Cosmology, calendars and society in Neolithic Orkney: a rejoinder to Euan MacKie

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The authors examine critically MacKie's long-standing contentions concerning Neolithic Britain — theocratic control of society, the relationships between monuments and sunrise or sunset on significant days of the year, the use of an 'elaborate and accurate' solar calendar and its survival into the Iron Age and into modern times.

Key-words: Neolithic, Britain, Archaeoastronomy, Maes Howe, Orkney

You can't measure time in days the way you can money in dollars because every day is different.
JORGE LUIS BORGES

In a recent article in ANTIQUITY Euan MacKie (1997) has presented new material to support a modified version of his long-standing contention (MacKie 1977a; 1977b) that there existed in later Neolithic Britain and Ireland theocractic élites who possessed what seems astonishingly precise and sophisticated astronomical and mathematical knowledge. He uses new archaeoastronomical data obtained at Maes Howe passage tomb in Orkney, combined with archaeological evidence from the nearby Neolithic settlement of Barnhouse, to reaffirm a number of earlier ideas (e.g. MacKie 1969; 1976; 1977a; 1977b; 1981; 1982; 1983; 1986; 1994). In particular, he suggests that certain pre-Christian calendrical festivals, some of which survive into modern times, could derive from a 'Neolithic solar calendar' in widespread use in later Neolithic Britain and Ireland in which the solar year was divided into 8 or even 16 parts of equal length measured to the nearest day, starting from one of the solstices. Further arguments in support of these ideas, extending the origin of the 'calendar' back to the earlier Neolithic, are also presented in a subsequent article on Neolithic and later structures at Howe, Orkney (MacKie 1998).

Some of these ideas are important because of their clear, and radical, implications for our understanding of aspects of prehistoric cognition and cosmology, social organization and the factors determining patterns of continuity and change. In considering the new evidence, it is helpful to separate three overlapping, although not necessarily mutually dependent, fundamental ideas. The first is that the theocracies occupied a powerful and influential place in a strongly hierarchical social structure present throughout Britain, using 'national' forms of monument and pottery (MacKie 1997: 339). The second is that precise relationships existed between monuments, points of reference on the distant horizon, and sunrise or sunset on significant days in the calendar year. The third is that an 'elaborate and accurate' ceremonial calendar was in widespread use from Orkney to southern England and even Brittany (*cf.* MacKie 1997: 340, 358).

MacKie refers back repeatedly to the 1977 proposition of his ideas in the book *Science and society in prehistoric Britain* (MacKie 1977a — hereafter *S&S*). He dismisses critical reviews and commentaries (e.g. Hawkes 1977; Piggott 1978; Daniel 1980; Ritchie 1982) as 'not finding favour' and accuses others of lacking the courage to deal head-on with his views (MacKie 1994). The propensity of this topic to generate more heat than light is undeniable, but in view of the continued propagation of these ideas the present authors felt it necessary to attempt to provide — if not the detailed refutation that MacKie (1983) has demanded — at least the main threads of such a case, both from an ar-

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chaeological and an archaeoastronomical point of view, together with pointers to some of the many relevant publications which, in our view, support that refutation.

Social hierarchy and theocracy

MacKie's basic belief is stated clearly on p. 22 of *S&S*:

> as in the Classic period Maya, a dominating class of priests and chiefs emerged of whom at least the former lived in special ceremonial centres supported by food surpluses grown by the rural population. Its members thus had plenty of time to engage in intellectual activities and to develop systematically a variety of skills — astronomy, mathematics, an accurate calendar, writing, a legal system, elaborate religions and so on.

By 1997 *S&S* is retrospectively described as arguing (MacKie 1997: 339) that

> the Grooved Ware sites in Orkney were a sign of the penetration into the far north of a society dominated by a religious élite with advanced skills . . . [which] had already been responsible for the late Neolithic earthworks and stone circles on Salisbury Plain.

MacKie (1997: 339) sees the discovery of the Barnhouse settlement 'as a vivid confirmation of his earlier reinterpretation of Skara Brae as a settlement of a religious elite'.

Not only does he take no account of the fact that the largest, clearly non-domestic structure at Barnhouse was built late in the life of, or even after the abandonment of, the settlement (Richards 1996: 200), but in presenting his case again he ignores a number of other developments: for example, that further settlements of the period have been discovered and excavated in Orkney (Barclay 1996 and references) and continue to appear (*Discovery and Excavation in Scotland (DES)* 1995: 10; 1998: 70), confirming that the architectural forms seen at Skara Brae and Barnhouse are typical rather than exceptional; that the Grooved Ware radiocarbon dates for northern Britain are now comparable with or even earlier than those for the south (MacSween 1992: 269; Ashmore 1998); that the henges of northern Britain may be built before those of Wessex (Parker Pearson 1993: 72); and that such a strongly diffusionist model for a homogenous 'British' Neolithic (early or late) is no longer sustainable. Significant studies have been published in the last decade that undermine the assertion (MacKie 1997: 339) that other archaeologists continue to interpret 'Skara Brae and allied sites . . . as peasant villages' (e.g. Richards 1990a; 1991; 1993; Parker Pearson & Richards 1994). That much recent work has been overlooked in the preparation of MacKie (1997) is shown by the supposed recent confirmation (1997: 338) of the distribution of Grooved Ware in two widely separated areas, in the far north and northwest of Scotland, and in southern England and East Anglia. Manby's work in Yorkshire, which pre-dates *S&S* (Manby 1974), and the results of a series of excavations in southeastern Scotland since the 1970s (Mercer 1981; Barclay & Russell-White 1993; Stevenson 1995; and now Barclay & Maxwell 1998) surely cannot be dismissed in this way.

