

Tracing the lines: Scottish Grooved Ware trajectories beyond Orkney

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ABSTRACT

This article presents the results of the recent Historic Environment Scotland-funded project Tracing the Lines: Uncovering Grooved Ware Trajectories in Neolithic Scotland addressing the timing and nature of the adoption, development and ultimate demise of Grooved Ware in Scotland beyond Orkney. Following analysis within a Bayesian framework of over a hundred Grooved Ware-associated radiocarbon dates from Scotland beyond Orkney, evidence is presented that Grooved Ware pottery very closely related to Orcadian prototypes began spreading rapidly between key locales across Scotland towards the end of the 4th millennium BC. This was followed by a process of stylistic drift with regional variations. The so-called Durrington Walls sub-style was introduced some 200 years after the earliest Grooved Ware and is an exception to this pattern of gradual change. Our modelling suggests that the latest Scottish Grooved Ware has a currency that overlaps with the earliest Beakers by between 1 and 145 years and probably between 1 and 60 years.

INTRODUCTION

Despite its ubiquity and its significance for understanding social developments during the Late Neolithic, the dating of the origin, spread, development and ultimate demise of Grooved Ware pottery remains problematic. Following on from recent work on the development of Grooved Ware in Orkney as part of the *Times of Their Lives* project (MacSween et al 2015; Richards et al 2016; Bayliss et al 2017; Card et al 2018), the Historic Environment Scotland-funded project *Tracing the Lines: Uncovering Grooved Ware Trajectories in Neolithic Scotland* addressed the timing of the adoption and evolution of the style across Scotland beyond Orkney through a re-evaluation of existing Scottish Grooved

Ware-associated dates alongside the commissioning of 28 new dates to address specific questions. Concentrating on evidence for the time when the pots were in use, the project aimed to determine precisely when and how Grooved Ware pottery first spread beyond Orkney, when and in what ways Grooved Ware subsequently developed in Scotland, and when and how its use there finally came to an end. In total, 131 radiocarbon dates were identified directly from Grooved Ware pots or from deposits containing Grooved Ware from Scottish sites beyond Orkney (ScARF 2019). These dates were subsequently investigated through the use of Bayesian modelling undertaken at the Scottish Universities Environmental Research Centre. On a region-by-region basis, evidence will be presented for the dating of the

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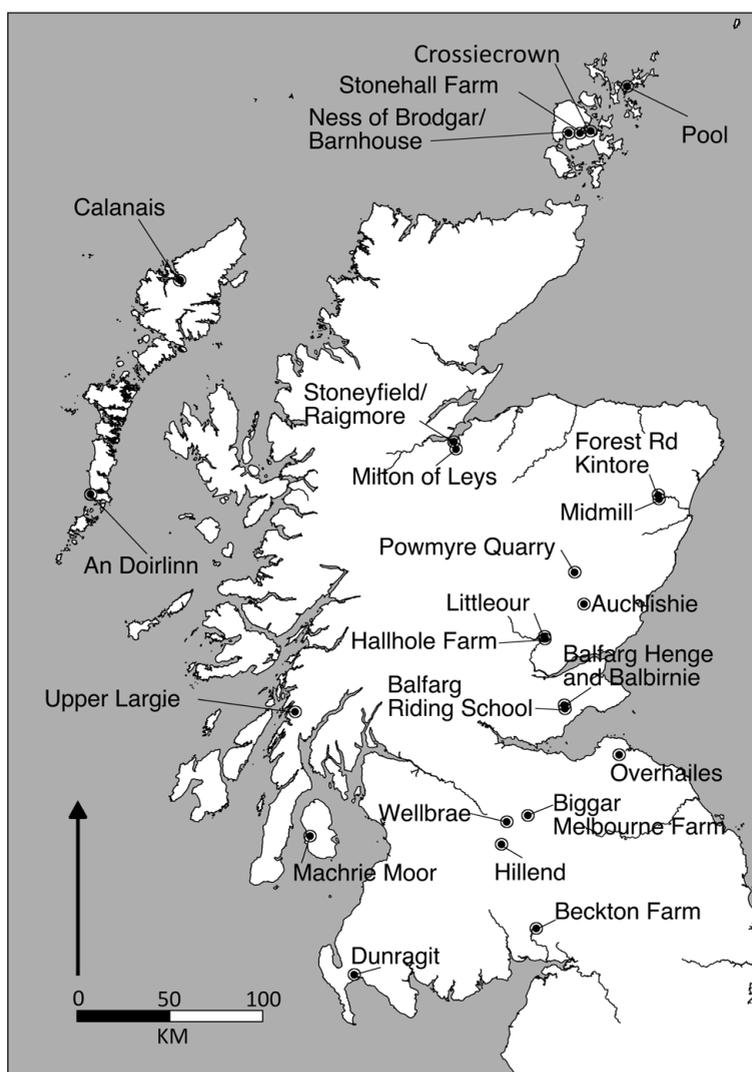
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earliest Grooved Ware followed by a discussion of subsequent developments. The dating of the demise of Grooved Ware in Scotland will be considered in relation to the adoption of Beaker pottery and Beaker-related practices. Details of the methods and results of this analysis are given in the supplementary material accompanying this article. Discussion of the social processes behind the spread, development and demise of Grooved Ware and the nature of the various sub-styles will form the focus of a future paper arising from this project.

THE EARLIEST ORCADIAN GROOVED WARE

Current dating strongly suggests that the distinctive, flat-bottomed and geometrically decorated Grooved Ware ceramic style developed in Orkney (MacSween et al 2015; Griffiths 2016; Richards et al 2016; Bayliss et al 2017; Card et al 2018), with the earliest reliable dates for unambiguous Grooved Ware presently coming from the Neolithic settlement of Barnhouse in the west of Orkney's largest island – Mainland – where

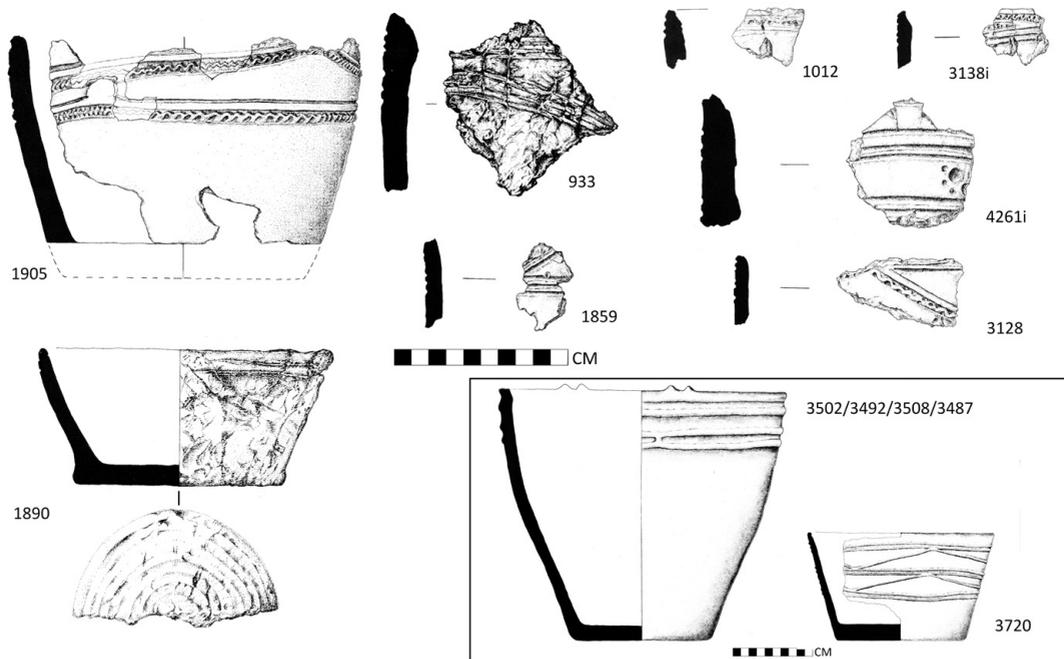


ILLUS 1 Location of key sites mentioned in text

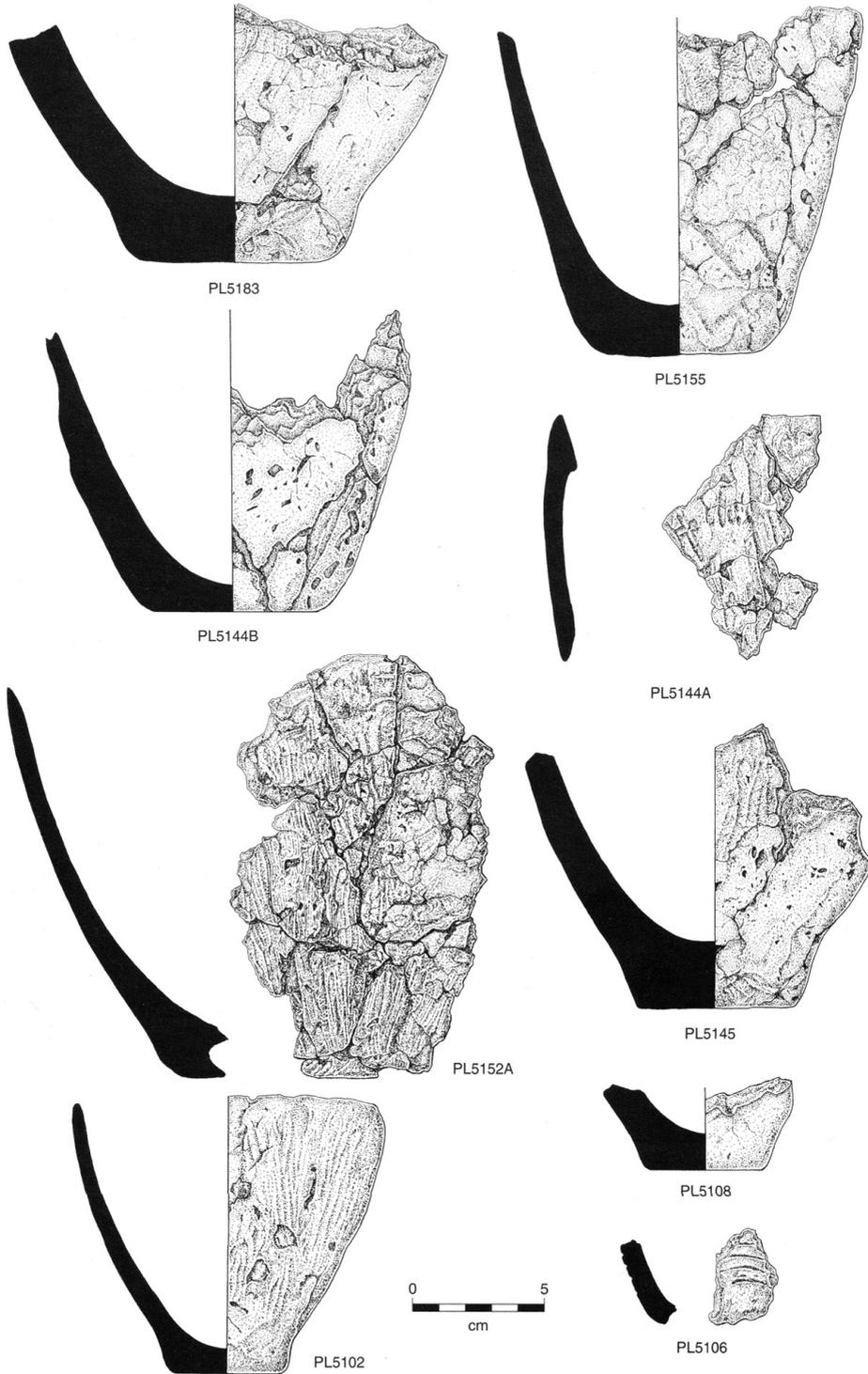
a highly ‘prototypical’ (*sensu* Lakoff 1987) Grooved Ware assemblage (Illus 2) was in use from 3160–3090 cal BC (86% probability; start Barnhouse) or 3080–3045 cal BC (9% probability) to 2890–2845 cal BC (95% probability; end Barnhouse) (Richards et al 2016: 219).

Elsewhere in Orkney, the Phase 1/2 pottery from Pool on the outlying island of Sanday (MacSween et al 2015) initially appears to indicate a gradual transition from earlier, round-based ceramic styles to Grooved Ware (Illus 3). However, incised Grooved Ware appears to have replaced round-based pottery at Pool by 3210–2935 cal BC (95% probability; start Phase 2.2–2.3), and probably by 3100–2980 cal BC (68% probability) (MacSween et al 2015: 302). There is therefore no reason to presume that it must pre-date the Barnhouse assemblage, making it less likely that the earlier Pool pottery represents ‘incipient’ Grooved Ware than the piecemeal adoption of Grooved Ware vessel forms and decorative motifs by a community

situated on the periphery of a Grooved Ware ‘heartland’ on Mainland. The earliest Grooved Ware-associated activity at Stonehall Farm, 5km east of Barnhouse, is poorly dated, though the occupation of the ‘Barnhouse sub-square style’ House 1 is associated with a single modelled date of 3340–3020 cal BC at 95% probability (SUERC-5792, Griffiths 2016: 272 and 277–8). Unfortunately, the pottery from this structure is decoratively and formally undiagnostic. The Grooved Ware from Structure 1 at Stonehall Farm (not to be confused with House 1) differs significantly from that at Barnhouse, with a more limited range of decorative motifs and with applied (and slashed) cordons a significant feature (Jones et al 2016: 314–29). However, given the uncertain dating of Structure 1 (Griffiths 2016: 277–8), comparisons with better-dated assemblages elsewhere in Orkney – including Pool and the post-3000 BC pottery from Barnhouse – imply that its associated Grooved Ware assemblage could well be of a later date.



