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Excavation of a Neolithic farmstead at Knap of Howar, Papa Westray, Orkney

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ABSTRACT

Re-excavation of two stone-built houses and associated midden deposits identified a farming community of the later fourth millennium BC, attributable to the makers of Unstan ware, and yielded extensive information about the contemporary natural environment.

INTRODUCTION

The island of Papa Westray is one of the northernmost islands of the Orkney group, with the open Atlantic to the NW and Fair Isle and the Shetlands to the NE. The island is almost 7 km long and 2 km wide, and it rises to a maximum height of only 48 m OD at the N end where there are steep cliffs; elsewhere it consists of gently rolling and very fertile fields. A visitor at the beginning of the 19th century described Papa Westray as

> a beautiful little island... Never did our eyes behold richer tracts of natural clover, red and white, than in this island. The soil is good, and was at this time clothed with abundant crops of oats, bear [bere, six-row barley] and potatoes... We left with regret, as we believe every visitant must do (Neill 1806, 41, 44).

The bedrock of the island belongs to the Rousay Flags group of Middle Old Red Sandstone rocks and provides excellent building material. The presence on the Holm of Papa Westray, a tiny island just off the E coast of Papa Westray, of three Neolithic chambered tombs is eloquent witness to the attraction of the fertile loamy soils of the area to early settlers.

Knap of Howar lies on the W coast of Papa Westray (NGR HY 483 518), among the modern pasturelands of Holland farm (fig 1, pl 2a). The NE coast of the island of Westray is only 1·9 km away, across Papa Sound where the sea-bed rises to a depth of no more than 7 m; the topography of Orkney is characterized by its drowned appearance (Miller 1976, 29), and it is possible that Papa Sound hides a submerged beach-flat linking Papa Westray with Westray.

The name Knap of Howar (sometimes spelled Hower; the form used on OS maps is here preferred) is derived from ON *howe* or mound and ON *knapp-r*, knob or cap. This somewhat tautologous name describes the site prior to excavation, when the houses were buried beneath 2·5 m of windblown sand. Preserved in this way, the walls of the houses have survived to a

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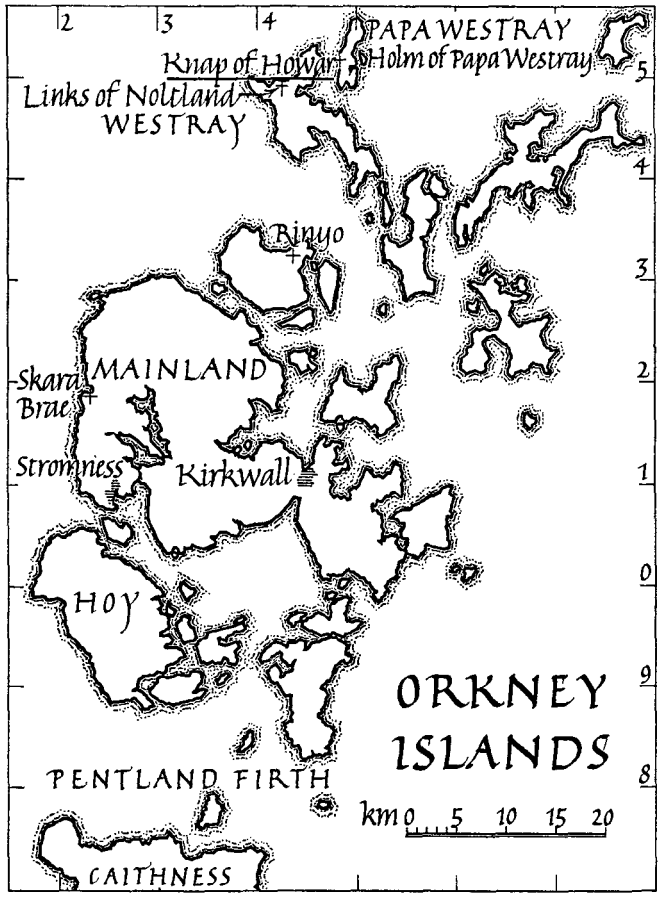

FIG 1 Location map

remarkable height of 1·62 m maximum, and the lintel slabs roofing both the entrance passages and the side passage joining the two houses were still in position at the time of the first excavation.

PREVIOUS EXCAVATION

The entrance into house 1 was first uncovered in 1929 (pl 2b), but the presence of an extensive midden, revealed by coastal erosion, had been known for some years. Excavation of the two houses was carried out in the early 1930s by the landowner, William Traill, and by William Kirkness (Traill & Kirkness 1937); their report to the Society of Antiquaries of Scotland in 1937 was illustrated by a 16 mm silent film, shot after the completion of the excavation. In some respects, the account published in the *Inventory of the Ancient Monuments of Orkney and Shetland* (RCAMS 1946, no 524) is more detailed in its description of the houses than the Traill and Kirkness excavation report.

The method adopted in the early excavation was to clear out the sand filling the interior of the two houses and then to follow the exterior face of the walls with a narrow trench which did not penetrate below the base of the walls, although the presence of underlying midden was noted. A large number of photographs was taken during the excavation, the negatives of which have been deposited in the National Monuments Record of Scotland; these were of considerable help in re-excavating the site. The surviving finds from the original excavation, none of which can be provenanced exactly within the site, are listed

separately in the catalogue, along with artefacts found before and after that excavation (nos E–I (pottery catalogue), 228–54).

None of the artefacts was sufficiently diagnostic to provide secure dating evidence, and an Iron Age context was suggested on the grounds of similarities in architecture and artefacts with Orcadian brochs (Traill & Kirkness 1937, 314), although it is clear from the surviving correspondence that Mr Traill's private opinion favoured a Neolithic date. (The attribution of rotary querns to the site which crept into subsequent literature is a myth which appears to have originated in Marwick 1952, 30.) The site was taken into State guardianship in 1937, when a sea-wall was built to prevent further erosion and minor consolidation of the house-walls was carried out.

Re-excavation of a site partially dug more than 40 years previously involves a certain amount of detective work, in this case facilitated by the existence of a photographic record unusually full for its time; less happily, re-excavation also means the frustration of questions for which there can never be answers. In terms of artefacts, it is likely that most of the small finds and other domestic refuse found in the early excavation belong to Period II, because Traill and Kirkness did not, to any extent, explore either the underlying midden or the material forming the wall-core of the surviving houses.

DESCRIPTION OF BUILDINGS

For convenience, the two buildings are here labelled house 1 and house 2, but the term 'house' is not used in a strictly functional sense; it is likely that neither building fulfilled a single function, although house 1 may have been predominantly a dwelling-house while house 2 was probably used as a workshop and for storage. As the superstructure of both these buildings was uncovered during the previous excavation and subsequently conserved, their basic form will be described before an account is given of the recent excavations.

HOUSE 1

This is the larger and southerly of the two buildings, which, even in 1929, was in a better state of preservation than house 2. It is rectilinear in plan-form with rounded corners, and the quality of drystone walling is very good; the wall is faced with stone both internally and externally, with a core of midden material, and it survives to a maximum height of 1·62 m along the N side. The average width of the wall is 1·5 m, but it widens to 1·7 m at the main entrance in order to create a long draught-proof passage-way, 0·75 m wide. The entrance passage is paved with two and roofed with three large stone slabs, and the paving is overlapped on either side by the drystone walls of the passage-way. The roofing-slabs were laid to abut one another at a height of 1·3 m above the floor, flush with the outer wall-face and with the door-checks at the inner end. This inner doorway is furnished with long upright slabs forming checks and jambs, and with a low sill-stone between the checks (pl 3a). The door itself was presumably portable, made of wood or animal skins stretched on a wooden frame, and it would have been closed against the checking slabs, held by a bar. The jambs are now broken at a low level, but in the 1930s they were complete and 'notched as if to admit small bars' (RCAMS 1946, 182–3).

A smaller passage-way (B) through the N wall leads into house 2 at a point where the walls of the two buildings abut one another. Its roof has been reconstructed at a height of 1·03 m with three lintel slabs, but there must originally have been four, allowing for the collapse at the house 2 end. The passage is 0·7 m wide between drystone walls which, at the house 1 end, were faced on either side by a large upright stone jamb. The door appears to have been at the N end of the passage in house 2, where there are slab checks and jambs. The passage was only roughly paved and there were no sill-stones.

The interior of house 1 is divided into two rooms, 5·0 by 5·3 m and 4·5 by 4·6 m, by a stone partition. The larger compartment (1a) is furnished with a low bench or platform along the S wall, c 0·18 m high at its kerb formed by three long slabs laid flat. The interior of the platform consisted of irregular slabs and sand, and it is divided into two by an upright slab set at right angles to the house-wall and surviving to a height of 0·6 m; a similar slab may originally have bounded the W end of the platform. The floor was partially paved in front of the two passage-ways and in the centre of the room where a hollow in the natural subsoil required levelling.

The stone partition consists of four upright stone slabs; two are set partially into the house-wall and survive incomplete to heights of 1·61 m on the N and 1·24 m on the S, while the other two, each

intact and 0·68 m high, are set on either side of the entrance into the inner compartment. The entrance is further defined on the E side by two low slabs, 0·2 m high (a third slab shown on earlier plans was not an original feature, Traill & Kirkness 1937, fig 1; RCAMS 1946, fig 268).

A massive trough quern (no 225) stands in the inner room (1b), though not precisely in its original position; 'two rubbing-stones and a quantity of broken razor-shell' were found beside the quern (RCAMS 1946, 183). The floor deposit, undisturbed until 1973, will be described in the next section. There was a small recess built into the N wall at a height of 0·9 m above the floor (this section of wall including the recess was dismantled and re-built in 1975); it measured 0·64 m wide, 0·38 m high and 0·44–0·55 m deep, with its lintel and sill each formed by a single slab.

It is possible that there once existed a paved annexe or porch outside the main entrance into house 1, although no trace of this feature now survives. A short length of walling extended westwards at right angles to the wall of the house, on the N side of the entrance (Traill & Kirkness 1937, 310–11, fig 1), and the area in front of the entrance was paved. Erosion had destroyed most of the feature, and only c 1·2 m of the wall survived to a height of some eight courses (visible on 1929 photograph); it was not bonded into the house wall. If this were a porch, it would find parallels among Neolithic houses in Shetland.

HOUSE 2

This building had not survived in such good condition as house 1, perhaps because its wall was inherently weaker as a result of all the recesses built into it. The overall plan-form is rectilinear with rounded corners, but the internal area, measuring 7·5 by 2·6–3·6 m, is divided into three compartments (pl 6a). The wall is again built with fine drystone facings and a midden core, c 1·0 m thick widening to 1·3 m at the main W entrance. Although the two houses abut at the adjoining passage-way, there is no evidence of any attempt to bond the two walls; the house 2 end of the passage-way has already been described. The main (W) entrance is now much reduced in height, although at least the innermost lintel was still in position in the early 1930s, at a height of just over 1·0 m, flush with the door-checks; the door was again at the inner end of the passage, where there are broken slab jambs and checks but no sill-stone. Excavation in 1975 showed that the paving of the passage, like that in house 1, was overlapped on either side by the passage-walls. The passage is 1·3 m long and 0·6 m wide. The internal wall-face to either side of the main entrance shows a use of post-and-panel technique not found elsewhere on the site: at a distance of c 0·3 m from the door-jamb on either side is an upright stone 'post', 0·86 m high on the N and 0·80 m high on the S, with a 'panel' of drystone walling between jamb and 'post' (pl 6b; partially collapsed on S).

The subdividing partitions in house 2 mirror that in house 1, each consisting of two pairs of thin upright flagstones. The partition between the outer and middle compartments has not survived well; both of the slabs set partially into the house-wall are severely reduced in size, but the inner slabs appear to be complete, that to the N being 0·76 m high and that to the S an unusually thick pillar 0·5 m high. There are two recesses in the S wall of the middle compartment, both of which had collapsed and have been re-built, and a rough stone bench lined the N wall (this feature will be discussed in the next section). The partition between the middle and inner-most compartments has no gaps between the two slabs forming each pair of uprights, and the inner slabs are unusually tall. On the N side, the slab set into the house-wall is 1·0 m high, while its neighbour is 1·14 m high, and on the E side, the slab set into the wall is 1·2 m high and the inner slab is 1·39 m high. The function of these partitions will be discussed in a later section.

The innermost room is intensively furnished with wall-recesses and would appear to have functioned as a storage area: five cupboards or storage cells have been created within the thickness of the house-wall at ground level, and, in the S wall, there are three recesses set into the wall at a height of c 0·45 m above the floor. The ground-level cupboards, running clockwise from N to S, measure respectively 0·95 m long by 0·8 m deep and 0·8 m in height, 0·75 by 0·5 m and 0·8 m in height (paved), 0·8 by 0·5 m and 0·65 m in height (secondarily almost filled with drystone walling perhaps in an attempt to counter instability), 0·75 m by 0·4 m and 0·7 m in height, and 0·3 by 0·5 m and 0·77 m in height. They are built with upright slabs and roofed with stone lintels. Immediately to the E of the N partition, there is a low stone kerb formed by a single upright slab, 0·26 m high, delimiting a small compartment within the house. The wall-recesses in the S wall are all about 0·4 m deep and high and, clockwise, measure 0·3, 0·25 and 0·4 m wide.

Traill and Kirkness excavated two small pits in the floor of the inner-most compartment, one containing animal bones and a hammerstone and covered by a stone slab, and the other interpreted as a well (1937, 312). The latter, centrally placed, might be better regarded as a large posthole, thus explaining the presence of chocking stones in a pit c 0·25 m deep; it is certainly not a source of water.

The closing phases of the history of the two buildings are obscure. Traill and Kirkness found both doorways into house 2 to have been deliberately blocked up (1937, 311), and they appear not to have removed much of the blocking material. To judge by the unpublished Kirkness photographs, the blocking of the passage (B) adjoining house 1 took place after there had been a certain amount of collapse in that area of house 2; the horizontal slabs forming the blocking were clearly laid on top of a mass of tumbled stones extending over much of the outermost compartment. Only the house 2 doorway into the passage was blocked and the rest was left clear, perhaps to use as storage space. The lintel-stones over the main entrance and the upper blocking of both doorways collapsed or were removed subsequent to the early excavation. It may well be that house 2 was abandoned and blocked off during the lifetime of house 1, owing to the instability and partial collapse of its walls.

It is clear from the old photographs that both buildings and especially house 2 contained a large quantity of tumbled walling, sometimes lying as if stacked at an angle where sections of wall face had fallen inwards. Together with the slightly corbelled effect still apparent in the upper courses of the wall of house 1, this suggests that the roofs may have been formed by a combination of partial corbelling at the wall-heads and timber frame-work.

It would seem that both houses had been abandoned and were in a ruinous state before they were covered over by blown sand. Traill and Kirkness noticed a substantial turf-line at the level of the top of the house walls, after which there had been a build-up of some 2·5 m of sand (1937, 314). This same turf-line was found in trench II, truncated close to the S wall of house 1 by the old excavation trench (fig 4) and sealing a pit in which a cow had been buried, and it is likely to correlate with similar turf-lines sealed between sand-blows in trench III and test pit 4. Averaging 0·11 m thick, this turf-line represents a stable period of some length, but there is no evidence as to when it took place.

EXCAVATION

The Department of the Environment (now Scottish Development Department, Ancient Monuments) sponsored further excavation at Knap of Howar in 1973 and 1975 with the dual objectives of preparing the houses for the consolidation work required by collapsed or sagging walls and of obtaining cultural and chronological evidence with which to set the site in its true context. House 1 was re-excavated and two areas of midden to the S were examined in a three-week season in 1973, and house 2 was re-excavated together with adjacent areas of midden in a four-week season in 1975, when a series of test pits was also excavated in order to determine the total extent of the midden (fig 2).

The basic stratigraphy of the site is simple and indicates two main periods of activity. A layer of midden some 0·4 m thick represents the primary phase but, apart from the remains of stone paving to the S of house 1, there was no trace in the excavated areas of any contemporary structure (Period I). The two surviving houses were then built into and on top of the primary midden, and an upper layer of midden deposits represents contemporary domestic refuse (Period II). Both the archaeological evidence and the radiocarbon dates indicate that there was no cultural and no significant chronological difference between these two main periods: the site represents the remains of a small Neolithic farmstead belonging to people who used Unstan ware during the period approximately 3500–3100 BC.

Samples of soil from each midden deposit and floor level were wet sieved in the sea; aside from the problems of bringing fresh water to the site, there was a water shortage on the island. The target sample was 50 kg from each deposit, but some layers were too small to yield that total in which case the entire deposit was sieved, using wire baskets with meshes of 3 and 1·5 mm.

PERIOD I, LOWER MIDDEN

The lower midden was traced in trenches II, III, IV, V and VI and in the core of the later house-walls. In trench III, the lower midden (layer III, 4) was distinguishable in character from the upper midden (layer III, 3) by containing less shell and being lighter in colour and texture,

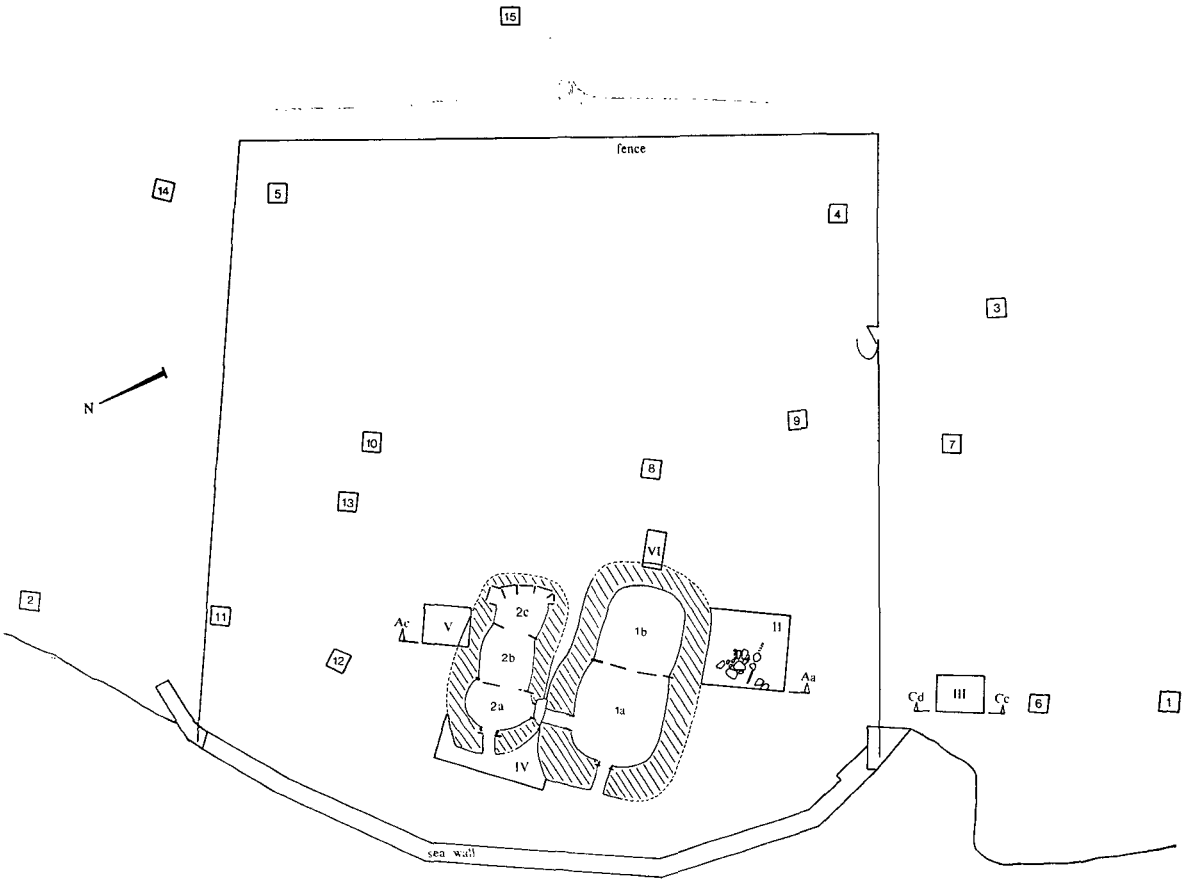

FIG 2 Site plan showing location of trenches and main sections; Period I structure in trench II (scale 1:400)

but in trench II, where the midden was uniformly damp, clayey in texture and dark grey in colour, the division between the upper (layer II, 3) and lower midden (layer II, 11) was necessarily arbitrary. The stratigraphy in the area immediately adjacent to the S wall of house 1 had been destroyed by the earlier excavation (fig 4), but it was assumed, on analogy with the evidence elsewhere on the site, that the outer wall-face had been built on top of the earlier midden rather than dug into it, and therefore the division between upper and lower midden was arbitrarily fixed at the level of the base of the wall. This decision was supported by the absence of any cultural divisions apparent in the artefactual content both of midden and houses and, with hindsight, by the uniformity of the overall chronological pattern provided by radiocarbon determinations.

Even allowing for this artificial division, there is enough evidence to show that the lower midden was a fairly standard 0·4 m deep, tapering off to the E of the houses where the level of the subsoil rose. It is possible that the level surface of the midden relates to the construction of the houses, for it is unlikely that the area cleared of midden within the houses provided sufficient material for their wall-cores, and additional material must have been obtained from the midden outside. At the same time, it should be noted that a level surface was maintained on the upper midden as well, suggesting that this was a desirable end in itself, perhaps to allow small-scale intensive cultivation.

Within the restricted areas explored, the only structural remains attributable to Period I were the fragmentary paving, upright stone and grooves left by the removal of two upright stones found at the base of the lower midden in trench II (fig 2). There were no traces within the interiors of houses 1 and 2 to suggest that they had replaced earlier structures on the same spot, and it is likely that the major structures of Period I lay to the S or W of the extant houses. It is difficult to estimate how much of the western part of the site has been destroyed by coastal erosion.

Period I artefact assemblage

Comparison of the artefact assemblages recovered from the two main periods underlines their cultural homogeneity; there are some differences but little weight can be placed on them. Amongst the pottery, there is slightly more diversity of form and decoration in Period I, but this may relate to the fact that more pottery was recovered from the primary midden than from secondary contexts, a fact that may itself reflect the greater volume of excavated primary midden. Thirty-five bone and stone artefacts (excluding flint) were recovered, including the stone axe (no 199), the whalebone spatula (no 167), one whalebone and one antler hammer (nos 170, 189), and four stone borers (nos 190–193). The artefacts from both periods will be discussed together in a later section.

PERIOD II, HOUSES 1 AND 2 AND UPPER MIDDEN

The degree to which the two buildings had been cleared out internally in the 1930s varied from almost complete in the W compartment of house 1 to superficial in the middle and W compartments of house 2. Undisturbed floor deposits were unmistakeable, contrasting in colour and texture with the clean sand filling the houses after their abandonment, and it would seem that Traill and Kirkness were primarily interested in the superstructure. It was possible to distinguish both on archaeological grounds and from the visual record of Kirkness's photographs the extent of the earlier disturbance.

House 1 (fig 3)

Very little trace of the original floor deposit survived in the W compartment (1a), except between the paving stones and in the passage-way adjoining house 2; it consisted of compacted, dirty brown sand with a scattered trampling of charcoal (spruce or larch, sample A, appendix 9) and small patches of dark grey-brown midden (layer 1a, 2). To judge by the number of artefacts found in the remanent layer of floor deposit, 0·33 m thick in the adjoining passage (layers 1, 4 and 2, 2), this deposit was rich in artefacts: nos 102, 129, 130, 145, 152, 153, 165 and 223 all came from this small area. It is likely that some at least of the floor deposit in passage B post-dates the blocking up of its N end, when the open S end remained accessible from house 1. Beneath this layer of brown sand lay a paved floor, the irregular character of which was quite unlike the meticulous paving of the two main entrance passages. Also unlike the latter, the slabs did not extend beneath the side-walls of the passage. Between and on top of the paving-stones was a primary floor deposit consisting of dark grey-brown organic soil with a clayey texture (layer 1a, 6).

The floor deposit in the inner E compartment (1b) was very different from that in the outer compartment and must reflect a difference in function between the two rooms. There was no paving in this part of the house, and the surface of the natural boulder clay was covered in a layer, 0·02 m thick, of dark grey-brown occupation material of a fine and almost greasy texture (layer 1b, 2). The central hearth consisted of a shallow ash-filled hollow, c 0·80 m in diameter and up to 0·09 m deep (layer 1b, 5); it proved impossible to identify the fuel burnt (samples H and I, appendix 9) (pl 3b). The ash extended into several smaller adjoining hollows, and it also filled a small pit (1b, 7). A small hollow (S) to the N of the hearth contained a roughly made small pot (no 57) and was covered over by a large rimsherd (no 61); this phenomenon was also encountered

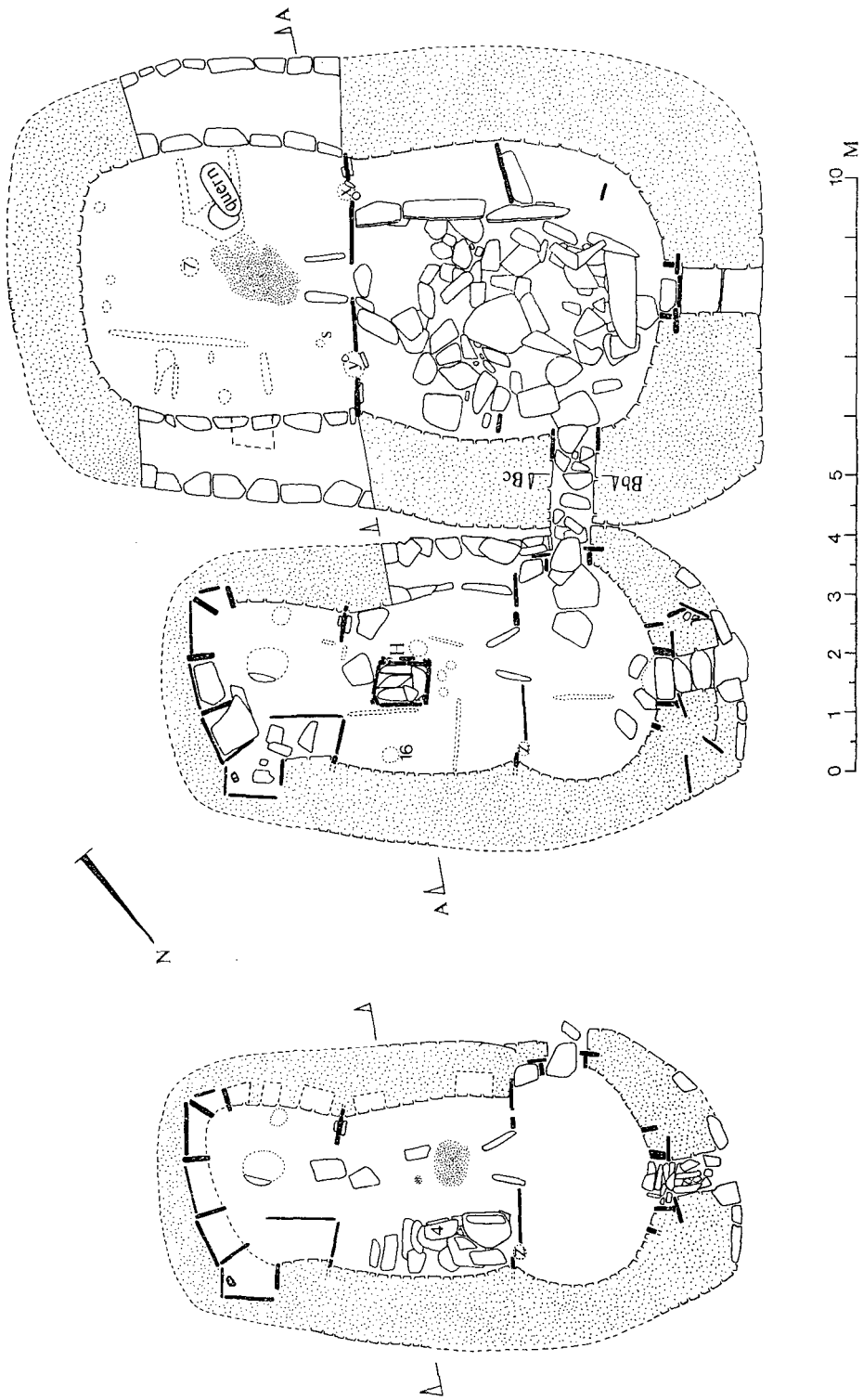

FIG 3 Plans of houses: secondary phase of house 2 with blocked entrance, primary phase of house 2 and house 1

in house 2. There were other shallow hollows in the natural clay surface round the perimeter of the inner compartment, including a longitudinal groove and three transverse grooves which may represent bedding slots for a wooden bench along the N wall. There were also two transverse grooves on the S side of the compartment, again stopping short of the inner face of the wall and therefore likely to relate to the house rather than to an earlier period. These grooves were a wide U-shape in section and averaged 30–50 mm in depth. The floor deposit (1b, 2) had spilled over into these grooves, but its depth decreased from the central hearth area outwards and did not extend E of an approximate line between pit 7 and the NE transverse groove. It was impossible to be certain how close the great quern (no 225) was to its original position; it overlay part of one of the S transverse grooves, which would imply, if it were still *in situ* as discovered in the early 1930s, that the groove, whatever its function, belonged to an earlier phase in the occupation of the house. In view of the unequivocal evidence for two phases of occupation in house 2, a similar sequence might well have existed in house 1, but the evidence no longer survived.

From the very imperfect archaeological record remaining in house 1, it would appear that the two compartments fulfilled different functions, the inner compartment acting as a work area although its hearth undoubtedly warmed the entire building. The low stone partition between the two compartments separated floor areas rather than living space. The pit (1b, 7) lay on the central long axis of the house and may originally have held a roof-support: it could have contained a post up to c 0·15 m in diameter. An equivalent post in the outer compartment could have stood on a pad-stone, thereby leaving no obvious trace on the paved floor.

The gaps between the upright slabs bonded into the house-walls and the inner low partition slabs were occupied originally by wooden posts. Postholes X and Y were wedged by chocking-stones and could have held posts up to 0·25 m in diameter, but the post-pipe surviving in posthole X would indicate a post of about c 0·12 m in diameter. These posts would have been so close to the house-walls that they are likely to have helped to support the corbelled slabs at the wall-head rather than the roof itself, although it is also possible that they supported a cross-beam at wall-head level. Small fragments of wood and charcoal were retrieved from the filling of posthole X; the wood was not identifiable but the charcoal proved to be some sort of conifer (appendix 9, sample O).

Two sections of the wall of house 1 were dismantled and excavated, one on the S side of the inner compartment where collapse had occurred, and one on the corresponding N side where eventual collapse was inevitable (pl 4a). In both sections, the wall was found to consist of a double skin of good drystone walling, one stone thick, with redeposited midden forming the core. The inner wall-face was laid directly on the surface of the natural boulder clay, while the outer face was laid on top of the lower midden, so that there was a difference of some 0·35 m between the levels of the two basal courses (pl 4c). It was evident that the house-builders had cleared an area of the existing midden approximately the size required for the floor-space of the house and had in effect revetted the midden with the inner wall-face. The cleared midden was then used as wall-core to create a solid and weatherproof structure on average 1·5 m wide overall.

In both the S and N walls, there were patches of sand at the junction between the midden filling the walls (layers 1, 9 and 1, 14) and the underlying midden on which the walls were built (layers 1, 11 and 1, 16). In addition, there was a large patch of clayey midden at the junction beneath the S wall.

House 2

Once this house had been re-excavated to the level left after the earlier excavation, the immediate problem was to elucidate the structure against the N wall in the middle compartment

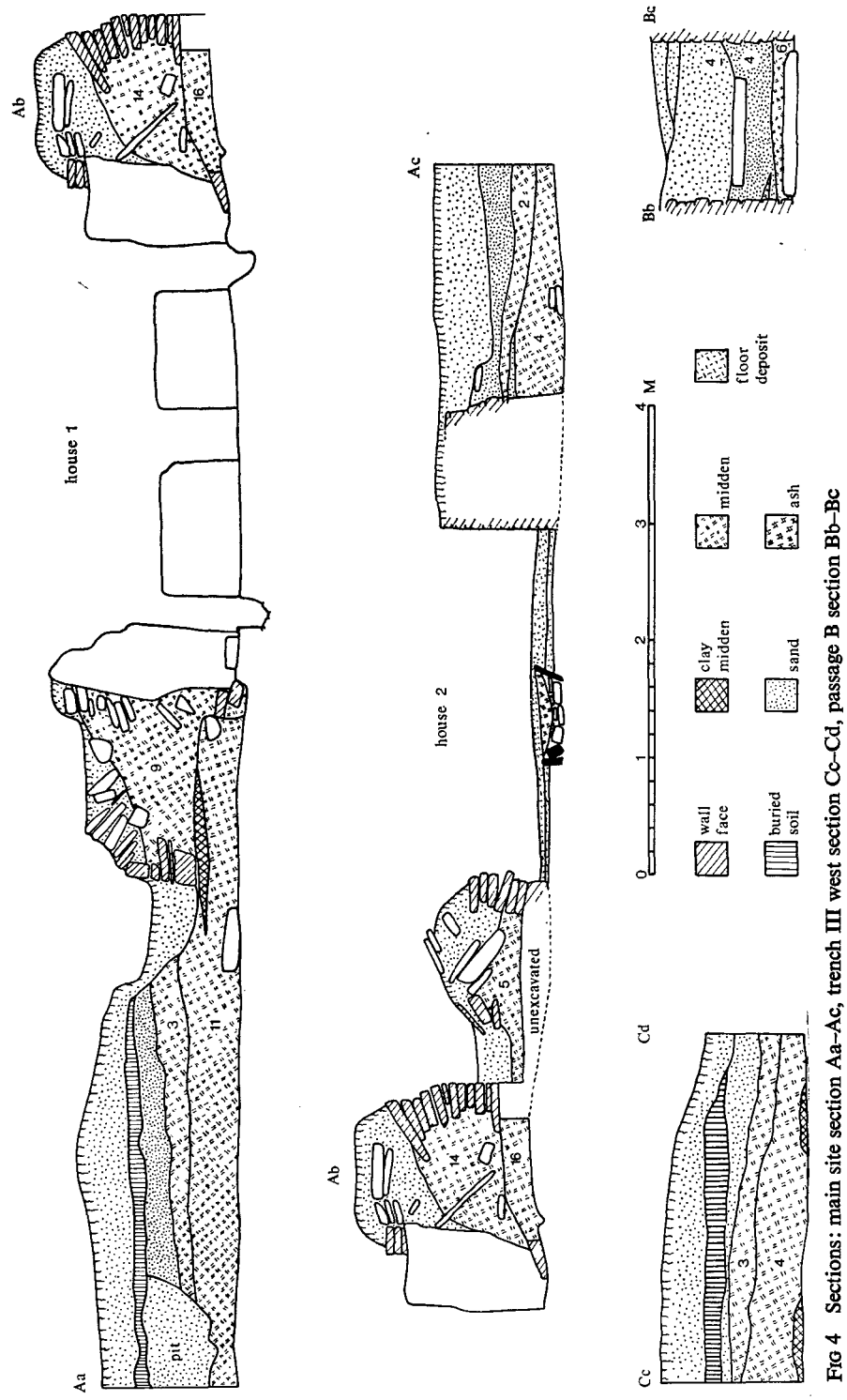

FIG 4 Sections: main site section Aa–Ac, trench III west section Cc–Cd, passage B section Bb–Bc

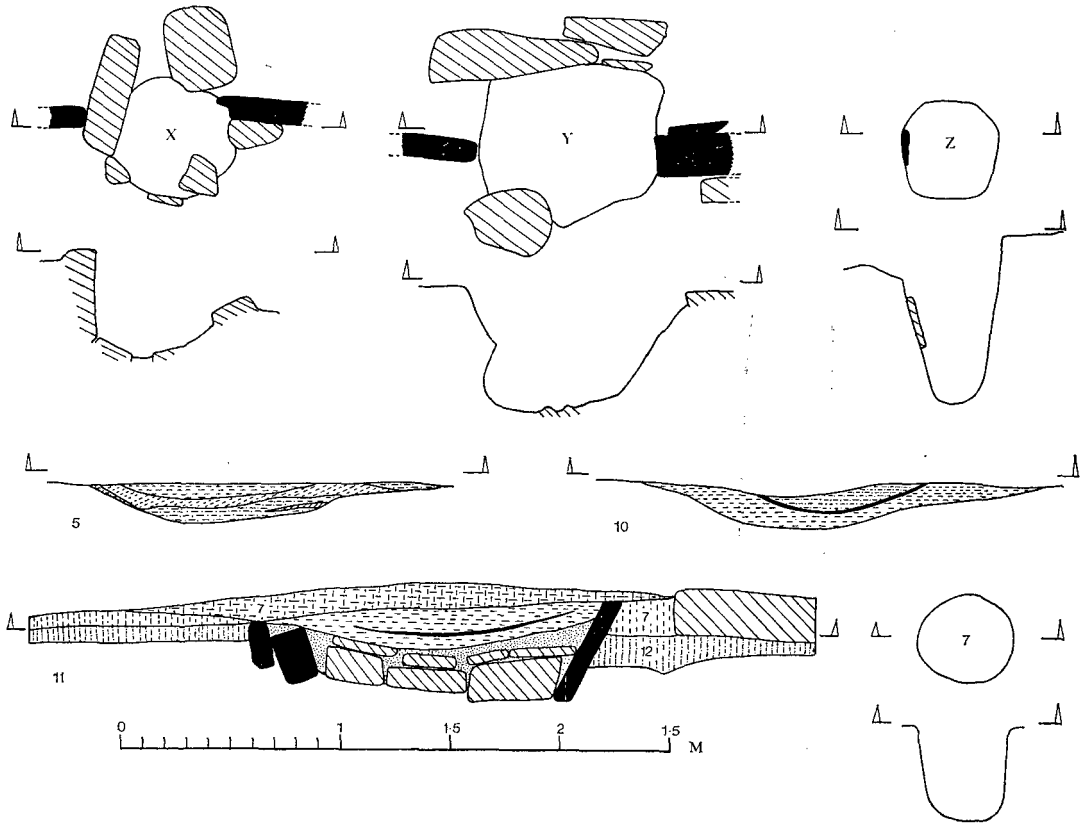

FIG 5 Plans and sections of postholes and sections of hearths: posthole X, posthole Y, posthole Z, hearth 5, hearth 10, hearth 11, pit 7

described by Traill and Kirkness as 'slabs and very rough masonry of a later occupation' (1937, 312). Although Traill and Kirkness had subsequently tidied it up, photographs taken by Kirkness during their excavation show quite clearly that this irregular pile of stones and loose midden material had been the result of the upper part of the N wall collapsing prior to the house becoming filled with sand. On earlier plans (Traill & Kirkness 1937, fig 1; RCAMS 1946, fig 268), this feature has been reduced to two upright slabs and a block of masonry, implying a side compartment or kerb along the wall, but the feature with its rubble filling was not in fact dismantled in the earlier excavations, and, although there were upright slabs as depicted, they were not earth-fast and represented no more than tumbled stones. Nevertheless, beneath the mass of collapsed walling, there were up to three courses of properly laid stones forming a rough kind of bench up to 1·0 m wide and 2·4 m long (fig 3, 4; pl 5a), which was contemporary with the upper floor level (layer 2, 7). Two of the pitted grinding stones were found on this low stone bench (nos 196, 198). It may have replaced an earlier wooden bench, because there were grooves in the primary clay floor surface (fig 3) similar to those found in house 1.