S&S was set out in three main parts: an introduction, a section entitled 'The Achievement' and a third entitled 'The Society'. In the introduction it is made clear that MacKie based his argument on three foundations that he felt were firm:

1 the calibration of radiocarbon dates, which many archaeologists then used as if it provided calendar year determinations accurate to a few tens of years; it was also assumed that relatively few dates could provide a secure dating sequence for a site;
2 Alexander Thom's ideas about prehistoric astronomy, geometry and mensuration; and
3 the results of the excavations at Durrington Walls, in particular the interpretation of the circular timber settings as roofed buildings—the dwellings of an élite (Wainwright & Longworth 1971).

Time has dealt harshly with all three, or at least the way in which they can be used.

Radiocarbon

In the last 20 years the calibration of radiocarbon dates has been shown to be far less cut and dried than was at first believed (Aitken 1990: 98–101; Ashmore 1996; 1998), and MacKie's use of calibrated dates in *S&S*, the norm in the 1970s, as though they allowed exact relative dating, is no longer tenable. His assertions of the contemporaneity of key sites are therefore no longer sustainable.

Astronomy, geometry and metrology

The work of Alexander Thom has been subjected to detailed scrutiny. While the last 20 years have seen a broad archaeological acceptance of a prehistoric interest in the cosmos and

the movements of the sun and moon, Thom's claims for high-precision astronomical alignments have not been substantiated, quite apart from his ethnocentric interpretations of them (Ruggles 1999: chapter 2) (see below). Thom's hypotheses on geometry and mensuration have also been challenged, and largely dismissed, from both archaeological and statistical perspectives (Ruggles 1999: 82–3 and references).

In brief, Thom (1955; 1967) had argued for the existence of a prehistoric unit of measurement—the 'megalithic yard' or MY—which was defined so precisely that 'standard' measuring sticks would have had to be used to communicate it from one end of Britain to the other (Thom & Thom 1978: 177). He also concluded that many non-circular stone rings were laid out using certain constructions, some of considerable complexity, which involved knowledge of the techniques of Euclidean geometry. The latter conclusion was challenged mathematically by authors such as Angell (1977), who showed that a number of different multi-parameter shapes, some less complex to construct in practice than Thom's, could be fitted equally well to the groundplans considered by Thom. It was also challenged by archaeologists such as Barnatt & Moir (1984) who concluded that the majority of stone circles could simply have been laid out by eye to appear circular. Barnatt & Herring (1986) documented an experiment in which over 100 circles were set out by eye by a range of individuals; it was found that these 'circles' could then all be described by the 'complex geometries' of Thom, even though they had not been set out using them. MacKie's quotation (1977a: 16) from Dingle (1972) is particularly resonant:

> the greatest danger is the fallacy to believe that 'everything that is mathematically true must have a physical counterpart; and not only so, but must have the particular physical counterpart that happens to accord with the theory that the mathematician wishes to advocate'.

It is as well to remind ourselves that any shape may be *described* by complex geometry, but that there is no evidence that the shape was *laid out* using it (Angell 1977).

The dataset used by Thom to deduce the existence of the MY comprises the diameters of best-fit circles imposed on over 100 roughly circular stone rings. Even if the data are taken at face value, the statistical evidence for a common unit of length is, at best, marginal, and even if it is accepted as existing, our knowledge of its value is only of the order of centimetres, far poorer than the 1-mm precision claimed by Thom (Kendall 1974; Freeman 1976; Angell 1979). The evidence is adequately explained by, say, a common practice of pacing (Heggie 1981: chapter 3). Huxley's wise comment (1869), ironically also quoted by MacKie (1977a: 16), sums up our view:

> this seems to be one of the many cases in which the admitted accuracy of mathematical processes is allowed to throw a wholly inadmissible appearance of authority over the result obtained by them . . . pages of formulae will not get a definite result out of loose data.

Durrington Walls and the Neolithic of Wessex

Finally, MacKie's use of the evidence from Durrington Walls and the other multiple timber ring sites is selective. In all his papers he presents as acknowledged fact that the timber structures were roofed, and disregards Musson's conclusions in the final report (Musson 1971). MacKie states (1977a: 164–5) that

> consideration of the problem by a professional architect led him to the conclusion that there was no evidence against . . . roofed buildings but that size, spacing and general arrangements were consistent with the hypothesis that they had once supported fairly massive, conical superstructures.

However, Musson makes it clear that the patterns of posts at Durrington Walls, Woodhenge and the Sanctuary allow equally well for unroofed as well as roofed interpretations. He states clearly (1971: 375) that the explanation seems 'more closely related to a purely numerical or dimensional reasoning than to any structural logic' and that 'it must be stressed again that no conclusive evidence has been produced that these monuments *were* in fact roofed buildings'. Gibson (1998: 104) has recently noted that 'the negative arguments which Musson produced . . . have largely been ignored' by subsequent writers.

