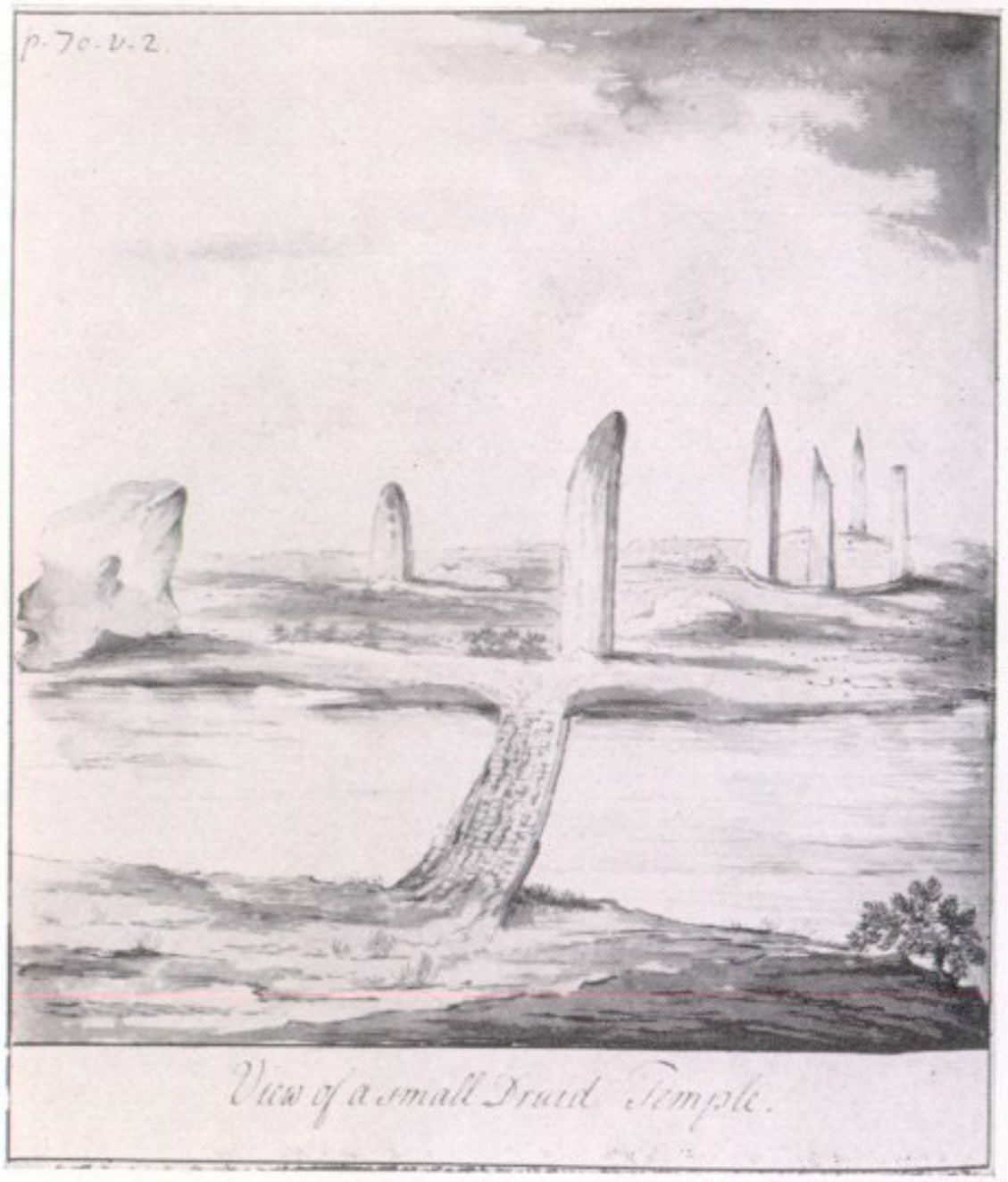