ILLUS 2 Pottery from Barnhouse: early phases (probably pre-3000 BC) above and left, later phases (probably post-3000 BC) inset, lower right. (After Richards 2005: figs 3.38, 4.17, 4.33, 5.33, 11.8 and 11.9)



ILLUS 3 Phase 2.2 pottery from Pool, Orkney. (After MacSween in Hunter et al 2007: illus 8.1.4)

Lying just 500m to the north-west of Barnhouse, the unusual site of the Ness of Brodgar (Card et al 2020) comprises a sequence of very large, stone-built ‘halls’ enclosed between two immense walls traversing the narrow Brodgar peninsula. While currently under excavation and as yet undated, Structure 5 at the Ness of Brodgar shares architectural features with both the Grooved Ware-associated Structures 1, 8, 10, 12, and 14 at Ness of Brodgar (Card et al 2018; Card et al 2020) and with pre-Grooved Ware Early Neolithic houses elsewhere in Orkney (eg Knowes of Trotty, Stonehall Knoll, Brae of Smerquoy; Richards & Jones 2016). MacSween (2008a) has noted the presence of shell-tempered pottery from the trench in which Structure 5 lies, though the structure’s primary occupation layers remain to be excavated. Shell-tempering preceded rock-tempering at Pool and occurs elsewhere in Orkney in probable pre-Grooved Ware contexts at Rinyo (Childe & Grant 1948: 36) and the Knap of Howar (Ritchie 1983: 71 and 88–90), suggesting that Structure 5 could potentially represent an early phase at the Ness of Brodgar before rock-tempered Grooved Ware became predominant. Its presence at the site could therefore indicate that if incipient Grooved Ware were to be found anywhere in Orkney (and this remains far from certain) then the area around the Ness of Brodgar and Barnhouse would probably be the most likely location.

While it has become widely accepted that Grooved Ware pottery developed in Orkney before spreading southwards (Renfrew 1979: 205–8; Sheridan 2004: 33; Ashmore 2005; Schulting et al 2010: 30–9; MacSween et al 2015: 305–6; Richards et al 2016: 219–21; Sheridan 2016: 205) the precise reasons for this remain the subject of debate (cf Sheridan 2004; Thomas 2010; Sheridan 2014a; Carlin 2017). ‘Exotic’ materials found at the Ness of Brodgar, including Cumbrian tuff and Arran pitchstone, illustrate the site’s links to more distant communities (Card et al 2018: 218). The monumental nature of the Ness of Brodgar and its location between two stone circles on a narrow peninsula hint at its political, social and probably ceremonial significance. If the Ness of Brodgar, together

with surrounding sites including the Stones of Stenness (Ritchie 1976: 22–5), where Grooved Ware-associated activity probably began in the 30th century cal BC (Schulting et al 2010: 36), constituted a gathering place for significant individuals from far-flung regions, it could be argued that Grooved Ware emerged within communal practices such as feasting at the site. In this respect, the presence on Grooved Ware pots of designs that may have been adopted from Irish passage-tomb art may indicate that a translation of symbolic motifs occurred in Orkney towards the end of the 4th millennium BC (Brindley 1999b). Nonetheless, given the seemingly gradual incorporation of Grooved Ware elements into the ceramic assemblage at Pool, it is clear that even within Orkney itself understanding of Grooved Ware’s significance varied from site to site.

Following the work of Isobel Smith (1956) and Ian Longworth (in Wainwright & Longworth 1971: 236–44), Grooved Ware has conventionally been divided into four sub-styles. While the present authors are not alone in feeling that this scheme is increasingly problematic, Longworth’s terminology has been retained here for the purpose of clarity as it is widely understood (M Copper in prep. will present a re-evaluation of Longworth’s scheme and a suggested alternative taxonomy). For reference purposes, the key features of each of the sub-styles, as defined by Longworth, are set out in Table 1.

The first Grooved Ware beyond Orkney, unsurprisingly, exhibits a strong Orcadian character (M Copper in prep), though our dating suggests that it is unlikely to have spread as a simple ‘wave of advance’ with each community adopting the new style from its immediate neighbours, a probability underlined by recent work suggesting that Woodlands-style Grooved Ware was in use as far south as Wessex by 2950 cal BC (Wessex Archaeology 2020: 102). Before considering Scotland in detail it is worth noting that in northern England Grooved Ware from the Milfield basin in Northumberland is associated with dates from the 29th century cal BC (Millson et al 2011; Waddington et al 2011). Three unmodelled dates on charred hazelnuts found with ‘Woodlands-style’ Grooved Ware (Wainwright & Longworth

TABLE 1

Defining characteristics of the four Grooved Ware sub-styles proposed by Ian Longworth (Longworth in Wainwright & Longworth 1971: 236–43)

<i>Sub-style</i>	<i>Woodlands</i>	<i>Clacton</i>	<i>Durrington Walls</i>	<i>Rinyo</i>
Characteristic (though not exclusive) vessel forms	Small, open bowls and tubs often with thin walls	Vertical to splay sided, tub-shaped pots	A range of forms, but notably deep bucket-shaped vessels often with closed mouths	Flat-bottomed, truncoconic and tub-shaped vessels of various sizes
Definitive features	<p>Plain and slashed horizontal or converging cordons applied to, or pinched up from, the external surface</p> <p>Ladder patterns on the external surface</p> <p>Groups or strips of clay applied across the rim</p> <p>Incised herringbone motif on rim</p> <p>Applied or grooved 'knots' at intersections of converging cordons</p>	<p>Simple, rounded rims with horizontally grooved internal decoration</p> <p>Complex plastic decoration on internal rim bevel</p> <p>Dot-filled grooved or incised triangles, lozenges and rectangles</p> <p>Multiple grooved or incised chevrons, often opposed</p> <p>Staggered or evenly arranged oval impressions</p>	<p>Internally concave or 'vertically bevelled' rims</p> <p>Internal incised decoration below rim</p> <p>Grooved spirals or concentric circles</p> <p>Vertical cordons or multiple or single incised lines dividing the vessel surface into panels</p> <p>Incised or grooved filled triangles</p> <p>Twisted or whipped cord impressions</p>	<p>Rims with internal step bevels</p> <p>Continuous scalloped rims</p> <p>Applied roundels and pellets</p> <p>Applied complex patterns</p> <p>Grooved cordons other than horizontal or vertical</p> <p>Cordons other than horizontal or vertical with round impressions</p>

1971: 238–40) in Pits 6553, 6677 and 6701 at Marton-le-Moor in Yorkshire fall between 3697 and 3024 cal BC at 95% probability (3632–3101 at 68%) (Abramson 2003). A third hazelnut date, from Pit 6210 that also contained 'Woodlands-style' Grooved Ware, calibrates to 3098–2760 at 95% probability. However, given that other pits at this site produced Middle Neolithic Peterborough Ware and charred hazelnuts, there is a strong possibility that the earlier three dates derive from residual material and must therefore be regarded as unreliable in respect of dating the associated Grooved Ware. Nonetheless, it is of interest that of Longworth's categories it is the Woodlands sub-style that exhibits the closest similarity to the early Orcadian Grooved Ware. In northern England, as in Scotland, the so-called

'Durrington Walls' sub-style (Wainwright & Longworth 1971: 240–2) appears to have been adopted some time after the first Grooved Ware appeared (Manby 1999: 68–9; Abramson 2003).

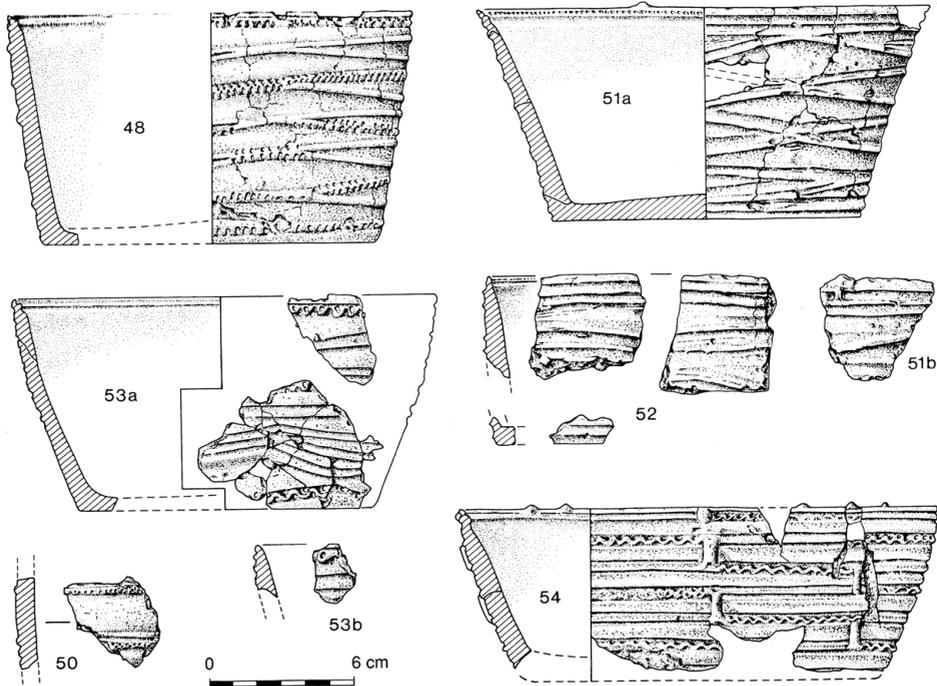
EARLY GROOVED WARE BEYOND ORKNEY

THE EAST OF SCOTLAND 1: THE BALFARG/BALBIRNIE COMPLEX

Of considerable importance for our understanding of the adoption of Grooved Ware beyond Orkney is the Balfarg/Balbarnie ceremonial complex in Fife, which has produced Grooved Ware that almost certainly pre-dates the earliest

English examples. The stone circle at Balbirnie was probably erected around 3000 BC (Gibson 2010), though a putative Grooved Ware sherd from Stonehole 10 (SF29: McInnes in Ritchie 1974: 15–17) could well be an intrusive Bronze Age urn fragment. While it is not possible to say if Balbirnie was erected earlier than the Stones of Stenness stone circle in Orkney, which lies just 250m from Barnhouse, it is probably earlier than the henge that encloses the Stenness circle and the central, hearth-like features (possibly part of a house) in its centre (Challands et al 2005; Sheridan & Higham 2006, 2007; Schulting et al 2010: 35–6). If, as the excavator argued, the stone circle at Stenness pre-dated the henge (Ritchie 1976: 17) we do not know if this was by several days or many years. Significantly, however, the construction of a stone circle at Balbirnie at around the time that the Stones of Stenness were raised and while Barnhouse was still occupied is suggestive of close connections between Fife and Orkney at around 3000 BC.

A second close link between the Balbirnie/Balfarg complex and Orkney Mainland is represented by the Grooved Ware-associated activity at Balfarg Riding School, just 100m north-west of Balbirnie. Our modelling of the dates associated with Grooved Ware deposited within the upper post-pipes of two sub-rectangular, wooden putative mortuary structures (Barclay & Russell-White 1993: 178–82) and in surrounding ditches and pits at the Riding School (Illus 4) (Barclay & Russell-White 1993: 159–61; Copper et al 2018) estimates that this was in use from 3110–2940 cal BC (95% probability; start: Balfarg Riding School), and probably 3065–2975 cal BC (68% probability), to 2905–2445 cal BC (95% probability; end: Balfarg Riding School), and probably 2885–2660 cal BC (68% probability). The sharing of sherds between contexts at this site, along with similar levels of abrasion, implies that the Grooved Ware was probably deposited over a fairly short period of time, though how long after the abandonment of the wooden structures this



ILLUS 4 Grooved Ware from Balfarg Riding School. (After Barclay & Russell-White 1993: illus 28; image courtesy of the Society of Antiquaries of Scotland)

occurred is uncertain. Morphological and decorative differences suggest that the vessels served varied roles, possibly related to the preparation and consumption of food during formal rituals (Richards in Barclay & Russell-White 1993: 185–92), though the overall stylistic coherence of the assemblage is clear, as are its close decorative and formal resemblances to the pottery from Barnhouse.