Barrett's perceptive re-analysis of the southern circle at Durrington Walls (1994: 20–24), not referenced by MacKie, has demonstrated a far more complex construction sequence and simultaneously provided a more convincing interpretation of the structures — the 'steady

embellishment of [a] *locale*' through a 'lengthy and piecemeal programme of construction', rather than two phases of massive roofed building. The subsequent discovery of vast complexes of concentric rings of posts clearly far too large to roof (as recently at Stanton Drew, where nine concentric rings between 23 m and 95 m in diameter have been located (David 1998)), must cast further doubt on MacKie's assertions. In Scotland Mercer (1981: 159) proposed a convincing interpretation of the concentric circles of posts within the henge at Balfarg (Fife) as a series of barriers.

Social theory

There is surely irony in MacKie's (1977a) criticism of archaeologists for avoiding social theory before that time, as it is the subsequent development of a complex body of social theory by archaeologists (e.g. in the context of archaeoastronomy, Thorpe 1983) that exposes the weaknesses of his own cultural-historical approach to the later Neolithic. In the main body of *S&S*, and more recently (1997: 339) MacKie always offers a limited choice to the reader: either his preferred Maya-style hierarchy or a 'barbarian' or 'simple peasant' society that only undertook construction for utilitarian purposes. For example, the interpretative choices for henges are either

1 the site of 'barbarian rituals concerned with economic needs' or
2 (as MacKie would wish) 'ceremonial centres of skilled learned orders'.

Or again: society is either 'predominantly homogeneous, segmented and rural' or a 'complex, highly stratified hierarchical organisation with advanced political structure and many specialised groups, almost a proto-urban society in fact'. In contrast to the offering of 'barbarian peasants', Richards and others (Richards 1990a; 1991; 1993; Parker Pearson & Richards 1994) have demonstrated the complexity of the society that built and used the later Neolithic settlements, perhaps even involving 'ritual specialists', without resorting to MacKie's model.

Regional archaeologies

But there are broader problems. The 1977 study is a product of its period: there were very limited amounts of reliable excavated data in most parts of the country, and the creation of a coherent 'story' required the pulling together of material widely separated geographically. This process tended to create homogenous, broad brush prehistories that underemphasized regional variation and promoted a diffusionist approach. It is possible to see now that the sites drawn together to create a 'British Neolithic' are probably parts of different regional 'Neolithics' throughout Britain and Ireland (Kinnes 1985; Harding *et al.* 1996; Cooney 1997; Barclay 1997a; in press). We must also consider the extent to which Orkney's supposed prominence in the Neolithic (e.g. as a destination for pilgrimage — MacKie 1994) is an accurate reflection of prehistory, or whether it is, to some extent, a product of the recent history of investigation (Barclay in press).

We therefore believe that MacKie's 1977 consideration of Neolithic society has not stood the test of time. The excavations at Durrington Walls cannot be interpreted now as directly applicable to material many hundreds of kilometres away, as it was believed they could 20 years ago; there is a far greater understanding of regional diversity in the Neolithic in Britain. It is significant, for example, that MacKie draws such diverse monuments as the henges and recumbent stone circles into his homogenous cultural, astronomical and geometrical structure; it can be seen that the distribution of henges and RSCs is almost mutually exclusive (FIGURE 1), and it has been suggested that, if the monument types are broadly contemporary, their very different nature and the ways that members of the classes inter-relate may indicate considerable differences in ceremonial practice and indeed in social structure (Barnatt 1989; Barclay 1997a). MacKie's reliance on the evidence of Wessex to interpret material in the rest of Britain, and the identification of Stonehenge and Silbury Hill as drawing on resources from a British-wide base, rests on a view of British prehistory that few would now find acceptable.

A further fundamental weakness of MacKie's approach, both in 1977 and 20 years later, is the assumption that the data he has to work with is complete (*cf.* Barclay 1997b). For example, his assumption that the three later Neolithic settlements known in Orkney at that time — Skara Brae, Rinyo and Links of Noltland — were all there ever were of their kind, and could therefore be seen as rare, élite, settlements, has been shown to be erroneous by later work. We can see that other excavated settlements