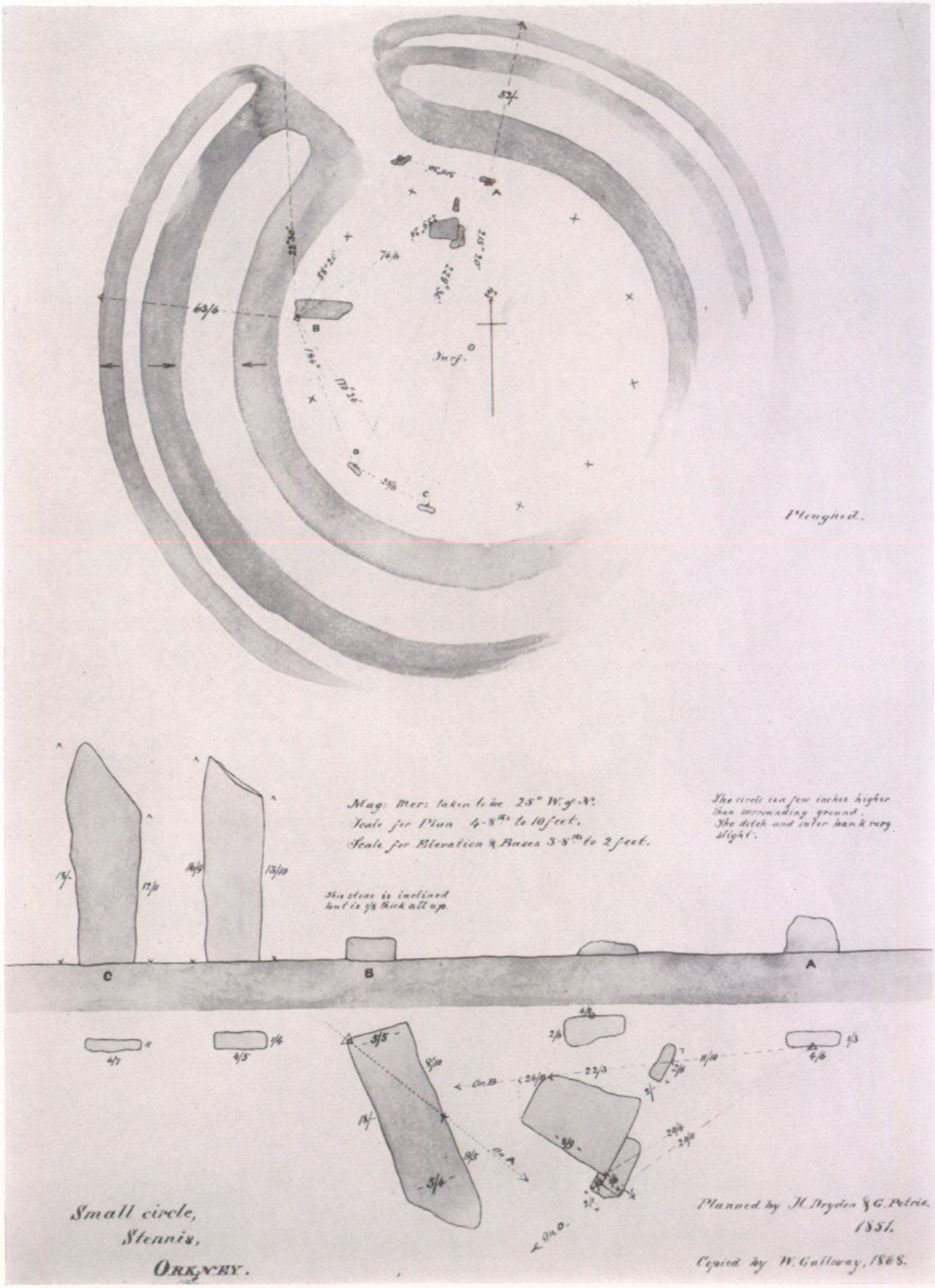