As in house 1, a posthole (Z) was found in the gap between the NW partition slabs dividing the outer compartment from the middle compartment (2a and b), but no trace could be discovered of a corresponding posthole between the SW pair of slabs (this area was, however, severely disturbed). Posthole Z could have held a post c 0·12 m in diameter.

Entry into the middle compartment between the central partition slabs was lined, as in house 1, by two recumbent slabs, the angle of the S slab suggesting that it had been displaced by collapsing walling.

Perhaps because of the problems posed by collapsed walling, the blocking in both entrance passages and the block of masonry in the middle compartment, house 2 was not cleared in the early excavations as thoroughly as house 1. Only the innermost compartment (2c) with its shelves and cupboards was almost entirely emptied – and it is noteworthy that no artefacts were apparently found in any of these presumptive storage facilities, suggesting that the original abandonment of the house was a deliberate and unhurried decision. Even here, the floor deposit was virtually intact, consisting of 20–40 mm of dark brown, fairly clean soil with some ash trampled in from the next compartment. Little new structural information was obtained about this innermost compartment: the floor of one cupboard was paved with a single large slab (cracked in antiquity); the floor throughout house 2, as in house 1, was the natural boulder clay subsoil.

In the middle compartment (2b), there survived a depth of up to 200 mm of floor deposit, dark brown to red-black in colour, fine greasy texture and containing a large proportion of ash from the hearths. There were two distinct layers of floor deposit, separated by a thin scattering of sand, and they corresponded broadly with two different hearths (pl 5b). The primary hearth (2, 11) was approximately square, 0·65–0·70 m internally, and was both kerbed and paved with stone slabs; there were two layers of paving, of which the lower comprised oddly massive boulders. A large stone on the immediate E side of the hearth may have been part of the hearth furniture, either as a seat or a work surface, and four shallow hollows, 30–60 mm deep, in the clay floor on the S and W sides of the hearth may have been designed to hold steady round-based pots. (Once the occupation deposit began to accumulate, there would be no problem in wedging pots upright.) A flint scraper (no 226, 6) was found in the hollow on the S side, and another (no 226, 9) in the hearth itself together with a broken awl (no 133). The primary floor deposit (layer 2, 12) associated with hearth 11 was up to 70 mm thick, and contained few artefacts: a broken stone disc or 'pot-lid' (no 217) and, in a hollow (2b, 16) 120 mm deep, a scapula blade (no 166).

In contrast to the primary hearth, hearth 10 was simply a hollow in the upper floor deposit (layer 2, 7), though more contained than the similar hearth in house 1. It was approximately 0·9 m in diameter and up to 80 mm deep, and a slightly dished boulder nearby may have been associated with it as a seat. Although the upper floor deposit was up to 100 mm thick, hearth 10 can have been associated only with the later period of its accumulation, since it was scooped into the floor deposit, and it is likely that hearth 11 remained in use during the earlier build-up of the upper floor level.

Some of the ash-rich floor deposit extended into the outer compartment (2a), but for the most part the floor here consisted of dark grey-brown humic sand (layer 2, 6), which was also found in the passage adjoining house 1 (=layer 1, 6). Finds included a large portion of a pottery vessel (no 64). A third grinding stone was found in front of the passage entrance (no 197). The paving in the passage extended into the outer compartment of house 2.

The passage appeared to have been partially blocked in the first instance by irregular collapsed walling at the entrance in house 2, and the task completed by deliberate drystone walling (visible on the old photographs but no longer extant in 1973). In contrast, the main entrance into house 2 had been deliberately blocked from the start, using large oblong boulders piled in such a way as to suggest that they had been inserted from outside the house (pl 7b). Between the blocking stones was some redeposited midden (layer 2, 3). The entrance-passage had been paved with four large slabs, overlain by the side-walls as in passage A. Unlike the latter, the outer paving-slab extended beyond the passage itself, and there was no inner sill-stone. The

innermost paving-slab partially filled a shallow hollow in the clay subsoil (2a, 14), which also contained a nondescript sherd of pottery (SF 868) and half a sheep's jawbone. Trench IV was opened outside the entrance into house 2 in order to check for any external structures, but none was found. It was also designed to elucidate the relationship between the two houses at the point where they joined.

RCAMS pointed out two pieces of evidence suggesting that house 1 was built earlier than house 2: the joint between their walls in the linking passage is not bonded, and the wall-face of house 1 is smooth at that point, whereas that of house 2 is roughly built (1946, 184). Supporting evidence for the primacy of house 1 is provided by a thin lens of sand found in trench IV to underlie the outer face of house 2 but not the adjacent face of house 1. Nevertheless, as RCAMS noted, the passage linking the two houses was an integral part of the design of house 1, and it is likely that there was no lengthy chronological gap in the sequence of their construction.

The post-and-panel technique employed internally at the entrance into house 2, its partial subsequent collapse and the blocking of the entrance prompted investigation of the house-wall on either side of the entrance, in case multi-period construction had been involved. Traces of jointing in the side-walls of the passage appeared to confirm this possibility. The outer wall-face on either side of the entrance was crude in comparison to house 1, but only two courses survived. Within the wall, there appeared to be an inner wall-face, particularly to the immediate N of the entrance, but its combination with the use of upright radial slabs pointed to a comparison with the cairn construction of tombs (eg Bigland Round, ORK 2, Henshall 1963, 183) rather than to support for the notion of multi-period construction of the entrance-passage (pl 7b). This aspect of the construction of the houses will be discussed later, because it is one of a series of architectural traditions shared with Orkney–Cromarty tombs.

One section of the wall of house 2 was excavated, on the S side of the middle compartment where the wall had collapsed (pl 4c). The structure of the wall was identical to that of house 1, with the inner face laid directly on clay and the outer on the earlier midden, a core of redeposited midden (layer 2, 5) and an overall width of 0·9 m. The outer face of part of the N wall was exposed in trench V (pl 4b).

The trench dug round the exterior wall-faces of the houses by Traill and Kirkness had not entirely destroyed the stratigraphical evidence for the relationship of the houses to the midden. It was clear from trench V that very little midden material had been dumped to the immediate N of house 2 after the latter's construction (fig 4); here the lower midden (layer V, 4) is clearly separated from the upper (layer V, 2) by a thin layer of sand. Trench VI revealed that here the outer wall-face of house 1 virtually coincided with the E perimeter of the lower midden.

Apart from the occasional discrete dump of shells (appendix 8), there was no hint in either the primary or the secondary midden of localized debris from any particular activity.

Period II artefact assemblage

Amongst the pottery there are more elaborate rim forms and a little evidence of flat bases, but otherwise the fabrics and vessels remain the same as in the earlier period. The 56 bone and stone artefacts (excluding flint) include twice as many bone awls and points, two scapula 'knives' (nos 165, 166), the whalebone 'knife' (no 171), a possible whalebone 'hoe' (no 172), two stone borers (nos 194, 195), and all three grinding stones (nos 196–198). Apart from a notable concentration of flints in the floor deposit in the inner compartment of house 1, there were fewer artefacts from house 1 than from house 2, reflecting the difference in preservation of their respective floor levels. House 2 yielded 28 bone and stone artefacts, 14 flints, 20 deposits of pottery and eight pieces of pumice, mostly from the upper floor deposit (layer 2, 7) in the central compartment.

The 1930s photographs show clearly that small finds and animal bones encountered during the

clearance of the house interiors were commonly placed on the adjacent wall-top. To judge by the number of artefacts and bones found in the topsoil of the sections of wall dismantled in the 1970s, many of those old finds were never recovered, and it seems reasonable to assume that most of them derive from the house interiors. In some cases, such finds apparently fell back into the houses in due course: the quern (no 224), which was found in 1973 upside down on the floor of house 1, is visible on several of the 1930s photographs on top of the adjacent N wall. Among the artefacts thus provenanced, it is unfortunate that both of the distinctive dimpled bone implements were found in displaced contexts, nos 168–169, as were the bone pin-head/spoon no 155, and the whalebone 'hoe' no 173, although in all cases it is likely that they were originally derived from the floor of house 1.

Although none of the artefacts found by Traill and Kirkness has any provenance, it is likely that most derive from Period II and were found in the course of clearing out the houses. There is no evidence to suggest that the early excavation penetrated the lower midden, but it is possible that artefacts from the primary midden in the core of the house walls may have been redeposited within the houses where walls had collapsed, particularly in house 2. The provenance of the old finds is of some importance in relation to the chronological weighting of two distinctive types of artefact: the whalebone and antler hammers and the stone borers. Both of the hammers (nos 170, 189) from the recent excavations and four of the six stone borers (nos 190–195) derived from Period I contexts, but, if old finds nos 238, 240 and 241 are assumed to belong to Period II, the weighting is more balanced with two hammers in each period, four borers in Period I and three in period II. Another borer possibly from Period II is illustrated in Traill and Kirkness (1937, fig 5 upper) but this artefact is now missing (there is also a drawing at a scale of 1:1 amongst the old correspondence, NMRS).

TEST-PITS 1–15 (fig 2)

A series of 15 test-pits, each 1 m square, was excavated in order to determine the extent of the midden beyond the two buildings. The depth at which the old land surface was encountered varied from 0·45 m in TP 12 to 1·8 m in TP 9, but midden was found in only two test-pits, 6 and 7, to the S of the buildings. In TP 6, the top of the midden lay at a depth of 1·2 m from the present turf-line, and the deposit was 0·2 m thick, while in TP 7 the top of a 0·3 m thick layer of midden was at a depth of 1·5 m. Together with the evidence from trenches V, VI and III, this suggests that the periphery of the midden lies some 4 m to the N of house 2, approximately coeval with the E end of house 1 and some 20 m to the S of house 1, an overall area of about 500 m^2. As in the main trenches, it was not possible to distinguish an old land surface separate from the midden in TP 6 and 7.

Three grains of cereal were recovered from the midden in TP 6 and one grain, probably barley, from the midden in TP 7; the texture, colour and content of these midden deposits were very similar to the midden in the main trenches, but no artefacts were found and it is impossible to identify the deposits as primary or secondary in the main site sequence. A very weathered bone point (no 149) was recovered from the old land surface in TP 12.

Soil samples from the old land surface at the bottom of test-pits 4, 8, 14 and 15 were analysed (appendices 9, 10), yielding one grain of grass pollen from TP 14 and 10 pollen grains from TP 4: four grass pollen grains, one pine, one birch, one dandelion type and three grains of wheat pollen. The buried soil in TP 4 was unusually deep (0·17 m), thus supporting the evidence for arable agriculture. The overall sequence in TP 4 was as follows: a well-established modern turf-line 0·6 m deep, a substantial sandblow 0·47 m deep, a buried soil 0·1 m deep, a sandblow 0·26 m deep, a buried soil 0·17 m deep and finally the surface of the boulder clay at a depth of 1·6 m from the modern surface. This basic sequence in which two major sandblows are separated by a buried soil is typical of the environmental history of the site following the abandonment of the two houses.

TEST-PIT 16, Holland (NGR HY 485 523)

This test-pit is unrelated to the archaeological site and was located in a field some 0·45 km to the NE, within the pocket of blown sand, marked on the Geological Survey OS 1 inch Drift map sheet 121, in which Knap of Howar also lies. Its object was to provide additional environmental data, and the results are described in appendix 10. A basal buried soil 0·06 m thick lay beneath a substantial sandblow, but no pollen had survived in the soil, which yielded a radiocarbon date of 2880 bc ± 100 (Birm – 817) (appendix 11).

DISCUSSION OF ARTEFACTS

Detailed discussions of the pottery and flint and chert by Miss Audrey Henshall are incorporated into the catalogue.

The petrological analysis both of pottery fabrics and of clay samples from the midden confirms the local manufacture of the pottery (appendix 1), not only the coarse domestic ware but also the fine Unstan bowls. The latter, which Audrey Henshall describes as 'dainty bowls', are smaller and thinner-walled compared with the range of Unstan bowls from Orcadian tombs (catalogue, pottery discussion). Prior to the recent excavations at Knap of Howar, it remained possible that Unstan ware was purely a funerary ware, but it is now clear that there was a complementary domestic range of Unstan bowls. Given the strong connection between Knap of Howar and chambered tombs in terms of pottery, there may be some common idea behind the deposition of pottery in small pits on both domestic and funerary sites. It might be argued that the pottery in pit 14 in house 2 was an accidental deposition, but there can be little doubt that the small crude pot placed in a pit in house 1b and sealed by a slab of pottery was a deliberate act. Pottery has been found in small pits in the tombs at Unstan and Blackhammer and possibly at Holm of Papa Westray North (Henshall 1963, 95–6), though at the latter site the provenance may rather have been beneath a stone shelf.

Much of the pottery includes in its fabric fragments of shell (appendix 1) and Traill and Kirkness mention ground shells beside the great quern in house 1b (1937, 310), while RCAMS is more specific in identifying the ground shells as razor-fish (1946, 183). It was proved experimentally on site in 1973 that razor-shells could indeed be ground down to medium filler in a few seconds in the quern, though fresh shells may have taken a little longer. Oyster shell was also employed as filler, and there was a marked tendency for more top shells than bottom shells to have survived in the oyster sample, presumably because bottom shells are more friable and better suited to being ground down into filler.

Bone awls are conventionally regarded as leather-working tools, used to pierce holes in skins, and it seemed likely that other items in the tool assemblage from Knap of Howar might also relate to leather-working. Consultation with a modern leather-worker, Christopher Sharman of Manacraft, Edinburgh, confirmed that the whalebone 'knife', no 171, could be used to clean the underside of hides, and that the blunt-tipped bone tools, including the two dimpled examples (nos 168, 169), would make efficient creasers or embossing tools. On naturally pale-coloured hide, a creaser can be used to create very effective two-tone decorative designs, because the friction between the creaser and the hide burns the surface of the leather to a dark brown hue. Bone points might be used as pegs to stretch fresh hides on a wooden frame, although they might also be used by the knapper in trimming flints.

There are parallels for the whalebone 'knife' (no 171) from the Neolithic levels at Jarlshof, Shetland, in antler (Hamilton 1956, fig 5, 11) and from the beaker levels at Northton, Harris (Simpson 1976, fig 12.5). Although blunt-ended tools appear to be a basic component of the common Neolithic material culture, the distinctive dimpled version (nos 168, 169) is at present unique to Knap of Howar.

Bone pins form a minor part of the bone assemblage, but they range from the tiny example, no 153, to the broken shanks of large round-sectioned pins reminiscent of Grooved ware assemblages (nos 150, 154) (cf Clarke 1976b, fig 13.5; Renfrew 1979, fig 35, no 52). No 151 is unusual in having a perforated head and a notched shank, and its roughly cut tip suggests that this is re-use of an originally longer implement. The spatulate-headed no 155 might be a pin similar to one from Skara Brae (Clarke 1976b, fig 13.5) or a small spoon or spatula: the rectangular section of the surviving shank and the tapering section of the head may support the latter interpretation.

Barbara Noddle has identified the sheep bones from Knap of Howar as belonging to a very primitive animal which is unlikely to have been wool-bearing in the proper sense (appendix 4). It would probably have had hair rather than wool, similar to goats, and its value for clothing would have been primarily its skin. The hide of the primitive cattle would have been too thick and tough to make garments, and skins for clothing are likely to have been provided mainly by sheep and calves.

Artefact no 162 may have been connected with fishing either as a double-ended gorge or as part of a composite barbed spear in the manner of the NW American Indian tradition of binding bone points at an angle on to stone or wooden shafts (BM HEC 1925, fig 256, 3, 6, 8). There is a larger but very similar object from early levels at Jarlshof (Hamilton 1956, fig 8, 15).

The two hammers or maceheads, one of whalebone (no 170) and one of antler (no 189), were both found in the primary midden forming the wall-core of house 1, and they are matched by two unprovenanced finds from the earlier excavations (whalebone no 238, antler no 240). A closely comparable antler object was found amongst the main bonespread in the chamber at Quanterness, Orkney, and Henshall suggested that this, along with the Knap of Howar hammers, should be connected with stone maceheads (Renfrew 1979, 83, fig 35, no 58). Roe has suggested not only that crown antler maceheads were the prototypes for stone maceheads but also that Orkney is the most likely place of origin for this type of artefact (1968, 152, 166). A crown antler macehead was associated with pottery related to Unstan ware in a Neolithic level at Northton, Harris (Simpson 1976, 222), while the stone maceheads from the tombs at Taversoe Tuick, Rousay, and Isbister, S Ronaldsay, appear to represent secondary activity at those sites. The perforated antler object from Skara Brae, often quoted in connection with antler maceheads, would appear to be an unlikely candidate; Childe regarded it as a haft for a stone adze (which would presumably have been mounted on a wooden handle) (Childe 1931, 99–100, pl 36).

Unlike stone maceheads, bone and antler maceheads are associated only in Orkney at Quanterness with Grooved ware. There are, however, elements of a common material assemblage associated with both stone and bone or antler maceheads, including skewer pins and triangular stone axes as well as the more ubiquitous types of bone and stone tool, suggesting that the development of maceheads ought not to be given a cultural label. Roe argued that the inspiration for the translation of antler maceheads into stone was provided by the appearance in Britain of battle-axes (1968, 169), thereby losing their original function. Stone maceheads with their convex ends relate more closely with crown antler maceheads, which have a rounded burr, than with the flat-ended hammers of Knap of Howar and Quanterness, though the latter are worn and fragmentary. Among the possible functions of the bone and antler forms may be mentioned use as hammers or mallets in flint-working and in driving in the pegs by which skins were stretched and dried, although the small diameter of their perforations (22–36 mm) would not allow very substantial handles.

It is clear both from the quantity of bone-working debris and from the unfinished state of several awls (nos 100, 129, 130, 138) that the manufacture of bone tools, like that of the stonework and the pottery, was carried out at or near the settlement. Some awls are very highly polished by wear (eg nos 93, 97, 106, 111), and one has a particularly worn tip (no 104), demonstrating their intensive use and probably quite frequent replacement (many are broken at the tip). None is decorated – amongst the surviving artefacts decoration is confined to pottery.

There are no imported artefacts among the assemblage. In common with other Orcadian axes, the stone axe (no 199) was locally made from a fine-grained dolomite (appendix 1). The stone borers (nos 190–195) appear to have been a strong constituent of the cultural assemblage, but they are not unique to the site: one example has been found at Links of Noltland (infor-

mation D V Clarke). It is not easy to link this tool with its product, but it may have been used to perforate the bone and antler hammers. There is a wide variation in the degree of wear on the tips of these tools, but the direction of the visible striations confirms their function as borers.

The pitted grinding stones (nos 196–198) are at present unique in the archaeological record for Neolithic Scotland (no 208 may be an unfinished example of the same type of artefact, again from the secondary floor deposit in house 2). There are parallels for this tool among food-gathering societies in Africa and Australia, and Dr Ray Inskeep undertook very kindly to make a study of them (appendix 3). Additional information on handstones used by Aborigines in New South Wales was kindly supplied by Mr Norman Blunden and Mr J D Tolhurst (Wellington, NSW, Australia), confirming their multi-functional aspect: they were used as grinders for wild seeds, as hammers for flaking other stones, as anvils and as targets for teaching children to throw spears. Overall it would appear that the most common primary purpose of these stones was to grind wild seeds, often in conjunction with trough querns. It has been argued elsewhere (Ritchie, A, forthcoming) that the gathering and processing of wild plant food in early Neolithic Orkney should not be underestimated. Inskeep suggests that the damage on the domed surface of the Knap of Howar examples may be the result of cracking nuts or hard-husked seeds (appendix 3), and it may be noted that a fragment of hazelnut shell was recovered from the midden (appendix 9). The importance of hazelnuts as a food resource is likely to have dwindled during the early Neolithic along with other woodland species.

The pebble flakes that have become known as Skaill knives have hitherto been given a restricted chronological range in the late Neolithic period (Henshall *in* Renfrew 1979, 82), but their occurrence at Knap of Howar in contexts belonging to both Period I and Period II suggests that this time-range should be extended at its earlier bracket. The absence of secondary working to emphasize their cutting edges does not detract from the usefulness of such artefacts, many of which are likely to have been made, used and thrown away on the spot without having been brought back to the settlement to be included in the archaeological record.

ECONOMY AND ENVIRONMENT

The detailed evidence on which this section is based will be found in appendices 4–10. The settlement appears to have been an entirely self-supporting unit based on mixed farming, though the true balance between stock-breeding and plant cultivation is impossible to judge on the imperfectly surviving evidence. Soil conditions were virtually prohibitive to the preservation of seeds and pollen, but the recovery of a few grains of barley from the midden and of wheat pollen from the contemporary buried soil in TP 4 indicates that cereal cultivation was part of the economic pattern. The possibility of wild plant gathering was considered in the previous section. Cattle and sheep were reared in equal proportions and both show evidence of recent domestication; most of the animals were slaughtered young as a source of meat, hides and bone for tool manufacture. A few domestic pigs were probably kept. Hunting wild animals appears to have been infrequent, but birds such as the guillemot, razorbill, puffin and great auk were caught, probably to maintain a supply of oil for lighting. A variety of fish was caught: young saithe, ballan wrasse and rockling indicate inshore fishing, and large saithe, cod, ling and other deepwater fish imply line-fishing from boats 3–8 km out to sea. There was an equally diverse exploitation of shellfish in which limpets were predominant but oysters, winkles, cockles and razorfish were also significant; some of these shellfish are likely to have been used for human consumption rather than as fishbait alone, but their contribution as a food source was negligible.

The use of wood for benches in the houses has been suggested, and substantial quantities

of wood would have been required for the framework of the roofs and for posts. Much of this timber must have been derived either from driftwood or by importing logs from mainland Scotland, but it seems likely that a certain amount of small-scale timber was available locally. Pollen of pine and birch were recovered from the site, along with carbonized fragments of birch, alder, spruce and unidentifiable conifer. The pollen, especially the pine, is likely to have been windborne from outside Orkney, and the wood, with the possible exception of birch, was probably derived from driftwood (Dickson & Dickson *in* Ritchie, J N G 1976, 43). There is some evidence from the land molluscs to suggest that there was scrub or woodland close to the site prior to the deposition of the primary midden, and this may have included birch and hazel, of which a fragment of a hazelnut was recovered. Both the molluscan evidence and site stratigraphy indicate that there followed an environmental change to more open habitats with some sand accumulation, and it is possible that cultivating activities by Neolithic man contributed to the surface instability of the landscape. The major factor is likely to have been the increased wind-speeds leading to sandblow around 5000 BC argued by Keatinge and Dickson (1979); this climatic change may have been associated with the establishment of the machair environment indicated by the molluscan evidence from Knap of Howar. It may also have initiated the erosion process by which the sandy shore of Neolithic times gradually became transformed into the modern rocky shore, with the assistance perhaps of coastal submergence.

Analysis of the contents of all three hearths failed to identify the fuel used beyond the category of carbonized plant material (appendix 9, samples H, I, U, V). There is unlikely to have been suitable peat available at this period in Orkney (Keatinge & Dickson 1979, 594), but several other fuels are possible: dried animal dung and turf (both of which would account for the plant material) are known to have been used extensively in Orkney in the more recent past, together with seaweed and driftwood (Fenton 1978, 206–13; 1981, 213), and the potential quantity of driftwood should not be underestimated (Clarke 1976a, 24). Among the shellfish from Knap of Howar were two very small species (*Patina pellucida* and *Littorina littoralis*) which are most likely to be a by-product of the collection of seaweed. Aside from its potential use as fuel, seaweed may also have been used as manure, as compost material or applied fresh, or the two uses may have been combined by employing the ash from burning seaweed as manure (Fenton 1978, 274–9). It could also serve as food for animals or humans.

CHRONOLOGY

A series of 10 radiocarbon dates was obtained from collagen in animal bones (appendix 11). Both the earliest and the latest chronological determinations were produced from the same sample of bones from the primary midden, suggesting that neither date is reliable (SRR-347, 3756 bc $\pm$ 85 and SRR-452, 2131 bc $\pm$ 65) (and supporting in this respect Renfrew's diagram of radiocarbon dates, 1979, fig 54, *pace* Fraser 1980, 12). Leaving both aside, the remaining date range lies between 2300 bc $\pm$ 130 (Birm-815) and 2820 bc $\pm$ 180 (Birm-816), and there is no statistical difference between dates obtained from Period I contexts and those from Period II contexts, underlining the cultural homogeneity evident among the artefact assemblages. In calendar years, using Clark's calibration curve (1975) and one standard deviation, the potential chronological range for Knap of Howar lies between about 2800 and 3800 BC, although the actual duration of the settlement is unlikely to have exceeded 500 years.

GENERAL DISCUSSION

The architectural design and, to some extent, the internal layout of the houses at Knap of

Howar appear to be entirely different from the classic type of squared, one-room house at Skara Brae and Rinyo. House 8 at Skara Brae has always been an oddity, set apart from the rest by stratigraphy, function and plan-form, but in the latter respect at least it finds parallels among the Neolithic houses of Shetland. The apparent uniformity of house-plan in the rest of the Skara Brae settlement has, however, been upset by recent excavations revealing fragments of quite different buildings (Clarke 1976a) while excavations at Grobust, Links of Noltland, Westray, have confirmed that there is no set blueprint for Grooved ware houses. There the building has an irregular multi-celled plan (Clarke, D V *in* The Prehistoric Society, *Orkney Islands Field Guide*, 1982, fig 6). Equally, the plan-form of the houses at Knap of Howar cannot be assumed, in the absence of other Unstan ware settlements in Orkney, to be typical of that cultural group. There is perhaps some corroborative evidence in the marked similarities between the design of the houses at Knap of Howar and that of stalled cairns, a class of tomb which appears to have been used primarily by the makers of Unstan ware. In both houses and tombs, large upright slabs are used to subdivide the internal floor-area of a chamber which is essentially rectangular and approached by an entrance passage. The upright slabs are set into the side-walls, and the line of the latter is often bowed between the uprights. The similarities extend to furnishing, for low stone benches and shelves are a feature of stalled cairns and tripartite chambers in Orkney, where it appears to be an innovation compared to mainland tombs of this class (Henshall 1963, 119).

There is a marked contrast between the size of the social units represented by Knap of Howar and the Grooved ware settlements, even allowing for the incomplete survival of every site. Knap of Howar would appear to have been a single, if extended, family farmstead, whereas Skara Brae, Rinyo and Links of Noltland represent the nucleated settlements of considerably larger groups of people. If Knap of Howar is typical of Unstan ware settlements, it implies a dispersed settlement pattern similar to that in Neolithic Shetland.

There appear to be few links in architectural or cultural terms between the Knap of Howar houses and the Neolithic and later houses of Shetland, even allowing for the inevitable geological difference between the available building stone. It is of interest in this respect that, although William Kirkness worked with Charles Calder on the Shetland houses (Calder 1956) and Calder had earlier been involved in planning Knap of Howar on behalf of RCAMS, neither of them expressed in print any comparison between the houses. There are faint similarities between Knap of Howar and Ness of Gruting: in both cases the wall-cores consisted of midden material, but at Ness of Gruting it was made up almost entirely by 'peat-ash' (Calder 1956, 351–3). Other excavated house-sites in Shetland suggest an earth and rubble core to have been more normal (eg Stanydale, Calder 1956, 340). Traces of low stone benches were found at Ness of Gruting and elsewhere, and at Scord of Brouster overlay 'pits and slots' (Whittle 1979, 168) which may suggest earlier timber furniture. Many of the Shetland houses are likely to belong to the third millennium BC or later, but Scord of Brouster appears to be contemporary with the latter part of the Knap of Howar chronological range.

At present, the use of midden as wall-core, foundation or revetment for houses appears to have been an Orcadian phenomenon. Unlike Skara Brae, there was no attempt to mound up the midden round the base of the houses at Knap of Howar and, although there was a deliberate decision to build on a midden foundation, there was a clear preference for a clay rather than midden floor. Midden was also used in Orkney as a constituent of the deliberate filling of chambered tombs, but it is not certain whether this was truly domestic refuse or debris from feasting or other activities directly connected with the tombs themselves.

There are several factors which inhibit useful comparison of the artefact assemblages from Orcadian tombs with that from Knap of Howar. With rare exceptions, few artefacts have been

recovered from tombs and even fewer have secure provenances within the sequences of construction, use and blocking of individual tombs. Differential and often poor preservation of bone in tombs has unbalanced further the surviving archaeological record. The fact that Knap of Howar remains at present the sole Unstan ware settlement in Orkney is itself inhibiting, but nevertheless the site does provide an impression of the domestic backcloth to the tombs. One would expect a wider range of artefacts in a domestic context than in a funerary assemblage, and this is certainly the case here. The tomb assemblages are dominated by flintwork, especially scrapers, knives and arrowheads, and by polished stone axes and maceheads (Henshall 1963, 110–12), and the overall implication is that these are personal belongings, perhaps with an element of the status symbol about them. There is little impression of the wide range of domestic activities evident at Knap of Howar. The little stone axe (no 199) was surely an accidental loss into the midden rather than discarded rubbish; apart from the axe, the Knap of Howar assemblage lacks overtly prestigious artefacts.

The discovery of more Unstan ware settlements would clearly be helpful. Sherds of Unstan ware were associated with evidence of flint-working on the lower N slope of Wideford Hill on mainland Orkney, but no trace of structures or permanent habitation was found (Rendall 1934). The once-controversial sherds from the lower levels at Rinyo (Henshall 1963, 132; Clarke 1976b, 238) are now more logically seen in the context of the mixture of Unstan ware/Grooved ware elements identified by Henshall (pottery section of catalogue); they have never been taken to imply more than contact between the two communities.

No chambered tombs are known at present on Papa Westray itself, but there are two tombs, and a possible third, on the Holm of Papa Westray, just off the E coast. One is a stalled cairn, Holm of Papa Westray North (ORK 21), and the other is a morphologically exaggerated version of a Maes Howe tomb, Holm of Papa Westray South (ORK 22), but no grave-goods have survived from their mid 19th-century excavations. Although the Holm is now an island, it is likely that in Neolithic times it was a promontory of Papa Westray, but nevertheless marginal to the fertile agricultural interior of the island.

The excavation at Knap of Howar achieved its primary objectives of establishing the date and cultural affinities of the two houses, and it has also proved valuable for the information it has yielded about the contemporary Neolithic environment. There remains a large amount of unexcavated midden, both outside the houses and inside the house-walls, because total excavation was excluded from the mandate of 1973 and 1975; if, in the future, Knap of Howar is still the only known Unstan ware settlement, there could be justification in excavating the rest of the midden in order to obtain the maximum possible information. A more immediate need is to explore the architectural, cultural and chronological links between Knap of Howar and chambered tombs.

CATALOGUE OF ARTEFACTS

POTTERY: CATALOGUE AND DISCUSSION

Audrey S Henshall, 46 Findhorn Place, Edinburgh

1–56 *Period I*

1–21 Undecorated rimsherds (fig 6)

1 Rounded section, somewhat friable fabric heavily tempered with small angular grits with some shell and grog, uneven slipped outer surface with sooty accretions, burnt pink inside, diameter 180–200 mm. SF 235.