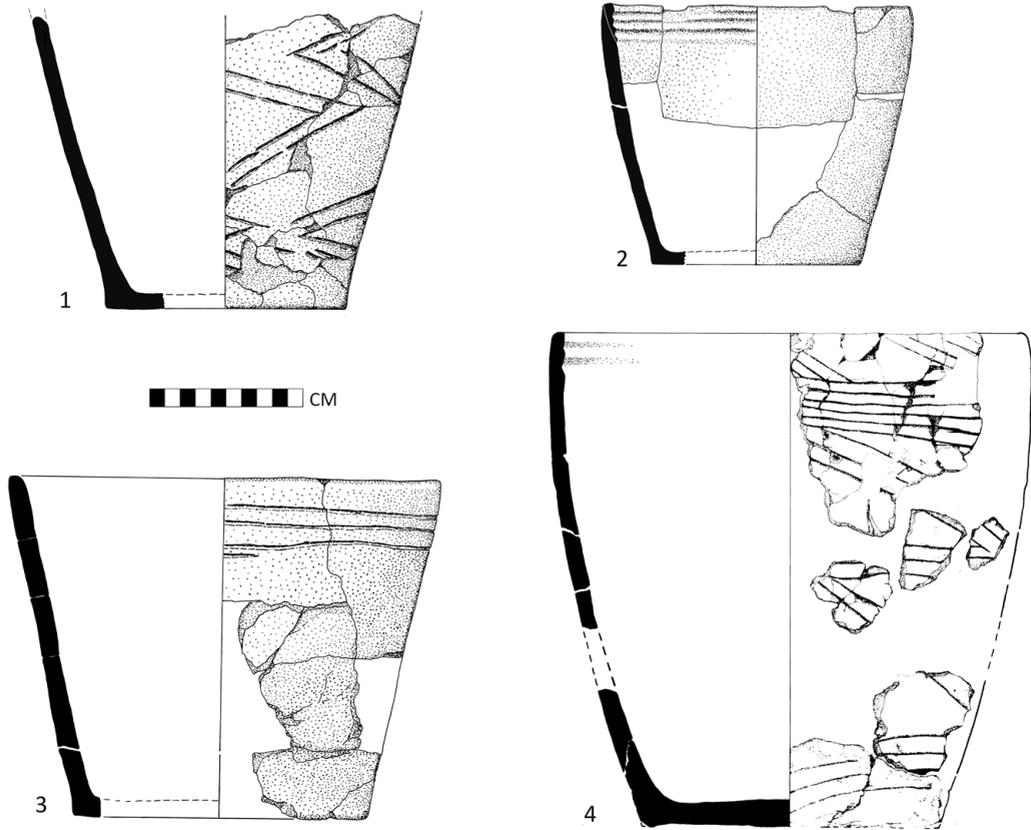
The Grooved Ware associated with the large timber circle within – but pre-dating – the Balfarg Henge (Mercer et al 1981) differs both formally and decoratively from that at the Riding School just 300m to its east. Our model suggests that Grooved Ware deposition at the timber circle began in *3040–2665 cal BC (95% probability; start: Balfarg Timber Circle)*, and probably *2915–2720 cal BC (68% probability)*, and ended in *2825–2360 cal BC (95% probability; end: Balfarg Timber Circle)*, and probably *2725–2470 cal BC (68% probability)*. While there is some degree of overlap with the Riding School Grooved Ware dates at 95% probability (though not at 68%), meaning that it is not possible to say with absolute certainty that Grooved Ware-related activity at the Riding School pre-dated that at the timber circle, decorative differences would appear to be indicative of stylistic drift. In the light of our modelling, the most parsimonious explanation for this is that the timber circle pottery is of a slightly later date. It is of interest that certain motifs found at Balfarg Riding School are absent from the timber circle assemblage, notably the distinctive false-relief wavy line that is also found at Barnhouse (cf Illus 4, Vessel 54 and Illus 2 sherds 1012, 3138i and 3128).

The Balbirnie/Balfarg Grooved Ware and monuments not only indicate connections between Fife and Orkney from 3000 BC but also between both of these regions and the monument-rich Boyne valley in Ireland. Attention has been drawn to the similarity of the Balfarg Henge pottery and vessels from Knowth in the Boyne valley (eg Brindley 1999a; Sheridan 2004: 30–1; Schulting et al 2010: 37), most notably the pot from Tomb 6 (Illus 5 No. 4) (Eogan 1984: 312 and fig 118 and pl 81) which Gibson (1982: 180) has argued belongs to the ‘Clacton’ sub-style

(Longworth in Wainwright & Longworth 1971: 236–8) and which is currently the earliest dated Grooved Ware vessel from Ireland. (The plainer pottery from Tomb 18 and ‘Beaker concentrations A and C’ is, however, less reliably dated than the Tomb 6 vessel (Eogan 1984: 312–13 and fig 116; Eogan & Roche 1997: 148–61 and 204–14; 1999; Schulting et al 2017: 358) and could be later (Sheridan 2004: 31).) When combined, three radiocarbon dates from Tomb 6 ‘provide a tight range of c. 3080–2920 cal. BC’ (Schulting et al 2017: 353). This is broadly contemporary with our modelled start for Grooved Ware-related activity at Balfarg Riding School and the first phase at Balbirnie (which, like Knowth Tomb 6, contains deposits of cremated remains). The Knowth date also overlaps with our modelled dates for the Balfarg timber circle Grooved Ware at 95% probability, though not at 68%.

Modelled dates for the Stones of Stenness pottery suggest that it is probably slightly later in date than the Knowth Tomb 6 pot and the earliest Grooved Ware-related activity at Balfarg Riding School (Schulting et al 2010: 36), but earlier than the Grooved Ware deposition at the Balfarg timber circle. It is of interest that vessels bearing very similar motifs to the Tomb 6 pot have been found at Barnhouse (Richards 2005: 266) and the Quanterness passage tomb 11km to the east (Vessel 2, Davidson & Henshall 1989: 76), with the use of tempering materials available close to Barnhouse suggesting that the latter (undated) vessels probably originated from Barnhouse itself (Jones 2005: 280–1).

These comparisons and dates are suggestive of ongoing close connections and an exchange of ideas between significant locales in Orkney, Fife and the Boyne valley from the very start of the 3rd millennium BC, and are reflected in the similarity of the Grooved Ware from Balfarg timber circle, Knowth Tomb 6, the Stones of Stenness and Quanterness (Schulting et al 2010: illustration 20). Recent dates from Bulford, 5km east of Stonehenge (Wessex Archaeology 2020), indicate that this early Grooved Ware-using network probably also extended to significant locales in southern England. However, there are also significant differences between practices in



ILLUS 5 Grooved Ware from the Balfarg timber circle (Nos 1–3: redrawn by Mike Copper after Henshall in Mercer et al 1981: figs 44 and 45) and Knowth Tomb 6 (No. 4: originally published as fig 118 in Eogan 1984; image courtesy of the Royal Irish Academy)

each of these areas, indicating that the adoption of Grooved Ware and any associated practices did not exclude creative adaptation within local circumstances. Thus, in terms of context, while mortuary activity involving cremation appears to have continued at Knowth at around, or in the century or so after, 3000 BC, the deposition of cremated human bone at Balbirnie need not mark it out as being primarily a mortuary monument, while sherds were deposited in pits and ditches at Balfarg Riding School and pits at Bulford. Secondly, though of similar date, the elaborately decorated vessels from Balfarg Riding School contrast markedly in character with the pot from Knowth Tomb 6. The incised pottery from the Stones of Stenness that resembles the

timber circle pottery from Balfarg is most likely of slightly earlier date, and probably slightly later than the Knowth Tomb 6 vessel. It should, however, be remembered that applied decoration occurs at Quanterness (probably taken there from Barnhouse) though is absent from Knowth. Finally, while contemporaneous with Balfarg Riding School and Balbirnie, there are also stylistic differences between the later-stage pottery at Barnhouse and the fine and elaborately decorated component of the Balfarg Riding School assemblage (Illus 2 and 3), indicating that the latter did not result from a slavish copying of the former. Interestingly, and despite its probably slightly later date, the Balfarg timber circle pottery seems closer in style to the pottery from

the Stones of Stenness, Quanterness and Knowth Tomb 6 than does that from the Riding School.

Our preferred interpretation of these dates and patterns is that the Balfarg Riding School pottery developed from Orcadian antecedents with only limited stylistic change. The Knowth pottery may provide evidence of early stylistic drift that was also reflected, slightly later, in the pottery from the Balfarg timber circle and possibly that from the Stones of Stenness and Quanterness, suggestive of an ongoing exchange of ideas between Ireland, Fife and Orkney at this time. Gibson's (1982: 180) observation that the Knowth pottery belonged to the Clacton style suggests that such stylistic drift may have lain at the root of the development of this latter style. If so, then assemblages that would, in Longworth's model, appear 'transitional' between the Woodlands and Clacton sub-styles should be expected, and the Balfarg timber circle pottery could perhaps be considered a result of an early stage of such a process of stylistic drift. It should be borne in mind, however, that Clacton-style Grooved Ware is rare in Scotland and is seemingly confined to the south and the Hebrides, and that in Scotland no purely Clacton-style assemblages are known.

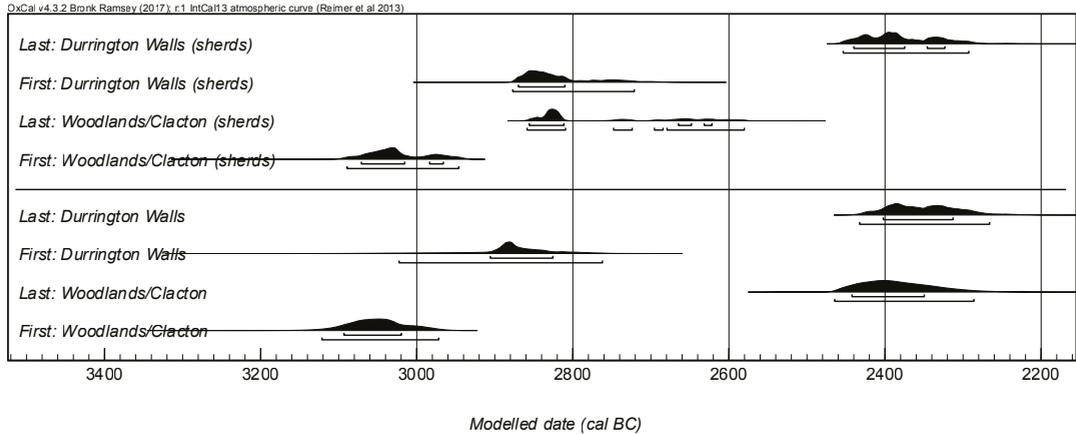
Stone circles replaced timber circles at a number of sites, including Machrie Moor Site 1 on the Isle of Arran (discussed below) and Balfarg. Grooved Ware is intimately connected with timber circles in Scotland at Balfarg (Mercer et al 1981), Machrie Moor Site 1 (Haggarty 1991) and Leadketty (Brophy et al nd), and indirectly at others (eg Greenbogs: Noble et al 2012; though the structures at this site are much smaller in size than those at sites such as Balfarg). While the relationship between Grooved Ware and *stone* circles in Scotland is indirect, as at the Stones of Stenness and Calanais (Ritchie 1976; Sheridan et al 2016), the dates and connections between timber and stone circles discussed above clearly link these two forms of monument with the period when Grooved Ware was in use, while Middle Neolithic Impressed Ware pottery is not associated with the construction and use of either timber or stone circles. Therefore, regardless of whether Grooved Ware is directly connected with the construction of the Balbirnie stone circle, this

site provides a date for the initiation of practices that are associated with Grooved Ware elsewhere in Britain and Ireland.

The pottery from Balfarg and other early sites, including Machrie Moor Site 1 and Forest Road, Kintore (discussed below), closely resembles Orcadian precursors. Two models (explained in the supplementary material) were produced for this style of Grooved Ware, which is conventionally – though not unproblematically – termed the 'Woodlands', or 'Woodlands/Clacton', sub-style (Illus 6). The first suggests that this sub-style first began to be used beyond Orkney from 3125–2970 cal BC (95% probability; *First: Woodlands/Clacton*), and probably in 3095–3020 cal BC (68% probability). The second, that it started in 3090–2945 cal BC (95% probability; *First: Woodlands/Clacton (sherds)*), and probably either in 3075–3015 cal BC (58% probability) or 2985–2965 cal BC (10% probability). It is therefore more likely than not that Grooved Ware was in use beyond Orkney before 3000 cal BC, and possibly several decades before.