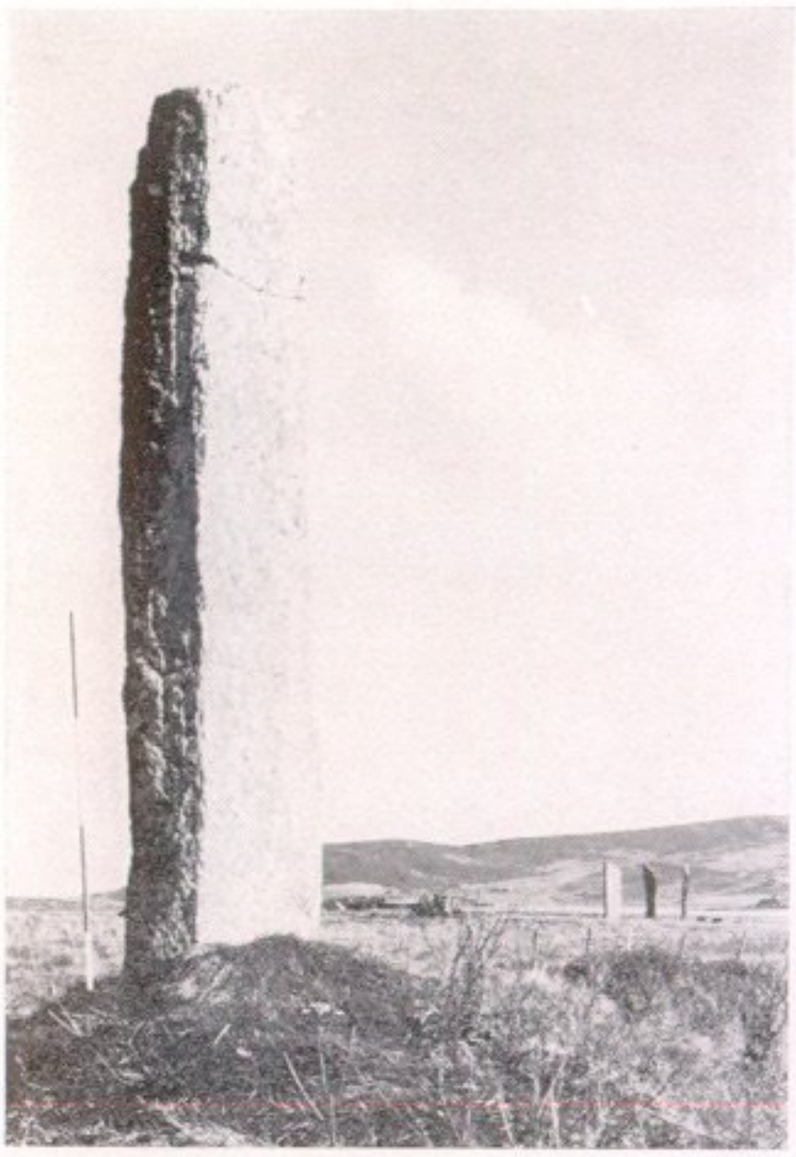
a View from NW, by Richard Pococke, 1760