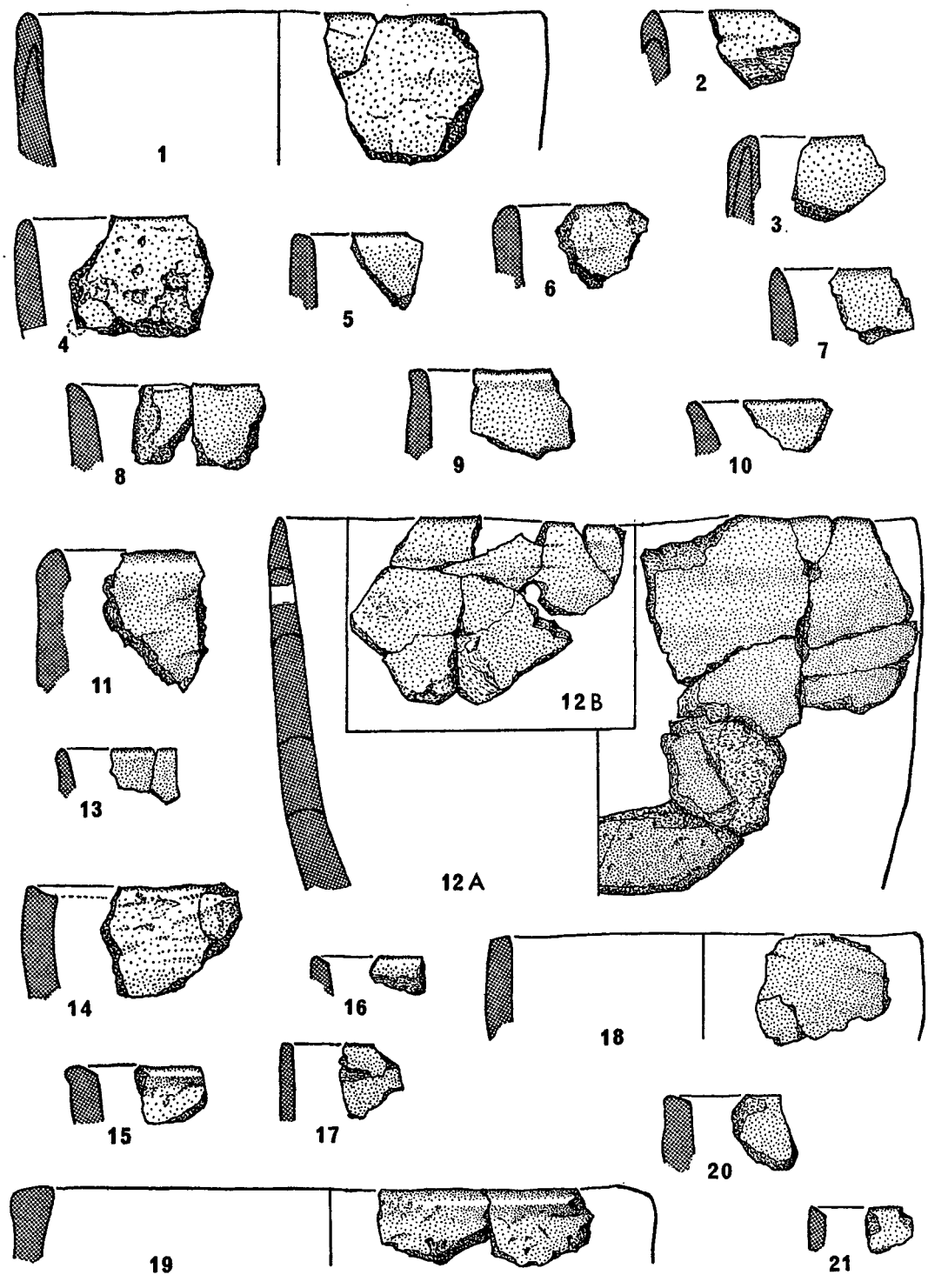

FIG 6 Pottery nos 1–21, Period I (scale 1:3)

2 Rounded section, very hard black fabric, small dark grits. SF 324.
3 Similar, hard dark fabric with fine grits giving harsh feel. SF 786.
4 Rounded section, from pot of rather irregular form, fairly hard black fabric tempered with dark and white grits and some shell, the brown outer surface flaking away, part of a perforation 37 mm below the rim, diameter c 140–150 mm. SF 478.
5 Similar to *2–3*, hard dark fabric heavily tempered with fine grits. SF 782.
6 Similar, three rimsherds probably from the same pot, harsh brown surface. SF 511, 558.
7 Similar, black fabric, the tempering including quite large white grits, slipped black-brown surfaces. SF 518.
8 Rounded section but projecting slightly to outside, fabric similar to *7*, faint horizontal toolmarks inside, diameter c 200 mm. SF 525.
9 Rounded section slightly thickened to outside, hard pink-buff fabric tempered with numerous smallish grits, slipped surfaces, diameter c 150 mm. SF 709.
10 Similar, black fabric with small grits, brown slipped surface. SF 554.
11 Numerous sherds from one large pot; the fabric is buff to black, generally c 13 mm thick, very soft and heavily tempered with grits of all sizes and also some shell, harsh surfaces tend to split apart; sooty inside many sherds and outside at least one sherd. A few sherds seem to have become soft in the ground and carry the impressions of the stone or object against which they lay. One sherd appears to be from a simple rounded rim, but the inside bears impressions which have distorted the profile. This is seemingly a different pot from that represented by rim *19*, found with it. SF 504.
12A Four rimsherds of thinned rounded section and probably from the same vessel, also numerous body sherds; fairly hard black fabric burnt buff outside below the rim, heavily gritted with fine and larger grits including some pale grey, uneven surface tending to horizontal pinched grooves outside, soot inside, diameter 250 mm; one sherd perforated 18 mm below the rim. SF 276, 359, 366, 367, 375, 438, 458.
12B Three rimsherds from a vessel almost identical to *12A* but distinguished by the lack of pale grey grits and harder fabric, semi-burnished but damaged black surface becoming red-brown lower down, perforation 22 mm below the rim, diameter 250 mm. SF 227, 376, 410.
13 Two sherds, rounded section, thin fine hard black fabric scorched red on surfaces, sparse grits; a third larger but damaged rimsherd probably from this pot. SF 295, 229.
14 Two sherds with internal bevel, burnt pink and now soft fabric with small-medium grits, dark slipped outer surface with light horizontal toolmarks, the inner surface damaged. SF 777.
15 Similar except rim projects slightly externally, scorched pink; also a number of featureless wall sherds; other sherds possibly of this pot listed under *49*. Possibly the same pot as *14* if this were rather irregular. SF 809.
16 With internal bevel, fabric similar to *14*. SF 446.
17 Similar to *16* but with thinner wall. SF 323.
18 Squared section, chalky grey-buff fabric with sparse fine grits, diameter c 140 mm. Also a number of small wall sherds, the maximum thickness 15 mm. SF 778, 781.
19 Four rimsherds and one wall sherd probably from the same pot, squared section thickened externally and somewhat variable, mainly grey fabric with fine-medium grits and pink-buff chalky slipped surfaces, two sherds without slip, diameter c 200 mm. SF 473, 504.
20 Squared section, fairly hard brown fabric, sparse grits including white specks (?shell), harsh black surface outside. SF 512.
21 Squared section, brown well gritted fabric. SF 118.

22–31 Rimsherds decorated with nicks, impressions and cordons (fig 7)

22 Thinning towards rim edge which bears one, and part of a second, transverse nick; hard dark fabric with very fine grits but including occasional large grits, semi-burnished slip outside with sooty accretion, rough inside. SF 334.
23 Two sherds, the flat rim projecting on the outside and bearing indistinct hollows, probably part of a row of thumb impressions; grey-pink soft chalky fabric with sparse grits, slipped surface outside flaking away, diameter c 150 mm. SF 457.
24 Six very small sherds from a squared section rim bearing fingertip impressions along the edge; friable heavily gritted brown fabric, black slip outside and on rim edge, remains of sooty accretion. SF 782.

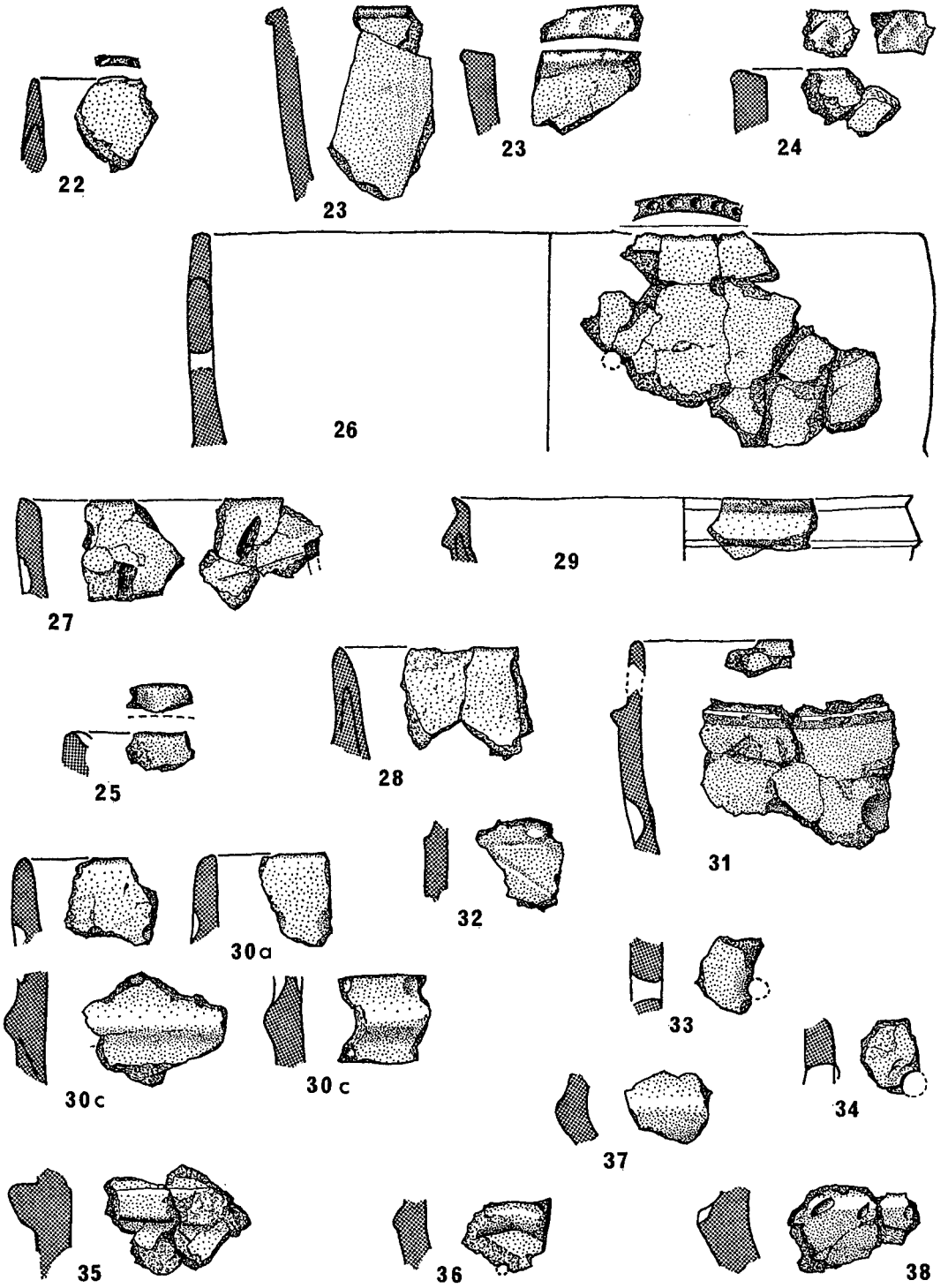

FIG 7 Pottery nos 22–38, Period I (scale 1:3)

25 Tiny sherd, inner surface missing but probably from a squared section rim bearing impressions, part of one impression surviving; heavily gritted fabric, black slip. SF 681.

26 Rimsherd, and rim fragment, the flattened rim edge bearing rough rounded impressions, the sherd everted at the lowest point possibly for a cordon; black friable laminating fabric, heavily gritted, slipped surfaces becoming buff below the rim outside; perforation, soot inside, diameter c 255 mm. SF 209.

27 Two sherds with squared section rim almost certainly from the same pot, decorated with deep rectangular jabs arranged irregularly, one sherd also bearing an incised line (possibly accidental); black-brown fabric with small grits, rather uneven slipped outer surface with soot accretion. SF 797, 798.

28 Rounded section; at lower edge of the sherd the wall is everted suggesting there was a cordon 30 mm below the rim; diameter 200–230 mm. SF 301.

29 Rimsherd with sharply defined collar and everted rim edge, the lowest point of inner surface contracting as if for a carination; hard dark grey fabric, grit temper, laminated structure, fine black semi-burnished surface outside, inner surface damaged, diameter c 150 mm. SF 243.

30 A group of sherds, the rather distinctive fabric being thick but tempered only by very fine grits, dark brown unless scorched, probably from one pot: a, three rimsherds, rounded section, two with round impressions 18 mm below the edge. SF 435. b, small wall sherd with similar impression. SF 324. c, three wall sherds with a cordon, one also with a pair of opposed impressions on the exterior and interior surfaces and part of two more impressions. SF 191, 273, 407.

31 Tiny rounded section rimsherd and wall sherd (apparently one sherd when found); the wall sherd bears a narrow applied cordon and parts of two round impressions; rather friable laminating black fabric, uneven outer surface with black-brown slip, breaking along building rings, diameter at the cordon c 250 mm. SF 785.

32–38 Wall sherds with impressions, perforations and/or cordons, or shoulders (fig 8)

32 Two sherds, one with half a round impression and faint grooves, very hard black fabric, brown surfaces, possibly part of *30*. SF 457.

33 With part of perforation, hard black ware, brown slip outside. SF 426.

34 Probably from just below the rim judging by the curve of the inner surface, part of a large perforation and two nail impressions; hard black fabric with large shell temper, fine black slip outside. SF 332.

35 Bearing a heavy horizontal cordon; fairly hard black fabric with small dark grits, the thick slip on outer surface is pink probably due to scorching. SF 328.

36 Decorated with a curved applied cordon, part of a perforation on the lower edge as drawn; hard dark fabric with sparse dark grits, slipped outside, soot accretions. SF 176.

37 From a shoulder (or just possibly from a basal angle); hard dark brown fabric with small grits. SF 478.

38 From a shoulder, the edge decorated with slanting impressions; rather friable black fabric, thick buff-pink slip outside. SF 475.

39–47 Sherds from Unstan-type bowls (fig 8)

39 Carinated wall sherd, the collar decorated by deep stab-and-drag lines; fairly hard brown fabric with fine grits, external diameter at the carination c 200 mm. SF 215.

40 From the carination angle, the collar decorated with deeply incised lines; hard dark grey fabric, small grits, slipped outer surface but inner surface broken away. SF 194.

41 From the collar, the lower edge of the interior being angled for the carination, decorated with deeply incised oblique lines with a horizontal line above; fairly hard dark grey fabric tending to laminate, brown slipped surfaces. SF 409.

42 Three sherds probably from one bowl: a, from the body and lower part of the collar, decorated with slanting incised lines; hard finely gritted dark grey fabric, dark brown slip outside. SF 821; b, from the collar, decorated with incised lines, the regular break along the lower edge as drawn probably being the junction of collar and body. SF 822, 236.

43 Probably from a collar, a regular break along lower edge as drawn probably being the junction between collar and body, decorated by a slanting stab-and-drag line and horizontal stabs; rather friable gritty buff fabric, slipped outer surface. SF 327.

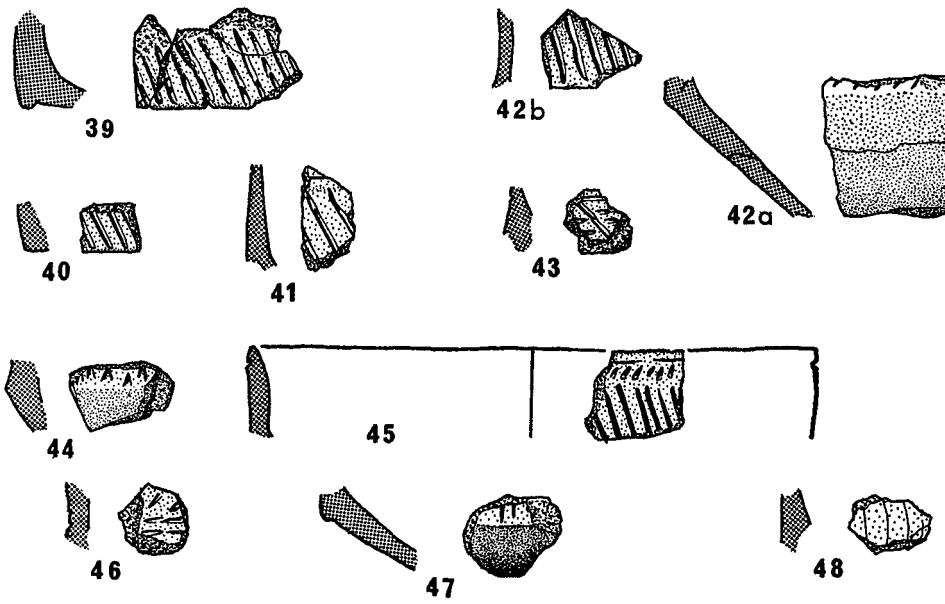

FIG 8 Pottery nos 39–48, Period I (scale 1:3)

44 From the angle of collar and body, the collar decorated with triangular jabs; fine black fabric. SF 782.

45 Rimsherd decorated by deeply incised lines and jabs; hard fine black fabric, the pink-buff surfaces damaged; at the lower edge the inner surface projects, probably indicating the join between collar and body; diameter 180–200 mm. SF 692.

46 Probably from the lower part of a collar decorated with stab-and-drag; rather gritty ware, outer surface damaged, fine black slip inside. SF 681.

47 From the body and carination angle (also a wall sherd), decorated with incised lines on the collar; hard black fabric with small to medium grits, burnished slip outside. SF 250.

48–56 Miscellaneous

48 Small wall sherd, scorched and friable, decorated with fine lightly incised lines. SF 835.

49 A number of wall sherds from one or more large vessels, distinguished by their fairly hard black to grey fabric and fine black slip inside and brown slip outside generally bearing tool marks, temper includes thin white fragments (? shell), soot remaining inside, 12–18 mm thick. SF 743, 809, 827, 835, 836, 856 (see *15*). Not illustrated.

50 Group of wall sherds, soft corky light brown fabric partly scorched pink, some grit temper but much organic temper which has burnt out, the two surfaces split apart, some surfaces striated, some so uneven as to suggest burnt clay or daub rather than pottery. SF 777. Not illustrated.

51 Two sherds, the larger from the round base of a small bowl, soft almost gritless chalky buff fabric, fine surface outside but inner surface missing. SF 836. Not illustrated.

52 Group of sherds; very friable heavily tempered fabric containing much shell, probably from two or more vessels, one with thick slip inside and outside, varying from 8 to 16 mm thick. SF 310, 313. Not illustrated.

53 Wall sherd from a large heavy pot, dark ware with large grits, hard except where scorched, inner surface very rough, outer surface red-brown with slip not covering the large grits and left rather rough and uneven with many tool marks, 18 mm thick. SF 669. Not illustrated.

54 Part of a rounded base, scorched pink, large grits, 15 mm thick. SF 331. Not illustrated.

55 Sherds from a rounded base, grey fabric fairly heavily gritted including many pale grits visible on the surface, soot inside, 12 mm thick. SF 414. Not illustrated.

56 Sherds from the round base of a small bowl, brown gritty fabric with fine slipped surface outside, maximum thickness 13 mm. SF 373, 303. Not illustrated.

57–90 *Period 2*

57–77 Undecorated rim sherds (figs 9, 10)

57 Almost complete small oval cup, rather sandy pinkish buff fabric including some quite large grits, roughly made with uneven surfaces and irregular form, the rim sections varying from rounded to squared, probably scorched. SF 92.

58 Bevelled rim from a small thick pot either irregular or oval in shape, heavily tempered with mainly medium grits, grey friable fabric with uneven black surface outside. SF 874.

59 Three rimsherds, rounded section, fine sandy buff-pink fabric, fine grits. SF 40, 300, 415.

60 Two rimsherds similar to *59* but thinner, one with remains of a fine burnished slip outside, inner surface damaged; also some wall sherds probably from this pot. SF 394.

61 Rounded section emphasized by an uneven groove below the rim edge, the sherd much distorted; heavily tempered dark friable fabric with large grits and shell, sooty outside. SF 92.

62 Bevelled but much damaged and distorted, fairly hard brown ware, small grits, scorched pink inside, diameter c 180 mm. SF 361.

63 Two sherds, very friable coarse fabric with large grit and shell temper, 16 mm thick; one sherd with a rounded though rough edge, perhaps a rim; the other sherd with part of a perforation. SF 56.

64 Sherds reconstructed to form about a sixth of a pot with bevelled rim, diameter 220 mm, (also some loose sherds); dark brown rather friable heavily gritted fabric, slipped surfaces, tending to break along building rings, the lower part scorched pink outside and very crumbly, thick sooty crust inside. SF 857.

65 External bevel, dark grey ware, sparse grits, scorched buff-pink. SF 590.

66 Many sherds from a large vessel, including sherds from the bevelled everted rim, diameter c 300 mm; very friable fabric with large grits and including large pieces of shell, a thick slip inside and outside in places bearing many tool marks, grey-black but extensively scorched pink; sherds from the lower part up to 20 mm thick. SF 624, 638, 662, 802.

67 a, Group of sherds from a large vessel, including four from the squared rim, diameter c 325 mm; also three apparently from just above a narrow flat base; wall sherds 12–18 mm thick; friable fabric with large grits including shell, slip outside, mainly scorched buff-pink. SF 678. b, Group of sherds including a squared rim, of very soft brown fabric, crushed and distorted, may belong to this pot; also some less damaged wall sherds with thick external slip. SF 715.

68 Thickened squared section, gritty black fabric but the surface scorched red and damaged. SF 298.

69 Squared section, hard grey fabric with small grits, brown outside. SF 830.

70 Squared section, sandy brown ware burnt red inside, broken along building rings, diameter 100 mm; also wall sherds maximum thickness 11 mm. SF 615, 678.

71 Rimsherd and wall sherd, similar to *70* but thicker, grey almost gritless chalky fabric, broken along building rings. SF 759.

72 Internal bevel, fairly hard dark grey sandy fabric with small white grits. SF 95.

73 Squared section, hard buff fabric, sparse fine grits, pink outside. SF 757.

74 Squared section, hard gritty dark grey fabric. SF 474.

75 Similar but thicker, buff fabric. SF 416.

76 Thickened squared section, hard grey fabric scorched pink outside, a curved impression probably accidental, diameter about 125 mm. SF 819.

77 Rounded everted section, dark grey fabric with white (? shell) grits, scorched red inside. SF 84.

78–79 Rimsherds from decorated pots (fig 10)

78 Two rimsherds, rounded section, the form of the pot irregular, fine slanting incised lines on the larger sherd, part of a perforation; soft buff-pink fabric with quite large grits and shell temper, hard black outer surface. Also a number of body sherds probably from this pot, undecorated except for two faint lines on one sherd. SF 56, 34.

79 Rounded section; two deep nail impressions 30 mm below the rim; hard black fabric, sparse fine grits, inner surface red and flaking away. SF 204.

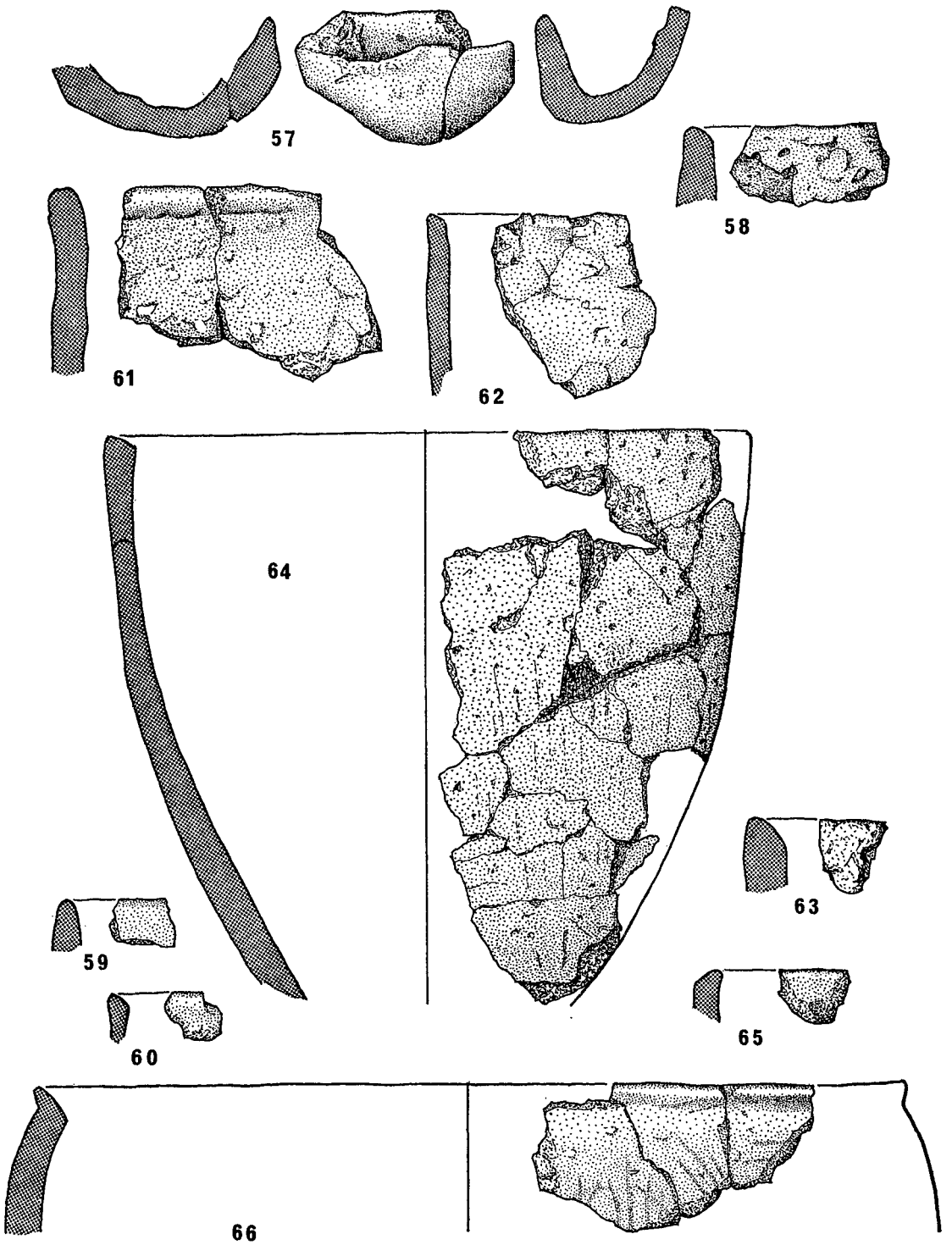

FIG 9 Pottery nos 57–66, Period II (scale 1:3)

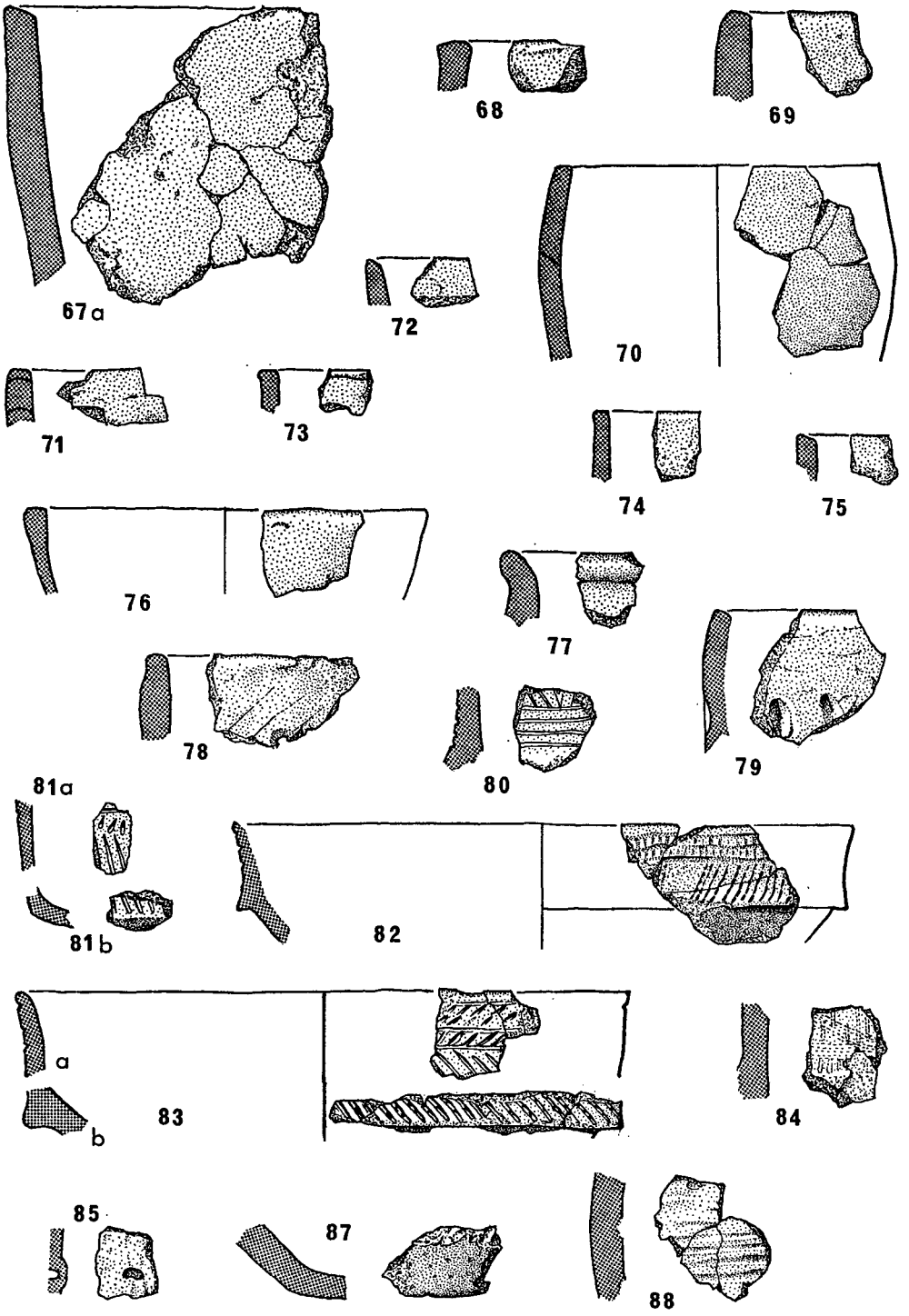

FIG 10 Pottery nos 67–88, Period II (scale 1:3)

80–83 Sherds from Unstan-type bowls (fig 10)

80 Two sherds, probably from the same pot and probably from the lower part of the collar of a carinated bowl (one sherd has broken evenly, probably along the junction of the collar and body); decorated by incised lines; fairly hard rather soapy grey fabric with small grits, buff slip outside. SF 24.

81 a, Small sherd probably from the collar of an Unstan type bowl; decorated with incised lines and jabs; hard fine black fabric. SF 285. b, Small sherd from the carination angle; the collar decorated with incised lines; possibly part of the same bowl. SF 19.

82 Sherd from the rim and collar of a carinated bowl; decorated by deeply incised and stab-and-drag-lines; hard thin brown fabric, fine grits, surfaces damaged, rim diameter c 230 mm. SF 156.

83 a, Rimsherd; decorated with deeply incised lines and stab-and-drag; fine dark brown fabric, the inner surface damaged. SF 76. b, Sherds from the carination angle and body probably of the same bowl; the collar decorated with stab-and-drag; the sherds broken along the junction of collar and body, the outer surface semi-burnished black, diameter at the carination 210 mm. SF 84.

84–90 Miscellaneous (fig 10)

84 Sherd with lightly incised decoration of two rows of vertical lines interrupted by smears; the rather smooth lower edge possibly broken from the body at the carination (but just possibly a rather rough rim), black fabric, heavily tempered with fine grits, slip outside semi-burnished. SF 820.

85 Wall sherd, a deep kidney-shaped impression has raised a lump on the inner surface; hard black fabric; the outer surface missing. SF 175.

86 Wall sherd with part of a perforation, hard dark fabric. SF 98. Not illustrated.

87 Three sherds, one with a sharp curve in one plane as if for a rounded basal angle or shoulder; fairly heavily gritted brown fabric, slipped outer surface. SF 175.

88 Three sherds, fairly hard dark grey fabric with medium grits, pink slip outside which bears faint parallel channels, in two directions on one sherd, interrupted on another sherd. SF 462.

89 Part of a bowl but lacking rim and base, black-buff fabric with much shell temper, outer surfaced slipped, scorched pink and sooty inside. SF 870, 678. Not illustrated.

90 Two sherds probably from the same large pot, heavily gritted black fabric including shell temper, buff-pink slip outside, black slip inside; 10–14 mm thick. SF 629, 761. Not illustrated.

A–D *Unstratified* (fig 11)

A Rimsherd, squared section, rather sandy brown-black fabric, sparse medium grits, slip outside and over the rim, diameter c 150 mm. SF 648.

B Wall sherd, brown-pink rather chalky fabric, the somewhat rough outer surface bearing lightly incised lines. SF 812.

C Group of sherds from a large heavy pot, soft brown-grey fabric heavily tempered with large grits and shell, a few sherds retaining a slip, most sherds distorted, 16–22 mm thick. One sherd with a rough but straight edge appears to be from a simple rim, squashed flat, with part of a perforation. Another sherd has a square perforation made before firing. SF 12.

D Part of the wall and round base, coarse black fabric with large pieces of shell temper, burnt red inside, slip outside, 10 mm thick. SF 577. Not illustrated.

E–I *Sherds not from the 1973–75 excavations*

E Rimsherd, rounded section, hard dark brown fabric, rather irregular form, diameter c 300 mm. Found 1980 in an eroding midden beside the houses.

F Three rimsherds of squared slightly thickened section, and two body sherds, all probably from the the same large pot, coarse pink-brown fabric with large shell temper, remains of fine slip outside, up to 22 mm thick (NMAS. HD 643; Traill & Kirkness 1937, 316).

G Rimsherd, squared slightly thickened section, hard dark grey fabric with some pale grits, diameter c 180 mm (NMAS. HD 644; Traill & Kirkness 1937, 316).

H Rimsherd, so like *12A* that it is probably part of this pot, faint pinched horizontal grooves, part of a perforation 45 mm below the rim. Not illustrated (NMAS HD 2020).