THE EAST OF SCOTLAND 2: EARLY GROOVED WARE BETWEEN CAITHNESS AND THE MIDLAND VALLEY

In eastern Scotland, reliable dates associated with Grooved Ware falling at least partially within the 30th century cal BC come from Inverurie Paper Mill (Murray & Murray 2013c), Forest Road, Kintore (Cook & Dunbar 2008) and Courthill Farm, Inverkeilor (Hawthorne et al 2016). At Forest Road, Kintore, in Aberdeenshire, Grooved Ware was associated with pits and ring groove-defined houses (Illus 7) (MacSween 2008b). Recent re-dating of Pit 52 (Copper et al 2019) means that the earliest reliably and *directly* dated Grooved Ware at the site dates to the 28th century cal BC. However, an earlier willow charcoal date from ring groove house RH27 (which produced possibly redeposited Grooved Ware sherds) suggests that this was probably constructed in the 30th century BC (Cook & Dunbar 2008: 30 and 73–83). Taking this into account, our model suggests that Grooved Ware-associated activity began at Forest Road at 3075–2905 cal BC (95%



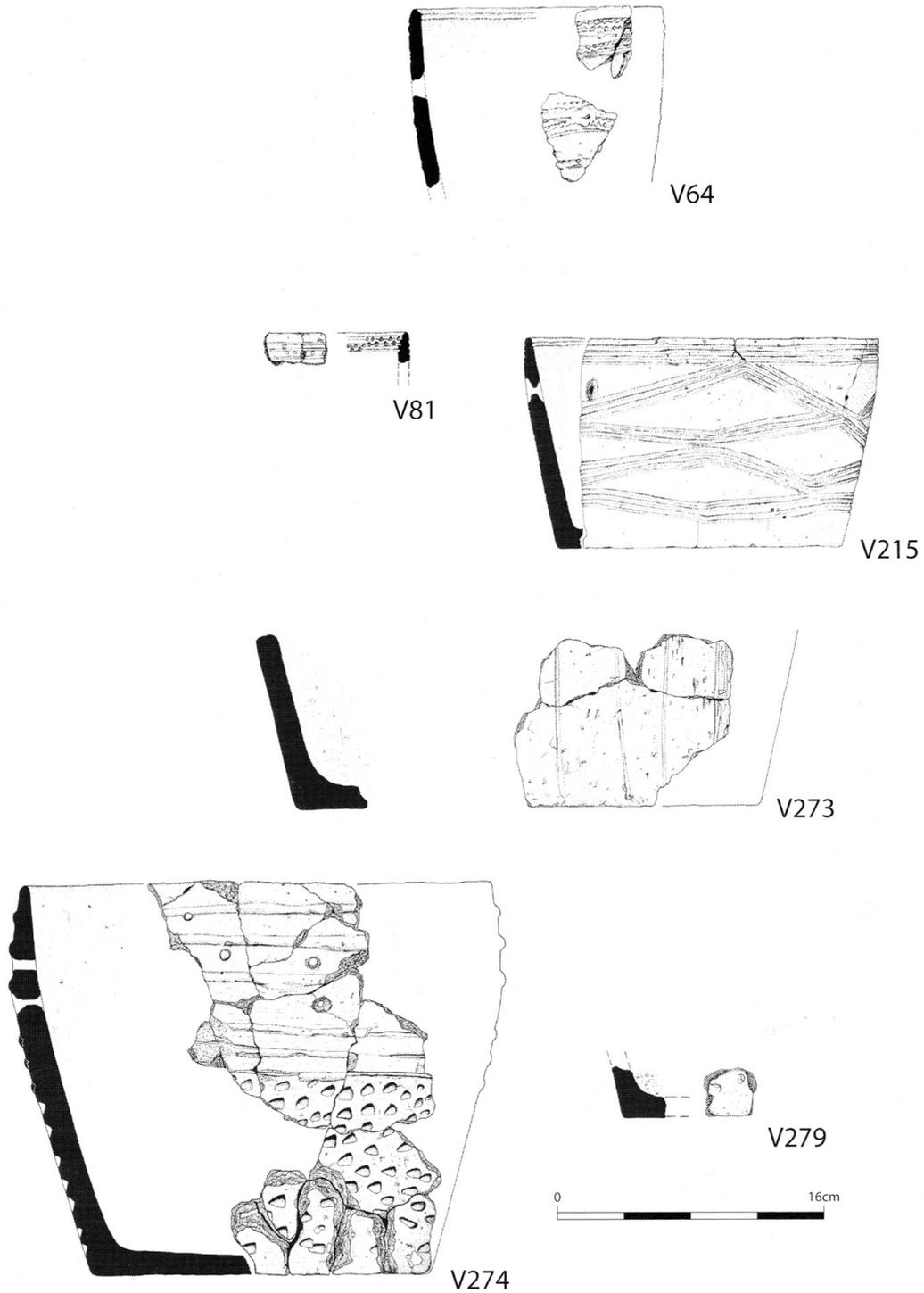
ILLUS 6 Secondary modelling of the dates for the Woodlands/Clacton and Durrington Walls sub-styles of Grooved Ware. Below: Model 1; above: Model 2. For details of the methodology used please refer to the supplementary materials.

probability; start: Forest Road, Kintore), and probably 3015–2925 cal BC (68% probability). Most of the Forest Road Grooved Ware is stylistically very close to the Barnhouse and Balfarg Riding School assemblages, and the distinctive false-relief wavy line motif, and incised ladder motifs that may represent variants of this design, appear on several vessels from the site. Other similarities with the Balfarg Riding School pottery include multiple incised lines, bands of circular depressions, and rim pellets.

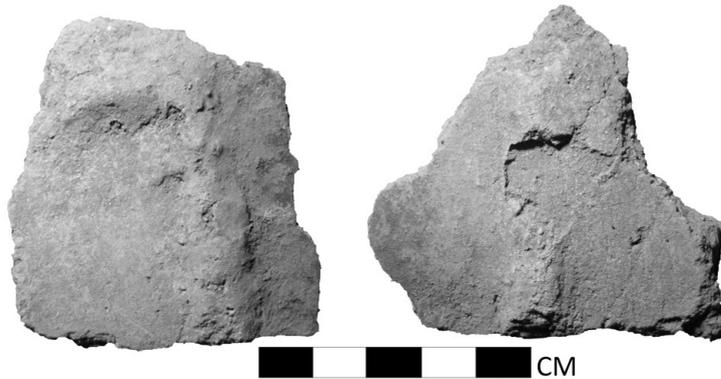
Grooved Ware Vessel 282 from Forest Road Pit 52 (Illus 8) belongs to the so-called Durrington Walls sub-style (Table 1). The earliest reliable dates for an assemblage of this style in Scotland – from a pit dug into an earlier wooden structure at Littleour in Perthshire – were modelled as 2970–2610 cal BC (95% probability; start: Littleour), and probably 2810–2640 cal BC (68% probability). Two methods were used to ascertain the likely start date for this sub-style in Scotland. Method 1 involves cross-referencing the probabilities associated with the sites that contain only one sub-style of Grooved Ware using either the dates from an unmodelled site or the start and end boundaries for modelled sites. This approach suggests that Durrington Walls Grooved Ware first appeared in Scotland in 3025–2760 cal BC (95% probability; First: Durrington Walls), and

probably in 2910–2825 cal BC (68% probability). However, as not all dates come from organic residues, taphonomic process could affect the results. Method 2 therefore considers only dates from organic residues adhering to Grooved Ware pots. While this may result in lower precision, Method 2 suggests a start date for the Durrington Walls sub-style in Scotland of 2880–2720 cal BC (95% probability; First: Durrington Walls (sherds)), and probably 2870–2810 cal BC (68% probability). It therefore appears that the Durrington Walls sub-style most likely appeared in Scotland at some point in the 29th century cal BC. (Both methods are described in more detail in the supplementary material accompanying this article.)

A significant question relates to a pot from Milton of Leys near Inverness (Vessel 1: Illus 9) whose date could imply that Durrington Walls-style Grooved Ware could have been produced on the mainland as early as – or even earlier than – any Orcadian Grooved Ware. While MacSween (in Conolly & MacSween 2003: 41) has argued that this is a Durrington Walls-style vessel, on balance this appears to the authors to be unlikely due to the combination of its later 4th millennium BC date (Conolly & MacSween 2003: 38–9; Copper et al 2019), the absence of any evidence for similar vessels for the next couple of hundred years, its unconventional (for Grooved Ware)



ILLUS 7 Grooved Ware from Forest Road, Kintore. (After Cook & Dunbar 2008: fig 143)

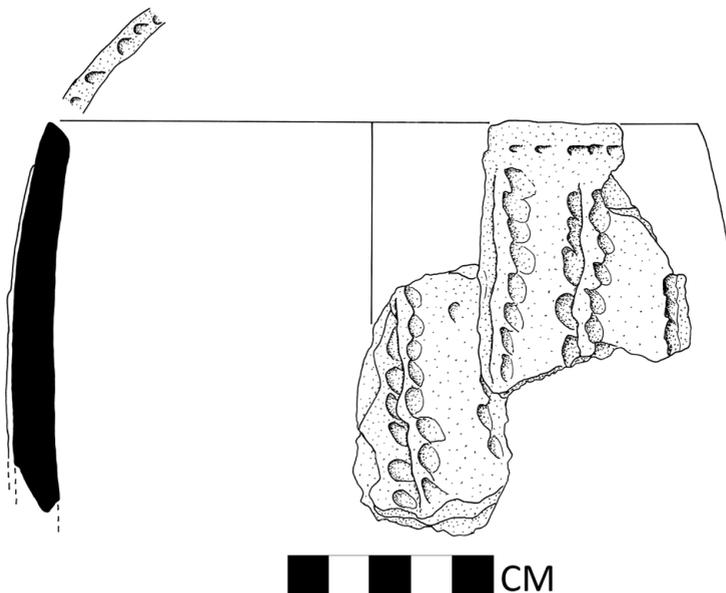


ILLUS 8 Vertical cordon on Grooved Ware Vessel 282 from Forest Road, Kintore. (Photo by Mike Copper, courtesy of the University of Aberdeen Museum Collections Centre)

impressed rim-top decoration and vertical cordons that reach almost to the rim, and the fact that the cordons are crudely worked up rather than applied. While not unknown, unambiguous raised cordons are uncommon on Scottish Grooved Ware yet are well represented on Impressed Ware pots from north-east Scotland that were in use at the same time as the Milton of Leys vessel (eg Kinbeachie and Forest Road, Kintore: Barclay et al 2001; MacSween in Cook & Dunbar 2008: 180–1). Unfortunately we do not know whether this vessel had a round or a flat base. As such, the present authors feel that this pot is for the time being best regarded as an Impressed Ware vessel whose vertical cordons mean that it fortuitously resembles Grooved Ware.

Woodlands-style Grooved Ware associated with a date of 3011–2878 cal BC has been excavated at Port Elphinstone, just 5km from Forest Road (Murray & Murray 2013c), and a vessel from Courthill Farm in Angus (Hawthorne et al 2016) that has been compared to a pot from the Balfarg timber circle (Vessel 16, Mercer et al 1981: fig 43; McLaren & MacSween in Hawthorne et al 2016: 9) was associated with a large deposit of crab apples that produced a date of 3001–2706 cal BC. Early 3rd millennium BC dates are also associated with incised Grooved Ware excavated during construction of the Inverness South West Flood Relief Channel (Peteranna 2011) and incised sherds, including one bearing a

ladder motif, were found in a possible grave with cremated bone at the nearby Culduthel Mains dating to the 27th or 28th century cal BC (Alison Sheridan pers comm). A date of 3090–2907 cal BC was obtained from cremated long bones associated with Grooved Ware sherds at Stoneyfield, Raigmore, Inverness, that display elements that could place them within both Longworth's Durrington Walls and Woodlands sub-styles: vertical cordons (Vessel P4 from Pit 20) and herringbone patterns on rim bevels (Vessel P6, also from Pit 20) (Simpson 1996: 80–1 and illus 12 and 13.6; Copper et al 2018). Our model suggests that Grooved Ware was in use at Raigmore from 3100–2920 cal BC (95% probability; start: Raigmore), and probably 3055–2955 cal BC (68% probability), to 2855–2335 cal BC (95% probability; end: Raigmore), and probably 2740–2405 cal BC (68% probability). Unfortunately, redeposition is a serious issue at this site, where Pits 41 and 50, both containing Grooved Ware, produced, respectively, Early Neolithic (pine charcoal) and Late Bronze Age (bone) dates (Simpson 1996: 82; Copper et al 2018). At the nearby Fortrose and Rosemarkie Waste Water Works (Sheridan in Fraser 2014) redeposition was also an issue. Here, a pit containing a Grooved Ware pot (Pot 43) with horizontal cordons produced a 30th century cal BC date on alder and birch charcoal but also sherds probably from an Early Bronze Age Cordoned Urn (Pot 44). This means that while it



ILLUS 9 Vessel 1 from Milton of Leys, Inverness. (Redrawn after Conolly & MacSween 2003: illus 4)