b View from SE, by John Cleveley, 1772



Plan by H Dryden and G Petrie, 1851

a The Stones of Stenness



b The Watch Stone

c Standing Stones, Brodgar Farm

d The Barnhouse Stone

a Aerial view, 1973

b Stone no. 8

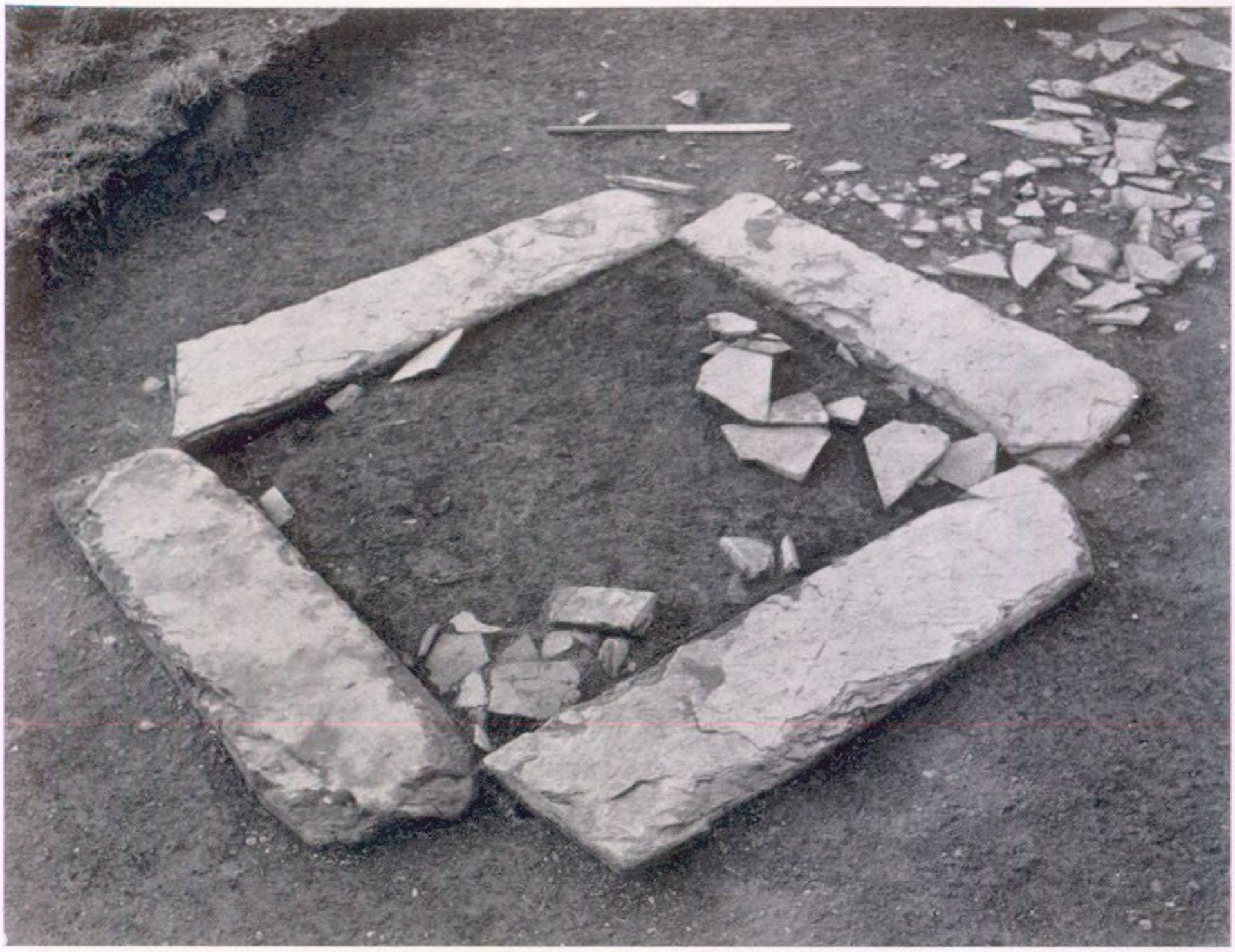
c Stone no. 11

d Stone no. 10

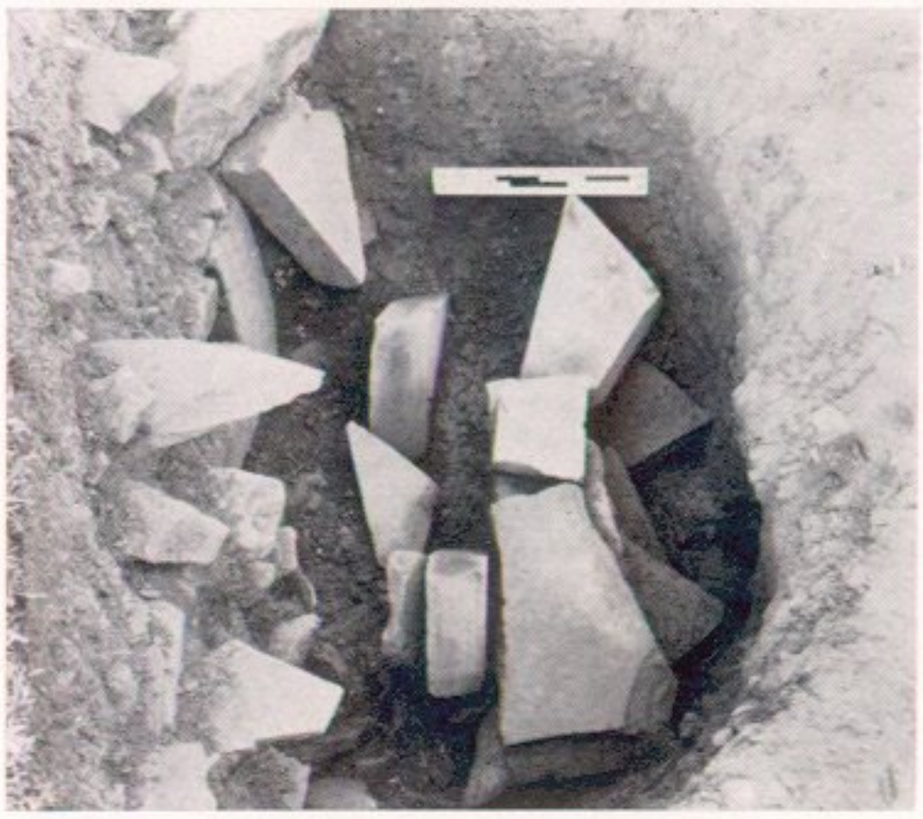
a E ditch terminal