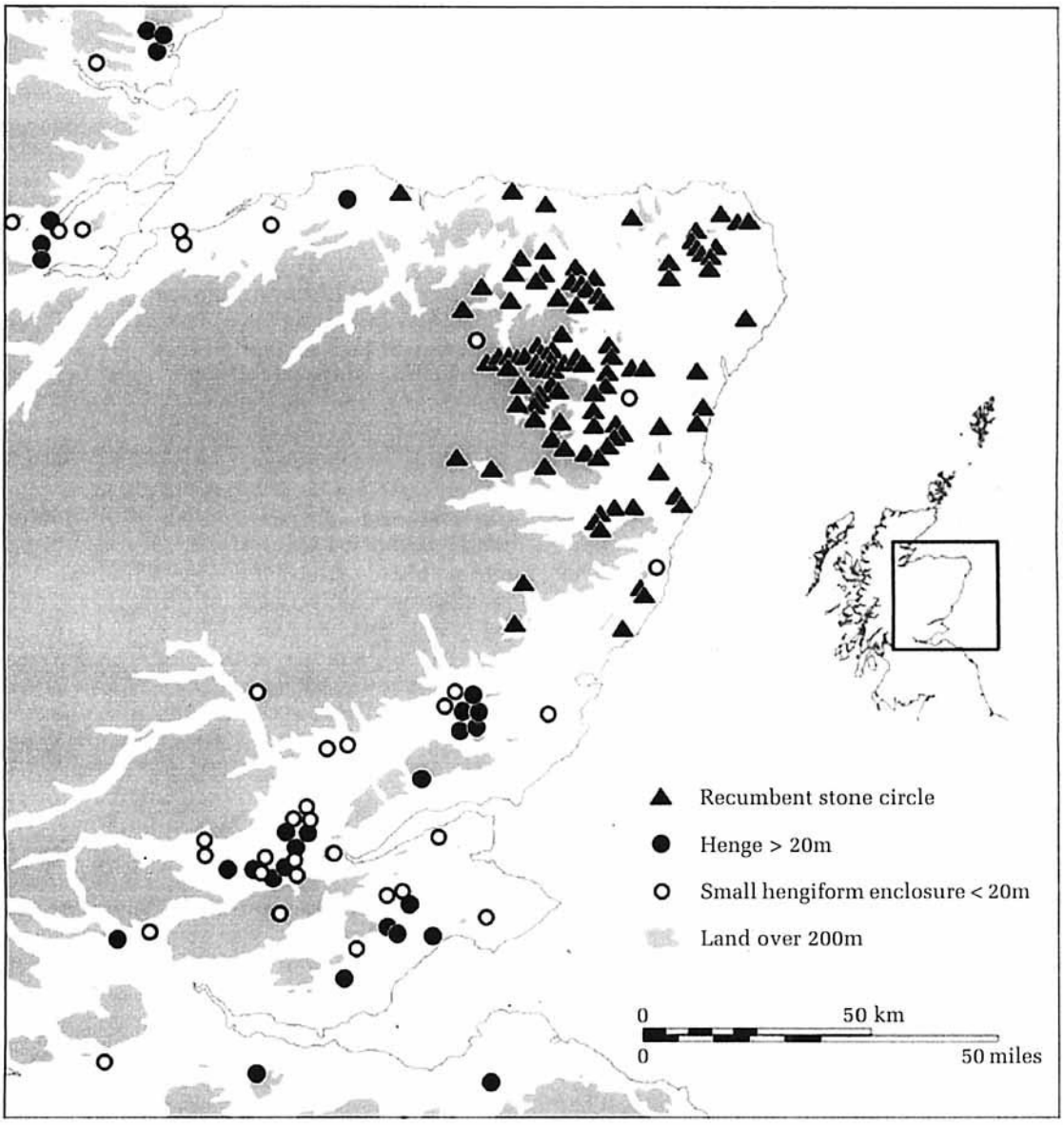

FIGURE 1. *Distribution map of henges, small hengiform enclosures and recumbent stone circles in eastern Scotland, apparently indicating strong regional traditions in the distribution of ceremonial structures in the later Neolithic.*

display broadly similar characteristics, and further discoveries continue to come to light (Barclay 1996 and references).

Problems with MacKie's interpretation

In summary, the problems with MacKie's hypothesized social structure are as follows:

1 the Megalithic Yard is not supported by the statistical evidence, and simple 'by eye' construction can explain the shapes of stone rings just as well as complex 'laying out geometries';
2 as will be discussed below, the precise astronomy proposed by Thom can be seen as a modern scientific imposition upon an intense, but different, interest in the sky;
3 the contemporaneity of events suggested by MacKie (1977a) based on a common 1970s

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view of ^{14}C calibration is no longer demonstrable;

4 it is no longer believed possible to make up deficiencies in evidence in one area by drawing on material from another, that may have different meanings;

5 there is no evidence that the 'roofed buildings' at Durrington Walls and other sites were in fact roofed; it seems very unlikely that they were the élite dwelling places claimed by MacKie;

6 the societies of later Neolithic Orkney need not necessarily lie at one of the two extremes ('barbarous peasant' and 'wise man') offered by MacKie.

Solar alignments, cosmologies and calendars

Solstitial alignments and cosmology

The tendency to measure prehistoric astronomy — along with mensuration and geometry — against the yardstick of modern science has, it seems, finally been laid to rest (Ruggles 1999: 80–81; Ruggles in press and references). However, there is no doubt that architectural alignments with celestial bodies and events are potentially of considerable importance within broader investigations of ways in which of the location and form of monuments served to express meaningful cosmological relationships, and the ways in which such relationships were exploited (Ruggles & Saunders 1993; Ruggles 1999: chapter 9). A variety of local groups of similar monuments in Britain and Ireland from the early Neolithic through to the middle Bronze Age show striking consistencies in orientation (Ruggles 1998; 1999: chapter 8), which suggest that celestial referents were used in the broadest sense to determine direction. Furthermore, many of these are confined to sectors of the horizon roughly demarcated by the cardinal directions or the directions of sunrise or sunset at the solstices (which from here onwards, we shall refer to simply as the 'solstitial directions'). In specific cases, such as the recumbent stone circles of northeast Scotland and the short stone rows of the Irish southwest, there is apparently a strong relationship to the moon (Ruggles 1999: chapters 5, 6). What these studies show perhaps most importantly is there is no overall pattern of development but rather various regional patterns of continuity and change.