I Rimsherd, the very edge somewhat damaged but probably rounded, a row of deep round impressions

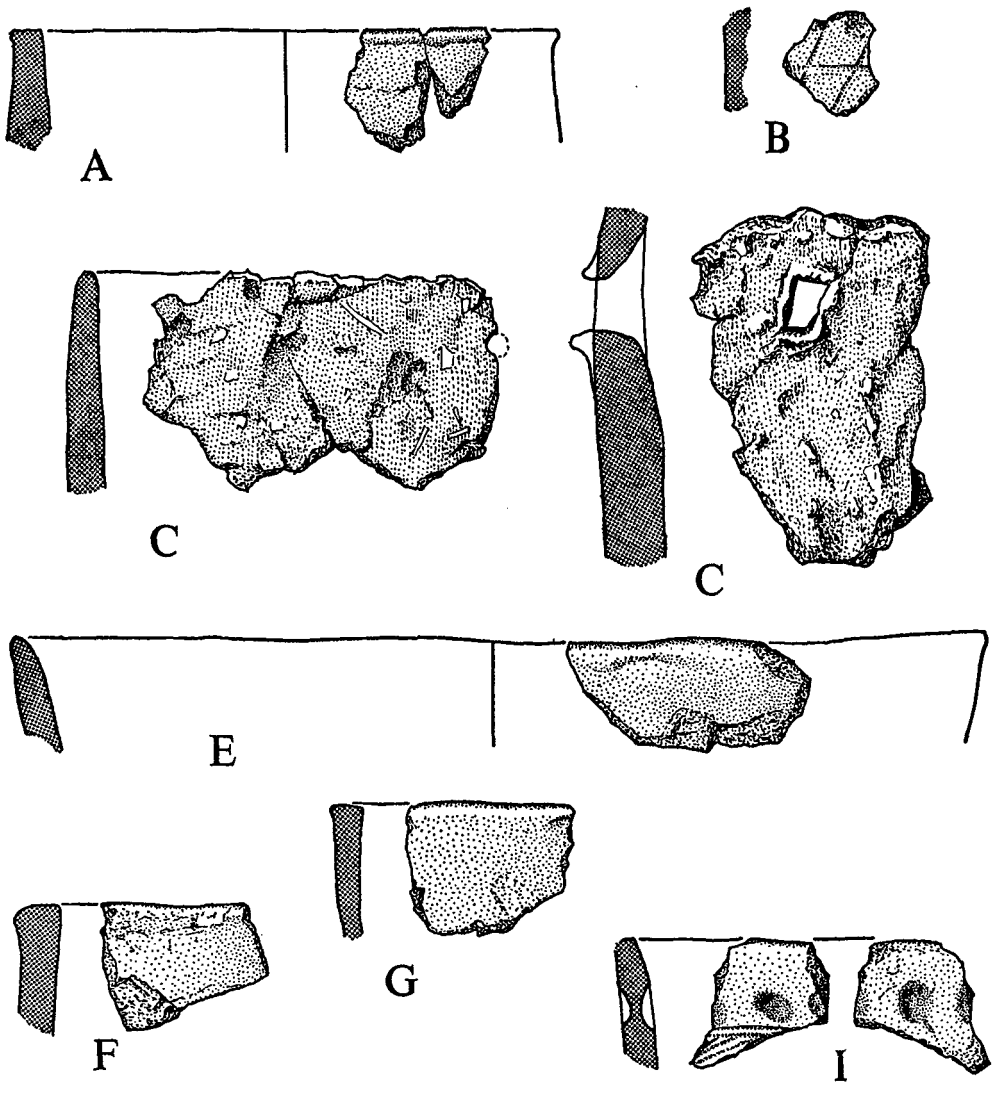

FIG 11 Pottery nos A–I, unstratified (scale 1:3)

inside and outside, paired so that the pot is almost perforated, and below them inside, horizontal and slanting incised lines; hard black fabric with fine grits, brown surface (NMAS HD 2021).

Discussion

A considerable quantity of pottery was recovered from the excavation, rather more from Period I than Period II, to which may be added some unstratified sherds. The total weighs about 21 kg; at least 78 pots are represented and probably considerably more. All the sherds with features, and sizeable featureless sherds, are listed in the catalogue, but small featureless sherds have been omitted. There are some additional sherds, not included in the following discussion: the rimsherd *E* found by a visitor in the eroding midden outside the excavations in 1980; the sherds of two pots, *F*, *G*, found during the 1936 excavations (Traill & Kirkness 1937, 314, 316); two rimsherds *H–I* found among Kirkness's possessions after his death, probably from the site, probably found after his excavations.

One small bowl, *57*, is almost complete. In a few cases, such as *11*, *12A*, *64*, *66*, *C*, a considerable amount of a vessel was found crushed but undisturbed. The majority of pots are represented by only one or two small recognizable sherds, and these often in poor condition. Most of the sherds have been affected by burning or scorching, and many bear sooty encrustations. The burning of the lower parts was presumably due to use over a fire, and has generally made the sherds friable, having altered both the texture and the colour. Sherds from the upper parts also have often been scorched though generally only the surface has been affected, making it softer and so liable to weather, or making it brittle and liable to flake off. Some large coarse pots have been of a soft fabric which has lost its surface and has become malleable and distorted under weight so that the curvature has been lost. In general the condition of the sherds, particularly their small size and the evident irregularity of many pots, has limited the number which can be reconstructed with any confidence, and only in 17 cases was it possible to assess both the diameter and the angle of the rim. In three more cases, *8*, *31*, *71*, the angle but not the diameter could be gauged, but in all other cases the angle is very approximate or guessed.

The pottery falls into four categories: the easily recognizable Unstan-type bowls with probably 13 examples (*39–47*, *80–83*); simple bowls either undecorated or with restrained decoration with about 41 examples (*1–25*, *27*, *57–76*, *78–79*, *A*, *C–D*), but admittedly including some small rimsherds which may come from more elaborate vessels; bowls having either cordons or shoulders with probably nine examples (*26*, *28–31*, *35–38*); miscellaneous small sherds with unusual features (*32*, *48*, *77*, *84*, *88*, *B*). Most of the bases appear to have been round, but there is evidence for two flattened bases (*67*, *87*).

The Unstan bowls are well-made pots of fairly hard dark gritty fabric, covered by a slip which in three cases retains its burnish. They tend to break along the junction of the collar and body. Compared with the range of Unstan bowls from Orcadian tombs (Henshall 1963, 248–53; 1983a) the Knap of Howar bowls are small and thin-walled (except for the two more substantial pots *39* and *80*), with rounded rims rather than the more usual wide bevelled rims. On three bowls the carination angles have been emphasized. Such dainty bowls are a minor type in the Orcadian tombs, for instance Calf of Eday *4*, Midhowe *4*, Unstan *9*, *13*, *15*, and interestingly find parallels at distant sites such as Urquhart (Henshall 1983b) and Eilean an Tighe (Scott 1951, 14, figs 7, 8). The decoration at Knap of Howar is characteristically in firm incised or stab-and-drag lines augmented by rows of stabs. The arrangement of slanting lines with horizontal lines below the rim, and once or twice above the carination also, is typical of the Unstan bowls from Orcadian tombs, of all sizes. The jabbed decoration on *44* is unusual, but can be paralleled at Blackhammer and Isbister.

For descriptive purposes the simple bowls can be divided into five groups though these are not entirely distinct. Firstly there are bowls of medium size (150–230 mm rim diameter) with rounded or sometimes bevelled rim profiles, characteristically made in a hard or fairly hard dark fabric, such as *1–10* or *64*. As far as can be seen, the upper walls are either vertical or somewhat everted, and in some cases at least the form is rather deep. There appear to be c 18 undecorated bowls of this group, but the number may well be inflated by small rims from bowls of other forms. There is also a small sherd with a narrow nicked rim (*22*), and two pots with deep impressions below the rim, in one case of irregular rectangular or oval shape (*27*), in the other case of fingertips (*79*). Another bowl has lightly incised lines (*78*). Little can be said about the second group, except that it includes some larger vessels, because they have been made of a fabric tempered with large grits which is so soft that it has suffered very badly, and indeed in some cases it is hardly recognizable as pottery at all. Examples are *11*, *61*, *63* and *67*, all having simple rims, but the last being exceptional in having evidence of a flat base.

The third group of simple bowls has bevelled or squared rims, sometimes thickened, and is generally of softer or more friable fabric than the first group; the walls are vertical or contracted towards the mouth. There are c 12 examples, such as *14*, *18*, *19*, *66*, *A*, ranging from 100 to 300 mm in rim diameter. Three of these, *23–25*, are decorated along the rim bevel by finger or thumb impressions. The fourth group consists of small thin-walled well-made bowls of fine hard fabric, all represented by very small sherds such as *13*, *17*, *21*, *73–75*, except for *76*, the thickest and probably largest of the nine examples; this sherd can be reconstructed as a slightly open bowl c 100 mm in diameter. The last group consists of the small but very thick crude bowl *57*, and sherd *58* which may be from a similar vessel.

In the third category, bowls with cordons or shoulders, there are sherds from several pots which appear to be differentiated from the moderate-sized simple bowls only by the addition of a horizontal cordon, 30 and 75 mm below the rim where this can be measured on *28* and *26*, and by decoration with round impressions. On *31* the cordon is a narrow crisply defined strip, but on *30* it is a heavier rounded moulding. Bowl *26* bears a row of irregular impressions along the rim edge; *30* has had a row of neat

impressions on either side of the cordon and 20 mm below the rim though unfortunately the relationship of cordon to rim is unknown, and curiously in one case an impression is backed by a similar impression on the inner surface; *31* has a row of large depressions, perhaps made by a fingertip, below the cordon, and pushed in so far as to raise a lump on the inner surface. The wall sherd *85* bears a deep kidney-shaped impression which also raised a lump inside the pot. Two other wall sherds bear cordons but the form of the vessel from which they derive is unknown. The cordon on *36* is of similar weight to that on *30* but is angled, and that on *35* is much heavier and of a squared section.

Bowl *29* is of a different form to those so far described. It is small and neatly made of fairly hard black burnished fabric tending to laminate, with sharply defined rim and a shoulder only 16 mm below. Two other shouldered vessels are represented only by a single sherd, *37*, having a simple curved profile, but *38* having the shoulder emphasized by thickening, and a row of stabs along the edge.

Lastly, in the miscellaneous category, rimsherd *77* is unique in the assemblage with its rounded everted profile.

Apart from the Unstan bowls incised decoration is rare. Sherd *32* has a lightly incised horizontal and slanting line, but also a round impression similar to those on pot *30*. The parallel lines on bowl *78* have been mentioned above, and lightly drawn parallel lines are also found on sherd *48*. Lines in two directions are seen on sherd *B*. On sherd *84* there are two rows of lightly channelled vertical lines, almost obliterated by subsequent smearing of the semi-burnished surface. The three sherds of *88* have parallel grooving, on one sherd running rather indistinctly in two directions.

In no case has it been possible to reconstruct a bowl with its base, but round bases are certainly present, the more complete listed under *51*, *54–56*. However there are two indications that flattened bases were also present. Sherd *87* is more likely to be from a rounded basal angle than a shoulder, and some thick friable sherds associated with pot *67* have a small diameter but nearly straight vertical section strongly suggesting they come from immediately above the angle of a narrow flat base. None the less the fact that this is the only evidence for flat bases, sherds of which are easily recognized, indicates that they were a very minor element amongst what must have been almost exclusively round-based forms.

Ten vessels have round perforations made before firing, varying in size from the small hole on *36* to the large hole on *34*. Pot *C* has a curious rough rectangular hole.

On the whole the fabric of the pottery is good, dark and fairly hard, sometimes very hard, with small grits and often including a relatively small amount of larger grit. Shell temper has been included in a certain number of pots, and in two there appears to be some grog. Much of the pottery has a rather harsh gritty feel, but this may be masked by a slip which may occasionally be burnished or semi-burnished (ie less thoroughly finished), but the surfaces have frequently been damaged. Some pots have been over gritted and so rendered rather friable (eg *24*, *26*), and some at the other extreme have little temper and thus a rather chalky texture (eg *18*, *23*). As has been mentioned, a certain number of pots were of an appalling thick soft friable texture (eg *61*, *62*, *C*). There is no correlation between fabrics and forms except that the Unstan bowls and small simple bowls are all of good quality. It may be noted that the fabric of the cordoned decorated sherds *30* is indistinguishable from many of the plain rims such as *3–7*, and other sherds in the last two categories conform to the general range of fabrics. Some simple bowls can be seen to have been ring built, though only occasionally is the join between rings a serious weakness. Many pots are irregular, and in one case, *12A*, this is clearly due to pinching along rings so forming faint wide horizontal grooves. Several pots bear toolmarks either inside or outside.

The petrological analysis of the pottery by D F Williams (appendix 1) indicates that there is every probability that the Knap of Howar pottery was made locally, and the four groups of fabrics he defined by their inclusions cut across both the groups of pots described above and the two periods.

As far as the Unstan bowls go, there is no difference to be detected between the two periods, and indeed *81* and *45* are noticeably similar. Among the simple bowls there are fewer with rounded rims and more with squared or bevelled rims in the second period, and only five decorated sherds in contrast with 10 in the first period. All rim decoration, cordons and shoulders belong to Period I. Both sherds apparently from flat bases are from Period II. But no difference can be seen in the range of fabrics in the two periods, and specific features appear in both, such as the similar pots *27* and *79*.

The diversity of form and decoration which is apparent in the Knap of Howar pottery, even in its extremely fragmentary state, is notable. The sherds from Unstan bowls can easily be isolated, and they immediately find parallels amongst the pottery from the Orcadian tombs of Orkney–Cromarty type (Henshall 1963, 106–9, 247–53; 1983a). It has been noted that mostly they are of the thin-walled high quality bowls with rounded rim section, which have a wider distribution than the large heavy bowls with

bevelled and sometimes thickened rims which are typically Orcadian; even the two heaviest bowls represented at Knap of Howar are not as large or thick as many from the Orcadian tombs. Although there are now a number of radiocarbon dates from the tombs including a series from Isbister, the difficulty of relating them to grave-goods, which themselves, though seemingly found in association, may not really be so, means that the Unstan bowls are not closely dated. The difference between the small Knap of Howar assemblage and those from such tombs at Calf of Eday Long, Taversoe Tuick or Unstan may be either chronological or functional, and as the soot-encrusted condition of some sherds from the tombs suggests the bowls had been in domestic use and so are unlikely to have been made for funerary use, the chronological explanation seems more probable. It is not likely that the difference is due to spatial factors, for the three tomb assemblages are closely similar, and come from Mainland, Rousay and Eday.

Along with the Unstan bowls in the Orcadian tombs there is a range of simple bowls, and these may be compared with the dominant form at Knap of Howar, though in the tombs they are never more than equal in numbers to Unstan bowls, and sometimes form a third or less of the total. Little can be said about most of the small sherds of such bowls at Knap of Howar, except to remark that at least some have a deep form, and on *12A*, *12B*, *64*, *67* there is little curvature in the vertical section below the rim. The deep form is present in the tombs, at Calf of Eday, Taversoe Tuick and Unstan, and in particular the straight upper walls of Calf of Eday *16*, *17*, *21* and Unstan *23* may be noted. The bowls from Knap of Howar and the tombs have similar rim profiles, and in the tombs the squared and bevelled rims are often on bowls slightly contracted at the mouth. The rare appearance of impressed decoration on the narrow rims of Knap of Howar *22* and *26* may be matched by single examples at Taversoe Tuick and Isbister, and on a carinated bowl at Midhowe. The treatment of the Knap of Howar rims *23–25* is paralleled only once in the tombs, and that not very closely, on Calf of Eday *29*. The light horizontal cordons seen on several Period I bowls at Knap of Howar are found at only two tombs, on the complete bowl *20* at Taversoe Tuick and the fragmentary bowl *30* at Isbister. The unusual crisp profile of Knap of Howar *29* with its everted rim and high shoulder is not unlike Isbister *4*, though the latter is closer to the Unstan bowl form. Simple bowls with somewhat similar treatment of the rim are Isbister *31* and Calf of Eday *29*. The quality of the small fine bowls from Knap of Howar is difficult to match, but an exceptionally delicate bowl was found at Isbister (*42*). The apparent absence of 'corky' fabric, sometimes thought of as characteristic of Unstan ware, may be attributed to the survival of shell temper in the Knap of Howar pottery.

In broad terms then, the bulk of the Knap of Howar pottery can be compared with pottery from the Orcadian Orkney–Cromarty tombs, and a certain number of exceptional features find parallels on equally unusual sherds from the tombs. Scarcity of pottery from tombs and habitation sites in the northern counties of the mainland inhibits consideration of the southward links of the Orcadian material, though it may be noted that amongst the small number of sherds from The Ord, Sutherland, besides the Unstan bowl, there are two sherds with channelled decoration partly obliterated by burnishing rather in the manner of sherd *84* from Knap of Howar (Sharples 1981, 33, fig 8, *3*, *4*), and some small sherds from a pot with a light cordon and impressions possibly related to Knap of Howar *26*, *28*, *30*, *31* (*ibid*, fig 9, *33*). Moving further south there are two assemblages from Boghead and Easterton of Roseisle, both in Moray, which are earlier in date than Knap of Howar and well over 100 miles away, but which include forms which gave rise to the Unstan bowl, and have a few wide rims decorated with thumb or finger impressions like Knap of Howar *23–25*, and a single narrow rim decorated by nicks (Henshall 1983b). But even if these sites are representatives of the ceramic family from which most of the Orcadian pottery derives, the connection is not all that close, in particular none of their characteristically fluted pottery has yet been found in Orkney. Lugs are uncommon at the two Moray sites, and their absence at Knap of Howar need not be of much significance. The curious fact is rather the distribution of lugs in Orkney, being absent (except on a single curious pot) from all the tombs except Isbister where there is a variety of lugged bowls.

There are a few features on the Knap of Howar pottery which appear to be alien to the ceramic tradition of the earlier Neolithic, even though found very occasionally in the Orcadian tomb assemblages, notably the cordons, the impressions on the walls, the shoulders, and the probable flat bases.

The heavy cordon of *35* and the angled cordon of *36*, probably part of a chevron or lozenge, immediately suggest Grooved ware, though the square section of *35* is not known in Orkney and is rare elsewhere. Lighter cordons, twice recorded on pots from Orcadian Orkney–Cromarty tomb assemblages, have been interpreted as imitation carinations in these contexts, but perhaps are more likely to be connected with Grooved ware. Horizontal undecorated cordons, sometimes close to the rim and sometimes lower down the vessel, are a feature of Orcadian Grooved ware, at Skara Brae (Clarke 1976b, fig 13, 2),

Rinyo (Childe & Grant 1947, 34) and at the Maes-Howe-type tomb of Quanterness (Henshall *in* Renfrew 1979, fig 33, 3).

Other minor features on the Knap of Howar pottery seem to have some Grooved ware affinities, but not specifically with Orcadian Grooved ware. Decoration by impressions is a widespread technique, though very seldom used on the rim edge as on *26*. In Orkney impressions are used either on cordons or as filling for parts of a pattern, except for the single tiny sherd Quanterness *19* bearing an isolated round impression. Precise parallels for Knap of Howar *30* with its round impressions allied with cordons, for *32* with a depression allied with grooved lines, and for the large depressions of *31*, are difficult to find. Lack of material from northern and central Scotland turns attention to Fife. Comparison with pot *16* in the later assemblage from Balfarg, which has cordons, rows of perforations, and grooved lines, may not be wholly inappropriate (Henshall *in* Mercer 1981, 128–33), and spaced impressions can be seen also on sherd *41*, and on several sherds from Tentsmuir (Longworth 1967, fig 8, 91). Impressions combined with cordons also appear at Luce Sands, Wigtownshire, as well as spaced large round impressions (McInnes 1964, *107* fig 4; *143* fig 8). The shoulder sherd Knap of Howar *38* presents a problem, for the row of pointed jabs is reminiscent of the decorated cordons at the three Orcadian Grooved ware sites already mentioned, but shouldered forms are not part of the Grooved ware tradition; a direct connection with the Hebridean shouldered jars such as Clettraval *9* in North Uist (Henshall 1972, 308) seems unlikely.

Three other features on the Knap of Howar pottery could be cited as indications of links with Grooved ware – the fingertip impression on *79*, the fine slanting incised parallel lines below the rim of *78*, and the probable flat bases of *67* and *87*, but it must be recalled that these are rarities at the site, and the comparisons require the selection of almost equally unusual sherds from assemblages far away, such as Balfarg, Balbirnie also in Fife (Ritchie, JNG 1974, 15), or Luce Sands. The date of the first just overlaps the end of the Knap of Howar sequence, but the other pottery is undated. However, Grooved ware bases are usually relatively wide and the thickness not substantially more than that of the walls. It seems to the writer that *67* must have had a narrow thick-walled base. One narrow flat base was found at Isbister amongst the mass of round-based pots, and in this instance the very coarse friable fabric further distinguished this pot from the rest of the assemblage.

It seems, then, that the Knap of Howar pottery and to an even smaller extent some of the pottery from the Orkney–Cromarty tombs, includes some features which at present cannot be satisfactorily explained. Some of these features may be related to Grooved ware, with varying degrees of confidence. From the radiocarbon dates presently available it is evident that, although Knap of Howar starts earlier than any Grooved ware site, there is an overlap of the two pottery styles for at least 300 years and possibly 500 years, and considering their physical proximity in Orkney, some give and take between them would be expected. It is perhaps surprising that the Grooved ware elements are more evident in Period I, and that they are not of a more specifically Orcadian character. It may be noted, too, that such typical Grooved ware features as stepped rims, and decoration inside rims, are not present. The more the pottery belonging to these two communities is studied, the more difficult it can be to distinguish them on grounds of fabric or rim form: the upper parts of those Knap of Howar bowls of hard gritty fabric with slightly flared walls without a vertical curve would probably have been classified as Grooved ware if found elsewhere.

Sherd *I*, found before the recent excavations, would have been puzzling if it had come from any other site, but the rounded rim section and hard gritty fabric is common at Knap of Howar, and the decoration by a row of external depressions below the rim can be compared with *27* and *79*. The decoration inside the rim is curious. Depressions paired with those outside have been noted once already on sherd *30c*. Incised decoration is rare except on Unstan bowls, though close parallel lines appear on the exterior of sherds *88*. It is unfortunate that the angle of the wall of *I* cannot be determined, for the internal decoration, found on this sherd alone, suggests the vessel may have been more open than is shown in the illustration. Sherds *F* and *G* belong to the third group of simple bowls described above.

Provenance of pottery

A total of 451 deposits of pottery was recovered. Numbers in brackets refer to excavation small find numbers; a deposit of pottery may contain more than one catalogued sherd.

Period I

Primary midden, trench II and below S wall, house 1, layer 11

2 (324), 4 (478), 6 (511), 7 (518), 8 (525), 9 (709), 17 (323), 19 (504, 473), 20 (512), 22 (334), 23 (457),

25 (681), 30 (324), 32 (457), 35 (328), 37 (478), 38 (475), 43 (327), 45 (692), 52 (313), 46 (681), 74 (474). (Total 105 deposits)

Primary midden, S wall-core, house 1, layers 9, 10
1 (235), 17 (446), 28 (301), 29 (243), 30 (191, 273, 407, 435), 33 (426), 39 (215), 40 (194), 41 (409), 42 (236), 52 (310). (Total 74 deposits)

Primary midden, N wall-core, house 1, layers 14, 15
3 (786), 14 (777), 15 (809), 42 (821, 822), 48 (835), 49 (743, 809, 827, 835, 836), 50 (777), 51 (836). (Total 12 deposits)

Primary midden, below N wall, house 1, layer 16
49 (856). (Total 6 deposits)

Primary midden, S wall-core, house 2, layer 5
5 (782), 18 (778, 781), 24 (782), 44 (782), 53 (669). (Total 8 deposits)

Primary midden, trench III, layers 4, 6
12A (276, 359, 366, 367, 375, 438, 458), 12B (227, 376, 410), 13 (229, 295), 26 (209), 34 (332), 47 (250), 54 (331), 55 (414), 56 (303, 373). (Total 36 deposits)

Primary midden, trench V, layer 4
27 (797, 798), 31 (785). (Total 7 deposits)

Period II

Secondary midden, trench II, layer 3
59 (40, 300, 415), 60 (394), 62 (361), 68 (298), 75 (416), 80 (24), 81 (285, 19). (Total 37 deposits)

Secondary midden, trench III, layers 2, 3
21 (118), 77 (84), 79 (204), 82 (156), 83A (76), 83B (84). (Total 29 deposits)

Secondary midden, trench IV, layer 2
67B (715). (Total 21 deposits)

Secondary midden, trench V, layer 2
65 (590), 67A (678), 70 (615, 678), 71 (759), 73 (757), 89 (678, 870), 90 (629, 761). (Total 18 deposits)

Floor deposit, house 1, layer 2
57 (92), 61 (92), 63 (56), 72 (95), 78 (56, 34). (Total 12 deposits)

Floor deposit, house 1, layer 3
88 (462). (Total 9 deposits)

Floor deposit, house 1, layer 4
86 (98). (Total 3 deposits)

Floor deposit, house 1, layer 6
(Total 1 deposit)

Lower floor deposit, house 2, layer 12
(Total 1 deposit)

Upper floor deposit, house 2, layer 7
58 (874), 76 (819), 84 (820). (Total 25 deposits)

Upper floor deposit, house 2, layer 6
64 (857). (Total 3 deposits)

Upper floor deposit, house 2, layer 4
(Total 1 deposit)

Upper floor deposit, house 2, layer 3
66 (624, 638, 802). (Total 3 deposits)

Upper floor deposit, house 2, layer 2
66 (662). (Total 3 deposits)

Redeposition on wall-top, house 1, layer 8
36 (176), 85 (175), 87 (175). (Total 8 deposits)

Midden, trench VI, layer 2
(Total 1 deposit)

Midden, test-pit 10
(Total 1 deposit)

Unstratified
A (648), B (812), C (12), D (577). (Total 22 deposits)

BONE

Bone awls and points (fig 12)

The heads of many awls and a few points utilize the natural articular end of the long bone (sheep); often the articulation is left in its natural state (pulley, claw, hollow), and sometimes it is modified by deliberate shaping (split-pulley, shaved-pulley, round).

91 $\frac{1}{1}$ Split-pulley head, 46 mm long (tip broken), primary midden, trench IV, Period I. Fig 12.

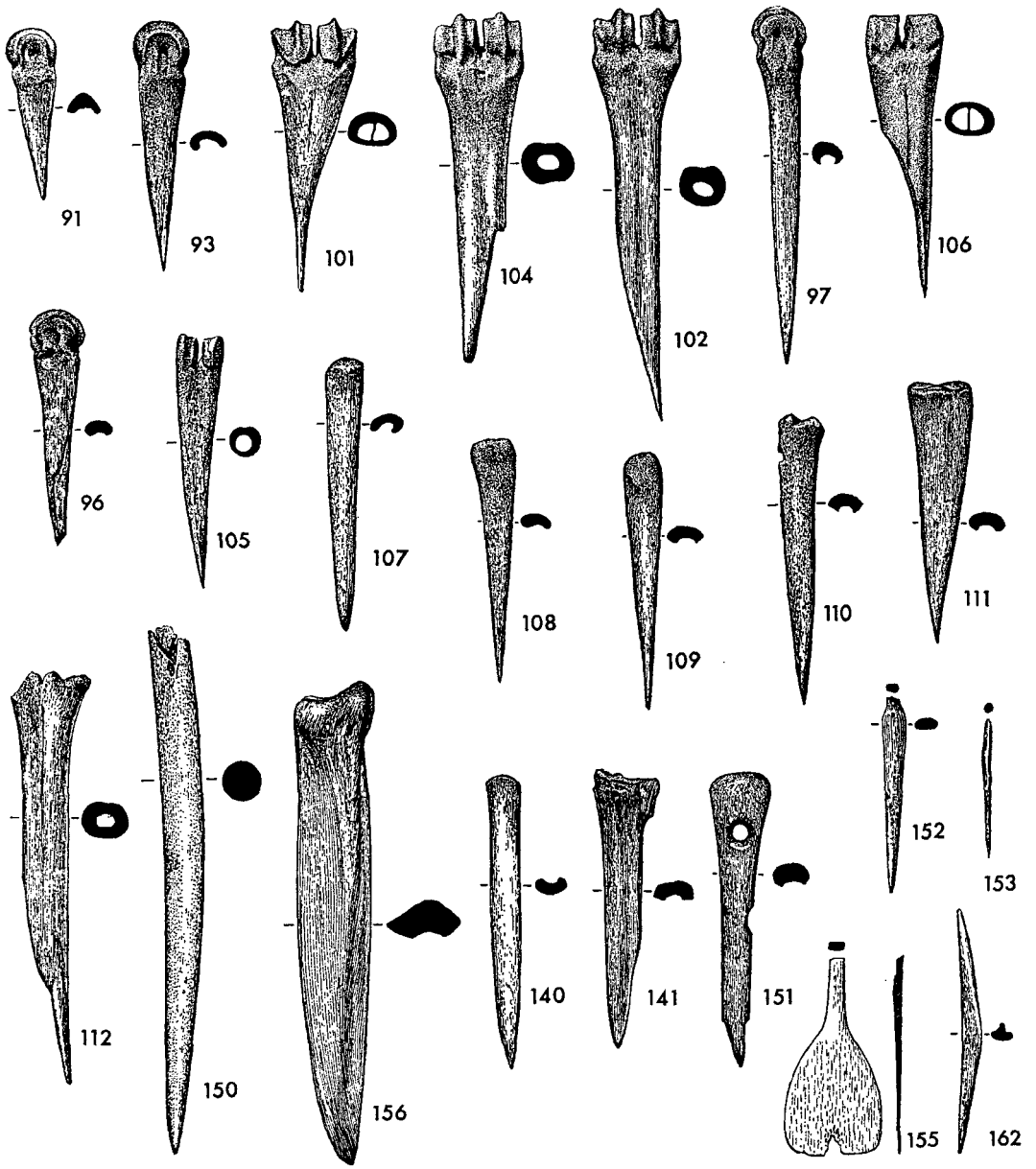

FIG 12 Bone implements (scale 1:2)

92 Split-pulley head, 68 mm long (tip broken), primary midden, trench III, Period I.
93 Split-pulley head, 67 mm long (extreme tip broken), house 1b floor deposit, Period II. Fig 12.
94 Split-pulley head, 56 mm long (tip broken), house 2 midden in blocking of entrance passage, Period II.
95 Split-pulley head, 27 mm long (broken), house 2b secondary floor deposit, Period II.
96 Split-pulley head, 64 mm long (tip broken), house 2b secondary floor deposit, Period II. Fig 12.
97 Split-pulley head, 97 mm long, house 2 wall-top, ? Period II. Fig 12.
98 Split-pulley head, 72 mm long (tip broken), house 2 topsoil, ? Period II.
99 Split-pulley head, 30 mm long (broken), house 1 topsoil, ? Period II.
100 Pulley head (unfinished), 82 mm long, unstratified.
101 Pulley head, 74 mm long, secondary midden, trench IV, Period II. Fig 12.
102 Pulley head, 112 mm long, house 2a secondary floor deposit, Period II. Fig 12.
103 Pulley head, 63 mm long (tip broken), secondary midden, trench III, Period II.
104 Pulley head, 94 mm long, house 2 wall-top, ? Period II. Fig 12.
105 Shaved-pulley head, 70 mm long, house 2b secondary floor deposit, Period II. Fig 12.
106 Shaved-pulley head, 76 mm long, house 2 wall-top, ? Period II. Fig 12.
107 Round head, 75 mm long (extreme tip broken), primary midden, trench II, Period I. Fig 12.
108 Round head, 66 mm long, primary midden, trench III, Period I. Fig 12.
109 Round head, 70 mm long (extreme tip broken), house 2b secondary floor deposit, Period II. Fig 12.
110 Claw head, 80 mm long, redeposited primary midden in S wall-core house 1, Period I. Fig 12.
111 Claw head, 72 mm long, house 2 wall-top, ? Period II. Fig 12.
112 Claw head, 113 mm long, house 1 topsoil, ? Period II. Fig 12.
113 Hollow head, 68 mm long (extreme tip broken), house 1 topsoil, ? Period II.
114 Sliver, 69 mm long (extreme tip broken), primary midden, trench II, Period I.
115 Tip only, 27 mm long, primary midden, trench II, Period I.
116 Sliver, 74 mm long, primary midden below N wall of house 1, Period I.
117 Sliver, 78 mm long, redeposited primary midden in N wall-core of house 1, Period I.
118 Sliver, 56 mm long, redeposited primary midden in S wall-core of house 2, Period I.
119 Sliver, 86 mm long, primary midden below N wall house 1, Period I.
120 Tip only, 18 mm long, primary midden, trench II, Period I.
121 Shank, 40 mm long (broken), secondary midden, trench II, Period II.
122 Sliver, 44 mm long, house 2b secondary floor deposit, Period II.
123 Shank, 85 mm long (head broken), house 2 midden in blocking of entrance passage, Period II.
125 Tip only, 20 mm long, house 1b floor deposit, Period II.
126 Tip only, 40 mm long, house 2b secondary floor deposit, Period II.
127 Tip only, 27 mm long, secondary midden, trench II, Period II.
128 Tip only, 19 mm long, secondary midden, trench III, Period II.
129 Sliver (unfinished), 42 mm long, house 2a secondary floor deposit, Period II.
130 Sliver (unfinished), 52 mm long, house 2a secondary floor deposit, Period II.
131 Tip only, 24 mm long, secondary midden, trench IV, Period II.
132 Shank, 68 mm long (head broken), house 2b secondary floor deposit, Period II.
133 Shank, 72 mm long (head broken), house 2b primary hearth, Period II.
134 Shank, 58 mm long (head broken), secondary midden, trench II, Period II.
135 Shank, 32 mm long (broken), house 2 topsoil, ? Period II.
136 Tip only, 48 mm long, house 2 topsoil, ? Period II.
137 Sliver, 49 mm long, house 1 topsoil, ? Period II.
138 Sliver (unfinished), 45 mm long, house 2 topsoil, ? Period II.
139 Sliver, 95 mm long, house 1 topsoil, ? Period II.
140 Round head, 81 mm long, primary midden, trench V, Period I. Fig 12.
141 Split-claw head, 77 mm long, redeposited primary midden in S wall house 2, Period I. Fig 12.
142 Sliver, 59 mm long, primary midden below N wall house 1, Period I.
143 Sliver, 83 mm long, house 2a primary floor deposit in passage, Period II.
144 Claw head, 82 mm long, house 2b secondary floor deposit, Period II.
145 Sliver, 125 mm long, house 1a secondary floor deposit in passage, Period II.
146 Sliver, 43 mm long, secondary midden, trench II, Period II.
147 Sliver, 97 mm long, house 2b secondary floor deposit, Period II.

148 Sliver, 218 mm long, house 1 topsoil, ? Period II.
149 Sliver, 111 mm long, old land surface, test pit 12.

Bone pins (fig 12)

150 Shank, 145 mm long (head broken), redeposited primary midden in N wall house 1, Period I. Fig 12.
151 Round head, perforated and notched, 81 mm long (possibly re-used as point after shank broken), house 2b secondary floor deposit, Period II. Fig 12.
152 Shank, 53 mm long (head broken at narrow neck), house 1a secondary floor deposit in passage, Period II. Fig 12.
153 Sliver, 37 mm long, house 2a secondary floor deposit, Period II. Fig 12.
154 Tip only, 77 mm long, house 1 topsoil, ? Period II.
155 Pin or spoon, 54 mm long (shank broken), house 1 wall-top, ? Period II. Fig 12.

Miscellaneous bone and antler implements (figs 12–14)

156 Blunt tip, claw head, 133 mm long, house 2b secondary floor deposit, Period II. Fig 12.
157 Blunt tip, 31 mm long (broken), house 2b secondary floor deposit, Period II.
159 Blunt tip, 48 mm long (broken), secondary midden, trench III, Period II.
160 Blunt tip, 56 mm long (broken), secondary midden, trench V, Period II.
161 Rounded tip, 120 mm long, house 1 topsoil, ? Period II.
162 Double-ended point or gorge, 67 mm long, secondary midden, trench II, Period II. Fig 12.
163 Round tipped sliver, 41 mm long, secondary midden, trench II, Period II.
164 260 g of bone-working debris.
165 Trimmed scapula, 120 mm long by max 71 mm wide, worn edges at wider end, house 1a secondary floor deposit in passage, Period II. Fig 13.
166 Trimmed scapula, 145 mm long by max 63 mm wide, worn edges at wider end, house 2b primary floor deposit, Period II. Fig 13.
167 Spatulate implement, cetacean bone, 191 mm long (handle broken), lower edge of blade worn, primary midden below S wall of house 1, Period I. Fig 13.
168 Split humerus with pulley-shaped distal end retained as handle, 114 mm long, tapering to worn point above which is a carved dimple, house 1 topsoil, ? Period II. Fig 14.
169 Split long bone, 126 mm long, shaped at one end to point (worn) above which is a carved dimple, topsoil trench II, ? Period II. Fig 14.
170 Hammer, cetacean bone, 102 mm long by 74–85 mm wide and 55 mm thick, cut perforation 27 mm diam (small natural perforation runs through object at an angle), redeposited primary midden in S wall-core of house 1, Period I. Fig 14.
171 Cetacean bone blade, 145 mm long by 47–66 mm wide, 11 mm thick, wear striations on wider end, house 2b secondary floor deposit, Period II. Fig 13.
172 Part of a cetacean bone rib or vertebral fin, worked to be a curved edge at one end, 85 by 80 mm, secondary midden, trench III, Period II.
173 Cetacean bone object, 185 mm long (broken), worked to a rounded point at one end, remains of perforation or notch at the other, house 1 topsoil, ? Period II. Fig 13.
174 Perforated cetacean bone object of irregular shape, max 220 mm diam, 30 mm thick, perforation 70 by 60 mm, house 2 topsoil, ? Period II.
175–181 Fragments of cetacean bone from primary midden contexts, Period I.
182–185 Fragments of cetacean bone from secondary midden contexts and house 2 secondary floor deposits, Period II.
186–188 Fragments of cetacean bone from topsoil contexts, ? Period II.
189 Part of an antler hammer, 116 mm long, perforation 25 mm diam, secondary notch probably representing re-use, redeposited primary midden in N wall of house 1, Period I. Fig 14.