b W ditch terminal

c Section at W ditch terminal

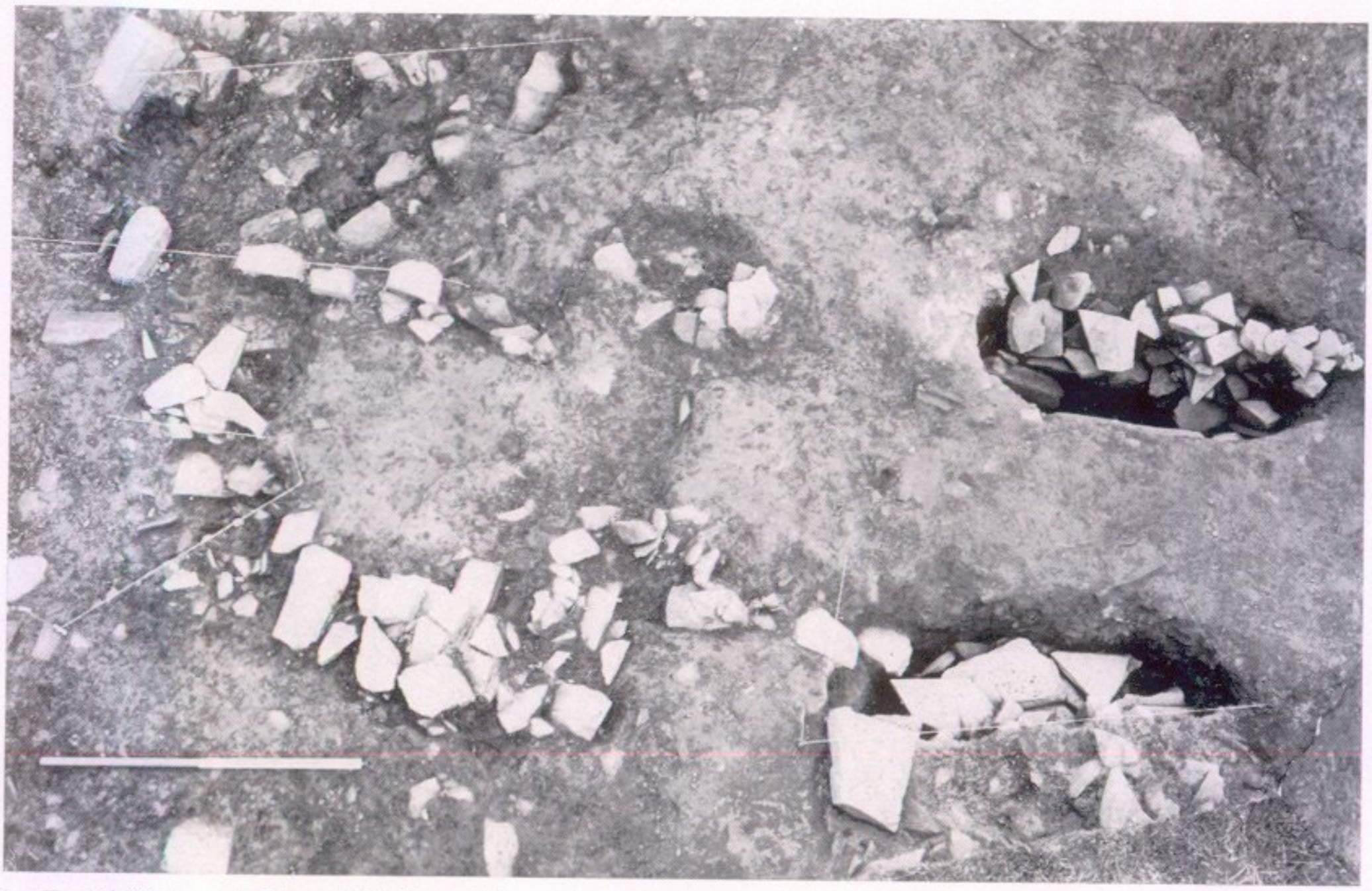


a Central setting



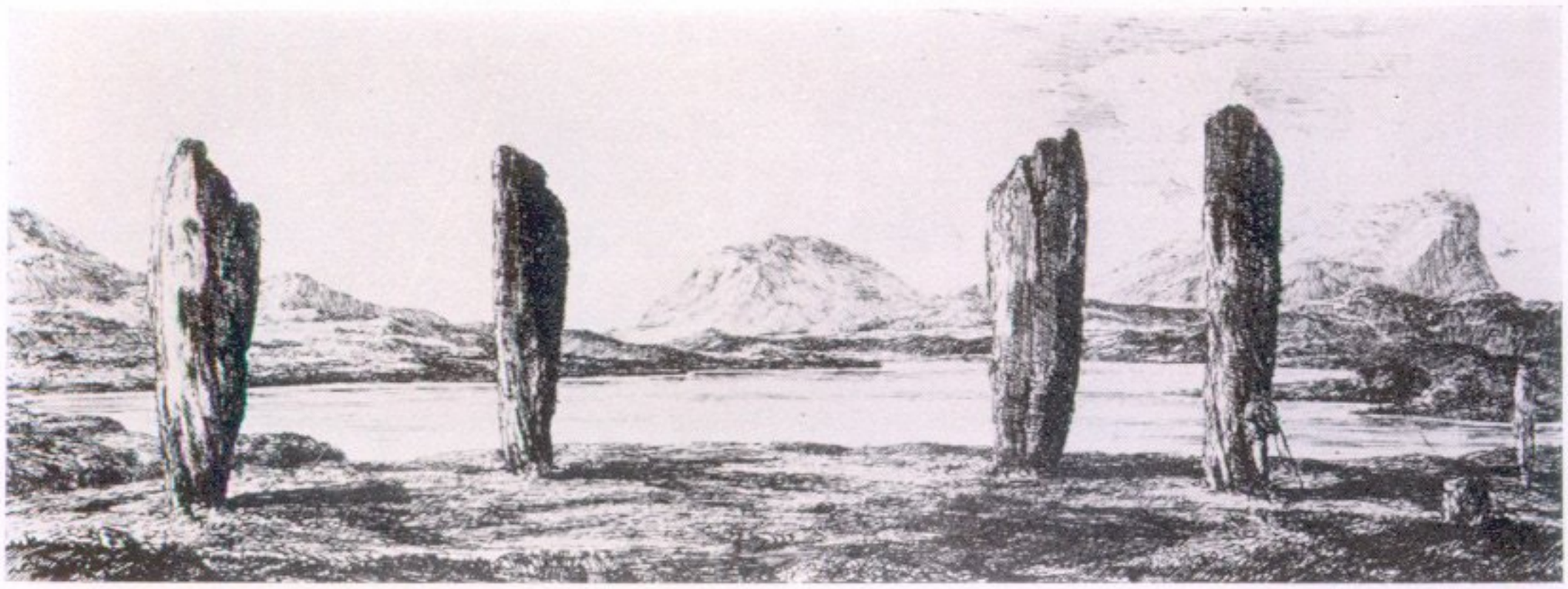
b W stone hole (showing packing)