In this context, the suggestion that the great passage tomb at Maes Howe may have been engineered in relation to the midwinter sunset is certainly not surprising in itself; there are other specific cases of the orientation of public monuments upon solstitial sunrise or sunset, examples now well known in the archaeological literature ranging from the Dorchester and Dorset cursus monuments (Bradley & Chambers 1988; Barrett *et al.* 1991: 56–7) to Wessex henges (Ruggles 1999: 138 and references), Newgrange (O'Kelly 1982) and Balnuaran of Clava (Bradley 1998). Some argue that harmonizing a monument with the cosmos in this way helped to affirm its place at the centre of things (e.g. Renfrew 1984: 178–80); others that this helped to place its operation above challenge and thereby reinforced political control (e.g. Barrett *et al.* 1991: 56). Yet others point out that astronomical alignments served to place a monument in time, empowering it perhaps with special meanings on certain regular occasions (*cf.* Bradley 1993: 68; Darvill 1996: 177–8; Ruggles 1999: 154). There is also much evidence from historical and modern indigenous communities of the widespread importance of the solstitial directions in schemes of sacred geography (Ruggles 1999: 148 and references).

In fact, there has been considerable confusion in the literature as to whether the passage at Maes Howe is in fact oriented such that the light from the setting sun at midwinter does illuminate the rear wall of the chamber (e.g. Ritchie 1985: 127; Parker Pearson 1993: 59) or whether this actually occurs a few weeks earlier and later (Burl 1981: 251). One must also consider the shift in the position of midwinter sunset since the time of construction (about half a degree). MacKie's discussion of the bent shape of the passage (MacKie 1997: 345–56) and clear presentation of the horizon profile information do a great deal to clarify the basic data. MacKie shows that the outer straight section ('axis B') is more or less aligned upon the setting point of the solstitial sun in the early 3rd millennium BC whereas the inner straight section ('axis A') is aligned more than 5° further round to the west.

But such matters should be interpreted in context. We cannot ignore the fact that the orientations of central hearths in Orcadian houses fall into four clearly separate, although wide, bands centred roughly upon the four solstitial directions (Richards 1990a: figure 5.5; Parker Pearson & Richards 1994: figure 2.3). This is strongly suggestive that they were con-

	Az	Alt	Dec
Ward Hill, left slope, junction with nearby ground	217°·1 [217°·0]	1°·3 [1°·3]	−23°·4 [−23°·4]
Ward Hill, right slope, junction with nearby ground	222°·9 [222°·9]	1°·0 [1°·0]	−21°·6 [−21°·6]
Cuilags, left slope, junction with nearby ground	225°·7 [225°·6]	0°·9 [0°·9]	−20°·7 [−21°·0]

TABLE 1. *A comparison of horizon data from independent surveys at Maes Howe by Ruggles (1979, previously unpublished) and MacKie (as reported in MacKie 1997). MacKie's data are shown in square brackets.*

strained according to quadripartite cosmological principles associated with the solstices. The structural similarity between Maes Howe and the principal building at Barnhouse, and the approximate orientation of the latter upon midwinter sunrise (Richards 1990b: 312–13), is suggestive of a dichotomy between houses for the living and monuments for the dead which is reflected in a symbolic dichotomy between the rising and the setting sun. These modest interpretations are consistent with the wider archaeoastronomical evidence concerning houses for the living as well as those for the dead, but are suggestive of broad cosmologies rather than exact calendars. Furthermore, they are not affected by the subtleties of the exact play of sunlight in the Maes Howe passage at or close to midwinter.

Using video evidence and three-dimensional computer models, Victor Reijs has recently demonstrated that sunlight strikes the back of the chamber shortly before sunset for some 35 days on either side of the solstice, and did so for perhaps 40 days either side 5000 years ago (http://www.geniet.demon.nl/maeshowe/ see also Ashmore in press). This in itself also suggests that the orientation of that tomb was designed without great precision of alignment in mind.

The horizon at Maes Howe

MacKie, however, goes considerably further in insisting that Maes Howe was an 'observing instrument'. Even though he now distances himself from claims of 'scientific' astronomy, he continues strongly to endorse Thom's claim that prehistoric people set up alignments of high precision, using features on the distant natural horizon as foresights (MacKie 1997: 340–41). He also maintains that they provide evidence of 'scientific capability', Maes Howe functioning as a 'solar temple/observatory' (1997: 343).

On a factual level, the data relating to certain points on the southwestern horizon are in almost complete agreement with an unpublished theodolite survey of Maes Howe undertaken by one of the present authors (CR) in August 1979 (from a point 10 m from the present entrance on axis B). The results for three common points are shown in TABLE 1.

There are therefore no reasonable grounds for doubting the azimuth, altitude and declination figures quoted by MacKie for these and other points in the southwestern horizon as viewed from Maes Howe.

It is in the interpretation of these data that we are in strong disagreement with MacKie. His claim is that Maes Howe is a 'multiple calendar site' incorporating two precise alignments upon horizon features marking sunset at two epoch dates in Alexander Thom's 16-month solar calendar. Before examining these specific conclusions it is necessary to review the wider *interpretative* context in which they have been formulated.