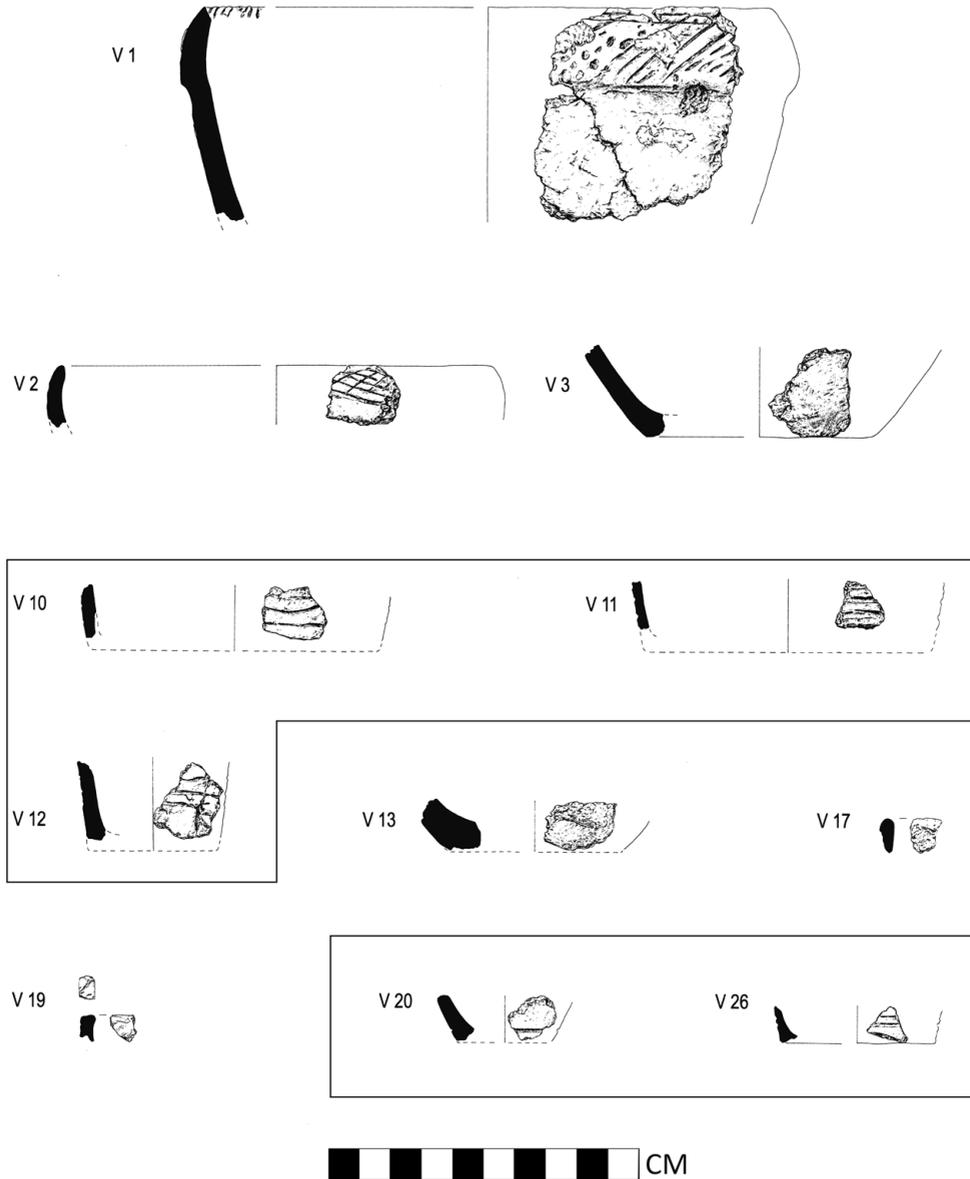
is clear that there was Grooved Ware-related activity at both sites, it is difficult to match pots to dates with any significant degree of confidence.

EARLY GROOVED WARE IN THE SOUTH OF SCOTLAND

Grooved Ware deposited at Eweford West in East Lothian (Sheridan 2006a; MacGregor & Stuart 2008) included sherds exhibiting slashed cordons and ladder motifs and is associated with a radiocarbon date on hazelnut shell of 3013–2759 cal BC (Lelong & MacGregor 2008: 286), while at Beckton Farm in South Lanarkshire a date of 3324–2883 cal BC was obtained from a pit (F150) producing Grooved Ware (Vessel P11) with applied cordons (Pollard 1997: 86). The date was, however, on mixed-species charcoal and so cannot be considered entirely reliable. Other Grooved Ware-associated pits at Beckton Farm (F080 and F159) produced pottery with slashed cordons and horizontal incisions, though the associated dates – also on mixed-species charcoal – were slightly later than Pit F150, extending from the late 30th to early 25th centuries cal BC (Pollard 1997: 88–9). A single vessel

from this site exhibiting features characteristic of Longworth's Clacton sub-style from Pit F159 is discussed below. Unfortunately, Pit F150 had no demonstrable relationship to the two 'four-poster' structures lying just 25m away.

At Overhailes, East Lothian (MacGregor & Stuart 2008), just 10km from Eweford, sherds from five vessels with some features reminiscent of Grooved Ware were found within an assemblage of Fengate Ware pottery, part of the Middle Neolithic Impressed Ware tradition (Illus 10). Four dates on hazelnut shell and hazel and Maloideae charcoal from two large pits within the boundary of a putative dwelling at the site suggest that deposition took place here between the late 34th and later 30th centuries cal BC (MacGregor & Stuart 2008: 75–6 and table 12.2). While grooved lines appear on the lower bodies of several of the pots, the specialist report on the assemblage (Sheridan 2006b) notes that 'other characteristics of Grooved Ware (such as slashed cordons) are not present, and it is a moot point whether the Overhailes assemblage represents a combination of these two, chronologically overlapping, ceramic traditions'. Due to its stylistic ambiguity this assemblage has not been included



ILLUS 10 Fengate Ware assemblage from Overhailes, with sherds exhibiting decoration reminiscent of Grooved Ware boxed. (After MacGregor & Stuart 2008: fig 4.6; courtesy of Jill Sievewright)

in our models. It is of note, however, that a date of 3010–2883 cal BC at 95% probability (2916–2896 at 68%) has recently been obtained as part of *Tracing the Lines* on carbonised food residue on a Fengate Ware sherd from Mountcastle Quarry in Fife (Vessel 1b from Pit 005, Copper

et al 2019). Fengate Ware appears to have gone out of use south of the border in the last century of the 4th millennium BC or the first century of the 3rd (Marshall et al in Beamish 2009: 68–81; Bayliss et al 2011: 551 and fig 11.19), and the Mountcastle Quarry date would therefore be in

keeping with a scenario where the use of Grooved Ware and Fengate Ware could have overlapped by a century or so in southern Scotland, though unambiguous mixed assemblages do not occur.

EARLY GROOVED WARE IN THE WEST OF SCOTLAND

Lying on the most likely sea route between the Boyne and Orkney, Machrie Moor Site 1 on Arran (Illus 11) (Haggarty 1991) has produced what is so far the earliest reliably dated Scottish Grooved Ware outside Orkney (Copper et al 2018; 2019) and the earliest date securely associated with a timber circle, a widespread type of structure that may represent a monumentalising of smaller domestic buildings (Thomas 2010; Noble et al 2012: 149–66). Modelling of both older and recently acquired dates from the site indicates that Grooved Ware-related activity began in *3110–2945 cal BC (95% probability; start: Machrie Moor)*, and probably either *3095–3020 cal BC (63% probability)* or *2990–2975 cal BC (5% probability)*, and ended in *3090–2700 cal BC (95% probability; end: Machrie Moor)*, and probably *3055–2915 cal BC (68% probability)*. The style and decorative motifs at Machrie Moor 1 fall within the range identified at Balfarg Riding School and at Forest Road, Kintore, as do those from Upper Largie in the monument-rich Kilmartin Glen (Sheridan 2012a), where Grooved Ware resembling vessels with early dates elsewhere in Scotland, and possibly resulting from a feasting event (Alison Sheridan pers comm), was probably in use from the late 30th century cal BC. Interestingly, although

undated, Grooved Ware sherds closely resembling those from Machrie Moor 1 have also been found in the nearby Tormore chambered cairn (Henshall 1972: 305 and 371–2). The deposition of Grooved Ware sherds at the large and presumably ceremonial structure at Site 1 suggests that, like Kilmartin Glen, Machrie Moor may have been a place of some significance within large-scale social networks, and it is therefore of note that pitchstone from Arran has been found at both the Ness of Brodgar and Balfarg Riding School (Wickham-Jones & Reed in Barclay & Russell-White 1993: 159; Card et al 2018: 218). Close formal and decorative parallels for both Upper Largie and Machrie Moor Site 1 can be seen in Orcadian Grooved Ware, and this is also the case for the undated vessel from Calanais on Lewis, which bears a false-relief wavy line (Sheridan et al 2016: 592–5). Further notably early Grooved Ware dates in the west include a date of 3093–2927 cal BC from Station Brae, Dreghorn, on the Ayrshire coast facing the Isle of Arran (Addyman 2004; Copper et al 2018).

THE DEVELOPMENT OF GROOVED WARE IN SCOTLAND

SUBSEQUENT DEVELOPMENTS IN ORKNEY 2900–2500

Later Grooved Ware in Orkney exhibits distinctively insular characteristics that set it apart from developments on the mainland. Following a probable hiatus, Pool was reoccupied in the later 27th or earlier 26th century cal BC (MacSween



ILLUS 11 Grooved Ware Vessel 17a from Machrie Moor Site 1, Arran. (After Haggarty 1991: illus 6; image courtesy of the Society of Antiquaries of Scotland)

et al 2015: 297). The primarily rock-tempered later Pool pottery, with its scalloped and notched rims, applied decoration and thick slips, would fit comfortably within Longworth's 'Rinyo' style (Table 1; Wainwright & Longworth 1971: 242–3). While applied cordons occur at Barnhouse from the 30th century BC, the Phase 3 pottery at Pool post-dates the Barnhouse settlement, which seems to have been abandoned shortly after 2900 cal BC (Richards et al 2016: 215). As noted above, while poorly dated, it is possible that the Grooved Ware at Stonehall Farm (Jones et al 2016: 314–26) also dates to the period after 2900 BC.

Excepting earlier midden deposits, the settlement at Crossiecrown, lying close to Stonehall Farm, falls into the second half of the 3rd millennium BC (Griffiths 2016: 278, table 10.1 and figure 10.3). Scalloped rims, incised horizontal grooves and applied cordons are the most common decorative features. Clay pellets also occur, as at Rinyo (post-dating the aforementioned midden, Childe & Grant 1948: plate XX), the Ness of Brodgar, Skara Brae (Childe 1931: 65) and the slighted putative passage tomb at Pierowall (Sharples 1984: 93–5). Internally decorated bases are known from Crossiecrown (Jones et al 2016: 352–3 and figures 11.3.3 and 11.3.5) and Links of Noltland (Sheridan 1999: 120–1). At the Ness of Brodgar, similar pottery to the later phases at Pool has been recovered from the main area of the excavation (Trench P), where a series of very large stone-built structures were in use from the 31st or 30th century BC (Card et al 2018: 246). As in the later phases at Pool and at Stonehall Farm and Crossiecrown, applied decoration predominated at the Ness of Brodgar (Towers & Card 2015), though much of the pottery derives from redeposited midden material and is therefore hard to date.

SUBSEQUENT DEVELOPMENTS IN EASTERN MAINLAND SCOTLAND

While it is probable that Grooved Ware-associated activity was taking place at Forest Road, Kintore, from the 30th century BC, it seems

likely that the main phase of Grooved Ware deposition in pits occurred in the following centuries. In terms of form and decoration, most of the Forest Road Grooved Ware resembles the other early, so-called Woodlands-style assemblages discussed above, though it is significant that Vessel 282, which produced a date on organic residue of 2871–2583 cal BC (Copper et al 2019), belongs to the Durrington Walls sub-style. Our model suggests that the latest Grooved Ware from Forest Road dates to between 2845–2460 cal BC (95% probability; end: *Forest Road, Kintore*), and probably 2820–2575 cal BC (68% probability). Similar Durrington Walls-style vessels have been excavated at Hallhole Farm in Angus, where dates extend from some time between the 29th and 27th centuries to the 24th century cal BC (Chris Fyles and Ann MacSween pers comm). MacSween has noted parallels between the Hallhole Farm pottery and vessels from Durrington Walls itself as well as sites in Yorkshire (eg Carnaby Top and North Carnaby Temple, Manby 1974) and southern and eastern Scotland, including the nearby site of Littleour (Sheridan 1998). While the earliest date for the Littleour Grooved Ware was discussed above, our model provides an end date for this assemblage of 2470–2295 cal BC (95% probability; end: *Littleour*), and probably 2450–2360 cal BC (68% probability).

At Raigmore, Inverness, a date of 2877–2490 cal BC from Pit 49 (Simpson 1996: 82), which lies within the outline of a probably slightly later timber structure, suggests that Grooved Ware-related activity may have continued at the site into the middle of the 3rd millennium BC, while recently acquired dates for a series of Durrington Walls-style vessels deposited in two pits at Powmyre Quarry, Angus (Illus 12) (Copper et al 2019), suggest that these were in use from 2620–2470 cal BC (95% probability; start: *Powmyre Quarry*), and probably either 2570–2540 cal BC (28% probability) or 2505–2470 cal BC (40% probability), until 2560–2400 cal BC (95% probability; end: *Powmyre Quarry*), and probably 2545–2530 cal BC (12% probability) or 2490–2450 cal BC (56% probability).