c E stone hole (unexcavated)



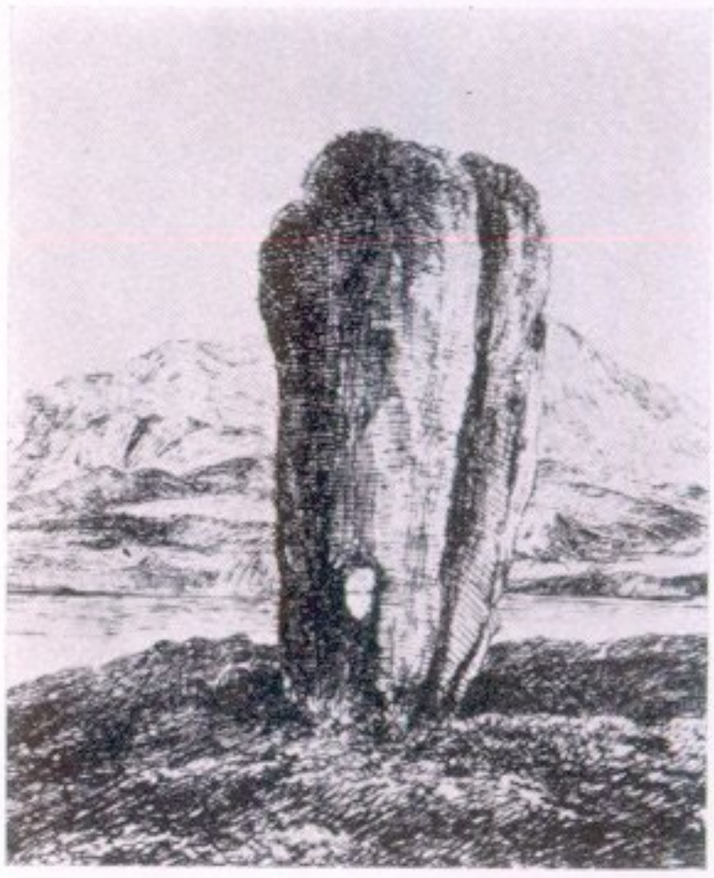
a E and W stone holes and timber setting

b Pits



a View by Elizabeth, Marchioness of Stafford, 1805

b



c

d

b–d The Stone of Odin

b Detail of title of F H Walden's map, 1772
c Detail of view by Lady Stafford, 1805
d View by John Thomas Stanley, 1789

The Cove at Stanton Drew, Somerset; detail of drawing by William Stukeley, 1723