STONE

Borers (fig 15)

190 Sandstone pebble, 117 mm long, tapering to worn and rounded point, redeposited primary midden in N wall-core of house 1, Period I. Fig 15.

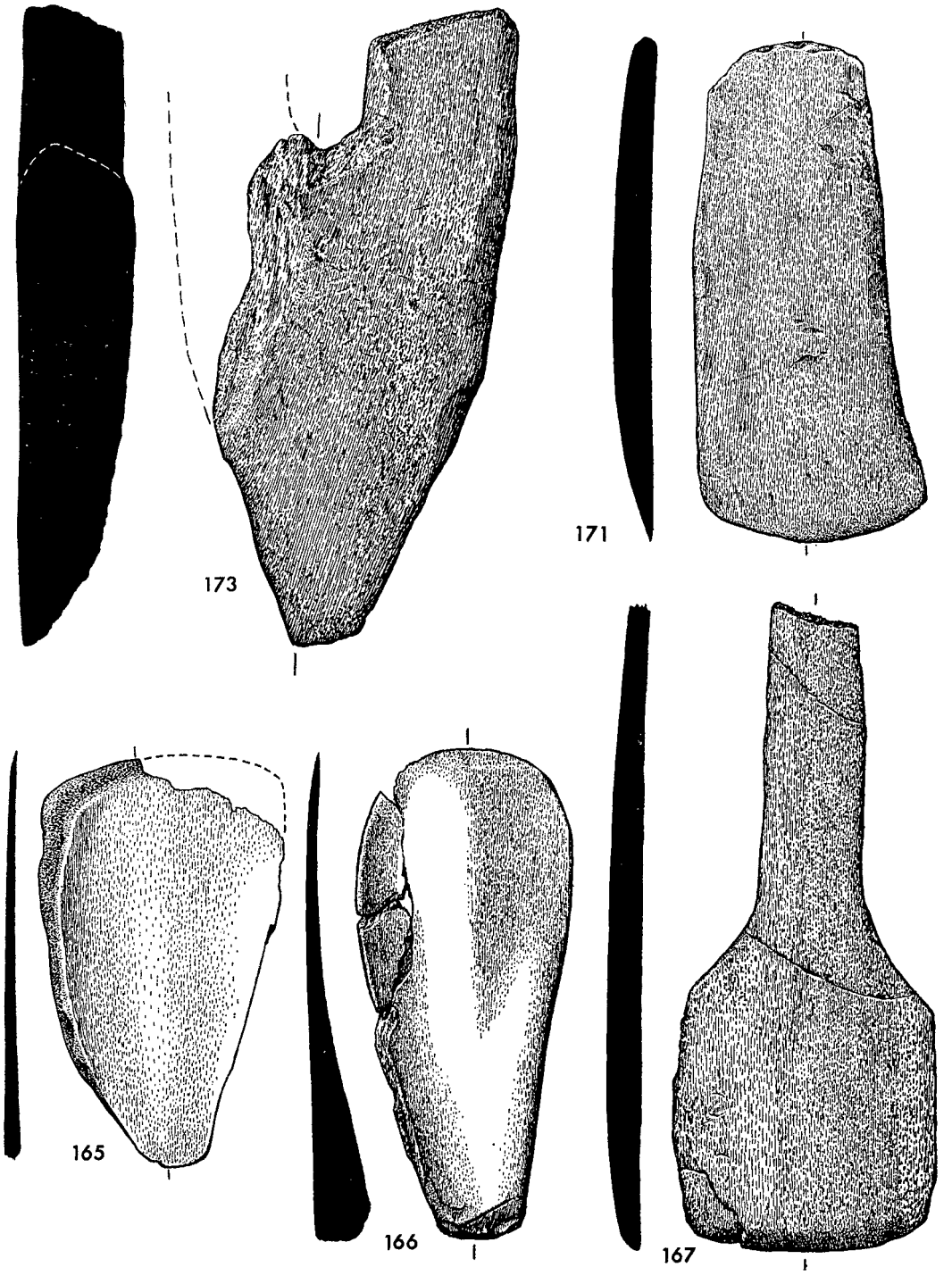

FIG 13 Bone implements (scale 1:2)

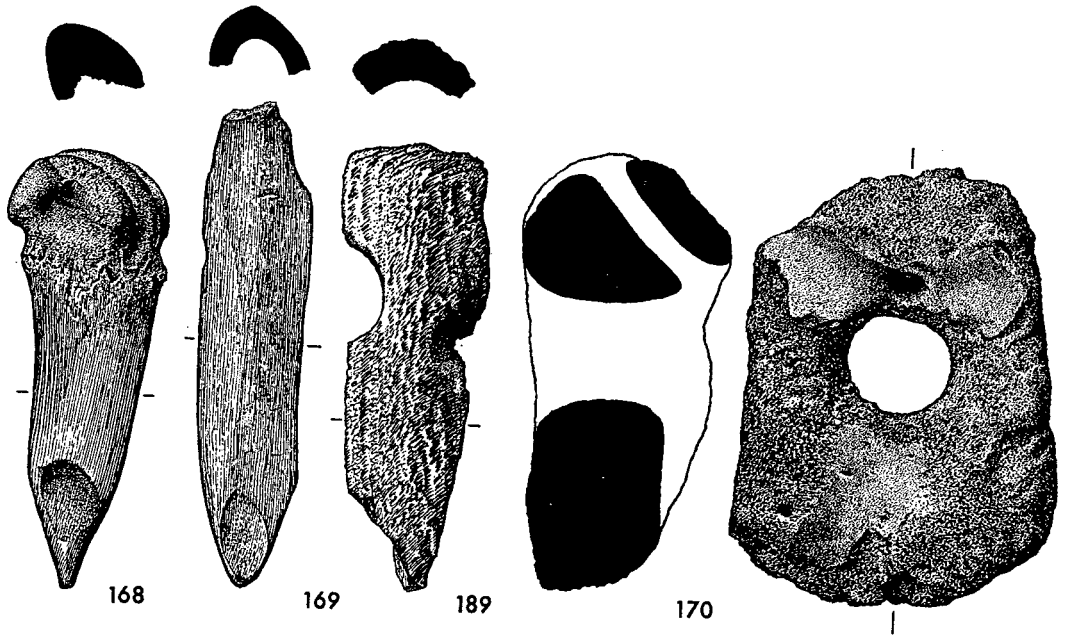

FIG 14 Bone and antler implements (scale 1:2)

191 Flagstone pebble, 54 mm long (handle end broken), tapering to worn and rounded point, redeposited primary midden in S wall-core of house 1, Period I. Fig 15.

192 Flagstone pebble, 102 mm long, tapering to worn and rounded point, redeposited primary midden in S wall of house 1, Period I. Fig 15.

193 Flagstone pebble, 172 mm long, tapering to worn and rounded point, redeposited primary midden in S wall-core of house 1, Period I. Fig 15.

194 Flagstone pebble, 100 mm long, tapering to worn and rounded point, house 2b secondary floor deposit, Period II. Fig 15.

195 Flagstone pebble, 116 mm long, tapering to worn oval point, house 1 wall-top, ? Period II. Fig 15.

Grinders (fig 16)

196 Flagstone pebble, 95 mm diam, 56 mm max thickness, one side convex with pitted apex, other side ground flat with central pecked area, some secondary wear on perimeter, house 2b secondary floor deposit, Period II. Fig 16.

197 Flagstone pebble, 98 by 83 mm, 51 mm max thickness one side convex with twin areas of pitting at apex, other side ground flat with central pecked area, extensive secondary wear on perimeter, house 2a floor deposit, Period II. Fig 16.

198 Flagstone pebble, 96 by 85 mm, 45 mm max thickness, one side convex with twin areas of pitting at apex, other side ground flat with central pecked area; wear on perimeter some of which preceded manufacture of flat surface and some secondary to latter, house 2b secondary floor deposit, Period II. Fig 16.

Axe

199 Axe, polished dolerite, 53 mm long (butt broken), primary midden, trench V, Period I. Fig 17 (Appendix 1).

Hammerstones, etc (fig 18)

200 Flagstone pebble, 128 mm by max 62 mm, extensive abrasion at either end, primary midden, trench III, Period I. Fig 18.

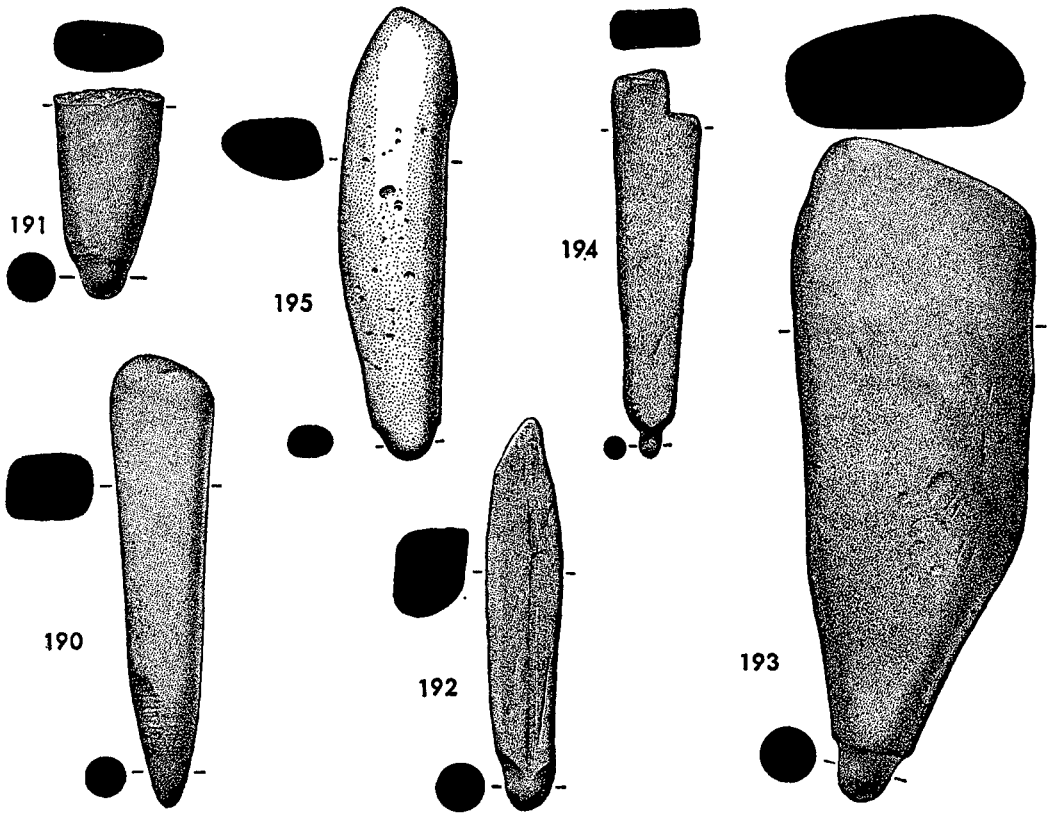

FIG 15 Stone borers (scale 1:2)

201 Flagstone pebble, 100 mm by max 84 mm, extensive abrasion at either end and on sides, primary midden below S wall of house 1, Period I. Fig 18.
202 Flagstone pebble, c 90 mm diam, extensive abrasion at either end and on sides, primary midden, trench II, Period I. Fig 18.
203 Flagstone pebble, 100 mm by max 65 mm, slight abrasion on one side, redeposited primary midden in N wall-core of house 2, Period I.
204 Flagstone pebble, 125 mm by 65 mm (broken), abraded at either end, redeposited primary midden in S wall-core of house 1, Period I.
205 Flagstone pebble, fragment with abrasion at one end (broken), primary midden below S wall of house 1, Period I.
206 Flagstone pebble, 142 by 74 mm, one end abraded and the other broken, primary midden, trench III, Period I.
207 Amphibolite pebble, 63 by 23 mm, abraded at either end, primary midden, trench II, Period I.
208 Flagstone pebble, 210 by 170 mm, max 100 mm thick, one side convex with extensive pitting, other side naturally flat, house 2b secondary floor deposit, Period II.
209 Flagstone pebble, 165 by 90 by 65 mm, one end abraded, sides pitted, house 1a floor deposit, Period II.
210 Flagstone pebble, 60 by 50 mm, one end abraded, sides pitted, secondary midden, trench III, Period II.
211 Flagstone pebble, 70 by 60 mm, sides pitted, secondary midden, trench III, Period II.
212 Flagstone pebble, c 80 mm diam, sporadic overall pitting, house 1a floor deposit, Period II.
213 Flagstone pebble, 86 by 44 mm, pitting on either side, house 1 wall-top, ? Period II.
214 Flagstone pebble, 55 by 36 mm, pitted on one side, house 1 topsoil, ? Period II.

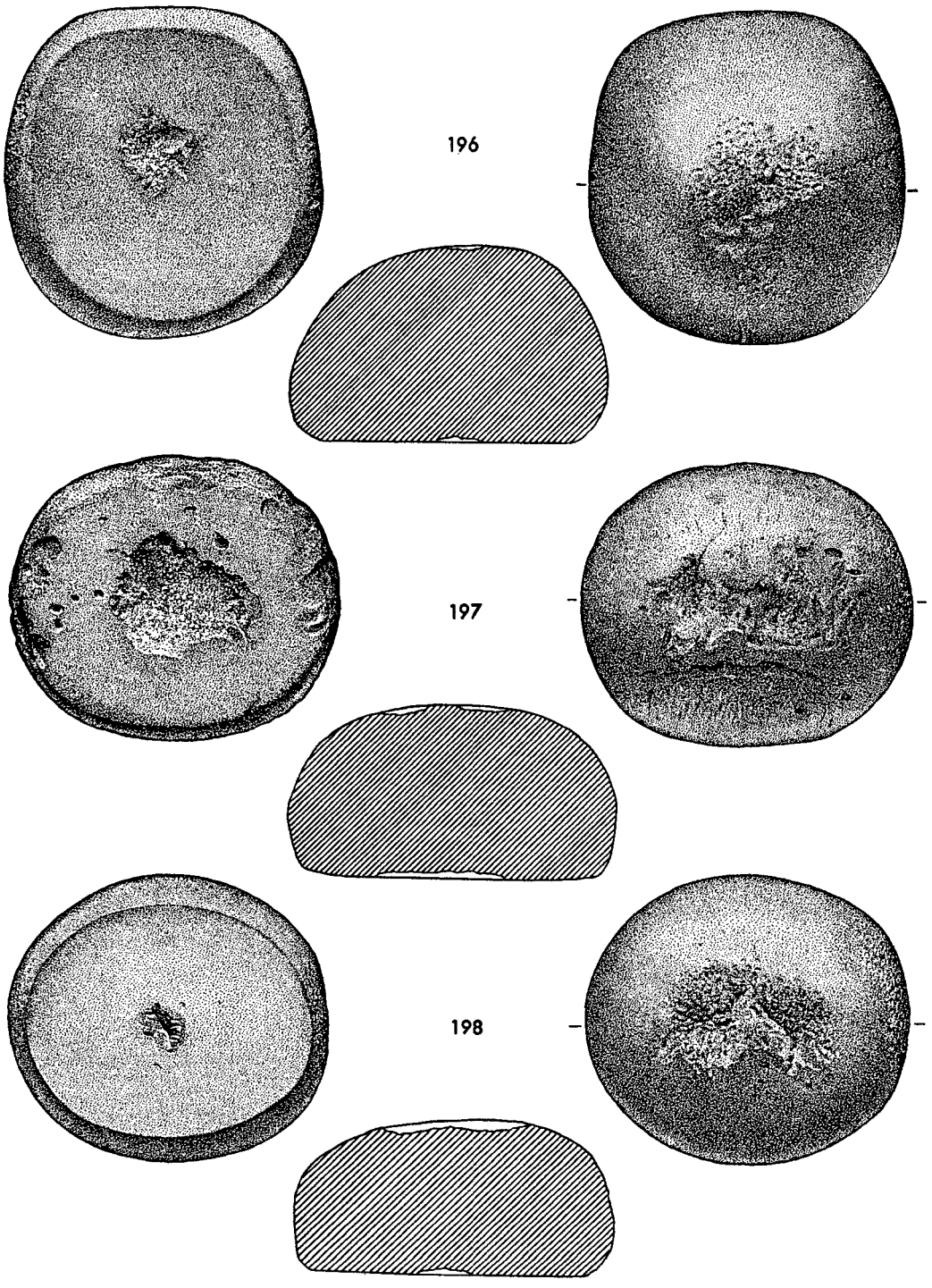

FIG 16 Grinding stones (scale 1:2)

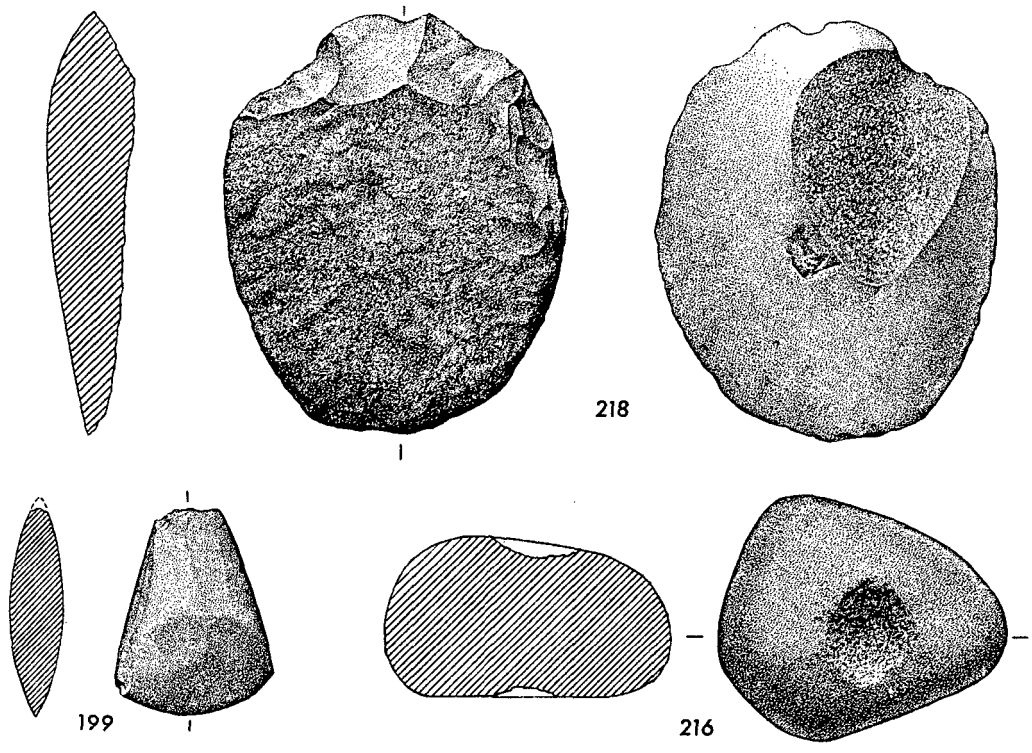

FIG 17 Stone implements (scale 1:2)

Miscellaneous stone implements (fig 17)

215 Flagstone pebble, 101 mm by max 37 mm, tapering to blunt abraded tip, primary midden below S wall of house 1, Period I.

216 Sandstone pebble, 76 by 63 by 41 mm, pecked hollow on either side, house 1 wall-top, ? Period II. Fig 17.

217 Flagstone disc, c 250 mm diam by 15 mm thick, trimmed edge (pot lid), house 2b primary floor deposit, Period II.

Pebble flakes (*Skaill knives*) (fig 17)

218 Flagstone, 108 mm max diam, edge partially worked, primary midden, trench III, Period I. Fig 17.

219 Flagstone, 107 mm max diam, edge partially worked, redeposited primary midden in S wall-core of house 1, Period I.

220 Flagstone, 60 mm max diam (broken), no secondary working, primary midden, trench III, Period I.

221 Flagstone, 68 mm max diam, no secondary working, secondary midden, trench III, Period II.

222 Flagstone, 41 mm max diam, no secondary working, secondary midden, trench III, Period II.

223 Flagstone, 72 mm max diam, no secondary working, house 1a secondary floor deposit in passage, Period II.

Querns

224 Sandstone, 666 by 318 by 124 mm, hollow 490 by 260 mm by max 40 mm deep, house 1b topsoil, Period II. Pl 7c.

225 Sandstone, 910 by 492 by 420 mm, hollow 640 by 344 mm by max 80 mm deep, house 1b floor, Period II (Traill & Kirkness 1937, 315). Pl 7d.

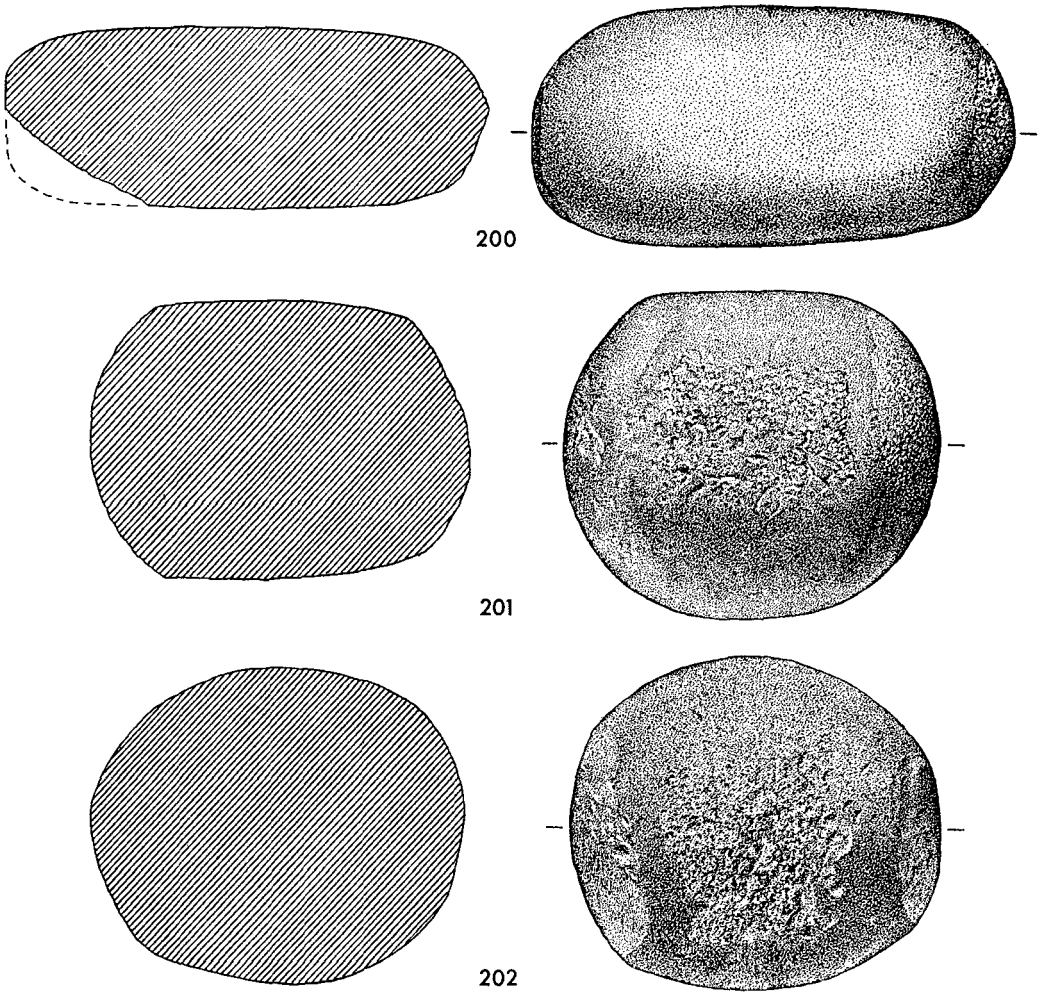

FIG 18 Hammerstones (scale 1:2)

FLINT AND CHERT

A total of 2·05 kg of flint and chert artefacts and debris was recovered, of which some 0·6 kg represents pieces showing secondary working. Intensive micro-examination of this material would have been costly in monetary terms and probably beyond the relative archaeological value of the information obtained; it was decided to submit a sample (c 200 g) of pieces showing secondary working for examination by Miss A S Henshall, whose report and illustration of 31 flint and chert artefacts follows. It is hoped that the entire assemblage may receive full analysis as part of some future research programme.

226, 1–31 Catalogued and illustrated: 15 artefacts from Period I, 14 from Period II, 2 from topsoil (c 200 g).

226, 32–103 Unillustrated flint and chert showing secondary working: 19 from Period I, 39 from Period II, three from topsoil (c 400 g).

226, 104 Flint and chert showing no secondary working: c 550 g from Period I, c 900 g from Period II.

226, 105 Tiny fragments of flint and chert derived from sieved samples of midden material.

The proportions of flint and chert tools and debris assignable to the two main periods of occupation appear to imply that this material was more important in Period II than in the preceding period, but a

more realistic interpretation may be that the houses formed the focus of flint-working and flint-use in Period II, whereas the earlier focus lay outside the excavated area or had been dispersed by later building. There was a notable concentration of 36 items from the floor deposit in the rear compartment b of house 1, including not only worked pieces but also flakes showing no secondary knapping which may nevertheless have been used as tools.

Flint and chert (fig 19)

Audrey S Henshall

226, 1–18 End scrapers

1 Ginger-brown flint, some cortex on back; on reverse one side chipped by use. Primary midden, trench II, Period I.

FIG 19 Flint and chert implements (scale 1:2)

2 Buff leached chert, some cortex on back, steep retouch on three sides, finer and shallower retouch on fourth side forming working edge. Topsoil, trench II, ? Period II.
3 Ginger-brown flint. Secondary midden, trench V, Period II.
4 Similar, cortex on back, broken down one side. Primary midden, trench II, Period II.
5 Flint scorched red-grey. Secondary midden, trench IV, Period II.
6 Speckled buff flint, cortex at one side. Primary floor deposit, house 2b, Period II.
7 Similar but consisting mainly of cortex. Primary midden, trench II, Period I.
8 Similar, cortex along one side, notably fine regular trimming of working edge. Secondary midden, trench III, Period II.
9 Grey chert, cortex along sides and base. Primary hearth, house 2b, Period II.
10 Pale grey chert, partly corticated, edge chipped by use. Secondary midden, trench IV, Period II.
11 Dark grey flint, some cortex on each side, the working edge damaged. Floor deposit, house 1b, Period II.
12 Heavily corticated flint, damaged. Primary midden, trench II, Period I.
13 Corticated flint. Secondary floor deposit, house 2b, Period II.
14 Fragment of large scraper, ginger-brown flint, some cortex on back. Primary midden, trench II, Period I.
15 Pale grey speckled flint, cortex over back. Secondary midden, trench II, Period II.
16 Similar but scorched and lower surface damaged. Secondary floor deposit, house 2b, Period II.
17 Speckled brown flint but mainly cortex, damaged at one side. Primary floor deposit, house 2b, Period II.
18 Ginger-brown flint, surface patinated buff, one corner damaged. Topsoil, trench VI.

226, 19–20 Triangular scrapers with two working edges

19 Buff flint, cortex along base, working edges damaged by use. Secondary midden, trench II, Period II.
20 Speckled grey cherty flint, the third side broken. Primary midden, trench III, Period I.

226, 21–23 Side scrapers

21 Speckled ginger-brown flint, cortex at one corner, shallow retouch along end and one side. Redeposited primary midden in N wall-core of house 1, Period I.
22 Grey flint, a lump of cortex remaining along one side, probably unfinished. Floor deposit, house 1b, Period II.
23 Leached chert, fine retouch along working edge, some damage at distal end. Primary midden, trench III, Period I.

226, 24–26 Knives

24 Made on a narrow steep-sided blade of mottled dark grey flint, a small area of cortex adjacent to striking platform; careful retouch down one side and round one end, the opposite side nicked through use. Redeposited primary midden in S wall-core, house 1, Period I.
25 Made on a blade, almost entirely cortex but with a small area of speckled brown flint on the concave face and exposed down one side by crude retouch which forms a knife edge. Secondary midden, trench II, Period II.
26 Portion of a blade of mottled ginger-brown flint, fine retouch along one side on one face. Primary midden, trench II, Period I.

226, 27–29 Points

27 Mottled flint stained ginger-brown, both long edges retouched on one face. Primary midden, trench III, Period I.
28 Made on a flake of speckled buff flint, cortex on the striking platform, fine retouch along both sides of both faces to form a neat point. Redeposited primary midden in S wall-core of house 2, Period I.
29 Beaked point formed by a pair of steeply trimmed notches at the distal end of a flake of speckled ginger-brown flint, cortex on back. Redeposited primary midden in N wall-core of house 1, Period I.

226, 30 Leaf-shaped arrowhead

30 Dark grey flint crudely flaked on both faces, the tip broken; perhaps unfinished. Primary midden, trench II, Period I.

226, 31 Microlith

31 Pink quartzite; steep retouch down one side of convex face. Primary midden below S wall house 1, Period I.

Flint is the main material used, ranging from ginger-brown to buff, or pale to dark grey, with chert as a minor material (two or three out of 23 scrapers). The only other material recognized is quartzite, used for a microlith. Some of the flints are corticated (see definition in Ritchie & Crawford 1978, 88), ie the surface has been altered to a soft powdery white texture by the extremely alkaline conditions in which they have lain. A few specimens, including the chert scrapers, have been less affected, the surface colour but not the texture being modified.

In all 23 scrapers have been identified, and eight other tools including the microlith which presumably should not be considered part of the assemblage. Most of the scrapers are quite small, made on primary flakes struck from small pebbles. Some are thin, with slanting trimmed edges, and others are thick with steeply or almost vertically trimmed edges. Two chert scrapers, *2* and *9*, are noticeably larger and heavier than the rest. The majority of scrapers are end-scrapers, generally with convex working edges which sometimes curve round more than half the tool; there is the occasional straight or near-straight edge. There are also three side scrapers, and two rather unusual triangular scrapers with two working edges. One scraper, *8*, exhibits fine controlled retouch, and the long careful secondary flaking on *23* may be noted. A number of the working edges have been chipped by use.

The other tools comprise one good quality knife and two blades with retouch along one edge, three points of which *28* has been carefully worked and *29* is of unusual beaked form, and *30* which appears to have been intended as a leaf-shaped arrowhead but which was not finished.

The material which has not been illustrated mainly consists of flakes and chips, but includes several core trimmings and worked-out cores.

Provenance of bone and stone artefacts

Period I

Primary midden, trench II and below S wall, house 1, layer 11
107, 114, 115, 120, 167, 176, 179, 180, 201, 202, 205, 207, 215, 226 (1, 4, 9, 12, 14, 26, 30, 31)
Primary midden, S wall-core, house 1, layers 9, 10
110, 170, 177, 178, 191, 192, 193, 204, 219, 226 (24)
Primary midden, N wall-core, house 1, layer 14
117, 150, 189, 190, 203
Primary midden, below N wall, house 1, layer 16
116, 119, 142, 226 (29)
Primary midden, S wall-core, house 2, layer 5
118, 141, 226 (28)
Primary midden, trench III, layer 4
92, 108, 175, 181, 200, 206, 218, 220, 226 (20, 23, 27)
Primary midden, trench IV, layer 4
91
Primary midden, trench V, layer 4
140, 199

Period II

Secondary midden, trench II, layer 3
121, 127, 134, 146, 162, 163, 182, 226 (15, 19, 25)
Secondary midden, trench III, layer 3
103, 128, 159, 172, 185, 210, 211, 221, 222, 226 (8)
Secondary midden, trench IV, layer 2
101, 131, 226 (5, 10)
Secondary midden, trench V, layer 2
160, 226 (3)
Floor deposit, house 1, layer 2
93, 125, 209, 226 (11, 22)

Floor deposit, house 1, layer 3
212
Floor deposit, house 1, layer 4
145, 152, 165, 223
Lower floor deposit, house 2, layer 12
133, 166, 217, 226 (17)
Upper floor deposit, house 2, layer 7
95, 96, 105, 109, 122, 126, 132, 144, 147, 151, 156, 157, 158, 171, 184, 194, 208, 226 (6, 13, 16)
Upper floor deposit, house 2, layer 6
143, 197, 226 (7)
Upper floor deposit, house 2, layer 3
94, 123, 124, 196, 198
Upper floor deposit, house 2, layer 2
102, 129, 130, 153, 183
Redeposition on wall-top, house 1, layer 8
195, 213, 216
Midden, test-pit 12
149
Unstratified
97, 98, 99, 100, 104, 106, 111, 112, 113, 135, 136, 137, 138, 139, 148, 154, 155, 161, 164, 168, 169, 173, 174, 186, 187, 188, 214, 226 (2, 18)

PUMICE

227 Sixty-nine small to medium pieces, rounded but unworked, of which 17 pieces belong to Period I, 42 pieces to Period II (including eight from house 2 floor deposits), and 10 were topsoil finds and probably belong to Period II.

Although pumice is likely to have been used as a finishing abrasive on the points of bone implements, none of the pieces is grooved or shaped by wear in the manner of pumice found at Skara Brae (Clarke 1976a, 20, fig 8). One recent use for pumice in Orkney has been to rub off the dried fat on the underside of sealskins (information J Yorston).

ARTEFACTS FOUND PRIOR TO 1973

There are objects from Knap of Howar in the National Museum of Antiquities of Scotland in Edinburgh (NMAS cat nos) and in Tankerness House Museum in Kirkwall (THM cat nos). Some of the finds from the previous excavation were presented to NMAS in 1937 (HD 628–646), while others, some identifiable from the original report (Traill & Kirkness 1937), were presented from the estate of the late William Kirkness by Mr A Dutch in 1975 (HD 2020–2029) and from the collection at Holland by Mr and Mrs J Rendall in 1967 (HD 1900) and 1973 (HD 2003–2016). The provenance of a small pottery cup with a pedestal foot (HD 1899) must be considered doubtful. Sherds of pottery found in the midden in 1920 by W Traill (THM 130) and artefacts found by J M Corrie (THM 211, 380, 382, 212) are in Tankerness House Museum.

Pottery

Eight rim and body sherds (NMAS HD 663–644, HD 2020–2021) are catalogued in the main pottery report above by Miss Henshall (nos *F–I*).

228 One body sherd, coarse pink-brown fabric with large shell temper (HD 1900).
229 Two body sherds, pink-buff fabric with small grits, burnt black on inside surface; three rimsherds, rounded section, black fabric with shell temper, representing vessel c 200 mm diam (THM 130).
230 Six body sherds, pink-buff fabric with small shell temper, black inner surface; two body sherds, hard orange fabric, raised cordon; one rimsherd, rounded section, hard black fabric (THM 211).

Bone

231 Awl, pulley head, 79 mm long (HD 2022).
232 Awl, pulley head, 69 mm long (HD 2023).
233 Point, 84 mm long (HD 640; Traill & Kirkness 1937, 315).
234 Point, 42 mm long (broken) (HD 641; Traill & Kirkness 1937, 315).