ILLUS 12 Durrington Walls-style Vessel P from Powmyre Quarry, Angus. (Image by Mike Copper, courtesy of Angus Museums)

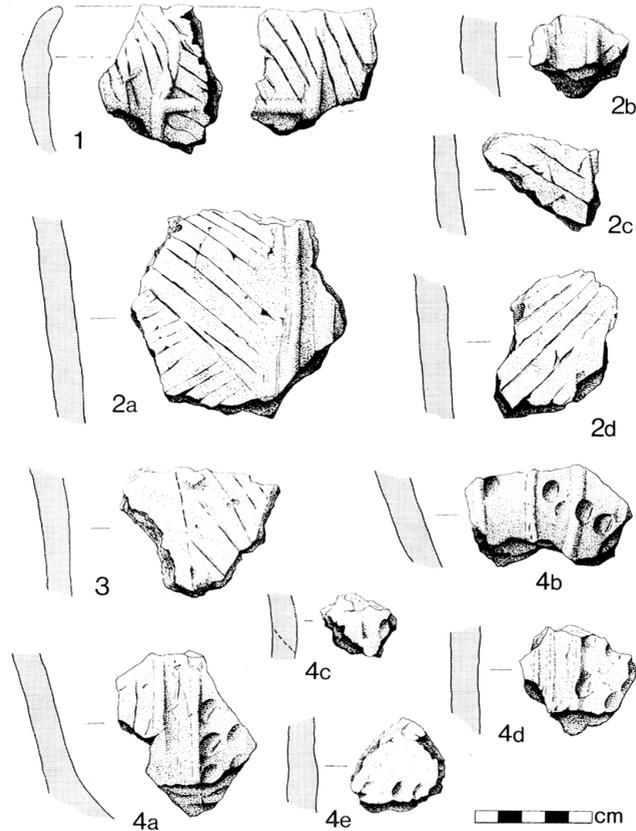
SUBSEQUENT DEVELOPMENTS IN SOUTHERN MAINLAND SCOTLAND

Durrington Walls-style Grooved Ware is associated with a number of large, palisaded enclosures across Britain and Ireland. Our model combining older and newly acquired dates for the palisaded enclosure at Dunragit in Dumfries and Galloway (Thomas 2015; Copper et al 2019) suggests that Grooved Ware, probably of Durrington Walls style, was in use there from 2875–2590 *cal BC* (95% probability; start: *Dunragit*), and probably 2745–2620 *cal BC* (68% probability), to either 2830–2805 *cal BC* (3% probability; end: *Dunragit*) or 2655–2455 *cal BC* (92% probability), and probably 2620–2540 *cal BC* (68% probability). The similarity of the dates for the pottery and the timber structures suggests – perhaps unsurprisingly – that the pots were in use at the same time as the enclosure. Recently re-dated, Durrington Walls-style Grooved Ware was also deposited in three pits close to a henge-like enclosure at the site of Hillend in South Lanarkshire (Illus 13) (Armit et al 1994; Copper et al 2018). Our model suggests that Grooved Ware was deposited here between 2985–2505 *cal BC* (95%

probability; start: *Hillend*), and probably either 2840–2825 *cal BC* (1% probability) or 2760–2575 *cal BC* (67% probability), and 2825–2810 *cal BC* (1% probability; end: *Hillend*) or 2655–2330 *cal BC* (94% probability), and probably 2610–2460 *cal BC* (68% probability). At the nearby site of Wellbrae (Alexander & Armit 1992) similar pots were in use during the second quarter of the third millennium *cal BC* (Copper et al 2018), while at Melbourne Farm, Biggar, Durrington Walls-style Grooved Ware appears to have been deposited between the 29th and the 25th or 24th centuries *cal BC* (Ward 2013; Copper et al 2018). At both Wellbrae and Melbourne Farm the pottery was deposited in pits.

While most of the pottery from Beckton Farm in Dumfriesshire (Pollard 1997) sits well with other ‘Woodlands’ assemblages in Scotland, a sherd from Pit 159 stands out on account of its decoration of lozenges infilled with oval impressions, and its fabric, which contains grog, a substance otherwise rare in Scottish Grooved Ware though known from a few southern Scottish sites (*Hillend*, *Dunragit* and *Wellbrae*) and from Upper Largie in Argyll (one sherd only). Unfortunately, a date of 2911–2478 *cal BC* from this pit is on mixed-species charcoal and so cannot be considered entirely reliable. The filled lozenge motif is characteristic of Longworth’s ‘Clacton’ sub-style (Wainwright & Longworth 1971: 236–8) though as noted above the distinction between this and the Woodlands style is often blurred in Scotland, where Clacton features are very rare and occur in the same assemblages as pots with Woodlands-style characteristics, reinforcing the argument that these represent separate aspects of a single style. A similarly decorated sherd was found at Melbourne Farm in South Lanarkshire in a pit associated with a hazel charcoal date of 2885–2620 *cal BC* (Ward 2013: 30 and 70).

Cord-impression is found only on vessels of the Durrington Walls-style, and occurs at Monktonhall and Hedderwick in East Lothian (Callander 1929; Stevenson 1946; Jorge 2014), Echline Fields in West Lothian (Robertson et al 2013), Wellbrae in South Lanarkshire (Alexander & Armit 1992), Guardbridge in Fife (MacSween



ILLUS 13 Durrington Walls-style Grooved Ware from Hillend. (After Armit et al 1994: illus 5; image courtesy of the Society of Antiquaries of Scotland)

forthcoming), Laigh Newton West in Ayrshire (Toolis 2011), Powmyre Quarry, Glamis in Angus (Robertson 2009), Luce Sands and Dunragit in Dumfriesshire (McInnes 1963; Thomas 2015), Midmill in Aberdeenshire (Murray & Murray 2013a; 2013b) and on a single sherd from Inverness (Kenworthy nd). Comb impression is much rarer, occurring on Durrington Walls-style vessels at Littleour in Perthshire (Sheridan 1998), at Guardbridge (MacSween forthcoming), and possibly at Wellbrae (Alexander & Armit 1992: 20 and fig 19.38), and on a single 'Woodlands'-style sherd from Luce Sands (McInnes 1963: 66 and fig 4.97). It is notable that the use of both of these techniques on Grooved Ware at Littleour pre-dates the arrival of Beaker pottery in Britain.

SUBSEQUENT DEVELOPMENTS IN THE WEST OF SCOTLAND

While it is likely that Grooved Ware from Pit 19 at Machrie Moor Site 24/3 (MacSween in Barber 1997: 84–5 and fig 45) is redeposited, Bayesian modelling of dates from the coastal settlement of An Doirlinn on North Uist (Garrow et al 2017; Garrow & Sturt 2017) suggest that the Grooved Ware-related Phase 2 began in 2830–2600 *cal BC* (at 95% probability, 2750–2630 *cal BC* at 68%) and ended in 2480–2330 *cal BC* (at 95% probability, 2470–2400 *cal BC* at 68%). Our own modelling of the Grooved Ware-associated dates alone suggests a start date of 3020–2630 *cal BC* (95% probability; start: *An Doirlinn*), and

probably 2875–2665 *cal BC* (68% probability) with Grooved Ware use ceasing in 2470–2295 *cal BC* (95% probability; end: *An Doirlinn*), and probably 2455–2365 *cal BC* (68% probability). The first of these models includes dates for pre-Phase 2 activity and so provides a more reliable start date for Grooved Ware use at the site, though the two models together suggest that Grooved Ware ceased to be used at An Doirlinn probably in the mid to late 25th century *cal BC*.

The An Doirlinn pottery is both morphologically and decoratively similar to the small but undated assemblage from the Udal (Squair & Ballin Smith in Ballin Smith 2018: 183–97) and the single vessel from the Unival passage tomb (Scott 1948; M Copper 2017), both in North Uist. All three exhibit decoration that makes use of dot infill and multiple-line-defined geometric motifs, conventionally indicative of Longworth's Clacton sub-style. Interestingly, no unambiguous Durrington Walls-style Grooved Ware has been recovered from the Hebrides and it has yet to be found in Orkney, suggesting that this style may not have penetrated into these regions or, indeed, north of the Great Glen. The most northerly currently known example of the Durrington Walls sub-style is from Raigmore, Inverness (Simpson 1996: illus 13.6).

SHETLAND

Despite the superficial resemblance to Grooved Ware of the small assemblage from House 2 at the Scord of Brouster (Whittle 1986: 59–62) and a single sherd from Sumburgh Airport (Downes & Lamb 2000) there are currently no clear examples of the style in Shetland, though it is evident that the islands maintained contact with areas further to the south during the 3rd millennium *BC* (Sheridan 2014b: 77–8). The Sumburgh sherd came from a Bronze/Iron Age structure, currently has no parallels elsewhere in Shetland, and is far from universally accepted as Grooved Ware (Sheridan 2012b: 24). Sheridan (2012b: 20; 2013: 49) has suggested that the decorated pottery from the Scord of Brouster may in fact be domestic Beaker, though with the exception of an intrusive sherd recently dated to the Middle

Bronze Age (Copper et al 2019) all of the reliable currently available dates from House 2 fall within the later 4th or very earliest 3rd millennium *cal BC*. Although less well dated than the Phase 1 house, stratigraphic relationships suggest that the Phase 2 building was constructed very soon afterwards. A single reliable radiocarbon date also adds weight to the suggestion that Phase 2, which produced the bulk – if not all – of the decorated pottery, is unlikely to be much later in date than Phase 1 (Whittle 1986: 8), while fabric types and decorative motifs suggest that the pottery from both Phases 1 and 2 belongs to a single assemblage. As such, it is argued here that the Scord of Brouster House 2 pottery represents indigenous Shetlandic Middle Neolithic pottery rather than Grooved Ware or domestic Beaker. As a result, the nature of Shetlandic pottery during the 3rd millennium *BC* remains, for the time being at least, frustratingly obscure.

THE DEMISE OF GROOVED WARE IN SCOTLAND

Dating the end of the use of Grooved Ware in Scotland has recently taken on new significance following the publication of research into ancient DNA (aDNA), which has significant implications for our understandings of the arrival of artefacts, monuments and practices originating in continental Europe shortly after the middle of the 3rd millennium *BC* (Cassidy et al 2016; Olalde et al 2018a).

THE DEMISE OF GROOVED WARE IN ORKNEY

The latest dates for Grooved Ware use at Pool came from Phase 3, which Bayesian modelling indicates came to an end at 2460–2280 *cal BC* (95% probability), and probably in 2455–2370 *cal BC* (68% probability) (MacSween et al 2015: 297), while Skara Brae probably ceased to be occupied some time before this date (Sheridan et al 2012). Two Bayesian models have been presented for the end of activity at the Ness of Brodgar (Card et al 2018: 246–9), suggesting that the deposition of a large quantity of cattle bone

(and a barbed and tanged arrowhead and possible Beaker sherd) late in the site's history occurred in either 2340–2200 cal BC or 2565–2360 cal BC (at 95% probability). Though poorly dated, the so-called 'Red House' at Crossiecrown produced an assemblage of Grooved Ware probably dating to the mid-3rd millennium BC (Card et al 2016; Griffiths 2016: 272). Here, however, the later activity at the site was associated with Beaker pottery, with a date of 1973–1748 cal BC being associated with the building's eventual collapse (Griffiths 2016: 262). Interestingly, it has been suggested that there was notable technological similarity between Grooved Ware and Beaker productions at the site (Jones et al 2016: 351 and 356–7). Fragments of a Beaker were also found at the settlement of Rinyo 'closely juxtaposed' to a Grooved Ware sherd with a scalloped rim (Childe & Grant 1939: 26). Unfortunately, the imprecision of Childe's excavation report means that it is difficult to know precisely what the relationship between these sherds may have been. While Beaker finds are relatively rare in Orkney, an assemblage of Beaker sherds (probably from a single vessel) is associated with a date of 2336–2047 at the Braes of Ha'Breck on the island of Wyre (SUERC-37960, Griffiths 2016: 263). It is also of interest that practices other than pottery manufacture, including the continued ceremonial deposition of animal carcasses (Clarke et al 2016), are perhaps suggestive of a metamorphosis of Late Neolithic traditions in Orkney in the late 3rd millennium BC rather than their absolute replacement. Unfortunately, as only one Bronze Age individual from Orkney (a woman from Stenchme, Lop Ness, Sanday with continental 'steppe-related' ancestry) was included in Olalde and colleagues' recent paper on population change in the Early Bronze Age (Olalde et al 2018b) this can contribute little to explaining such processes.

THE DEMISE OF GROOVED WARE BEYOND ORKNEY

With the exception of An Doirlinn, all Scottish sites outwith Orkney that have produced Grooved Ware-associated dates potentially

post-dating 2500 cal BC are from the east or south of the country. Organic residue dates from Pot 2 from the assemblage of Durrington Walls-style Grooved Ware at Littleour in Perthshire calibrate to 2489–2153 cal BC and 2477–1309 cal BC, while a further residue date of 2574–2474 cal BC was obtained from Pot 5 (Barclay & Maxwell 1998; Copper et al 2018). Our Bayesian model (detailed above) suggests that the latest date for the Littleour assemblage as a whole is 2470–2295 cal BC (95% probability; end: Littleour), and probably 2450–2360 cal BC (68% probability).