Calendars and continuity

MacKie (1997: 340) states that 'the reality of . . . solar calendar alignments is shown by independent archaeological and historical evidence which supports also the existence of the sixteen "month" calendar inferred statistically by Thom'. He also strongly contends that this solar calendar was not only widespread in Britain in Neolithic times but that the solstices, equinoxes and mid-quarter days continued to be important through to the Iron Age, where they were incorporated in the ancient Celtic calendar as festivals such as Beltane and Samhain, and hence survived through to modern times (MacKie 1997: 355).

Despite the support for this idea that has been shown by some other archaeologists (e.g. Burl 1988: 197) and archaeoastronomers (e.g. Krupp 1994: xi), it rests upon the assumption that dividing the year into 8 or 16 precisely equal parts was likely to have been important to prehistoric people. This may seem natural from a modern European perspective where time is seen as an abstract 'axis', but is unconvincing in the context of a non-Western world-view where notions of (space and) time are likely to have been highly contextualized (Shanks &

Tilley 1987: chapter 5; McCluskey 1998: 4–5). In any case, the evidence to support it is slight.

1 The evidence for Thom's solar calendar derives from accumulations of declinations corresponding to the upper limb of the sun rising or setting at dates at intervals of one-eighth (and possibly one-sixteenth) of a year measured from either solstice (the 'epoch' dates). It is important to realize that the evidence — from Thom's (1967) large-scale analyses of 145 'megalithic sites' — comes from a variety of 'indications' from many different types of megalithic structures scattered throughout Britain (*cf.* Ruggles 1999: 52). This wide variety is worrying in itself if there really was uniformity of astronomical and calendrical practice throughout Britain (Fleming 1975). It is also important to realize that the declination targets are 'fuzzy' because the number of days in a year is neither integral nor divisible by 16 (Ruggles 1999: 54–5). This increases the flexibility of being able to interpret any particular alignment as calendrical. Thom's data were thoroughly re-examined and reassessed by one of the present authors (CR) in the course of a major survey project between 1975 and 1981. Thom's results could not be reproduced once strict attention was paid to the demonstrably fair selection of data, and the inescapable conclusion was that the apparent accumulations of declinations at the calendrical epochs can easily be accounted for as data selection effects (Ruggles 1984; 1999: 70, figure 3.3).

2 Once Thom's own data are discounted, no evidence from coherent local groups of monuments supports the idea of an 8- or 16-part calendar; there are only isolated and scattered examples of putative alignments upon 'calendrical' epoch dates (Ruggles 1999: 142).

3 The geometric designs on the Bush Barrow gold lozenge have been interpreted by A.S. Thom and colleagues as a device for implementing Thom's solar calendar (Thom *et al.* 1988) and are cited by MacKie (1997: 340) as further evidence in support of the idea of the Neolithic solar calendar. By holding the lozenge horizontally and in a certain orientation, Thom *et al.* argue that the directions of sunrise and sunset at the calendrical epoch dates are marked on the lozenge. However, the regularity of the decorative design, the fact that only a small and apparently arbitrary subset of the lines actually appear to correlate with epoch directions, and the fact that the majority of the directions do not fit with lines on the artefact at all (*cf.* Ruggles 1999: figure 8.10) all argue strongly against this. The arbitrary nature of the theory is highlighted by North's (1996: 508–9) criticisms of it and the fact that he manages to impose an equally complex but completely different interpretation of his own (1996: 511–8). There is also the problem, acknowledged by North, that other lozenges exist, similar in form and decoration but with different angles, which do not appear susceptible to his own arguments or those of Thom *et al.* The Bush Barrow lozenge, like the others, is certainly a very fine decorative artefact, representing a high order of technological achievement, but its interpretation as a calendrical device is speculative.

4 The evidence to support the idea of a ubiquitous 'Celtic' calendar existing in later Iron Age times, with its seasonal festivals dividing the year into eight precisely equal parts, is itself very much weaker than is generally assumed (for detailed arguments see Ruggles 1999: 141–2 and references).

Attractive as it may be to envisage threads of continuity from early Neolithic through to Iron Age and even modern times, there is however a great deal of evidence that contradicts this conclusion, and we cannot agree with MacKie (1997: 340) that the existing evidence provides any support, let alone strong support, for the idea of 'calendrical' alignments.

High-precision alignments

Thom's 1967 analysis was followed by a succession of publications in which he argued the case for the existence of astronomical alignments of ever greater precision, finally claiming the existence of some which were precise to a single minute of arc (*cf.* Ruggles 1999: chapter 2). These claims were subjected to detailed reassessments by one of the present authors (CR) during the early 1980s (Ruggles 1981; 1982; 1983; 1999: chapter 2). It is misleading for MacKie to assert (1997: 340) that the statistical arguments against alleged high-precision align-

ments 'have been shown to be circular'. The article quoted in support of this (MacKie 1986) states that high-precision alignments were not found in a large independent survey of evidence from western Scotland by CR (Ruggles 1984) because they were not looked for. In claiming this MacKie himself ignored, and continues to ignore, an existing body of earlier published work directly addressing the very question of high-precision alignments and reassessing Thom's data in detail (Ruggles 1981; 1982; 1983). The earlier publications by Ruggles show beyond any reasonable doubt that all Thom's putative astronomical sightlines of a precision greater than about half a degree can be quite adequately accounted for as chance occurrences. Even the existence of deliberate high-precision solstitial foresights at 'classic' sites such as Ballochroy and Kintraw (*cf.* MacKie 1997: 342) is questionable (Ruggles 1999: 19–29 and references therein).