235 Point, 79 mm long (broken) (HD 642; Traill & Kirkness 1937, 315).
236 Point, 83 mm long (broken) (HD 2024).
237 Scapula blade, trimmed 156 by 70 mm (HD 638; Traill & Kirkness 1937, 315).
238 Hammer, cetacean bone, 110 by 54 mm (broken), slightly waisted, oval perforation 36 by 27 mm (HD 2003; Traill & Kirkness 1937, 315, fig 4 upper).
239 Cetacean implement, 120 by 38 mm and max 20 mm thick, oval tip worn on underside, other end broken (HD 639; Traill & Kirkness 1937, 314).

Antler

240 Hammer, 85 mm long (width incomplete), perforation 22 mm diam (HD 2004; Traill & Kirkness 1937, 316, fig 4 lower).

Stone

241 Flagstone pebble, 79 mm long (broken), tapering to worn tip (borer) (HD 2005; Traill & Kirkness 1937, 316, fig 5 lower, where handle end complete).
242 Flagstone pebble, 74 by 60 mm, max 52 mm thick, flat underside with central pitted area, convex upper surface with pecked hollow near apex, abrasion on sides (HD 630; Traill & Kirkness 1937, 315–16 'anvil stone').
243 Flagstone pebble, 127 by 60 mm and 50 mm thick, abrasion on sides and ends (hammerstone) (HD 631; Traill & Kirkness 1937, 316).
244 Flagstone pebble, 90 by 78 by 38 mm, abraded (HD 2025).
245 Flagstone pebble, 114 by 68 by 58 mm, abraded sides (HD 2026).
246 Flagstone pebble, 132 by 70 by 46 mm, abraded at either end and sides (HD 2027).
247 Sandstone pebble, 102 by 95 by 56 mm, abraded (HD 2028).
248 Flagstone pebble, 135 by 75 by 57 mm, abraded ends (THM 380).
249 Sandstone pebble, 200 by 150 by 55 mm, twin hollows (max 25 mm deep) in one face (HD 628; Traill & Kirkness 1937, 316).
250 Sandstone pebble, 135 by 120 by 70 mm, hollow (22 mm deep) in one face, slight hollow in other face (HD 629; Traill & Kirkness 1937, 316).
251 Three flagstone pebble flakes, no secondary working (HD 632–634; Traill & Kirkness 1937, 315).
252 Mudstone pebble flake, no secondary working (THM 382).

Flint and chert

253 Thirty flakes including three scrapers (Traill & Kirkness 1937, 317) and others found in midden after the early excavation (HD 2006–2016).
254 Six chert flakes (THM 212).

Pumice and shell

255 Three pieces (HD 635–637) and 13 pieces (HD 2029), none shaped (Traill & Kirkness 1937, 316).
256 Two oyster shells (HD 645–646).

The THM catalogue lists a 'whalebone dish' from Knap of Howar (THM 355); although unlabelled, a hollowed cetacean vertebra in the museum collection is likely to be the same object: 450 by 470 mm by 140 mm high.

The animal and bird bones and shells from the early excavations, identified by Margery I Platt, are stored in the Department of Natural History, The Royal Scottish Museum, Edinburgh (reg no 1941.9).

APPENDIX 1: PETROLOGICAL ANALYSIS OF POTTERY AND STONE AXE

D F WILLIAMS, Department of Archaeology, University of Southampton

POTTERY AND CLAY

Eleven sherds of pottery from Knap of Howar, together with samples of clay found at the site, were submitted for fabric analysis. Thin sectioning of the samples allowed a division into four groups on the basis of temper inclusions. These are listed below following the descriptions of the fabrics. Munsell colour charts are referred to together with free descriptive terms. SF numbers refer to the original excavation finds' list.

Description of the fabrics

1 Fairly thick, moderately hard fabric, light red (2.5YR 6/8) outside surface, dark grey inner surface, with a dark greyish brown core. Fairly sandy fabric. SF 191 (=cat no *30*)
2 Medium thick, moderately hard fabric, dark grey (5Y 4/1) throughout. Burnished on the outside surface, plain rim form. SF 227 (=cat no *12B*)
3 Thin, moderately hard fabric, yellowish red (5YR 5/6) outside surfaces, dark grey core. Plain rim form. SF 295 (=cat no *13*)
4 Thick, hard fabric, greyish brown (10YR 5/2) outside surface, dark grey inner surface and core. The outside surface has been lightly burnished. Numerous inclusions of large pieces of shell protrude through the surface. SF 358
5 Moderately thick, fairly hard fabric, dark grey (5Y 4/1) outside surface, buff inner surface and core. Numerous small inclusions of shell can be seen in fresh fracture. SF 144
6 Medium thick, fairly hard fabric, dark grey (10YR 4/1) throughout. Lightly burnished on the outside surface. SF 396
7 Thin, moderately hard fabric, dark grey (10 YR 4/1) outside surfaces, black core. SF 285
8 Medium thick, fairly hard fabric, black outside surface and core, reddish-brown inner surface. The outside surface has been lightly burnished. Small inclusions of shell can be seen in fresh fracture. SF 204 (=cat no *79*)
9 Group of small eroded sherds, light buff on one side, dark grey on the other. Small inclusions of shell are present. SF 3
10 Medium thick, dark grey (7.5YR N4/) throughout. Small inclusions of shell can be seen in fresh fracture. SF 24 (=cat no *80*)
11 Medium thick, moderately hard fabric, dark grey (7.5YR N4/) outside surface and core, buff-grey inside surface. Inclusions of shell can be seen protruding through the surfaces. Decorated with incised lines. SF 215 (=cat no *39*)

Group I (*shell/sandstone*) nos 4, 5, 8, 9, 10, 11

Numerous inclusions of small fragments of crushed fresh shell in an anisotropic matrix of fired clay. Also present are frequent fine-grained micaceous sandstone grains, together with a scatter of subangular quartz grains, average size 0·2–0·3 mm, and flecks of mica.

Group II (*sandstone*) nos 1, 6, 7

Nos 1, 6: inclusions of medium-grained sandstone, together with numerous grains of subangular quartz, average size 0·2–0·5 mm, set in an anisotropic matrix of fired clay.

No 7: inclusions of fine-grained micaceous sandstone, together with a scatter of subangular quartz grains, average size below 0·1 mm, and abundant flecks of mica, set in an anisotropic matrix of fired clay.

Group III (*mudstone*) no 2

The prominent inclusions are frequent grains of mudstone, up to 2·5 mm across, in a matrix of anisotropic fired clay. Also present are a scatter of subangular quartz grains, average size 0·15–0·3 mm, and a few crushed fresh shell fragments.

Group IV (*quartz*) no 3

Numerous well-sorted grains of subangular quartz, average size 0·2–0·4 mm, in an anisotropic matrix of fired clay.

Analysis of clay

Samples of unfired clay found at the site were baked and then sectioned for study under the petrological microscope in the same way as the pottery. Sample A came from midden material in the blocking of house 2 entrance, sample B from redeposited primary midden in the S wall-core of house 2, and sample C was associated with pottery (cat no 93) in house 1 topsoil.

Thin sectioning shows that all the samples contain numerous inclusions of crushed fresh shell, together with grains of fine-grained micaceous sandstone, and frequent grains of subangular quartz, average size 0·2–0·5 mm.

Discussion

The above analysis suggests that there is no reason to suspect anything other than a fairly local source for the pottery, as the main inclusions present in the samples are all to be found within the general area of the site. This view is strengthened by the degree of similarity between thin sections of clay recovered from the site and Group I.

These results confirm previous petrological examination of Unstan ware, which was shown to contain inclusions common to the area from which the pottery was found (Phemister 1942).

STONE AXE (cat no *199*)

The surface colour is pale greenish grey; the butt end is slightly damaged. Length, 53 mm; max width, 42 mm; thickness, 11 mm; weight, 34·9 g. A thin section was taken from the centre and revealed a fine-grained uniform aggregate of rhomboid dolomite grains, among which are scattered angular detrital quartz grains of similar size (pl 8a). Two veins of pyrite transverse the matrix, and can be seen on the surface of the axe running around the edges. The rock is a fine-grained dolomite. Small bands of dolomite occur fairly frequently within the Middle Old Red Sandstone formations of the Orkneys, and so the rock could have originated from a local source on Papa Westray.

APPENDIX 2: PETROLOGICAL ANALYSIS OF A STONE TOOL FROM KNAP OF HOWAR, ORKNEY

G H COLLINS, British Geological Survey (NERC), Edinburgh

Macroscopically the tool is a fine grained porous rock resembling a sandstone. It has obviously been subjected to some form of chemical alteration as it would be impossible to knap the material in its present state. A thin section (ED 7225, BGS) revealed that the rock is a cherty nodule, certainly of Mesozoic age, and probably Cretaceous, containing silica in the form of microcrystalline quartz and chalcedony, an iron-rich carbonate, and unidentifiable fragments of foraminifera. It seems that the nodule has been attacked by an alkali-rich soil which has at least partially digested the microcrystalline silica, thus leaving cavities in the chert and so causing the porous and slightly friable nature of the specimen. The ancients may have found the chert as a pebble on a recent beach in Orkney, but the possibility of it having been carried from the European mainland (eg Denmark) cannot be excluded. (Cat no 226, 2.)

APPENDIX 3: THE PITTED GRINDING STONES FROM KNAP OF HOWAR, ORKNEY

R R INSKEEP, Donald Baden-Powell Quaternary Research Centre, Pitt Rivers Museum and Department of Ethnology and Prehistory, University of Oxford

When Dr Anna Ritchie, in a television programme in 1977, declared herself puzzled by the three grinding stones from house 2 the writer was rash enough to draw her attention to very similar artefacts from the Later Stone Age in southern Africa, together with some meagre evidence for their function. During a meeting in the Orkney Islands in July 1982 Dr Ritchie invited the writer to contribute a note on the specimens and, at the time, this seemed a not too difficult task. Subsequent closer acquaintance with the subject, however, suggests that it is more complex than at first appeared, and is deserving of a rather more detailed treatment than time and space have, on this occasion, permitted.

That the stones have been used in some grinding or rubbing process is evident from their morphology (the clearly worn face opposed to the unworn, convex surface of the cobbles) as well as from the striation/polish of the worn face. Had it not been for the pecked dimples in the centre of the ground surfaces and, perhaps, the evidence of battering on the domed surfaces, it is quite likely that the specimens would simply have been listed as 'rubbers' or 'mullers' and left at that. But even for 'un-dimpled' stones of this small, domed variety, or of other shapes, it is not easy to find parallels in the literature. The grain-rubbers described by Curwen (1937, 134), used in conjunction with what Childe (1940, 34) termed saucer-querns, and said to be characteristic of the causewayed-camp phase of the British Neolithic (Curwen 1937, 135; Childe 1940, 34) are, so far as one can determine from the literature, generally larger than the specimens under discussion (cf Keiller 1965, 123). A rapid, but fairly wide-ranging sampling of the literature reveals that assumed food-grinding equipment receives rather cursory mention, usually being identified by name

(rubbing stones, rubbers, saucer querns, saddle querns, etc) with, at best, a cursory description and little or no illustration. For this reason it is difficult to ascertain to what extent parallels for our stones exist elsewhere.

Of several of the writer's colleagues in Oxford none had come across specimens like those under discussion, in British or European contexts, and in a good deal of page-turning the writer found only one illustration (Way 1867, fig III) which seems to represent the same kind of thing, found in the vicinity of hut circles at Ty Mawr on Holyhead Island, Anglesey. It is interesting that this specimen is shown in association with a trough-shaped lower stone, in which it was said to have been found. Greenwell (1877, fig 13) illustrates a similar grinder but without the dimple.

The nearest locality in which comparable stones are positively identified is Early Khartoum, in the Sudan (Arkell 1949). Here Arkell mentions 278 complete specimens and 280 fragments, associated with 156 quern fragments. The size range for 62 specimens is from 50 to 175 mm, with a mean of 91 mm, and at least 55 specimens (12%) are mentioned as having small pits in flat or slightly convex grinding surfaces. It is not possible to say with certainty what sort of lower grindstones these rubbers were used with as no complete specimens were found at the site. A complete specimen from a related site at Wadi Howar, to the west of Khartoum, is of the shallow trough variety (Arkell 1949, pl 42) and from his photographs it would appear that most of the fragments come from this type of quern, rather than the true saddle quern. Many of the Khartoum stones were stained with ochre and Arkell sees them as predominantly related to the grinding of ochre used in colouring both the fabric of associated pottery and for slip, but it is as likely that this is a secondary function and that their primary function was in food preparation. Early Khartoum is described as a Mesolithic site and, whilst it yielded no cultivated cereal remains or domesticated animals, several hundred seeds of *Celtis integrifolia* were recovered, a genus whose remains have been found in a number of Saharan Neolithic sites (Monod 1963, 194). Shallow trough-shaped querns (not saddle querns, as reported) and pebble rubbers were also the standard grinding equipment in the early Neolithic of Egypt (Caton-Thompson & Gardner 1934, 31–2, pl VII, 2), though here, where cultivated cereals were evidently abundant, there is no mention of the stones being dimpled.

Dimpled rubbing stones of the Knap of Howar type are well documented in southern Africa (cf Fagan & van Noten 1971), mainly from industries of Holocene date, but occasionally much older. They are invariably associated with hunter-gatherer sites and do not form any part of the grinding equipment of the Iron Age farming communities, ancient or modern. Among contemporary Iron Age communities dimpled stones are put to a variety of uses, but in no case known to the writer is the dimple cut in the centre of a grinding surface.

John Goodwin, commenting on such stones 50 years ago (Goodwin & van Riet Lowe 1929, 166) says 'this pit is still made in the grindstones of surviving San [Bushmen] folk, and . . . serves to catch up and turn over the tsama (melon) and other wild seeds they grind. The perfectly smooth grinder will not "catch" on the seeds otherwise, as the material being ground forms a smooth paste on the lower stone which resists grinding.' Van Riet Lowe (*ibid*, 166) remarks that the stones are of a size that indicates that they were held in one hand and that, in many, the surface opposite the ground surface is pitted and abraded from pounding.

Dunn (1931, 67–8) makes a very similar observation but, in this case, suggests that the material ground was wild grass seeds. 'Generally', he says, 'a small rough hollow was left in the centre of the grinding surface of the muller so as to catch the grain. . . . The Bushman woman crushed the grass seed that she had taken from the ants' nests with the muller, and winnowed it by blowing on it.' Unfortunately Goodwin does not here, or elsewhere, give the source of his information, and the same is true of Dunn, although the latter travelled extensively among the Bushmen in 1872, collecting both ethnographic and archaeological specimens. As a trained geologist Dunn was presumably an acute and accurate observer, and much of what he writes has a convincing ring to it. The fact that Goodwin refers specifically to *tsama* seeds, and the problem of their forming a paste, suggests that his information was not derived from Dunn and that the references in fact reinforce each other. Dunn had, at the time, been living for many years in Australia, and neither man makes any reference to the other.

At the time of writing it has not been possible to obtain information on dimpled rubbing stones in the New World where, however, they are known to occur, but useful information is available from Australia. The writer is grateful to Professor Richard Gould of Brown University, Rhode Island, for valuable comments. He writes (*in lit* 26.8.82) 'seed-grinding stones similar to the ones illustrated by Dr Ritchie are quite commonly used by ethnographic Western Desert Aborigines in Australia. Usually these are stream cobbles which acquire their faceting from use. In some examples, the ends show pecking, and

many examples also show the same kind of pitted depressions as on the [Knap of Howar] specimens ... about the only real difference I can see is that the Australian ones are always pitted on the flat surface – never on the convex or curved surfaces.... The pitted ones I saw were sometimes used to break open kurrajong and quandong nuts, but more often I have seen them used in seed-grinding with small amounts of water added to produce the sort of "seed-paste" your South African informant describes.'

Still in Australia, O'Connell (1977, 274, fig 7) distinguishes the type of stone under discussion, which he terms 'domed handstones', from 'flat or bevelled handstones'. The latter 'are used primarily to grind seeds, but may occasionally serve as hammers [with grinding slabs] to pulverize lizards and other small animals. Domed handstones ... were employed as multipurpose hammerstones and mullers, but were said to be particularly useful in crushing and grinding hard seeds or nuts ...' Tindale (1977, 346) in describing the Aborigines' exploitation of wild grass seeds describes upper millstones which sound very like O'Connell's 'flat or bevelled handstones' and makes no mention of the domed or dimpled stone.

All this has taken us rather a long way from the Orkney Islands and it is necessary to see, now, what conclusions may be drawn, albeit tentatively. The type of stone under discussion is perhaps best described in O'Connell's (*ibid*) words: 'Domed handstones ... are fist-sized cobbles, roughly circular or ovoid in outline, domed in section. Basal grinding surfaces are flat or slightly convex, and often have a small, circular pecked depression in their centres. Edges are often heavily pecked and battered.' As such they do not conform to the general type of upper grinding stone described for the earliest grain cultivating societies in the British Isles, nor yet, apparently, in Europe or Egypt. Nor do they occur among the grain-grinding equipment of the southern Bantu, among whom hand-grinding of cereals is still widely practised. They are, however, well documented in the Mesolithic site of Early Khartoum, and among non-agricultural peoples historically, and for many thousands of years past, in southern Africa and Australia. Undoubtedly they occur elsewhere but time has not permitted the examination of this.

On the South African evidence the function of the small pit in the grinding surface is to reduce 'skid', and improve the efficiency of the tool. The evidence there suggests that such stones were used for the processing of a variety of seeds, including grass, whereas in Australia it seems that different stones were generally used for grinding grass seeds and that the (dimpled) domed handstones were often multi-purpose tools commonly intended to deal with tougher and more recalcitrant elements in the diet. If nuts or hard-husked seeds were involved in the Knap of Howar case, it may be reasonable to suggest that the damage on the apex of the domed surface resulted from contact with a nether stone during intermittent cracking or pounding of tough elements. Just what those tougher elements may have been is possibly a matter for future investigation.

But whatever may be decided about the probable use to which these stones may have been put on Papa Westray, there still remains the question as to why the type is so curiously rare. If they were used for processing tough, wild foods their absence in Neolithic and later times might be explainable in terms of a decline in the role of wild fruits and seeds. But why should they (apparently) be absent from the Mesolithic and Upper Palaeolithic? The ethnographic and archaeological specimens mentioned have all come from warm, semi-arid environments where seeds and their pericarps may in some cases be tougher than their NW European equivalents, if not initially, at least seasonally, after drying out: perhaps wild plant foods in Europe require little more processing than the teeth are capable of. Which raises the question, was there some food resource, peculiar to the northern latitudes of the British Isles, which led to the evolution of domed handstones but which lost its importance once cereal crops were established? Finally, it may be suggested that the type is rather more common than has been suggested, but has not received the attention it perhaps warrants. The eye-catching feature is undoubtedly the pit in the polished grinding surface, and it may be worth remarking that, in a number of specimens examined by the writer in the Pitt Rivers Museum in Oxford, the pit has been so nearly worn away as to be almost invisible. The whole question of querns and rubbing stones/mullers in British prehistory is one that would undoubtedly benefit from closer scrutiny in the future. Certainly they are a class of artefact which should receive more meticulous description in site reports than they have hitherto received.

APPENDIX 4: ANIMAL BONE FROM KNAP OF HOWAR

B A NODDLE, Department of Anatomy, University College, Cardiff

The animal bone from Knap of Howar was very well preserved, as is common on Orkney sites, but it was very fragmentary. An indication of that fragmentary state can be given by the proportion that could

be identified, which was 56% by weight on that proportion of the material which could be weighed, which was about two-thirds. Since there was a distinct possibility that the upper two layers of the excavation might be contaminated by modern material (we were informed that eight Clydesdale stallions were buried in the area) these layers were treated as a separate group. However, the only modern burials that were detected were those of two cattle, which were excluded. Nevertheless all the stray horse bones were in the upper layers, so that it is thought unlikely that horse occurred at the Neolithic site.

The amount of fragmentation referred to above was of a rather unusual kind; much of it was bone splinters which were thought to be the debris from bone working. A sample of such splinters from all layers showed that some of the specimens were obviously worked. This fragmentary material was of a size to derive from large animals, ie cattle or possibly red deer. This makes a conventional species count by fragment, always rather unsatisfactory, even less reliable. More weight should therefore be given to the minimum number of individuals assessed on frequency and dimensions and age range of bones. For the purposes of this estimation it was assumed that each layer of each trench contained separate individuals.

Some of the preliminary identification was done on site, and this is the portion which was not weighed. Measurements were carried out by osteometric board for the large specimens to the nearest millimetre and smaller specimens by means of engineer's calipers to the nearest 0·5 mm.

RESULTS

A *Proportion of species*

This was estimated in three ways: by numbers of fragments, by minimum numbers of individuals and by bulked weight on part of the sample. The numbers of identified fragments are set out in table 1. A total of 6764 fragments was identified, of which 1931 came from topsoil contexts, 2270 from layers belonging to Period II and 2563 from Period I layers. This excludes rabbit bones, which were present in most layers, and frog, which was sometimes present in quantity. There is little difference between Period I and Period II, cattle and sheep making up the vast majority in roughly equal proportions. Pig was present at a minor level and all other species (domestic dog and cat, wild red and roe deer, seal, whale, otter) were rare. Horse and cat occur only in the topsoil and are probably of modern derivation.

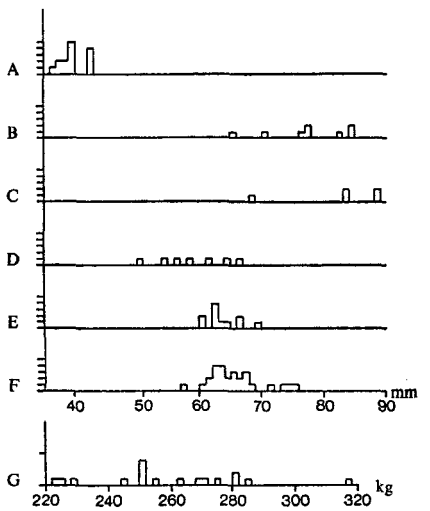

FIG 20 Measurements of cattle bones: A, length of lower third molar; B, distal humerus across condyles; C maximum width proximal radius; D, maximum width proximal metacarpal; E, maximum width distal tibia; F, length first phalanx (sagittal); G, estimated body weight derived from astragalus measurements (Noddle 1973)

TABLE 1

Proportions of species: numbers of fragments

	Cattle	Sheep	Pig	Deer	Seal	Otter	Whale	Dog	Cat	Horse
Topsoil	839	1049	18	1 roe	3	3	4	6	1	10
Period II	1010	1212	39	4 red	2	–	5	2	–	–
Period I	1379	1137	30	3 red	11	–	9	1	–	–
Total	3228	3398	87	8	16	3	18	9	1	10

NB These figures do not include bone and antler artefacts.

B *Minimum individuals and age structure*

Table 2 sets out the minimum number of individuals from cattle, sheep and pig and their age range where it could be determined. The age stages are determined as follows:

N, newborn. All bones small, no fused epiphyses, all dentition temporary and unworn.

W, weaning. Bones slightly larger than above but still retaining newborn character. No epiphyses fused. All dentition temporary with the exception of molar 1, showing some wear.

J, juvenile. No epiphyses fused except scapula. Bones larger than above but not full-sized. Temporary incisors and premolars still present, M2 in wear and M3 not present. In modern terms these animals would be up to c 18 months in age, but modern data cannot be strictly applied to these ancient types.

I, immature. Earliest epiphyses fused (proximal radius, distal humerus, phalanges). Intermediate epiphyses may be fused (distal metapodial, tibia) but not late group (proximal humerus, tibia, both ends femur, distal radius, ulna and calcaneum, vertebrae). Permanent premolars may be present but not much worn. Third molar present but not in full wear, some temporary incisors present. In modern terms these animals will range from c 18 months to four years.

M, mature. All epiphyses fused. All permanent teeth fully in wear.

TABLE 2

Proportions of species: minimum number of individuals and age range (common species only; see text for explanation of age range)

	Total	N	W	J	I	M
Cattle						
Topsoil	24	6	4	5	1	7
Period II	83	22	20	9	12	15
Period I	59	19	9	8	9	11
Total	166	47	33	22	22	33
Sheep						
Topsoil	44	9	5	11	10	10
Period II	101	13	13	17	25	19
Period I	63	10	7	8	16	14
Total	208	32	25	36	51	43
Pig						
Topsoil	6	–	–	–	3	3
Period II	15	–	–	3	7	2
Period I	8	1	–	1	2	2
Total	29	1	–	4	12	7

Over 50% of the cattle bones in both upper and lower layers derived from individuals which had died in the year they were born. Just over 20% were mature, and these would be the breeding stock, but some animals at the immature stage might have borne one offspring. This finding is the same as that of Watson for the material from Childe's excavation of Skara Brae (Childe 1931, 198–204). This genuine finding was extended to many other excavations at later dates where it was not just justified, and gave rise to the myth of autumn killing. These data indicate that the breeding females were capable of bearing an average of five offspring each to maintain numbers. The same findings apply roughly to sheep, except there is a lower proportion in the very youngest groups, but still only c 25% mature. In contrast only one of the few pigs

died when very young and the majority of animals died at the immature stage. However, the numbers are so low that they cannot be relied upon to any great extent.

C *Estimation by weight*

That proportion of the bone which was weighed according to species gave the following result: 73% cattle, 26% sheep and 1% all other species. These weights can be used to give an indication of the proportions of the different meats eaten, since bone weight makes up c 7% of the live animal, or some 12% of the dressed carcass (Meat and Livestock Commission data; Kubasiewicz 1956).

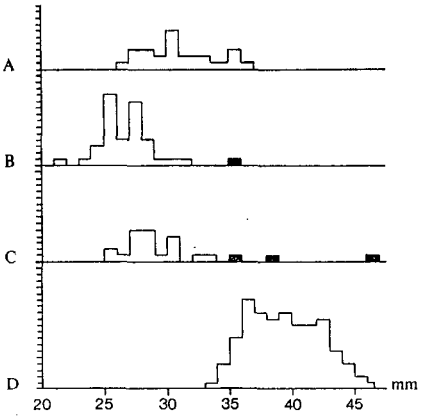

FIG 21 Comparative measurements of bovine bones, width of first phalanx: A, Knap of Howar; B, Durrington Walls (Harcourt *in* Wainwright & Longworth 1971); C, Windmill Hill (Grigson *in* Smith 1965); D, aurochs (Grigson 1969). Shading indicates specimens considered to have been derived from aurochs

D *Anatomical analysis*

The cattle and sheep bone were subjected to anatomical analysis into bone groups, as set out in table 3. This indicates that the parts of the carcass were found as bones in roughly the same proportion as they would occur in the living animal, given the fragility of the cancellous bone of the vertebrae, always under-represented.

TABLE 3
Anatomical analysis (%)

Anatomical region	Cattle upper layers	Cattle lower layers	Sheep upper layers	Sheep lower layers	Number present in each skeleton
Mandible	3	5	4	5	2
Vertebrae	14	10	13	12	c 30 (excluding caudial vertebrae)
Upper fore limb	12	11	17	16	8
Upper hind limb	10	13	18	18	6
Metapodials	8	9	9	13	4
Phalanges	17	17	9	8	24
Carpals and tarsals	12	11	9	8	20
Loose teeth	13	17	13	14	24 (excluding incisors)

E *Type of animal*

Since the type of animal from this early period in this remote region has not hitherto been described very fully, this will now be done in considerable detail. Watson found the Skara Brae cattle unlike those he had hitherto encountered from English excavations, but at that point the early date of this settlement was not fully realized, and he tried to make his comparisons with rather later material. Neither were there very much data available on the wild ancestors of these animals at that time. Nevertheless he came to the con-

clusion that he was dealing with a large primitive domestic race of cattle, more like the wild than he had hitherto encountered. However, he published little metrical data. He described the sheep as primitive and akin to Iron Age or Soay sheep. Platt described a long- and slender-boned form of sheep intermingled with others from the Shetland site of Jarlshof (*in* Hamilton 1956, 212–15). A more detailed account of what is believed to be the same animal was given by the writer for the Buckquoy material (Noddle *in* Ritchie, A 1977, 201–9), and this same sheep occurs at this early date (Noddle 1978).

The principal data available for describing archaeological animals are of course bone measurements, but the form of the horn core, where it is available, is also of value though there are massive sex differences. Unfortunately only one bovine horn core was found in anything like a complete state and this was from layer 1 (topsoil) and looks suspiciously like a modern Shorthorn. However, there are a number of sheep horn cores. The measurements of the complete bones are listed for all species in table 4 and this also includes all the measurements possible on pig and deer bone. The other commonly occurring measurements are set out in the form of histograms in the various figures.

TABLE 4

Measurements of complete bones (mm)

Animal	Bone	Length	Proximal width	Distal width	Midshaft width
Cattle	Metatarsal	220	50	57	30
		225	48	52	28
Sheep	Radius	153	29	27	17·5
		140	27	26	16
	Metacarpal	110	19	21	11
		110	19	22	12
		116	21	23·5	13
		117	21	22	12
		125	21	24	13
	Metatarsal	123	–	22	11
		127	–	–	11
		130	19	22	11

Pig (all measurements)							
	Metatarsal	Length	81	81			
	1st phalax	Length	36	41			
	Lower 3rd molar		38				
	Astragalus	Max Length	40	41	41	42	44
	Scapula	Min width neck	24	24·5	27		
	Humerus	Width across distal condyles				29	33
Red deer (all measurements)							
	Astragalus	Max length	57				
	Tibia	Distal width	58				

As Watson stated in his Skara Brae report, the cattle are indeed large. The measurements set out in fig 20 are considerably larger than the writer has encountered at other periods, being roughly similar to a collection of Friesian beef cattle in her collection (these were not fully grown animals). Fig 20 also contains an estimate of body weight reduced from various measurements on the astragalus which originally derived from these same Friesian cattle in part (Noddle 1973). The lightest of these animals overlap the heaviest weights found for later animals (Saxon, from Norfolk; Noddle 1975). Fig 21 comprises a comparison of the width of the first phalanx compared with two groups of English Neolithic cattle from Durrington

Walls (Harcourt *in* Wainwright & Longworth 1971, 265–76) and Windmill Hill (Grigson *in* Smith 1965, 141–67) and with a collection of Danish Maglemosian aurochs taken from Grigson (1969). The Knap of Howar specimens are rather larger than both these English examples and overlap the lighter aurochs. Furthermore, they form a continuous series, whereas both English sites include a few discrete larger specimens which were designated wild aurochs by their authors. The Knap of Howar specimens are comparable with certain continental examples discussed by Grigson (1969) and believed by her and the continental authors to be recently domesticated aurochs. This explanation would seem to apply to the Knap of Howar material.

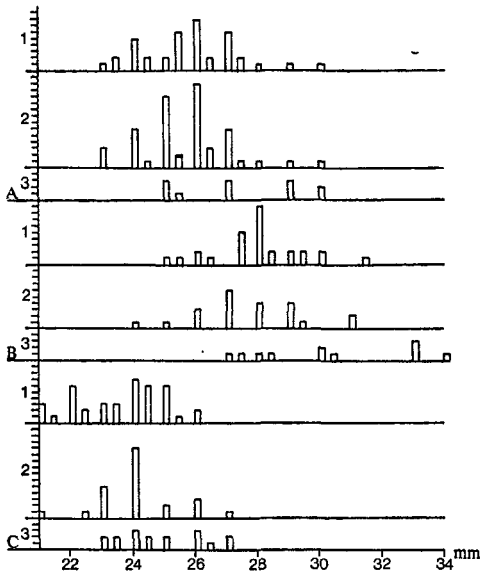

FIG 22 Comparative measurements of sheep bones: A, width distal humerus across condyles; B, maximum width proximal radius; C, maximum width distal tibia. 1=North Ronaldsay, 2=Knap of Howar, 3=mouflon

Though the bone measurements set out in fig 22 show a single consistent type of sheep, there were a variety of horned and polled forms. There was a total of 21 frontal bones or separate horn cores. Of these only one was fully polled, but polled frontals are more fragile than horned ones. This came from the deeper layers and so is not likely to be modern. Three more bore scurs (rudimentary horns); one of these was a more or less complete skull (pl 8b), but unfortunately comes from the upper layers. There were 11 complete adult horn cores, eight of which were similar, oval in shape, c 10 cm in length, and might derive from castrate males (pl 8c). Three more were considerably shorter and rounder in cross section; these together with the scurred and polled specimens might derive from females. Such a variety of horns and hornless is common amongst primitive sheep including the wild mouflon. Two further specimens appeared to be from male lambs, but their adult form could not be determined.

The frequently occurring bone measurements have been set out in comparison with the present day native sheep of North Ronaldsay and the form of mouflon maintained by the Zoological Society of London at Whipsnade Park, to whom I am indebted for the gift of the specimens (figs 22–4). As this flock has been at the zoo for many generations, it might be regarded as a semi-domesticated form. Though there is a considerable overlap between the comparative types, the Knap of Howar type would appear to be intermediate in size between the two, possibly more like the mouflon than is immediately apparent, because the majority of the mouflon specimens are male, and it might be expected from the age structure of the Knap of Howar sheep that the majority of the mature animals, which of course are only suitable for measurement, are likely to have been breeding females. There was, however, one major difference from both the modern sheep breeds in the femur. This is the position of the nutriant foramen, which is either on the anterior proximal aspect of the bone or on the posterior surface, sometimes both; the posterior position may be either distal or midshaft. The most common position in the Knap of Howar sheep was distal

midshaft, whereas in North Ronaldsay and mouflon it is almost invariably proximal anterior. The only modern breed exhibiting the midshaft position with any frequency is the Shetland, but both specimens of femur collected from the crossbred Orkney sheep still remaining on the Holm of Papa Westray also exhibited this position, which may be an interesting local long-term survival. The age structure of the Knap of Howar flock would also indicate that the majority of the animals were killed young for their meat and hides rather than their wool, which these primitive specimens are unlikely to have possessed.

As with other domestic animals, the measurements of the pig bones set out in table 4 indicate large animals, and overlap with the dimensions of the present day wild sow. Since there is little other evidence of hunting and the island is probably too small to have supported a population of wild pig once man was present, it is probable that these animals were domestic.

There is very little to say about such a small sample of deer bones. It seems improbable that they were Papa Westray animals, and would seem likely to have come from imported carcasses.

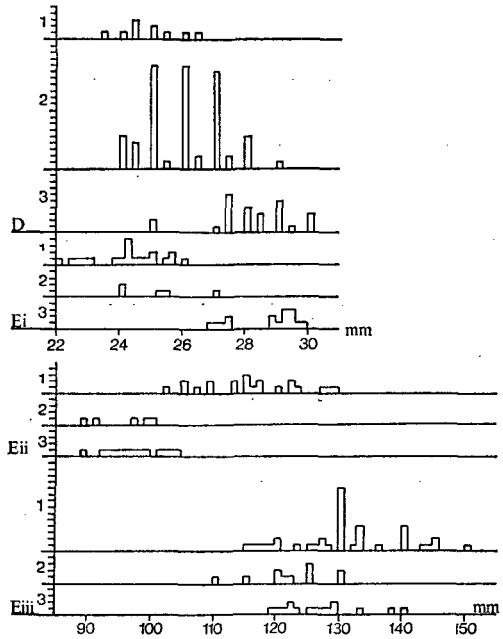

FIG 23 Comparative measurements of sheep bones: D, maximum length astragalus; Ei, maximum length metacarpal; Eii, index length/midshaft width × 100 metacarpal; Eiii, shaft index/midshaft width/AP × 100 metacarpal. 1 = North Ronaldsay, 2 = Knap of Howar, 3 = mouflon

Abnormalities and pathology

The most interesting specimen was the humerus of a newborn calf exhibiting classical signs of chondrodystrophia (bull-dog calf) (pl 8d). Unfortunately it came from topsoil and so might be modern, but if so other bones of the same animal might well have turned up. To the writer's knowledge this condition has not been reported previously from a British site.