Durrington Walls-style Grooved Ware from pits at Auchlishie in Angus, of a similar character to that from Littleour, is associated with hazel charcoal dates of 2476–2204 cal BC and 2465–2065 cal BC (Dick 2000; 2001), while Pit F1 in Area 2 at Melbourne Farm, Biggar (Ward 2013) produced a few sherds of Grooved Ware of a similar style to the Auchlishie and Littleour pots and a hazel charcoal date of 2620–2209 cal BC. A second date from the adjacent, though pit-free, pit F2 of 2622–2345 cal BC again suggests continuity of Grooved Ware-associated practices into the 25th and possibly 24th centuries cal BC. As noted above, Bayesian analysis suggests that the Grooved Ware-associated Phase 2 at An Doirlinn probably came to an end in the mid to late 25th century BC (Garrow et al 2017; Garrow & Sturt 2017). While the following phase was associated with the use of domestic Beaker pottery it was unfortunate that this produced no datable samples. Finally, a date of 2558–2286 cal BC was obtained from alder charcoal in Pit 3 at Mye Plantation, one of a series of possible pitfall traps close to the Dunragit palisaded enclosure (Sheridan 2002). Pit 3 also produced a single sherd of vertical-cordoned Grooved Ware, along with Impressed Ware sherds, though the association between the Grooved Ware and the date is insecure (Mann 1903; Sheridan 2002).

With the exceptions of Orkney and the Western Isles, the latest dates for Scottish Grooved Ware are all associated with the Durrington Walls sub-style. Secondary modelling of the dating of this style was undertaken using two different methods (outlined above, and in more detail in the supplementary material accompanying this

article). Method one suggests that Durrington Walls Grooved Ware fell out of use in 2435–2265 cal BC (95% probability; *Last: Durrington Walls*), and probably in 2405–2310 cal BC (68% probability). Method two suggests that it went out of use in 2455–2290 cal BC (95% probability; *Last: Durrington Walls*), and probably in either 2440–2375 cal BC (54% probability) or 2350–2320 cal BC (14% probability). Though it should be borne in mind that the earliest Beaker-related activity in Scotland is likely to have been small in scale and therefore extremely hard to detect, Bayesian modelling as part of the *Beaker People* project suggested that Beakers were deposited in funerary contexts in Aberdeenshire and Moray from 2410–2310 cal BC (95% probability), and probably 2370–2320 cal BC (68% probability), with their introduction across the rest of the country occurring shortly afterwards, probably within a generation or two (Jay et al 2019: 77). These models therefore suggest an overlap between the latest Scottish Grooved Ware and the earliest Beakers of between 1 and 145 years at 95% probability or 1 and 60 years at 68%. The likely later date for the introduction of Beakers to Angus and the fact that the latest dated Grooved Ware also comes from this region and neighbouring Perthshire suggests that the replacement of Grooved Ware by Beaker pottery may have occurred slightly later outside of Aberdeenshire/Moray.

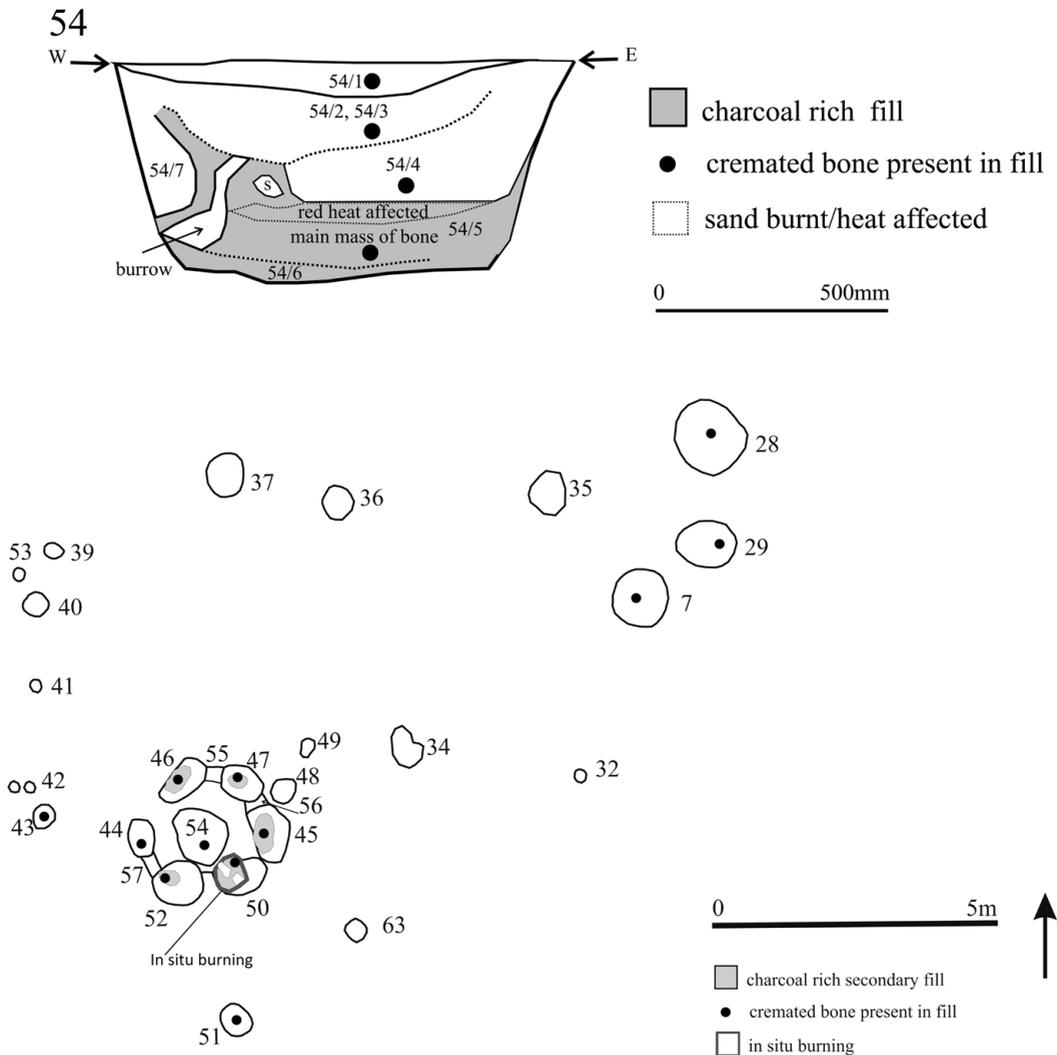
Bearing in mind the difficulty of identifying and dating the *very* earliest Beaker-related activity in Scotland, it is evident that Beaker-related mortuary practices showing clear connections with the lower Rhine were present from at least the 24th century BC (Jay et al 2019: 66–78). Sheridan (2007: 96–8) has argued that this reflects the movement of individuals from the Continent. In at least one case (Sorisdale, on the island of Coll) a woman who did not grow up locally (Montgomery et al 2019: 395) and who bore a closer genetic affinity to continental populations than to the indigenous Late Neolithic people (Olalde et al 2018b: 68–9) was buried with an All Over Cord (AOC) Beaker, a style well represented on the Continent (Cook et al 2010: 177–8). The burial, most probably dating to the 25th

or 24th century cal BC (Sheridan 2007: 109), cuts a midden containing ‘domestic’ Beaker sherds (Ritchie & Crawford 1978: 75–80). In contrast, Fokkens (2012) has suggested that local adoption of continental practices provides a better model for understanding the earliest Beaker-related activity in Britain. Either way, these early Beakers and burials could indicate what Needham (2005: 2009) has described as a ‘circumscribed, exclusive culture ... interstitial with British Final Neolithic Grooved Ware culture’ exhibiting strong links to continental practices and vessel forms, notably, in the case of Scotland, from the Netherlands. The extent to which the decline of Grooved Ware at the time of the arrival of the first Beaker pottery was driven by a desire among indigenous individuals or communities to adopt new practices or by their absorption within groups originating on the Continent is currently hard to tell.

Unfortunately, our models do not allow us to say with certainty whether Grooved Ware and Beakers were in use concurrently for any significant length of time during the 24th century cal BC. There may have been as much as a century and a half of overlap, but it is possible that Grooved Ware in any one region could have been abandoned as soon as the first Beakers arrived. If Grooved Ware continued in use until Beaker culture became ‘institutionalised’ (Needham 2005: 209) then this would raise the question of whether these two events were linked, and how this may relate to the nature and timing of the genetic changes identified by Olalde and colleagues. Very few Beakers exhibit designs also found on Grooved Ware (a possible exception being the Beaker from Keabog, Pitdrichie, with a Grooved Ware-style ladder motif and a date of 2476–2293 cal BC, Shepherd & Bruce 1987: 35; Sheridan 2007: 109), while the Aldbourne cups of southern England, whose decoration was once considered to reference Grooved Ware (Scott 1948: 27; Wainwright & Longworth 1971: 248), are most probably too late in date to represent a continuity of Neolithic traditions (Ford 1991; C Copper 2017: 167–73; C Copper in prep). In addition, it has been noted that the comb and cord impression on Grooved Ware pre-dates the

arrival of Beakers. An intriguing insight into possible interaction between Beaker and Grooved Ware users comes from the site of Midmill near Kintore in Aberdeenshire (Murray & Murray 2013a). Here, a group of three Late Neolithic pits containing Grooved Ware, Late Neolithic flints and fragments of burnt human bone – in at least one case (Pit 29) strongly suggestive of the deposition of pyre debris – were found close to a fourth pit (Pit 54) that contained cremated

human bone and sherds from an AOC Beaker (Illus 14). Also found in this latter pit were sherds of Grooved Ware and a single worked flint of Late Neolithic style, all originally considered to have been residual. Intriguingly, a series of dates on bone from Pit 54 and its surrounding pit circle (Murray & Murray 2013a: 11), falling between the mid-25th and late 23rd centuries cal BC, are almost identical to a recently acquired date on organic residue from Grooved Ware Vessel 109



ILLUS 14 Grooved Ware and Beaker-related features at Midmill. (Adapted from Murray & Murray 2013a: illus 3 and 10, courtesy of Hilary Murray)

from the severely truncated Pit 28 that also contained fragments of human bone (Copper et al 2019). Pit 54 exhibits features that link it with practices associated with both the Late Neolithic (cremated human bone in a pit) and Chalcolithic (AOC Beaker, burial probably surrounded by some form of screen). While rare, deposits of Beaker-associated pyre debris are not entirely unknown (Clarke 1970: 453–4), and in the Netherlands – the likely region of origin for the AOC Beaker tradition – they appear to date primarily to the same period as the Midmill burial (Drenth 2014). Nonetheless, Pit 54 is far from a conventional early Beaker burial and would appear to fit much better with Neolithic practices observed elsewhere in Scotland (eg Forest Road, Kintore Pit 53, Cook & Dunbar 2008: 77–8). Are we then looking at a very early Beaker being incorporated into local customs? If so, what might this tell us about the nature of social change at the end of the Neolithic and interaction between communities in Scotland and the Continent at this time? Could the Midmill Beaker burial represent a short-lived phase of cultural syncretism before the full adoption of Beaker practices? The Midmill Beaker was fragmentary and abraded, and sherds were recovered from a series of post holes that probably supported a fence or screen around Pit 54 as well as from the pit itself. Nevertheless, the possibility that Beakers and Grooved Ware were in use at the same time at this site remains intriguing.

DISCUSSION

While producing the earliest Grooved Ware dates, the absence of ‘incipient’ Grooved Ware in Orkney is in keeping with Sheridan’s (2016: 204) suggestion that it may well have ‘resulted from a conscious desire to create a novel style of pottery’. It is possible that the highly ‘prototypical’ Grooved Ware assemblage from Barnhouse reflects slightly earlier developments at the nearby Ness of Brodgar with its long-distance connections. A case may be made that early Grooved Ware was associated with large-scale commensality at sites such as the Ness of

Brodgar in which vessel ‘shape, size and decoration assumed more significance than previously’ (Jones in Jones et al 2016: 331). In this respect, the use of similar motifs on Irish passage tomb art (Brindley 1999b), on megalithic monuments in Kilmartin Glen (Campbell et al 1961), and on early Grooved Ware in Orkney suggests that shared ideas were at this time circulating over considerable distances, perhaps as a result of the expansion of inter-communal networks reflected in earlier pottery styles and shared social practices (Copper 2015: 453–64; Copper & Armit 2018). In Orkney, it would appear that these were adapted for use on pottery. It is also significant that vessels bearing decoration remarkably similar to that at the Stones of Stenness, Quanterness and Barnhouse occur as far away as Knowth in the Boyne Valley and Balfarg in Fife from the 30th – if not the 31st – century BC, and that stone circles were being erected more or less contemporaneously in Orkney, Fife and Wessex (Gibson 2010; Schulting et al 2010: 35–6; Willis et al 2016), probably, given the dates from Machrie Moor Site 1, at the same time as the earliest timber circles. The presence of Grooved Ware in both domestic (eg Barnhouse, Pool) and ceremonial (eg Stones of Stenness) contexts in Orkney indicates that the style could easily be adapted to serve various roles.