In sum, the case in favour of high-precision astronomy is completely unproven. And to say that 'there is increasing evidence . . . that . . . the sixteen "month" Neolithic solar calendar was a reality' (MacKie 1997: 355) ignores an overwhelming range of evidence to the contrary.

The alignment evidence from Maes Howe

Returning to the alignment evidence from Maes Howe, we must bear in mind the definition of the calendrical alignments set out by MacKie (1997: 340):

> To be plausible the structure must have some built-in direction indicator which points to [a] . . . distant natural mark on the horizon like a notch or hill slope which is the foresight.

To achieve adequate precision, we should expect to find alignments upon places on the horizon where the upper limb of the sun rises or sets on dates at some multiple of 1/16-year from either solstice. These should be marked by conspicuous horizon features such as notches between distant hills, and 'indicated' by archaeologically evident structures.

We can now examine the specific alignments listed in MacKie 1997: table 1.

1 Axis B, as already discussed, was approximately aligned upon the upper limb of the solstitial setting sun. There is no horizon foresight at this point; the horizon is relatively close and featureless, a little over 1° to the left of the point where the left slope of Ward Hill disappears behind the closer ground.
2 Axis A is aligned on a point some 1°·5 to the left of where the right slope of Ward Hill disappears behind closer ground. It is thus a plausible, though not precise, indicator of the latter point, whose declination, –21°·6, does correspond (within the margins of uncertainty mentioned above) to the upper limb of the setting sun at a time 1/16 of a year before or after the winter solstice. The upper limb of the sun would actually reappear at this point, so this is a classic Thomian foresight.
3 The right-hand end of Cuilags is not indicated. According to MacKie it yields a declination –17°·0, corresponding to a centre disc declination of –17°·3. The declination of centre of the sun on the appropriate mid-quarter days would be between –16°·8 and –16°·0 (Ruggles 1999: 55). MacKie proposes that a bump at the top of the slope, rather than the extreme right-hand end, might have been the foresight, but its declination –16°·6, corresponding to a centre disc declination of –16°·9, is still marginal if it is to be interpreted as a precise mid-quarter day alignment.

Only (2) fits MacKie's own criteria for a calendrical alignment, and only then if an indication 1°·5 to the left of the target is thought to be acceptable. (1) has no foresight. (3) has no indication, and is also only marginal as a indicator of the appropriate calendar date, and then if one makes the assumption that a secondary feature, rather than the right-hand end of the slope itself, was the intended foresight.

In view of the fact that there is no convincing background evidence for calendrical alignments, we would be inclined to put down the precise calendrical alignments proposed at Maes Howe to chance. On the other hand, we would be inclined to accept the idea that the outer axis (Axis B) was aligned upon midwinter sunset, to 'good' but not to 'calendrical' precision. The argument that the solstitial sun itself may originally have shone down the passage after passing through a light-slit above the door (MacKie 1997: 356) has been published before (Welfare & Fairley 1980: 93, quoted in Ritchie 1982) and certainly seems plausible and worthy of further investigation. We would also be inclined to accept that the general alignment

of the tomb passage upon 'the most conspicuous natural foresights on the southern mainland of Orkney' (MacKie 1997: 357) might also have been deliberate, and meaningful, in itself.

The general alignment upon the standing stone at Barnhouse and the Hills of Hoy, as well as roughly with the midwinter sunset, accords with other instances where monuments are aligned upon conspicuous features in the landscape, man-made and natural, and/or celestial bodies and events, all as part of organizing the landscape according to the principles of a cosmology that does not separate people, land and sky into separate categories but in which they are intimately tied together. This is very different from the sort of view of time as abstraction, strongly redolent of a modern Western world-view, which encourages thoughts of dividing the solar year into exactly equal parts.

The alignment evidence from Howe

In a separate paper, MacKie (1998) has examined a sequence of structures from Neolithic times through to the Iron Age at Howe, some 4·5 km west-southwest of Maes Howe and 3 km southwest of the Ring of Brodgar across the Loch of Stenness. Unfortunately he has not referred to Hingley's more wide-ranging survey of the re-use of Neolithic monuments in Scotland in the Iron Age, in which the relationship between the features at Howe is placed in a broader context (Hingley 1996).

On a factual level, MacKie is to be congratulated on determining the correct orientation of the passage of the Neolithic tomb at Howe from confused earlier reports and on his clear presentation of the orientation and horizon profile data (MacKie 1998: table 1 & figure 3). The problem is once again in the interpretation. The reader should recall that the nature of the evidence invoked to support a precise Thomian calendar is supposed repeated alignments upon precise epoch dates at 1/8 or 1/16-year intervals from either solstice, marked by the upper limb of the sun rising or setting behind conspicuous horizon features such as notches between distant hills, 'indicated' by archaeologically evident structures (*cf.* MacKie 1998: 10, 12).

In fact, none of the potential alignments listed and illustrated by MacKie (1998: table 1 & figure 3) fulfils these criteria.