Two cases of periodontal disease in sheep mandibles were observed, both of which were from the primary midden (house 1, layer 14). This condition occurs at all archaeological periods both in Britain and in Continental Europe, sometimes affecting a large proportion of animals. One of the Knap of Howar specimens appears to be a chronic case which has stabilized after loss of teeth. Also from the primary midden (trench III, layer 4), there was a sheep metacarpal which showed signs of mild rickets.

One of the few pig bones, an accessory metapodial from Period II (house 2 layer 3) bore a peculiar smooth exostosis, for which no cause can be suggested. Seal phalanges from floor deposits in house 1 (layer 4) and house 2 (layer 2) showed signs of massive infection. This might indicate that sick or dead seals were scavenged rather than actively hunted.

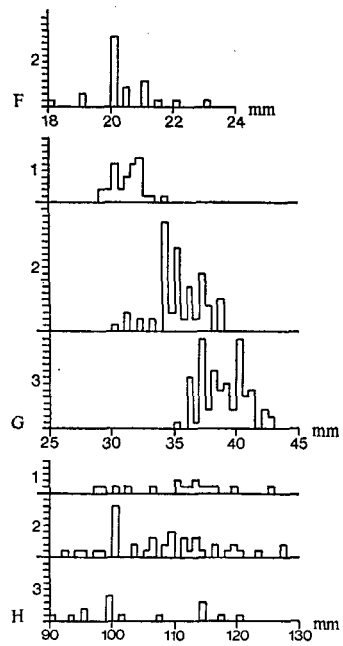

FIG 24 Comparative measurements of sheep bones: F, length lower third molar; G, length first phalanx (sagittal); H, scapula neck, ratio glenoid spine distance/minimum shaft width. 1=North Ronaldsay, 2=Knap of Howar, 3=mouflon

DISCUSSION

The vast majority of large mammal bones derived from cattle and sheep in about equal proportions, but a few domestic pigs were probably kept. There was little evidence of hunting; the few deer bones were probably imported and the seal carrion. Only 20% of the individual animals were mature, and some 50% of the cattle died in their first year. The usual explanation for this is that there was a dearth of winter fodder, but the impression gained here was that the animals had a good standard of nutrition, and it is possible that the calves were killed for their skins, other clothing materials being in short supply.

The high proportion of newborn animals, particularly cattle, requires some explanation. The same pattern has been found at the Neolithic sites at Grimes Graves (Legge *in* Mercer 1981c) and Hambledon Hill (Mercer 1980); Legge believes that this is the result of using adults as milk producers, but there are other explanations. The first is that the abundance of juvenile bones is an effect of extensive bone-working, using the more suitable adult bone; a large amount of bone débitage was certainly found at Knap of Howar. Another possibility is that the primitive cows would not breed every year if they were allowed to rear their calves. Thirdly, the calves may have been valued for their own sakes, principally for their skins, which would have been more suitable for clothing than the heavy hides of the adults (although sheep skins were also available). These suggestions are not, of course, mutually exclusive, but a primary dairy function is thought unlikely; modern cattle with a long history of domestication will give milk in the absence of their calves, but these are primitive and recently domesticated animals. There is a famous illustration of a Babylonian cow, a polled animal, being milked with her calf tethered in front of her. The modern pastoral societies of Soviet Asia do not kill the offspring but keep them separate from their mothers for sufficient periods for milk to accumulate in the udder for human extraction.

Both cattle and sheep were primitive forms, recently domesticated though not, in the case of sheep, locally as no recent wild sheep occur in Britain. The sheep are thought not to have been wool-bearing. The origin of the Orcadian Neolithic livestock is of considerable interest, and it is possible that they might be Scandinavian or at least North European. Hatting describes sheep and cattle from the Neolithic site on Lidsø, an island S of Zealand (1978); the cattle are particularly large, and their measurements overlap those of the Knap of Howar animals in both directions. These animals are related to other N European assem-

blages, and the horn cores illustrated from Lidsø are reminiscent of those from Skara Brae; there were few remains of sheep, but the skull of a young castrate male was similar to the old breed of Gotland sheep, again close to the Orkney type. Hatting does not mention the age range of the Lidsø material.

APPENDIX 5: BIRD BONES FROM KNAP OF HOWAR, ORKNEY

D BRAMWELL, Fulwood, Baslow Road, Bakewell, Derbyshire

The bird species (table 5), presumably all taken for food, are predominantly pelagic, that is, birds which take their food from the open sea, mainly in the form of fish, small crustacea and other marine

TABLE 5

Number of fragments of species and estimate of number of adult and juvenile birds

Site provenance (H = house, T = trench)	Great northern diver	Black-throated diver	Little Grebe	Fulmar	Manx shearwater	Shearwater sp	Gannet	Cormorant	Shag	Velvet Scoter	Eider	Duck sp	Shelduck	Goose, greylag	Goose, barnacle size	Swan, whooper	Buzzard	Crake, spotted	Corncrake	Oystercatcher	Plover, grey	Turnstone
H1, 1			1				4			1								1			1	
H1, 2		3					3							1					1			
H1, 4																1						3
H1, 8							5															
H1, 9								1														
H1, 10																						
H1, 11				1				1			1				1							
H1, 13																						
H1, 14				2			4	2	6		1				3							1
H1, 15							1								1							
H1, 16							1							5	1							
H2, 1				2					3						1							
H2, 2																						
TII, 3							4					1	1	2			1					
H2, 4														1								
H2, 5											1											
H2, 6																						
H2, 7															1							
H2, 10																						
TII, 11				11	1			1	2					1								
TII, 13									2													
TIII, 2																						
TIII, 4						1								1								
TIV, 1														1								
TIV, 2							2		1							2						
TIV, 2B				1																		
TIV, 4								2							2							
TIV, 5																						
TV, 2								2														
TV, 4	1																					
TVI, 2																				1		
Fragments	1	3	1	17	1	1	24	9	14	1	3	1	1	12	10	3	1	1	1	1	1	4
Adults	1	1	1	2	1	1	2	2	2	1	1	1	1	1	2	1	1	1	1	1	1	1
Juvenile									1													

organisms. Twenty-three species belong to this group while another five species largely feed on the mud and sand areas between high and low tides. The remaining 12 species are either freshwater or land birds. Ocean-going species would normally be difficult to capture for food and it may be assumed that the majority would be taken in early summer when they came to land for breeding purposes, some to cliff ledges, some to grassy places, others to burrows or under rocks and rubble.

Sea birds are notoriously full of oil, due to their fishy diet, but this oil could have made them attractive to the islanders. Some possible uses of the oil are suggested by the activities of the St Kildans and other island communities. Oil was valuable for illumination, as medicine, for cooking, etc, and was particularly obtained from the fulmar, a bird which was not (according to Fisher & Waterston 1941),

Snipe	Curlew	Redshank, spotted	Wader, small sp	Wader, large sp	Skua, great	Skua sp	Gull, Great-Black backed	Gull, lesser-Black backed or herring	Gull, common	Gull sp	Tern, Sandwich	Razorbill	Great auk	Guillemot	Guillemot, black	Puffin	Skylark	Raven	Thrush sp	Starling	Undetermined	Redshank	
		1					1					2	5			1							
	1				2		1												1				
												1											
			1					1															
				2					1			1	1										
							1					1	1									1	
													3	1									
													1	1									
				2				1					3	4							4		
													1										
							1						1	1				1			1		
1						1		1		1			1			1							
																				1			
					2								2		1						7	1	
	1									1		1	1										
								1													2		
															1								
							1	1															
															1		1				4		
				2	1		8					2	3				1				12		
													1	1	1								
								1	1	1			6	13							4		
							4				1	1											
																					1		
													1										
1													4	18		1					4		
2	2	1	1	6	5	1	17	6	2	3	1	9	35	39	4	3	2	1	1	1			
1	1	1	1	1	2	1	2	2	1	2	1	1	4	5	1	1	1	1	1	1			Total 60
				2										1									Total 4

breeding in Orkney until about 1900. Perhaps guillemot, razorbill, puffin and great auk supplied most of the necessary oil at Knap of Howar (12 birds) while only one fulmar was present.

Out of a total of 293 bird bones and fragments, 40 different species were noted, comprising 59 individual birds. There were also parts of only four juveniles showing that young birds did not figure very much in the hunting and diet. This differs from the practice over the last few centuries where there was an annual large cull of young gannets by the inhabitants of some Hebridean islands. Here, and in the Faroes, gannets were opened up by splitting them down the back. They were then dried by sun and air for winter use, but of this process there is no evidence at Knap of Howar.

TABLE 6

Habitat, seasonal appearance and breeding habit in Orkney

		Shore and sea	Fresh water	Estuaries	Land	Breed or bred on island	Summer visitor	Autumn and winter visitor
Diver, black-throated	*Gavia arctica*	×						×
Diver, great Northern	*Gavia immer*	×						×
Little grebe	*Tachybaptus ruficollis*		×			×		
Fulmar	*Fulmarus glacialis*	×				×		
Manx shearwater	*Puffinus puffinus*	×				×	×	
Shearwater sp	*Puffinus* sp	×						×
Gannet	*Sula bassana*	×					×	
Cormorant	*Phalacrocorax carbo*	×				×		
Shag	*Phalacrocorax aristotelis*	×				×		
Velvet scoter	*Melanitta fusca*	×		×				×
Eider	*Somateria mollissima*	×		×		×		
Duck sp						?		
Shelduck	*Tadorna tadorna*	×				×	×	
Goose, greylag	*Anser anser*			×	×			×
Goose, barnacle size	*Anser* or *Branta* sp			×	×			×
Swan, whooper	*Cygnus cygnus*		×	×		×		×
Buzzard	*Buteo buteo*				×	×		
Crake, spotted	*Porzana porzana*		×		×			×
Crake, corn	*Crex crex*				×	×	×	
Oyster catcher	*Haematopus ostralegus*	×	×	×		×		
Plover, grey	*Pluvialis squatarola*	×						×
Turnstone	*Arenaria interpres*	×			×			×
Snipe	*Gallinago gallinago*				×	×		
Curlew	*Numenius arquata*	×		×	×	×		
Redshank, spotted	*Tringa erythropus*	×		×				×
Wader, small sp		×		×				
Wader, large sp		×		×				
Skua, great	*Stercorarius skua*	×		×		×	×	
Skua, sp	*Stercorarius* sp	×		×		?	×	
Gull, Great black-backed	*Larus marinus*	×		×		×		
Gull, Lesser black-backed/herring	*Larus fuscus/argentatus*	×		×	×	×		
Gull, common	*Larus canus*	×		×	×	×		
Gull, sp	*Larus* sp	×		×		?		
Tern, Sandwich	*Sterna sandvicensis*	×		×		×	×	
Razorbill	*Alca torda*	×		×		×		
Great auk	*Pinguinus impennis*	×				×	×	
Guillemot	*Uria aalge*	×		×		×		
Guillemot, black	*Cepphus grylle*	×		×		×		
Puffin	*Fratercula arctica*	×				×	×	
Skylark	*Alauda arvensis*				×	×		
Raven	*Corvus corax*				×	×		
Thrush sp	*Turdus* sp				×	?		
Starling	*Sturnus vulgaris*				×	×		

The most esteemed pelagian bird at Knap of Howar appears to have been the great auk, a now extinct, flightless, North Atlantic member of the *Alcidae* which formerly came ashore on beaches with shelving rocks, to lay its single egg. Papa Westray appears to have provided favourable conditions, the last breeding pair in Scotland having been exterminated here in 1813 (Buckley & Harvie Brown 1891). The bird was like a huge razorbill with very reduced wings. Its inability to fly contributed to its decline and extinction but the remains of four adults and one juvenile at Knap of Howar show that in early Neolithic times it was not particularly rare around Papa Westray though further bones of hunted birds have also been recovered from Obanian shell middens on Oronsay and at mainland coastal sites. The occurrence of the juvenile bird is interesting as it was probably taken in late summer from a local colony. At Knap of Howar there is a singular absence of skull and foot bones, suggesting that the birds were butchered at the shore, by removing heads and feet and probably the viscera, to make the carcass more portable. So far there has been no indication from the bones as to the method of hunting these birds, or indeed of any other birds taken for food.

One cannot rule out the use of boats as a means of hunting in view of the remains of the two divers, since neither species is known to breed on the lochs on Orkney. They are seen in the coastal seas in autumn, winter and early spring (table 6). This is also the time of year when scoters and eiders might also seek coastal feeding grounds though the eider is a regular breeder on the archipelago and is notoriously easy to approach at the nest. The collection of eider down, used by the bird to line its nest, may also have been an activity in the early Neolithic economy. Other inland nesters would be gulls, skuas, shearwaters, puffins, black guillemots, crakes, ducks, snipe, curlew, redshank, skylark, thrush species and plover. Raven and buzzard would favour cliff ledges. Rushy and sedgy sites are preferred by little grebe and spotted crake whilst sand dunes are the preference of Sandwich terns. In winter the shores between tide lines would attract the waders such as curlew, redshank, oystercatcher, turnstone and plover. Whooper swans would feed on life in tarns, lochs and estuaries. The greylag goose has a history of breeding in Scotland but in winter large flocks of Iceland birds also move in, along with barnacle and other smaller geese. They all spend some feeding time on grassland and agricultural land, particularly where crops have been harvested.

In comparing Knap of Howar birds with later prehistoric sites along the Scottish coasts it is noticeable that gannet, cormorant and shag are not dominant. At Skara Brae, for example, gannet was abundant and the humeri were often sharpened into useful piercing implements, probably used in preparation for sewing animal skins. Shag bones were also very common at broch and wheelhouse sites.

APPENDIX 6: FISH REMAINS FROM KNAP OF HOWAR, ORKNEY

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The fish remains from this site are composed of a large number of hand-picked fish bones and a small amount of sieved material. The species identified from remains from each sampling method are compatible with one exception where the sieved material contains bones of a species not recognized in other samples but the size of specimens represented in the sieved material is, as would be expected, much smaller than the other material. This shows, although the point hardly needs further demonstration, that sieving produces both confirmatory evidence and supplementary material to that attained by hand-picking.

The species represented from each sample are listed below under the major headings for period and feature, together with an estimate of the size of the specimen(s) present, where such an assessment is possible. A list of the identified bones is not given but has been deposited in the National Monuments Record of Scotland. Square brackets indicate sieved samples.

PERIOD I

House 1 layer 9, cod (85 cm = 5 kg); ling (10 kg); ballan wrasse.
layer 10, cod; ling (4·5 kg).
layer 11, cod; gadoid indet.
layer 14, cod (8, 3·5 kg); saithe (10 kg) [length 20–45 cm]; gadoid indet; halibut; elasmobranch indet.
layer 16, conger (length 150 cm).

House 2 layer 5, conger (length 110 cm); gadoid indet; flounder [2 kg].

Trench II layer 11, ? *Trisopterus* sp; turbot (5 kg).
Trench III layer 4, saithe [length 20 cm]; gadoid indet; elasmobranch indet; halibut (length 130 cm); turbot (2 kg).
Trench IV layer 2B, conger (length 120 cm); cod; gadoid indet.

PERIOD II

House 1 layer 2, cod (6 kg)
layer 3, cod; gadoid indet; turbot (3 kg).
layer 4, ling (6 kg); gadoid indet.
House 2 layer 2, [saithe (length 20 cm); elasmobranch indet].
layer 7, [saithe (length 70 cm); cod 3·5 kg); eel].
layer 12, cod.
Trench II layer 2, saithe (10 kg); ling; [rockling]; gadoid indet; [elasmobranch indet].
layer 3, cod (5 kg); halibut.
Trench III layer 3, conger; elasmobranch indet.
Trench IV layer 2A, eel; cod (2, 4 kg); saithe; ling.
Trench V layer 2, cod (6 kg); elasmobranch indet ? *Raja* [saithe; *Raja*].

DISCUSSION

Like most fish remains from archaeological sites these remains are fragmentary and, while suggesting something of the diet of the inhabitants and their methods of exploiting the fishes in their environment for food, are by no means conclusive.

The exploitation they suggest is a varied one. The presence of eel (Period II, house 2 and trench IV) could be indicative of fishing in fresh water, either in a fresh water loch or stream, for this species is best known in such habitats. To some extent the presence of flounder (Period I, house 2) could also be interpreted as evidence of fishing in a freshwater loch, with a connection to the sea, for this flatfish occurs in fresh water and many lochs in Orkney (eg Stenness) contain large numbers of often large flounders. However, as is so often the case, the evidence is equivocal because both the eel and the flounder can also be captured in the sea, the former amongst rocks between tidemarks and the latter on sandy shores. Despite this it could be argued that both species are somewhat easier to capture in shallow fresh water where they can be seen in water less than a metre deep and they require no equipment more advanced than a fish spear for their capture.

The remainder of the fishes identified are without doubt sea fishes. Although most of them have a wide bathymetric range and are not highly selective of a particular habitat, it is possible to make subjective assessments of the probable fishing techniques which would result in their capture.

Several of the species represented are likely to have been caught from the shore, in relatively shallow water. In particular the young specimens of saithe (Period I, house 1 and trench III; Period II, house 2 and trench V), the estimated lengths of which ranged from 20 to 45 cm, could be captured close inshore, probably from rocky headlands using hook and line, or a baited dropnet. Such a fishing method would also account for a species like the ballan wrasse (Period I, house 1), a fish often seen close to sublittoral mussel beds, on which it feeds extensively. In addition, a fishing technique refined enough to capture small saithe, especially if it was using small hooks and line, could very easily also capture the small gadoid fishes identified here (Period I, trench II) as *Trisopterus* sp (a genus which contains the bib, Norway pout, and poor cod, all of which occur round Orkney although the first-named is the most common inshore). A fourth 'species', the rockling (Period II, trench II) – incompletely identified but probably a five-bearded rockling, as this is the most abundant species of the group on the shores of Orkney today – is also likely to have been captured by means of a baited dropnet, small hook and line, but could also be very easily caught by hand on the shore at low tide. The evidence for fishing on or from the shore during both periods of occupation is therefore strong.

However, the remainder of the species are strongly indicative of offshore fishing activity and, in view of the species concerned, a strong probability of fishing with hooks, or gorges, and long lines, and a certainty of fishing from boats exists. From the number of occurrences of cod, saithe and ling, some of them fish weighing in excess of 5 kg, and the numerous fragmentary bones labelled here as gadoid but almost certainly referrable either to cod or saithe, there is no doubt that these fish were important to the diet of the community on the site. The cod is found in moderately deep water of 10–50 m, mainly now on offshore banks near the edge of the continental slope but no doubt in the Neolithic also found closer inshore. The

saithe, after its first two or three years, quits the inshore waters and migrates offshore to be found in 20–100 m on rocky grounds mainly and usually 10 miles or more offshore. Large specimens, like some of the bigger ones identified in these remains, are often found close to areas where there are strong currents. The ling is also found mostly on hard bottoms in depths in excess of 10 m.

As significant as any of these gadiform fishes is the halibut represented in both periods (Period I, house 1 and trench III; and Period II, trench II). The halibut, unlike most flatfishes, forages off the sea bed and is most frequent over hard ground but in depths of more than 10 m. Size estimation of the remains in Period I, trench III, suggests a length of fish of around 130 cm, and fish of that length usually live in rather deeper water, at least 20–30 m. At this length a halibut would be close to a weight of 40 kg and thus a formidable fish requiring strong tackle to capture.

The turbot (Period I, trench II; and Period II, house 1) is another moderately large flatfish which lives most commonly on shingle or shell and sand banks offshore in depths of 5–10 m. It too is most likely to have been captured by hook and line fishing. A similar conclusion is reasonable to account for the presence of the conger eel, an often large eel which frequents rocks and hard ground in 5 m or more depth.

The occurrence of elasmobranch remains (chiefly vertebral centra which are indistinguishable as to species but could represent several small shark or ray species) is likewise in agreement with this. The presence of a jaw tooth of *Raja* (Period II, trench V – sieved remains) confirms that rays were captured, and the same sample contains elasmobranch vertebral centra – presumably ray also. An elasmobranch centrum of 17·5 mm diameter occurred in Period II, trench III, which if this is also of a ray was a large one, and it might be suggested came from one of the larger species, probably the skate which is common around the Orkneys and moreover is found on soft bottoms close to rocks in similar habitats to the halibut.

The overall impression from this species list is that, in addition to fishing from the shore for small species and young fish, there was also a fishery offshore in deeper water. Such a fishery implies the use of boats capable of withstanding the weather between two and five miles out to sea, and the use of fishing lines capable of holding fish of 10 kg (possibly even 40 kg) and of fishing in depths of 10 to 20 m (which would require about double that length of line).

One interesting biological point that emerges is the presence of turbot in both periods. Today, the turbot is a southerly fish and would be classed as rare in Orkney, so for two samples to contain its remains suggests that it may have been more abundant in the Neolithic than now. It may be that the climate was somewhat warmer than that today and the turbot ranged further north, but it could also be accounted for by the present range of the turbot reflecting the effects of fishing pressure rather than true distribution. The material is too sparse to allow further analysis of this point.

The remains from the site include bones from most of the skeleton. While numerically dominated by vertebral centra (which are the most numerous large recognizable bones in a fish), there are substantial numbers of jawbones, and bones from the head skeleton, including two otoliths (cod and saithe). This shows that the fish were not beheaded on capture but were brought to the site whole, or possibly after gutting.

NOTE

Scientific names of fishes mentioned in the text (nomenclature follows Wheeler 1978): ballan wrasse, *Labrus bergylta;* cod, *Gadus morhua;* conger (eel), *Conger conger;* eel, *Anguilla anguilla;* elasmobranch, group name for sharks and rays; Flounder, *Platichthys flesus;* gadoid, group name for members of the cod family; halibut, *Hippoglossus hippoglossus;* ling, *Molva molva*; *Raja*, genus name of rays and skates; saithe, *Pollachius virens;* skate, *Raja batis; Trisopterus*, genus name for three small gadoid fishes; turbot, *Scophthalmus maximus.*

APPENDIX 7: BEETLES FROM KNAP OF HOWAR, ORKNEY

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Two samples were submitted, and neither was helpful in terms of the environment of the site:

Nebria ?brevicollis (F), damaged left elytron, lacking diagnostic shoulder;
Staphylinidae – Staphylininae, cf *Philonthus* sp, undiagnostic abdominal sternites.

APPENDIX 8: THE MOLLUSCS FROM KNAP OF HOWAR, ORKNEY

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This report deals with the molluscs from the Knap of Howar. It falls logically into two parts. The first deals with the land and freshwater molluscs and is concerned solely with the palaeo-environment of the site and its surrounds. The second discusses the marine molluscs (the shellfish) and is largely concerned with the prehistoric economy, although having environmental implications as well.

THE LAND AND FRESHWATER MOLLUSCS

Analysis of land and freshwater molluscs preserved subfossil in Holocene deposits on and adjacent to the archaeological site has been used to work out aspects of the palaeo-environment. A number of locations was investigated, some exposed in the coastal cliff section, others in the archaeological excavation. In general terms they consisted of calcareous wind-lain shell sand, derived from the foreshore, sealing a buried soil and archaeological deposits. Within the wind-lain sand unit there was a series of marl horizons. The present-day environment is one of fixed-dune pasture in which little or no sand movement is now taking place.

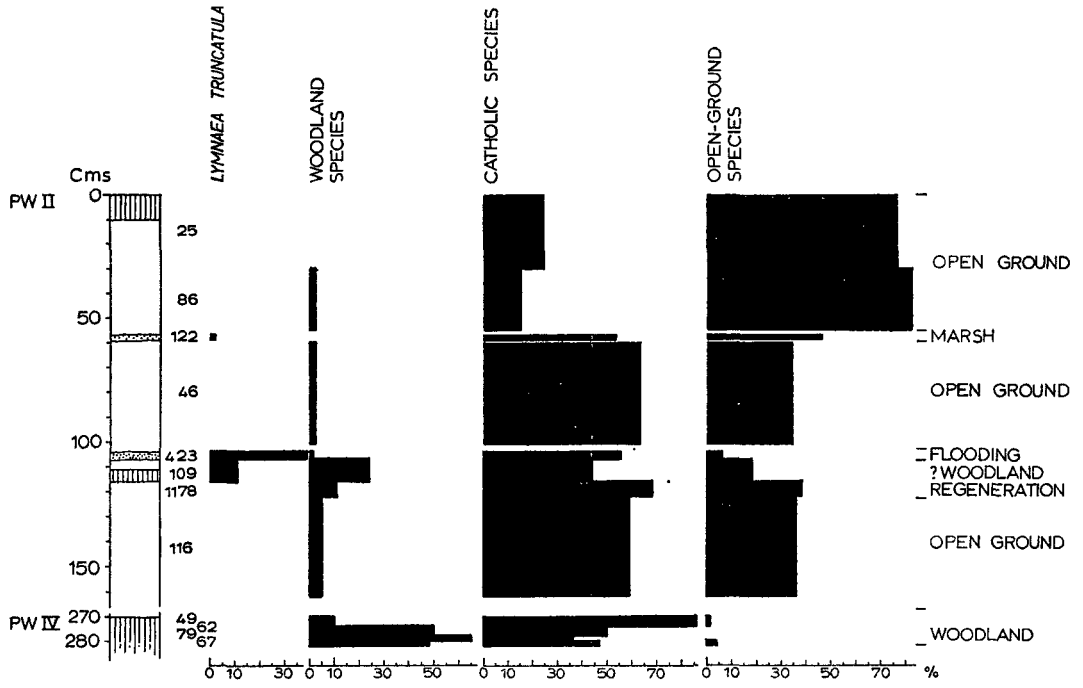

FIG 25 Land and freshwater molluscs from locations PW II and PW IV (stipple = clay, vertical hatching = organic horizon). Woodland species: *Carychium, Vertigo pusilla, V substriata, Leiostyla anglica, Acanthinula, Discus, Vitrea, Aegopinella, Oxychilus* and *Clausilia*. Catholic species: *Cochlicopa, Lauria, Punctum, Vitrina, Nesovitrea, Euconulus* and *Cepaea*. Open-ground species: *Vertigo pygmaea, Pupilla* and *Vallonia excentrica*

Dating of the coastal sections was impossible other than by the broad assumption that the main sand and marl horizons were contemporary with or later than the archaeological site. Only a selection of the results obtained has been presented in this report. The molluscan counts have been listed in tabular form (table 7). Fig 25 is a composite diagram made up from the results from two cliff sections, and it is

TABLE 7

Knap of Howar. Land and freshwater molluscs (nomenclature after Waldén 1976)

		PW IV				PW II							
Depth below surface (cm)	BS	280–282	278–280	274–278	270–274	122–162	116–122	107–116	104–107	60–101	57–59	30–55	0–30
Air-dry weight (kg)	2·5	1·0	1·0	2·0	2–0	1·6	1·0	0·85	0·55	2·0	1·0	1·0	2·55
Carychium tridentatum (Risso)	–	2	–	–	–	–	–	18	6	–	–	–	–
Lymnaea truncatula (Müller)	–	–	–	–	–	–	–	12	162	–	2	–	–
Cochlicopa lubrica (Müller)	14	–	2	10	6	21	106	15	42	25	23	–	–
Cochlicopa lubricella (Porro)	6	–	2	7	4	14	38	–	–	3	18	3	–
Cochlicopa spp	10	8	3	–	14	10	127	16	151	1	8	3	3
Vertigo pusilla (Müller)	3	–	2	–	–	–	–	–	–	–	–	–	–
Vertigo substriata (Jeffreys)	–	–	1	–	–	–	5	9	–	–	–	1	–
Vertigo pygmaea (Draparnaud)	2	–	–	–	–	3	8	1	21	–	–	1	1
Pupilla muscorum (Linné)	–	2	–	–	–	14	12	2	1	3	8	30	10
Leiostyla anglica (Wood)	–	–	1	4	–	–	2	–	–	–	–	–	–
Lauria cylindracea (da Costa)	5	8	18	11	10	10	299	3	2	–	11	3	–
Vallonia excentrica Sterki	–	1	–	–	1	24	362	17	4	13	48	40	8
Acanthinula aculeata (Müller)	–	–	2	–	–	–	–	–	–	–	–	–	–
Punctum pygmaeum (Draparnaud)	2	1	–	1	–	2	28	5	14	–	1	1	–
Discus rotundatus (Müller)	7	8	8	5	3	–	–	–	–	–	–	–	–
Vitrina pellucida (Müller)	–	–	–	–	–	4	14	–	–	–	–	1	2
Vitrea contracta (Westerlund)	–	1	3	–	–	6	54	–	–	–	–	1	–
Nesovitrea hammonis (Ström)	32	15	3	2	9	8	55	8	5	–	3	2	1
Aegopinella pura (Alder)	–	3	6	4	–	–	22	–	–	–	–	–	–
Aegopinella nitidula (Draparnaud)	–	18	21	15	2	–	8	–	–	–	–	–	–
Oxychilus alliarius (Miller)	–	–	5	3	–	–	21	–	–	–	–	–	–
Euconulus fulvus (Müller)	–	–	–	–	–	–	15	3	15	–	–	–	–
Clausilia bidentata (Ström)	–	–	2	–	–	–	–	–	–	1	–	–	–
Cepaea hortensis (Müller)	–	–	–	–	–	–	2	–	–	–	–	–	–

confidently considered that the lower sequence (PW IV) precedes the upper (PW II). The archaeological site probably falls at more or less the interface of the two, continuing into the upper sequence.

Location PW IV

A section in the sand cliff c 55 m N of the N fence of the site showed the following stratigraphy:

Depth below surface (cm)	
0–10	Modern turf
10–40	Brown humic sand becoming paler with depth
40–270	Pale silvery sand stained orange in parts
270–282	Buried soil. Dark-brown (10YR 3/3–4/3) stony loam with sand particles throughout
282+	Orange boulder clay. (B)-horizon of buried soil.

The buried soil contained fragments of marine shells and hairline sand layers. It also contained land snails. In these respects it differed from the buried soil in section PW II (see below). The initial blown sand accumulation was probably slow, sand becoming incorporated into the soil by faunal activity, and possibly human disturbance as hinted at by the presence of marine shell fragments.

A column of samples from the buried soil was analysed for land snails (table 7; fig 25). The fauna was characterized by a high species richness, especially in the lower levels, indicative of considerable habitat diversity. At the same time it was practically devoid of the familiar open-ground species, *Pupilla muscorum* and *Vallonia excentrica*. It is difficult to avoid the conclusion that this fauna reflects a vegetation of scrub or, more probably, woodland.

Buried soil on the archaeological site

A sample was taken from the entire thickness of the buried soil on the archaeological site at a point immediately below the division between houses 1 and 2 (BS in table 7). The molluscan fauna, while poorer in species numbers than that from PW IV, was similarly devoid of open-ground elements. This too may be considered indicative of scrub or woodland. It is likely that the differences between the two faunas reflect local variation over the woodland floor. PW IV was probably a wetter, and therefore richer, site.

Location PW II

A second cliff section c 100 m to the NE of the archaeological site exposed over 1·5 m of wind-lain sand and associated organic and marl horizons. The stratigraphy was as follows (fig 25):

Depth below surface (cm)	
0–10	Modern turf. Dark brown (10YR 4/3) sandy loam
10–30	Yellowish brown (10YR 5/4) sand with faint humic bands
30–57	Clean light yellowish brown (10YR 6/4) sand, lacking humic bands
57–59	Brown (10YR 5/3) clay with intercalated sand lenses
59–104	Clean pale yellow (2.5YR 7/4) sand
104–107	Very pale brown (10YR 7/3) clay with hair-line organic bands
107–111	Light grey (10YR 7/2) sand
111–116	Very dark reddish brown (5YR 3/2) organic clay
116–122	Dark yellowish brown (10YR 4/6) humic sand
122–162	Very pale brown (10YR 7/3) sand
162–172	Buried soil. Dark brown (10YR 4/3) non-calcareous loam
172+	Bedrock.

A column of samples from this section was analysed for molluscs. The results have been presented in tabular (table 7) and histogram (fig 25) form. In general terms both the stratigraphy and the molluscan sequence suggest a succession of stable land surfaces, sometimes flooded, alternating with episodes of instability and sand deposition.

The buried soil at the base of the section was devoid of shells, suggesting rapid initial deposition of

sand at this point. The wind-lain sand layers are on the whole loose and not compact, the sand being coarse and generally clean. Shells are sparse. These facts point to rapid build up from a virgin source, probably the upper shore.

On the other hand, the organic horizons reflect longer periods of time. The complex between 104 and 122 cm is difficult to interpret precisely. In general terms there is a massive increase in the numbers of shells, and a greater diversity of species with certain elements indicative of shaded habitats, and the marsh/freshwater species, *Lymnaea truncatula*, is characteristic of the upper levels. The deposits themselves, especially the clays, are suggestive of freshwater deposition. We can perhaps, therefore, say that at this stage in the succession there was some woodland regeneration and the development of a small pond. Similar ponds occur in the area today. The upper organic horizon (57–59 cm) is less complex and less substantial. Its fauna is less rich. It probably reflects a pause in the sand accumulation when damp grassland or marsh covered the area.

Modern faunas

In order to assess the possible ecological significance of the subfossil assemblages, nine modern collections were made (table 8). In most cases counts were made in the field and turf samples were analysed from the same spot. In the lists the results of both methods have been amalgamated. Care was taken not to include subfossil shells. All records were made in July and August over a two-year period.

TABLE 8

Orkney: modern land-mollusc faunas (* = presence noted, not counted)

	Collecting site								
	1	2	3	4	5	6	7	8	9
Oxyloma pfeifferi (Rossmässler)	–	–	*	–	–	–	–	–	–
Cochlicopa lubrica (Müller)	42	–	–	–	–	7	–	–	12
Cochlicopa lubricella (Porro)	7	9	12	4	3	30	3	1	61
Cochlicopa spp	89	27	6	–	8	47	1	4	50
Vertigo pygmaea (Draparnaud)	82	–	–	–	1	–	–	–	–
Pupilla muscorum (Linné)	6	–	16	–	–	–	1	22	–
Lauria cylindracea (da Costa)	–	–	9	80	22	145	–	153	1
Vallonia excentrica Sterki	183	94	37	–	–	–	–	–	–
Punctum pygmaeum (Draparnaud)	31	–	–	–	2	44	6	–	19
Arion circumscriptus (Johnston)	–	–	–	–	–	1	–	–	–
Arion hortensis (Férussac)	–	–	*	–	–	–	–	–	–
Arion intermedius (Normand)	1	–	*	–	3	4	5	–	3
Vitrina pellucida (Müller)	66	4	1	33	114	32	61	43	35
Vitrea contracta (Westerlund)	–	–	–	–	–	9	–	–	13
Oxychilus alliarius (Miller)	–	–	*	1	–	25	1	1	53
Milax sp	–	–	*	–	–	–	–	–	–
Deroceras reticulatum (Müller)	4	–	–	–	4	1	19	–	1
Limacidae	3	–	–	–	–	1	2	–	–
Candidula intersecta (Poiret)	–	–	–	–	21	–	–	–	–

The details of the collecting sites are as follows:

1 Skaill Bay HY 233 187. Short-turved calcareous grassland on shell sand, closely cropped by cattle and rabbits. Vegetation 3–5 cm tall. Level ground. Soil at base of vegetation, not sand.
2 Adjacent to Site 1, but sand, not soil at base of vegetation.
3 Adjacent to Site 1. Tall, damp grass and other herbaceous vegetation (eg *Rumex*) around the ruins of a stone building.
4 Skaill Bay HY 235 193. Fixed-dune pasture just above high-water mark; under stones.
5 Birsay HY 246 272. Sand-dune area to E of Birsay Bay. Poorly developed humic horizon. Grazed by cattle and rabbits.
6 Sands of Evie HY 378 262. Fixed-dune pasture on indurated sand, grazed by sheep and rabbits.