The early Grooved Ware assemblages from Upper Largie in Kilmartin Glen and from Machrie Moor Site 1 on Arran are associated with, or were close to, probably ceremonial timber and stone circles that also demonstrate the sharing of ideas over long distances at this time (Sheridan 2012a), and may represent the remains of formal commensal events, though on different scales. The concentration of monuments on Machrie Moor and in and around Kilmartin Glen (Cook et al 2010; Sheridan 2012a), and the presence of Grooved Ware-style nested lozenge motifs on slabs re-used within later cists at Kilmartin (Campbell et al 1961), highlights the significance of these places during the Neolithic and Early Bronze Age. If the idea of Grooved Ware spread southwards from Orkney from around 3000 BC, this may have been facilitated by its integration within commensal rituals held

at significant locales – and perhaps linked to significant individuals whose social networks increasingly extended well beyond their immediate local areas (Cassidy et al 2020) – that also resulted in the flow of ideas and representations from south to north as much as from north to south (Sheridan 2004; 2014a). Given its early appearance at such locales, it could be proposed that the idea of Grooved Ware was propagated at significant gathering sites before spreading into surrounding areas; a process akin to ripples spreading out from the points where a skimming stone hits the water. While the paucity of reliable dates for Scottish Impressed Ware pottery means that it is difficult to be certain how long this may have continued in use following the appearance of Grooved Ware, the 30th century cal BC dates from Mountcastle Quarry (Copper et al 2019) and the likelihood that Fengate style pots were in use at Overhailes into the 3rd millennium (MacGregor & Stuart 2008: 75–6) suggest that this could have been up to a century or so.

The fine (serving?) vessels and larger (cooking?) pots at Balfarg Riding School are also suggestive of food preparation and consumption at a possible ceremonial site, though the suggestion that one vessel contained hallucinogenic black henbane (Moffat in Barclay & Russell-White 1993: 109) has been called into question (Long et al 1999). Here, as at the nearby Balfarg timber circle where the Grooved Ware is of a somewhat different style that could have resulted from stylistic drift, the pottery seems to have been deposited over a short period of time. The Balfarg Riding School Grooved Ware is strikingly similar to the pottery from Barnhouse. Given the distance between Orkney and Fife this would seem hard to explain without suggesting that potters from Balfarg had actually visited Orkney or vice versa. At sites where analysis has been undertaken (eg Dixon & Dixon 2004; Jones 2005: 275–81) there is no evidence that the pots themselves were being transported.

As at Balfarg Riding School, the early Grooved Ware assemblage from Forest Road, Kintore, consists primarily of vessels that would fall within Longworth's Woodlands sub-style (though see M Copper in prep), with clear

antecedents at Orcadian sites such as Barnhouse. Forest Road Vessel 282 bears vertical cordons consistent with the Durrington Walls sub-style that our models suggest appeared a couple of hundred years after Grooved Ware was adopted beyond Orkney. Beyond Scotland, the earliest – though unfortunately imprecise – date for Durrington Walls-style Grooved Ware known to the authors is from Trelystan in Wales – 3086–2626 cal BC (CAR-272, 4260±70) (Britnell 1982: 191). It is difficult to be certain, however, whether vertically cordoned, Durrington Walls-style Grooved Ware followed on from the use of Woodlands-style vessels at Forest Road or if there was some temporal overlap. Durrington Walls-style vessels exhibit distinctive formal and decorative differences to Woodlands/Clacton Grooved Ware (see Table 1). Combined with the later date for its appearance and the lack of any transitional forms, this suggests that, unlike the Clacton and Rinyo sub-styles, the Durrington Walls sub-style did not result from a process of stylistic drift and that the factors behind its emergence must therefore be sought elsewhere. At present, however, it is hard to say why or where this may have happened.

After the 29th century cal BC, and setting aside the problematic mixed-species dates from Beckton Farm, there is little evidence for anything but the Durrington Walls style of Grooved Ware in Scotland beyond Orkney and the Outer Hebrides, with the exception of a handful of sherds that would fit within Longworth's Clacton sub-style from Melbourne Farm, Biggar. As pointed out above, however, no Scottish Grooved Ware assemblages are of purely Clacton style, which (*contra* Garwood 1999) should be regarded as a development of – or within – the Woodlands sub-style that did not greatly impact upon Scotland beyond the far south and the Hebrides (M Copper in prep). MacSween (1995; 2018) has considered regional variation in Scottish Neolithic pottery, noting an overall decorative 'syntax' with regional 'dialects'. Such variation is likely to reflect what have been termed 'social spaces' (Gosselain 2010: 251) in which interpersonal relations and identities develop and are maintained, and within which ways

of acting are shared through everyday practices. Such spaces are likely to have been closely integrated with economic and political practice.

There is no convincing evidence for a change in food habits corresponding to Grooved Ware stylistic changes, though it is likely that consumption of pork was less common in Scotland than in southern England during the Late Neolithic (Mukherjee et al 2008: 2067). Likewise, while an increase in vessel size through time has been suggested in southern England (Garwood 1999: 157) this is hard to discern in Scotland, where large (>30cm diameter) and small (<15cm diameter) vessels are present in both early and late assemblages (eg Barnhouse and Wellbrae). Vessel size is therefore more likely to have resulted from functional rather than stylistic considerations, though these will most likely have varied significantly from site to site given the variation in the nature of Grooved Ware findspots. While intriguing, suggestions that some Grooved Ware vessels may have been used for the production and consumption of ale (Dineley 2000; Dineley & Dineley 2000) are hampered by difficulties in differentiating evidence for brewing from that resulting from other forms of cereal processing.

The earliest Grooved Ware beyond Orkney may have held a particular significance within ceremonies or feasts, though it is also found in contexts suggestive of a continuity of practices associated with earlier ceramic styles, having been deposited more or less formally in pits, occasionally accompanying small quantities of human bone, as at Midmill, Forest Road, Raigmore and Culduthel. In some cases (eg Midmill Pit 29) this may reflect the deliberate burial of cremated human remains. At Forest Road, each of two adjacent pits dated to 3620–3347 cal BC (Cook & Dunbar 2008: 30 and 58–9) contained an Impressed Ware pot deposited in a way that very closely resembled later Grooved Ware practices at the site. Deposition in passage tombs, however, was uncommon and is associated only with vessels resembling the early Orcadian Grooved Ware from sites such as Barnhouse, suggesting that it was an early practice that soon died out. Palisaded enclosures have produced only vessels of the later Durrington Walls sub-style.

Orkney appears to have become increasingly isolated from developments on the mainland after *c* 2900 cal BC. Jones & Brown (2000) proposed that there was a decline in the quality of Grooved Ware in Orkney in the 3rd millennium BC, though care was still taken over the external appearance of the pots. While keen to point out at least one exception, Bayliss et al (2017: 1185) have suggested that there may have been a disjuncture in settlement patterns in Orkney around 2800 cal BC, with some villages abandoned, to be reoccupied some time later, significantly with new styles of architecture and Grooved Ware, before they were finally abandoned for good in the 24th century BC. Outwith Orkney, Wilkin (2016: 279) has proposed that there was likely ‘indigenous input and negotiation in the adoption of the earliest Beaker burial practices and their landscape settings’, giving ‘Beaker practices and practitioners a degree of continuity and gravitas’. In this respect, the discontinuation of the production and use of Grooved Ware need not imply the immediate wholesale abandonment of all established practices, but perhaps their reinterpretation in the light of new social constructions and people.

While the earliest Orcadian Grooved Ware may have developed as a component of feasting paraphernalia, this need not imply a high degree of formality or have constrained its use in other contexts. However, once formed, our dating indicates that the style spread rapidly between significant and widespread locales such as the Balfarg/Balbirnie complex and Machrie Moor on Arran from the final century of the 4th millennium BC, contributing an Orcadian component to a developing assemblage of ideas and associated artefacts and monuments with varied points of origin and degrees of uptake from the later part of the 31st century BC. Drawing on the idea of ‘cosmological acquisition’ (Helms 1993; Needham 2000: 188), Sheridan (2004; 2014a) has argued that this took place within an environment in which ‘elite’ groups undertook increasingly long-distance journeys, acquiring prestigious esoteric knowledge through their connections to exotic, faraway places. In many respects, this conception of the sharing of ideas by powerful and increasingly interactive political

and/or religious groups parallels the idea of peer polity interaction (Renfrew 1986) in which empowered groups of relatively equal standing come to exchange symbolic systems and technical innovations through processes of emulation and competition, both peaceful and violent. Such an environment would be conducive to the emergence of ‘imagined communities’ (Anderson 1983) of real and fictive kin, building upon earlier, smaller-scale regional networks and bound together by shared practices that included the use of the Grooved Ware pot, though it is important to avoid the assumption that this must imply some sort of absolute cultural, or even political, unity across Late Neolithic Britain and/or Ireland (Barclay & Brophy 2020). In such an environment, the rapid replacement of Impressed Ware and other regional ceramic styles may have occurred once a ‘critical mass’ of Grooved Ware use had been achieved (Rogers 2003). It has been argued that the dramatisation and ritualisation of the domestic is central to the emergence of persistent corporate entities (Thomas 2010; Bloch 2013: 90–4), whose origins are likely to have been mythologised. In Orkney, the earliest Grooved Ware occurs in both ceremonial (Stones of Stenness) and ‘domestic’ (Barnhouse) contexts, though there is likely to have been considerable overlap between the two, as evidenced by the presence of house-like structures in ‘ceremonial’ contexts (Challands et al 2005: 208–25). However, while it may be argued that the initial adoption of Grooved Ware beyond Orkney was facilitated by the interaction of political elites, its deposition in pits in ways closely reminiscent of the deposition of Impressed Ware, particularly in southern and eastern Scotland, suggests that its significance, and the affordances it provided, may have varied between different social groups. In this respect (and though not unchallenged: Bishop 2015a; 2015b) it is also of interest that claims have been made for a decline or stagnation in population and a move away from cereal agriculture towards animal resources and wild foods from the mid-4th millennium BC (Stevens & Fuller 2012; Shennan et al 2013; Whitehouse et al 2014; Woodbridge et al 2014; Stevens & Fuller 2015; Bevan et al 2017).

If so, in many regions this could have resulted in a more mobile population with a concomitant increase in the nature and geographical extent of social spaces (Gosselain 2010; 2016) and an increasing emphasis on temporary aggregation sites represented by pit clusters, timber circles and palisaded enclosure. Such an environment may well have been conducive to the emergence of new social entities, with Grooved Ware pottery, along with its associated practices, artefacts and monuments, acting as a catalyst for their emergence.

CONCLUSION

Grooved Ware is of considerable importance to our understanding of social processes in the Late Neolithic, yet it has long lacked a precise chronological framework. As a result of the re-evaluation of the dating of Scottish Grooved Ware within a Bayesian framework set out here, and as a result of recent work in Orkney, it is now possible to place certain key developments more precisely.

- The earliest Grooved Ware was adopted beyond Orkney during the late 31st century cal BC. This early Grooved Ware closely resembles Orcadian prototypes, and at Machrie Moor Site 1 is associated with the earliest dated timber circle. In the opinion of the current authors, the putative early Grooved Ware vessel from Milton of Leys is considered more likely to belong to the local Impressed Ware tradition.
- It is probable that the use of Fengate Ware continued into the first century of the 3rd millennium cal BC, overlapping with Grooved Ware for a century or so in southern Scotland. While the Fengate Ware assemblage from Overhailes includes sherds exhibiting features reminiscent of Grooved Ware, there is as yet no reliable evidence for stylistic hybridisation or for the contemporaneous use of both styles at the same site. Grooved Ware was therefore not adopted by all communities at the same time.

- A breakdown in the relatively restricted early Grooved Ware repertoire can already be detected in the less ‘prototypical’ assemblage from the Balfarg timber circle and in Ireland from perhaps as early as 3000 BC, followed by its gradual replacement in eastern and southern Scotland by the new Durrington Walls-style, and in Orkney by the insular Rinyo style, from the 29th century cal BC, though the extent to which the Woodlands/Clacton-style Grooved Ware continued in use alongside the new Durrington Walls pots is currently hard to ascertain due to the uncertainty surrounding the end date of the former style.
- In much of mainland Scotland throughout this period, deposition of Grooved Ware sherds (occasionally in a ‘structured’ fashion and/or accompanying human bone) occurred primarily in pits, in continuity of Middle Neolithic practices, as well as in formal ‘ritual’ or ‘ceremonial’ contexts such as at timber circles or – more rarely – in, or close to, earlier mortuary structures. Its adoption beyond Orkney need not therefore mark a universal break with earlier practices and suggests that the significance of Grooved Ware and the ways in which it was used may have varied from region to region.
- The demise of Grooved Ware in Scotland seems to have occurred between *c* 2400 and 2300 cal BC, and perhaps earlier in Aberdeenshire than elsewhere. It is not currently possible to say whether this process was very rapid or spread out over several generations, though our models suggest that the transition probably took less (possibly much less) than two or three generations in each region when it occurred.

It is hard to ascertain how indigenous groups reacted to the arrival of new ideas and people from the Continent. However they may have responded, aDNA evidence suggests that the Late Neolithic population eventually left only a minor genetic trace (Olalde et al 2018a). Furthermore, there is also no convincing evidence that the decoration of Beakers was influenced by Grooved Ware. This significant break with earlier practices

therefore raises the question of precisely what happened to the indigenous, Grooved Ware-using population after 2300 BC: a question that will present new and fascinating challenges for archaeologists in the years to come.

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