1 To judge from MacKie 1998: figure 2, the axis of the stalled cairn or rectangular house *S* seems to be somewhat (perhaps as much as 4°) to the right of the azimuth (123°) marked. The chosen orientation appears to have been selected because it corresponds approximately to the azimuth of the upper limb of the Quarter Day rising sun. However, this event occurs on a featureless stretch of horizon, so there is no horizon foresight to mark it.
2 The orientation of the passage tomb points at a saddle between the conspicuous hills of Mid Hill and Ward Hill, but the declination (–10°·6) has no obvious astronomical interpretation — and certainly none in terms of Thom's 16-month calendar, for which the closest epoch declination is around –8°·5 (Ruggles 1999: 55).
3 What is interpreted as an open-ended cross-passage between the 'stalled cairn' and mortuary house aligns in the southwest upon a dramatic cleft between the distant hills of Hoy. For a few days around midwinter, the disc of the setting sun would have passed across this cleft (whose lowest point has a declination –25°·0). But note that the whole sun appeared here — this was a dramatic affirmation of the relationship between the setting sun on days close to midwinter, and the visible horizon at that place. The top limb of the midwinter setting sun did *not* appear in a notch or twinkle down a hillslope, so there is no evidence of the use of the horizon as an observing 'instrument' to pinpoint the solstice. A similar argument applies to the appearance of this same cleft from the nearby Ring of Brodgar (MacKie 1998: figure 3d), from which the declination of the base of the cleft is only slightly greater (–24°·9).

Additionally, no information is given regarding the northeasterly alignment of the cross-passage, and there is no apparent reason (other than the astronomical potential of the southwesterly alignment) for selecting this direction in preference as the one that was meaningful to the builders.

4 The Keelylang Hill profile (MacKie 1998: table 1 & figure 3b) is not indicated. A shallow dip in the horizon at this point, whose declination according to MacKie is –0°·1, corresponds roughly to equinoctial sunrise, although the upper limb of

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the equinoctial sun would actually appear approximately 1° (two solar diameters) to the left. There is no reason other than its astronomical potential to mark it out for special attention from a large number of possible horizon features of equal prominence in other directions.

These data provide no compelling evidence for an interest in Thom's calendar in Neolithic times. This is not to say, however, that certain alignments upon conspicuous features in the landscape, and important celestial events, might not have been significant. Indeed, the general orientation of the passage tomb upon a conspicuous set of hills, as at Maes Howe, may well have been intentional. Furthermore, the apparent alignment of a cross-passage both upon a dramatic cleft between the distant hills of Hoy, and approximately upon midwinter sunset, does suggest that there was a deliberate encapsulation of a dramatic relationship between a spectacular terrestrial feature and the setting sun on days close to midwinter, which would have passed directly through the cleft, appearing to stand in it shortly before starting to disappear below the horizon.

Plausible as these relationships are, it is impossible to agree that the evidence from Howe gives any support to MacKie's contention (1998: 37) that 'concern with ... Quarter Day festivals now seems likely to go back into the earlier part of the Neolithic period in Orkney'. The calendrical explanation derives from a reading of the evidence that falls into all the methodological traps identified by one of the present authors (CR) many years ago (*cf.* Ruggles 1999: chapters 1–3) — criticisms that are ignored, and are certainly not addressed, in these new papers.

Conclusions

As questions of landscape cognition and cosmology take their proper place in archaeological thought it becomes important to look for astronomical referents, since meaningful associations between celestial bodies and events and objects and actions in other parts of the perceived world are an important feature of non-Western world-views. Astronomical associations encapsulated in architecture, serving perhaps as metaphors for perceived properties of the cosmos, may give important insights into such perceptions in the past. Well-established archaeoastronomical approaches, seeking to correlate the locations of monuments or houses in the landscape with celestial objects or events, are relevant as part of broader investigations. So also are novel approaches such as Bradley's (1998) exploration, at the passage tombs at Balnuaran of Clava, of apparent conflicts between the requirements of sound structural design and the desire to conform to certain cosmological requirements, in this case a broad solstitial alignment.

There remains considerable confusion in the archaeological literature about matters astronomical. A relevant example is the erroneous claim that the latitude of Orkney is especially favoured because only here do the four directions of the rising and setting solstitial sun fall at right-angles to one another (Parker Pearson 1993: 59; Souden 1997: 122). In fact, the azimuths of solstitial sunrise and sunset are dependent upon the horizon altitude, and the most favourable latitude is in fact around 55°. Certainly it is impossible to achieve at the latitude of Orkney (59°) (Ruggles 1999: 250).

Archaeoastronomy has the potential to clarify such confusions, and has an important role to play in broader studies of sacred geography and cosmology. The practice of presenting reliable and quantitative orientation and horizon profile data, as MacKie has done at both Maes Howe and Howe, is thus to be applauded and encouraged. It is crucial, though, to ensure that the interpretation of such data is in tune with wider developments in archaeological thought relating to the relevant social and cognitive issues.

This means abandoning a vision of a Mayan-type late Neolithic which rests upon Wessex-oriented diffusionist prehistories and which ignores so much that has been written about the period and about some of its most significant monuments in the last decade. It also means moving beyond simplistic interpretations featuring universal calendars which rest implicitly upon modern Western-style abstract conceptions of space and time, and which themselves ignore a weight of contrary archaeoastronomical evidence from the last two decades.

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