7 Sands of Evie HY 378 262. As for Site 6, but more sandy. About 20 m towards the coast from Site 6.
8 Skaill Bay HY 235 193. A coastward extension of Site 4. An area of marram grass immediately above high-water mark. Much bare loose sand.
9 Sands of Evie HY 378 262. About 20 m inshore from Site 6, but otherwise similar.

While admittedly made on a somewhat *ad hoc* basis and with little record of the physical and biological characteristics of the locations, these collections are of some value. In the first place they give us a good idea of the modern Orcadian land mollusc fauna, especially that from open-ground habitats (table 8). Not more than 17 species occur, and of these only four are at all abundant – *Cochlicopa*, *Lauria*, *Vallonia* and *Vitrina* – with about six others reasonably frequent. This is similar to the situation in the subfossil assemblages from the wind-lain deposits both at Knap of Howar and other Orcadian sites (Spencer 1975; Evans & Spencer *in* Ritchie, A 1977, 215–19).

A striking feature is the way in which only one or at most two species predominate in any one fauna. No fauna contains two species each at more than 30%, whereas eight of the nine faunas contain one species at over 40% and five of the nine contain one species at over 70%. These are faunas of extremely low diversity.

A third point is that there may be considerable variation over a short distance. This can sometimes be loosely attributable to habitat variation as in the case of the Skaill Bay collections. (Compare the *Vallonia*-dominated faunas from Sites 1, 2 and 3 with the *Lauria*-dominated faunas of Sites 4 and 8.) But equally, as with the Sands of Evie faunas (Sites 6, 7 and 9), such correlation is difficult.

The single collection made from a fairly damp habitat with tall herbaceous vegetation and stones (Site 3), which might have been expected to have yielded some of the more shade-preferring species found in some of the subfossil assemblages, was closely similar in general terms to the other modern faunas.

Discussion and conclusions

The molluscan assemblages from two locations in the buried soil at the base of the wind-lain sand deposits almost certainly indicate a former woodland environment. One of these faunas is unequivocally sealed by the Neolithic site, and the other (PW IV) is probably of similar age.

Wind-lain sand was already accumulating during this period as evidenced by the thin sand layers within the buried soil. And the preservation of shells at all can only have been brought about by the high calcium carbonate content of the soil, a property directly attributable to the calcareous sand.

An environmental change to more open habitats with surface instability and massive sand accumulation is clearly indicated both in the stratigraphy of the sections investigated and the molluscan faunas. Human intervention may have contributed to these changes but there is no direct evidence for this one way or another.

A period – or periods – when small ponds and marshy habitats formed in the area is indicated. Similar habitats are still present today.

Although there are areas in Orkney today where active dune movement is taking place, it seems likely that the episodes of sand deposition in the past were more extensive and dramatic.

These conclusions are broadly consistent with the results of similar work done on other Orcadian sites (Spencer 1975; Evans 1979; Evans & Spencer *in* Ritchie, A 1977), and they are supported by the palaeobotanical investigations of Keatinge and Dickson (1979).

THE SHELLFISH

All the shellfish (mainly marine molluscs) came from various horizons associated with the archaeological site. As excavation proceeded, all shells were identified and counted. For identification and taxonomy Graham (1971) has been followed for gastropods and Tebble (1966) for bivalves. In the case of the gastropods (marine snails such as whelks and winkles) only more or less complete shells or apices were counted, fragmentary and non-apical material being ignored. However, all specimens of the large whelk, *Buccinum*, were counted as there were sufficiently few of these to be certain that each represented only one animal. In the case of the bivalves (eg oysters and scallops), left and right (or lower and upper) valves were counted separately when these could be rapidly distinguished, thus giving a minimum count for each species. This was not done with *Cerastoderma* and one or two others, and the recorded totals for these should therefore be halved to bring them into parity with the rest. In practice, the precise numbers probably have little significance. Differential loss through fragmentation was considerable. For example the

proportion of measurable (ie complete) values of *Mytilus* and *Ensis* of the total counts gives an indication of the fragmentary state of the shells of these two groups: *Mytilus*, 26 out of 119; *Ensis*, one out of 621. On the other hand, the counts for the relatively tough shell of *Littorina littorea* are probably more nearly a reflection of true abundance. Equally there is some discrepancy between the counts for opposite valves of the same species, again indicating loss at some stage between collection by Neolithic man and recording by 20th-century archaeologists.

Measurements were made on samples from various contexts of *Patella*, *Ostrea* and *Cerastoderma*. In addition, all complete *Buccinum*, *Mytilus* and *Ensis* shells were measured. Measurements were made to the nearest millimetre. All measurements were of shell length with the exception of *Buccinum* where height was measured.

The results of identification, counting and measuring from the various contexts were amalgamated into three groups on the basis of their archaeological age. These were: Period I; Period II; and topsoil. The last has been excluded from further consideration.

Observations and results

Practically all the species recorded were littoral or offshore molluscs. *Cepaea hortensis* is a land snail which may have been collected for food but which equally could have constituted an element of the indigenous land-snail fauna. The crab fragments probably belong to the crustacean, *Cancer pagurus*. The single sea urchin fragment is probably of *Echinus esculentus*, an echinoderm.

As far as the species lists and counts are concerned, there are no significant differences between the collections from the two periods and they can therefore be considered as one (table 9). Predominant is the common limpet, constituting over 85%. The oyster, at c 7%, is the only other really prominent species. Winkles (c 2%), cockles (c 1%) and razor shells (c 0·5%) are of far less importance. The remaining species are present in very low numbers indeed.

TABLE 9

Knap of Howar, shellfish

fgt=fragment; lv=left valve; lov=lower valve; rv=right valve; uv=upper valve

		Period I	Period II
Patella vulgata (Linné) (common limpet)		23 760	40 326
Patina pellucida (Linné) (blue-rayed limpet)		–	1
Gibbula cineraria (Linné) (top shell)		8	12
Calliostoma zizyphinum (Linné) (painted top shell)		–	1
Littorina littoralis (Linné) (flat winkle)		4	47
Littorina littorea (Linné) (edible winkle)		782	619
Trivia monacha (da Costa) (cowrie)		2	1
Nucella lapillus (Linné) (dog whelk)		14	19
Buccinum undatum (Linné) (whelk or buckie)		7	13
Cepaea hortensis (Müller)		15	40
Mytilus edulis (Linné) (common mussel)	rv	46	12
	lv	53	8
Ostrea edulis (Linné) (common European oyster)	uv	2 596	2 150
	lov	2 219	1 942
Pecten maximus (Linné) (great scallop or escallop)	uv	13	10
	lov	26	22
Chlamys varia (Linné)	rv	13	17
	lv	23	19
Chlamys opercularis (Linné) (queen scallop)		–	2
Arctica islandica (Linné) (Iceland cyprine)		1	1
Cerastoderma edule (Linné) (common edible cockle)		353	311
Dosinia exoleta (Linné) (carpet shell)		2	1
Venerupis decussata (Linné) (carpet shell)		15	13
Ensis cf *arcuatus* (Jeffreys) (razor shell)	rv	100	199
	lv	132	164
Ensis spp (razor shell)	rv	6	4
	lv	6	10
Cancer pagurus (edible crab)		6 fgts	5 fgts
Echinus esculentus (sea urchin)		1 fgt	–

During excavation a number of discrete shell concentrations, mainly of limpets and oysters, was noticed. These probably represent dumps of the remains of individual or a few meals, and are a common feature of this kind of site. In a few cases there were articulated pairs of *Ensis* and *Cerastoderma* valves.

Measurements

Patella vulgata: 399 shells were measured from Period I and 396 from Period II (fig 26). In plotting the results, successive pairs of measurements have been combined to give a smoother histogram. The modes or peaks of the histograms are more or less the same although that for Period II is lower by c 0·4 cm (3·7 as against 4·1). Graham (1971) gives 3·0 cm as the normal length of *Patella*, so these specimens are large. Both histograms are skewed to the left, but the significance of this is unclear. It may indicate differential selection of the largest as opposed to the smallest shells by Neolithic man. Or it may be a recovery bias during excavation, or even during selection of the shells for measuring.

Buccinum undatum: seven out of 20 shells were measurable, giving an average for both periods combined of 6·7 cm. Graham (1971) gives 8·0 cm as the height of modern specimens.

Mytilus edulis: 26 shells were measured giving an average for both periods combined of 5·2 cm. Tebble (1966) notes that the species is marketable today at c 5·1 cm. He also notes that the largest animals are to be found low in the intertidal zone.

Ostrea edulis: 44 lower valves were measured from Period I and 236 from Period II. There was no apparent difference between the two groups of measurements. The mode of both was around 9 cm. Tebble (1966) notes that today they are usually up to c 10·2 cm in length.

Cerastoderma edule: 296 valves were measured from Period I and 234 from Period II. As with the *Patella* measurements, successive pairs have been combined in plotting the histogram (fig 26). The mode for both curves is approximately the same, at c 3·4 cm. Tebble (1966) notes 2·5 cm as a marketable minimum today. Both curves are skewed to the left suggesting, as with *Patella*, a bias in favour of the largest shells.

Ensis cf *arcuatus*: the single valve measured was 18·1 cm. This is very large, Tebble (1966) recording 15·2 cm for large specimens today.

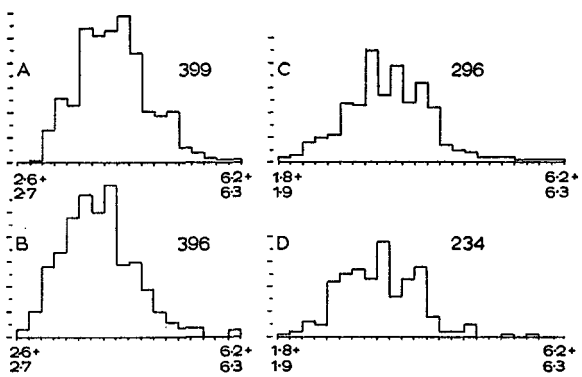

FIG 26 Shellfish measurements: A, limpets, Period I; B, limpets, Period II; C, cockles, Period I; D, cockles, Period II. X axis: each division represents 2 mm and is the combination of two groups of measurements. Y axis: each division represents five shells

Other observations, and notes on individual species

Patella vulgata: most of the shells were of the smooth, flattened form suggesting their origin to have been either from low in the intertidal zone or from a shore little exposed to heavy wave action, or both.

Patina pellucida: this species measures only 1 cm long and is unlikely to have been collected for food. It lives on the fronds and in the holdfast of the low-water razor-strop wrack, *Laminaria*, and may have been incorporated into the midden as a by-product of the collection of this seaweed.

Littorina littoralis: a small species, not more than 1 cm long, which lives on various bladder-wrack seaweeds in the intertidal region. Like *Patina* it may have been incorporated into the midden incidentally

as a by-product of the collection of seaweed. Horizons of *Littorina littoralis* are frequent in the sandy loams of coastal cliff sections elsewhere in Orkney and other parts of Britain. Alternatively the shells may have been collected for manufacture into beads, being tough, almost spherical and, with their bright colours, decorative. No perforated shells were noted at Knap of Howar but they have been recorded from Neolithic levels at Skara Brae.

Trivia monacha: a small, non-food species that may have been collected for decorative purposes.

Buccinum undatum: only seven out of 20 shells were complete. The shell is tough, and this leads one to suspect that the remaining, incomplete, examples (mostly specimens in which the top of the spire was missing) had been broken deliberately in antiquity.

Pecten maximus: the predominance of lower over upper valves (48 as against 23) suggests collection of these, perhaps for use as containers.

Cerastoderma edule: a few of the shells showed signs of chipping at the ends or along the ventral edge. Similar damage can be caused by oystercatchers, and if indeed this was the cause of these marks then the shells may have been empty when collected.

What habitats were being exploited? And how were the shellfish gathered?

Consideration of the present-day habitats of the various species of shellfish in the midden indicates that a variety of habitats was being exploited. These fall into three broad categories, namely rocky shores, sandy shores and a variety of compacted and immobile fine substrata habitats.

Practically all the marine gastropods and *Mytilus* could have been collected in the intertidal region of one and the same rocky shore. Some of the species, for example *Patella* and *Nucella*, may occur as far up the shore as the high-water neap tide level. Others such as *Gibbula* occur lower on the shore. And some, such as *Buccinum* and *Calliostoma*, could only have been collected at extreme low-water.

Ostrea edulis occurs from about low-water to 45 fathoms and may be found attached to a variety of firm substrata such as rocks or immobile, compact, muds, sands or gravels. The collections may have been made, therefore, from the same shore as the gastropods or from more sheltered situations in which the substrata were other than rock.

Of the remaining bivalves, *Pecten* and *Chlamys* are generally free swimming, occurring from low-water to several fathoms. They prefer sandy or gravelly, not rocky, substrata. *Cerastoderma*, *Dosinia*, *Venerupis* and *Ensis* are burrowers for which a variety of soft, relatively fine substrata are needed – mud, sand, muddy or shelly gravel.

The presence of a number of incidental species characteristic of the extreme low-water region taken together with other indications such as the shape of the limpets and the size of the mussels suggests that it was this zone that was being exploited especially. Collection in most cases would have been fairly straightforward, involving picking (or bashing in the case of limpets) the shells off rocks. Collection of some of the bivalves, especially the cockles, may have necessitated the use of rakes, or curved knives as used today in Wales (Jenkins 1977), but the species is not a deep burrower – not burrowing to more than c 5 cm. It is even possible that some sort of selection process was carried on by Neolithic man when collecting the cockles. If, for example, they had been collected by raking as is often done today one might have expected a number of other shallow-burrowing species (see for example the description of fossil life assemblages from late post-glacial cockle beds on the Firth of Forth (Smith 1971, 37)). Sieves may have been used to remove the smaller shells, a process too that might account for the slight asymmetry (skewing) of the size frequency distributions. The razor shells were probably recovered by digging for they burrow to greater depths (and faster) than other species. Some of the scallops, and possibly the oysters, may have been collected by underwater swimming.

Group gathering by women and children was the probable means of collecting. Probably only a proportion of the resources of any one patch or area of abundance was collected at a time, the group then moving to another patch.

In addition to their collection by man for food, some of the shells may have become incorporated into the archaeological layers as a result of other processes. Already mentioned is the possibility that *Patina* and *Littorina littoralis* were brought onto the site on seaweed collected for food (animal or human) or manure. Seabirds such as various gulls and waders (eg the oystercatcher and curlew) feed on molluscs and crabs, often bringing the animals on to land before devouring them. Human middens (as today) would almost certainly have attracted gulls to them as an alternative source of food. And the collection of shellfish for bait should not be forgotten.

Comparison with other Orcadian sites, Skara Brae (Evans, unpublished) and Buckquoy (Evans & Spencer *in* Ritchie, A 1977, 215–19) demonstrates certain differences. The collection from Knap of Howar is on the whole more diverse than the collections from the other two sites. At Knap of Howar, with the exception of the predominance of limpets, there is a relatively uniform distribution of numbers among the various species present. Also there is a greater dependence on non-rocky shore species. At both Buckquoy and Skara Brae, winkles often equal or exceed limpets, and at the former site, dog whelks are important in some levels.

How many people could the shellfish at Knap of Howar have supported? And for how long?

It is possible to make a crude estimate of the number of calories the shellfish collection might have yielded. Considering only the limpets, and using the figures employed in similar calculations on the Buckquoy shellfish (Evans & Spencer *in* Ritchie, A 1977, 215) of 100 shells = 0·15 kg cooked meat weight = 97·5 calories, one reaches the following results:

Period I, 23 760 limpets = 23 166 cals;
Period II, 40 326 limpets = 39 317 cals.

This calculation uses the weight of meat boiled for 20 minutes. If the flesh is eaten raw, the weight, and hence (presumably) the contained calories, are approximately doubled.

Assuming an average requirement of 2700 cals/person/day, the limpets would have supported approximately one person for 8·5 days in Period I, and one person for 14·5 days in Period II (17 and 29 days if the limpets were eaten raw.)

Data in Bailey (1975) would indicate a longer duration. Bailey suggests that 10 000 limpets would support four family groups (approx 24 people) for one day. In the case of Knap of Howar this would give for Period I: 57 man days; and for Period II: 96 man days. On this basis shellfish may be considered a more important resource than on my estimates.

Of course there is a whole number of unknown variables, such as the number of shells recovered as a proportion of total shellfish consumed, the length of time represented by each period, whether the shellfish were eaten on a seasonal or all-year-round basis, and whether they (especially the limpets) were eaten at all, that reduces seriously the value of these data and calculations. But both of the above calculations do serve to emphasize the overall insignificance of shellfish as a resource, especially if the site were occupied over tens or even hundreds of years as seems to be indicated by the radiocarbon dates.

General conclusions

About 20 species of shellfish, mostly intertidal molluscs, were recorded. Limpets predominated constituting over 85% of the collection. A variety of habitats was exploited including rocky and sandy shores. There were practically no differences between the collections from Period I and Period II either in the species counts or in the measured samples. Shellfish were probably an insignificant component of the diet of the Neolithic inhabitants of Knap of Howar.

As Spencer (1975) has already pointed out, evidence from a variety of sources, the shellfish collections, the land and freshwater molluscs, and the coastal stratigraphy, suggests more extensive sandy shore areas in the vicinity of the site than today. There was a more extensive and active sand-dune system also. The site was probably further back from the coast than now, perhaps sheltered by a high fore-dune ridge, and perhaps adjacent to small freshwater pools.

APPENDIX 9: MACROSCOPIC PLANT REMAINS FROM KNAP OF HOWAR, ORKNEY

CAMILLA DICKSON, Department of Botany, University of Glasgow

SAMPLES

Sample A, charcoal, house 1 (3)

Sample of lightly compressed plant material, too decayed to identify. Fragments of epidermal cells of grass and other plants. No charcoal or identifiable seeds. Pollen rare and too destroyed to identify.

Sample T, charcoal, house 2 (3)

Abundant charcoal, the largest pieces are c 15 by 10 by 5 mm. All are cf *Picea* (spruce); the identification is tentative since the thick-walled epithelial cells are not sufficiently preserved to distinguish them with absolute certainty from those of *Larix* (larch).

Sample H, hearth material, house 1 (2)

Brown and fawn coloured ash with small stones, and flecks of carbon 1–2 mm diam which were examined using a Leitz Ultropak microscope. Some are of carbonized plant material, only one fragment is tentatively identified as that of wood.

Sample U, hearth material, house 2 (10)

Light brown silty clay much penetrated by recent rootlets, and carbonized flecks mostly of amorphous carbon, one carbonized twig.

Sample V, hearth material, house 2 (11)

Light brown ash with small stones, and flecks of carbon. Those with a recognizable structure are of carbonized plant material.

Sample I, hearth material, house 1 (2)

Brown and fawn coloured ash with small stones, and flecks of carbon some of which are of carbonized plant material.

Sample W, soil from old land surface beneath midden, trench IV

Very highly calcareous shelly silty clay, penetrated by recent rootlets, no pollen seen.

Sample EE, soil from old land surface beneath sandblow, test pit 8

Very highly calcareous shelly silty clay with rare carbonized fragments, no pollen seen.

Sample O, posthole filling, house 1 (2×)

Small fragments of wood and charcoal. The charcoal is conifer, the fragments lack characters needed for a definitive identification. The wood is too decayed to identify.

WET SIEVING OF MIDDEN SAMPLES

It is possible that all the grain is of naked barley.

House 1 (14) – *Hordeum vulgare* var *nudum* (naked barley) – 1 grain
Cf *Hordeum vulgare* – 4 grains
Cereal – 6 grains
Conifer – charcoal, 8 by 9 by 4 mm
House 1 (15) – Cf *Hordeum vulgare* – 1 grain
House 2 (6) – *Betula* (birch) charcoal, 3 fragments, largest 6 by 5 by 3 mm
House 2 (7) – Cereal – 3 grains
House 2 (11) – *Alnus* (alder) – charcoal, 15 by 10 by 3 mm
Betula (birch) – charcoal 5 by 3 mm
Cf *Hordeum vulgare* – 1 grain
Cereal – 6 grains
TP 6 midden – Cereal – 3 grains
TP 7 midden – Cf *Hordeum vulgare* – 1 grain
Trench II (5) *Hordeum vulgare* – 1 grain
Trench IV (2) – Cereal – 1 grain
Corylus (hazel) – 1 nut fragment
Trench IV (4) – Cf *Hordeum vulgare* – 1 grain
Cereal – 2 grains
Trench V (2) – Cereal – 1 grain

APPENDIX 10: PALYNOLOGICAL STUDIES FROM KNAP OF HOWAR, PAPA WESTRAY, ORKNEY, 1975

GRAEME WHITTINGTON, Department of Geography, University of St Andrews

During the excavations of this site in 1975, samples for pollen analysis were taken from several points. In trenches II and V samples were taken at 5 cm intervals from the present soil down to the glacial till which underlies the site. In trench VI samples were also taken at 5 cm intervals down into the glacial till at 1·4 m; the highest sample obtained here, however, came from a depth of 1·0 m, as above that level the area had been disturbed by the excavations of the early 1930s. Samples were also taken at 5 cm intervals in test pits 4 and 14. Finally monoliths of material were taken from the bottoms of test pits 15 and 16. These pits were dug following upon conversation with the local farmer who had noted a well-developed

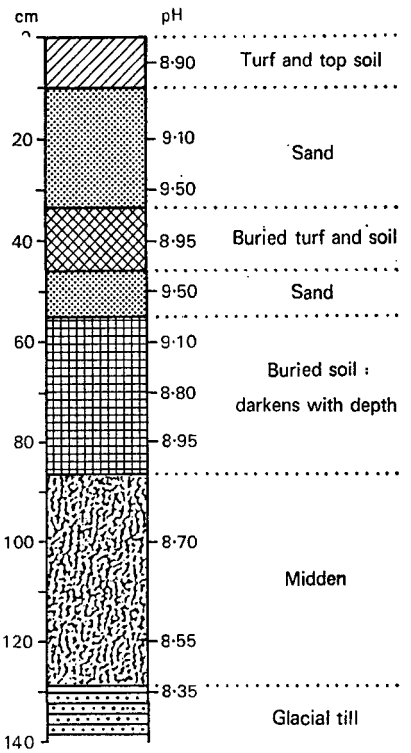

FIG 27 Soil profile with pH values, trench II

and contrasting stratigraphy in the area. The present fully developed soil profile overlay an accumulation of blown sand resting upon a dark organic band which in turn merged into a glacial till overlying the bedrock of Caithness Flag. The dark organic band sounded as if it might be the original soil, developed on the glacial till, which through two analyses might provide useful environmental data to complement the other data being provided directly by the excavation. The soil could conceivably yield evidence of the vegetation history of the area during the whole period of soil formation and thus perhaps of the environment into which the house builders at Knap of Howar came. Second, the date of formation of the topmost layer of the soil, immediately below a sand blow, could also be of interest in the interpretation of human activities at the Knap. Test pits 15 and 16 yielded buried soils of 0·11 and 0·06 m thickness respectively; these were frozen and then cut into 5 mm slices. All of the material for pollen analysis was treated in hydrofluoric and hydrochloric acids before Erdtman's acetolysis. The final preparations, after dehydration, were mounted in silicon oil and the pollen was identified at × 600 magnification apart from the cereal pollen which was examined at × 1500 under phase contrast.

The highly calcareous nature of the machair sand and the possibility that the midden, as it was built up, would have had exposed surfaces over a long period made it likely that pollen grains would not have survived in those materials. It was thought, however, that the buried soils might contain pollen and high hopes were entertained with regard to the basal organic layers from test pits 15 and 16. These hopes were unfounded and out of 146 microscope slides examined only three produced any pollen and then only in very limited quantities. At level 0·95 m (a buried soil area) in test pit 14, one Gramineae (grass) pollen grain was found. In test pit 4 at a depth of 1·55 m (again a buried soil), 10 pollen grains occurred – four grains of Gramineae, one of *Pinus* (pine), one of *Betula* (birch), one of *Compositae liguliflorae* (dandelion type) and, most interestingly, three pollen grains of *Triticum* (wheat). Despite the overall disappointment of the lack of pollen over the site in general, the discovery of the wheat pollen grains in the buried soil so close to the glacial till makes it virtually certain that the occupants of the stone houses were involved in arable agriculture. Even if the builders themselves did not cultivate, their predecessors certainly did. This is made clear by the radiocarbon assay of the uppermost portion of the buried soil in test pit 16 which accords stratigraphically with the buried soil of test pit 4 in which the cereal pollen was found. A date o 2880 bc ± 100 (Birm-817) is earlier than any of the dates obtained from the excavation site, even earlier than the lower midden which predates houses 1 and 2 (2820 bc ± 100, Birm-816). It is true that there are problems in dating buried soils due to the possibility of a refreshment of organic material by downward percolation of groundwater through the overlying material and also as a result of continued micro-organism activity after soil burial. If such factors were involved here, this would make the surface of the soil even older than the date obtained suggests. Even so, as the midden at Knap of Howar has neither a high sand content nor an underlying sand accumulation, it is clear that both the house builders and their predecessors (the originators of the lower midden) settled at a time when the landscape, whatever its floristic components, was developed upon a dominantly organic soil cover; one which contrasts very strongly with that which occurs in the vicinity today.

From the overwhelmingly negative results obtained from the analyses undertaken for Knap of Howar, and for two other machair sites, one at Sorisdale on Coll and the other from Kneep on the Isle of Lewis, it was considered that some general guidelines might be drawn up concerning the potential for pollen analysis of sites located on this material. The reason for the non-preservation of the pollen is clearly related to the high shell content of the machair and of the soils built up on that material. Some quantification of the alkalinity of these materials seemed desirable, thus pH tests were conducted. Fig 27 gives the results of some of these and appears to show quite conclusively why the pollen grains have not survived. The lowest pH in the whole profile is 8·35 for the glacial till which underlies trench II, while the value for the blown machair sand reaches 9·5. Even the buried soils, lying on the glacial till over the bedrock (Caithness Flag) at the bottom of test pits 15 and 16, have values of 8·0 and 8·3 respectively; these values are probably due to the calcareous nature of the bedrock and the leaching downwards of calcareous material from the overlying sands. It appears, therefore, that where machair is involved, with its high pH values, pollen grain survival is most unlikely. However, it is only possible to make this as a tentative suggestion rather than as a definite assertion because of the anomaly provided by test pit 4. Here the 10 pollen grains had survived in a buried soil which had a pH of 8·7; furthermore, they were not unduly corroded. Thus while pollen elimination is clearly related to high pH values, there must also be another variable at work in the machair which allows differential preservation. It would appear therefore still to be worthwhile to take samples from sites on this material in case pollen grains have survived.

APPENDIX 11: RADIOCARBON DATES FROM KNAP OF HOWAR, ORKNEY

A total of 10 samples of animal bone was submitted for radiocarbon analysis, together with one sample of organic soil from a location (Holland) unassociated with the archaeological site. Dates produced by the Radiocarbon Laboratory of the Scottish Universities Research and Reactor Centre (SRR) are the responsibility of Dr D D Harkness, while those produced by the Radiocarbon Dating Laboratory of the Department of Geological Sciences, University of Birmingham (Birm) are the responsibility of Mr R E G Williams. In view of the fact that some of the dates have already been published (Renfrew *et al* 1976, 199; Renfrew 1979, 207), they are given here in the same form, as presented originally by the laboratories, rather than in the rounded figures in which they will appear in *Radiocarbon*. The archaeological implications of the dates from the settlement are discussed in the text (p 57) and those of the Holland date in appendix 10. The dates are quoted in years bc, using the Libby half-life of 5568 years.

SRR-345 2398 bc±75 d 13C= −20·7‰
Floor deposit, house 1, Period II
SRR-346 2582 bc±70 d 13C= −21·2‰
Secondary floor deposit in passage, house 1a, Period II
Birm-814 2740 bc±130 d 13C= −19·1‰
Secondary floor deposit, house 2, Period II
Birm-815 2300 bc±130 d 13C= −19·1‰
Primary midden, trench IV, Period I
SRR-344 2501 bc±70 d 13C= −21·1‰
Secondary midden, trench III, period II
SRR-348 2815 bc±70 d 13C= −21·9‰
Secondary midden, trench II, Period II
SRR-349 2472 bc±70 d 13C= −22·0‰
Primary midden, ternch II, Period I
Birm-816 2820 bc±180 d 13C= −19·4‰
Primary midden, trench V, Period I
Birm-813 2320 bc±100 d 13C= −23·1‰
Primary midden in wall core, house 2, Period I
SRR-347 3756 bc±85 d 13C= −22·2‰
SRR-452 2131 bc±65 d 13C= −21·5‰
Both dates were determined from the same sample: primary midden in south wall-core, house 1, Period I

HOLLAND

Birm-817 2880 bc±100 d 13C= −25·2‰
Organic buried soil at base of test-pit 16

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Scottish Museum, and the photographic negatives and other archival material have been deposited in the National Monuments Record of Scotland. I am very grateful to Mrs Elizabeth Glass for her impeccable typing.

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a Knap of Howar from the air

b Entrance into house 1

a Inner end of entrance passage, house 1

b Inner compartment, house 1

a Redeposited midden in S wall, house 1

b Primary midden below outer (N) wall-face, house 2

c S wall of house 2 showing difference in level between inner and outer faces

a House 2, stone workbench (4)

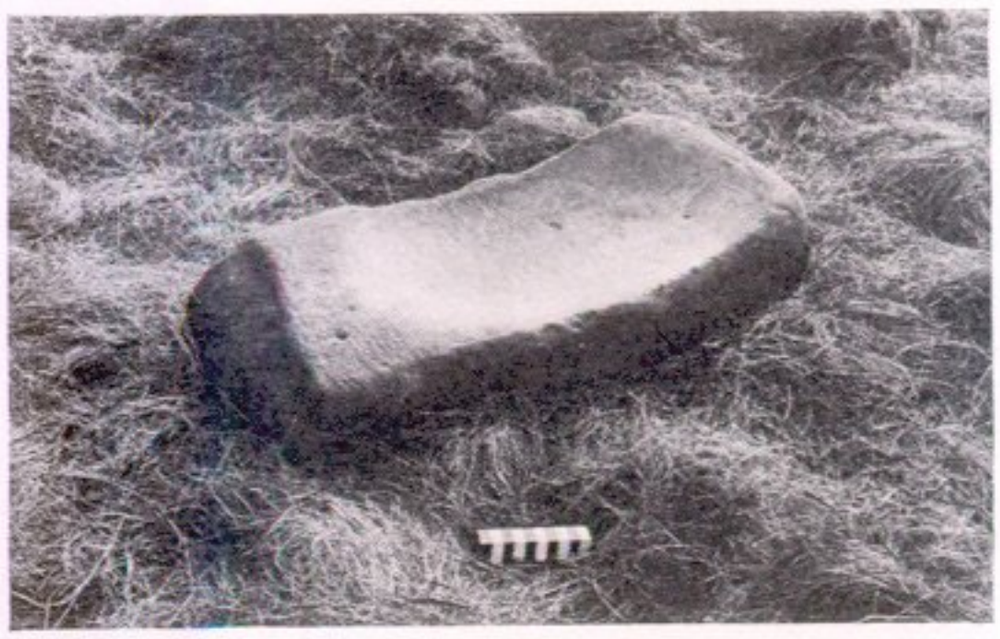
b House 2, secondary hearth (10) and kerb of primary hearth (11)

a House 2

b Inner end of entrance passage, house 2

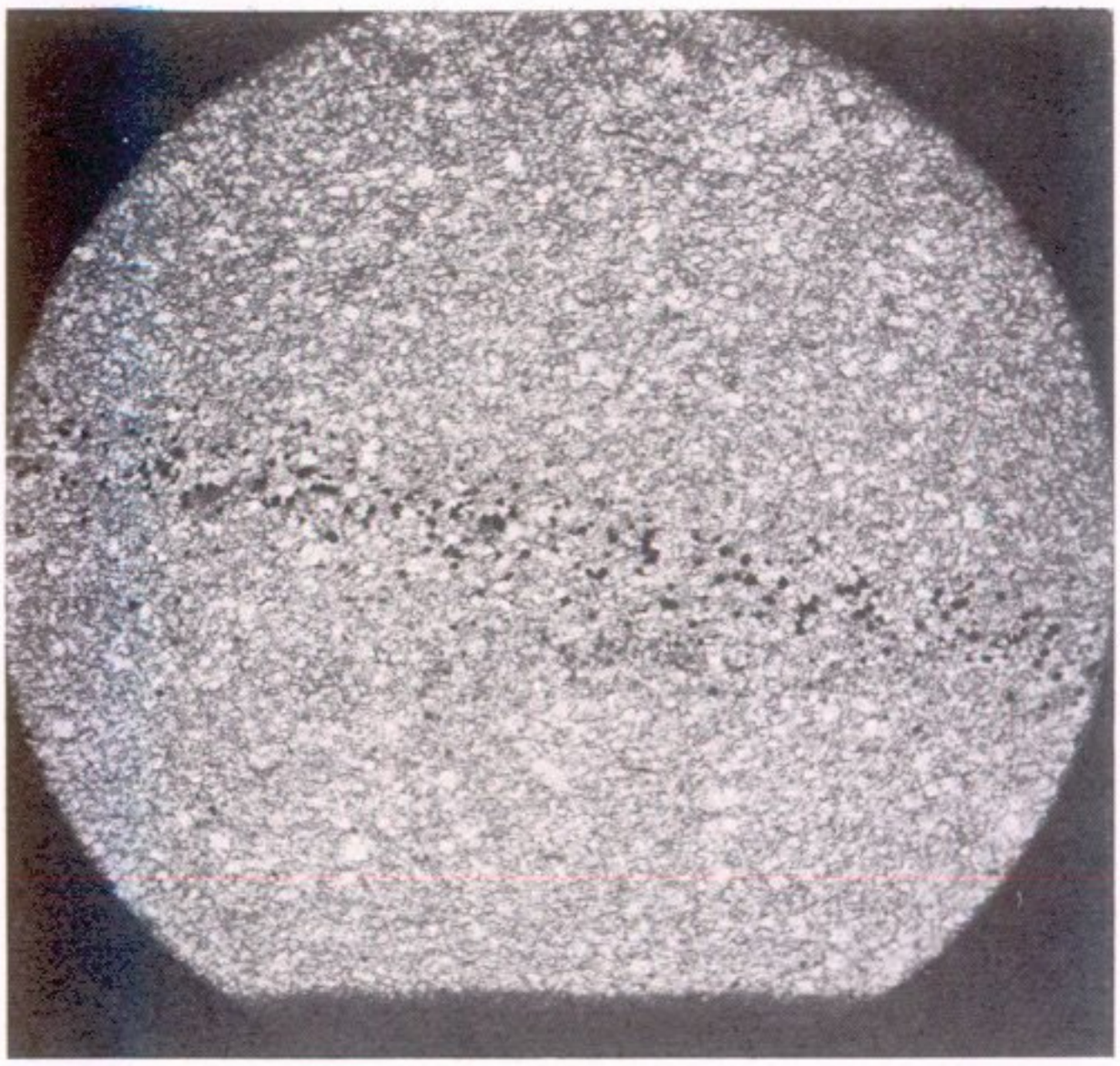
a Blocking of entrance passage, house 2

b Internal wall-face and radial slabs within wall at entrance, house 2



c Quern (no 224)

d Quern (no 225)



a Photomicrograph of axe matrix: fine-grained dolomite with scatter of angular quartz grains and central band of pyrite (polarized light × 60; N Bradford)

b Sheep skull showing scur or rudimentary horn on left side (topsoil)

c Sheep horn core showing typical conformation believed to derive from castrate male (Period I)

d Cattle humerus, new born, showing typical signs of chondrodystrophy (bull-dog calf)